SLOVENSKI STANDARD
SIST EN 50600-4-7:2020

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Informacijska tehnologija - Naprave in infrastruktura podatkovnih centrov - 4-7. del: Faktor učinkovitosti hlajenja

Information technology - Data centre facilities and infrastructures - Part 4-7: Cooling Efficiency Ratio (CER)

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ICS:

35.110	Omreževanje	Networking

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Informationstechnik - Einrichtungen und Infrastrukturen von Rechenzentren - Teil 4-7: Wirkungsgrad der Kühlung (CER)

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CENELEC

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

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European foreword

This document (EN 50600-4-7:2020) has been prepared by CLC/TC 215 "Electrotechnical aspects of telecommunication equipment".

The following dates are fixed:

- latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement   (dop)   2021-02-10

- latest date by which the national standards conflicting with this document have to be withdrawn   (dow)   2023-02-10

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Introduction

The unrestricted access to internet-based information demanded by the information society has led to an exponential growth of both internet traffic and the volume of stored/retrieved data. Data centres are housing and supporting the information technology and network telecommunications equipment for data processing, data storage and data transport. They are required both by network operators (delivering those services to customer premises) and by enterprises within those customer premises.

Data centres need to provide modular, scalable and flexible facilities and infrastructures to easily accommodate the rapidly changing requirements of the market. In addition, energy consumption of data centres has become critical both from an environmental point of view (reduction of carbon footprint) and with respect to economic considerations (cost of energy) for the data centre operator.

The implementation of data centres varies in terms of:

a) purpose (enterprise, co-location, co-hosting, or network operator facilities);

b) security level;

c) physical size;

d) accommodation (mobile, temporary and permanent constructions).

The needs of data centres also vary in terms of availability of service, the provision of security and the objectives for energy efficiency. These needs and objectives influence the design of data centres in terms of building construction, power distribution, environmental control and physical security. Effective management and operational information is required to monitor achievement of the defined needs and objectives.

This series of European Standards specifies requirements and recommendations to support the various parties involved in the design, planning, procurement, integration, installation, operation and maintenance of facilities and infrastructures within data centres. These parties include:

1) owners, facility managers, ICT managers, project managers, main contractors;

2) architects, consultants, building designers and builders, system and installation designers;

3) facility and infrastructure integrators, suppliers of equipment;

4) installers, maintainers.

At the time of publication of this document, the EN 50600 series will comprise the following standards and documents:

— EN 50600-1, *Information technology — Data centre facilities and infrastructures — Part 1: General concepts*;

— EN 50600-2-1, *Information technology — Data centre facilities and infrastructures — Part 2-1: Building construction*;

— EN 50600-2-2, *Information technology — Data centre facilities and infrastructures — Part 2-2: Power supply and distribution*;

— EN 50600-2-3, *Information technology — Data centre facilities and infrastructures — Part 2-3: Environmental control*;

— EN 50600-2-4, *Information technology — Data centre facilities and infrastructures — Part 2-4: Telecommunications cabling infrastructure*;

— EN 50600-2-5, *Information technology — Data centre facilities and infrastructures — Part 2-5: Security systems*;

— EN 50600-3-1, *Information technology — Data centre facilities and infrastructures — Part 3-1: Management and operational information*;

— EN 50600-4-1, *Information technology — Data centre facilities and infrastructures — Part 4-1: Overview of and general requirements for key performance indicators*;

— EN 50600-4-2, *Information technology — Data centre facilities and infrastructures — Part 4-2: Power Usage Effectiveness*;

— EN 50600-4-3, *Information technology — Data centre facilities and infrastructures — Part 4-3: Renewable Energy Factor*;

— FprEN 50600-4-6, *Information technology — Data centre facilities and infrastructures — Part 4-6: Energy Reuse Factor*

— FprEN 50600-4-7, *Information technology — Data centre facilities and infrastructures — Part 4-7: Cooling Efficiency Ratio;*

— CLC/TR 50600-99-1, *Information technology — Data centre facilities and infrastructures — Part 99-1: Recommended practices for energy management*;

— CLC/TR 50600-99-2, *Information technology — Data centre facilities and infrastructures — Part 99-2: Recommended practices for environmental sustainability;*

— CLC/TR 50600-99-3, *Information technology — Data centre facilities and infrastructures — Part 99-3: Guidance to the application of EN 50600 series*

The inter-relationship of the standards within the EN 50600 series is shown in Figure 1.
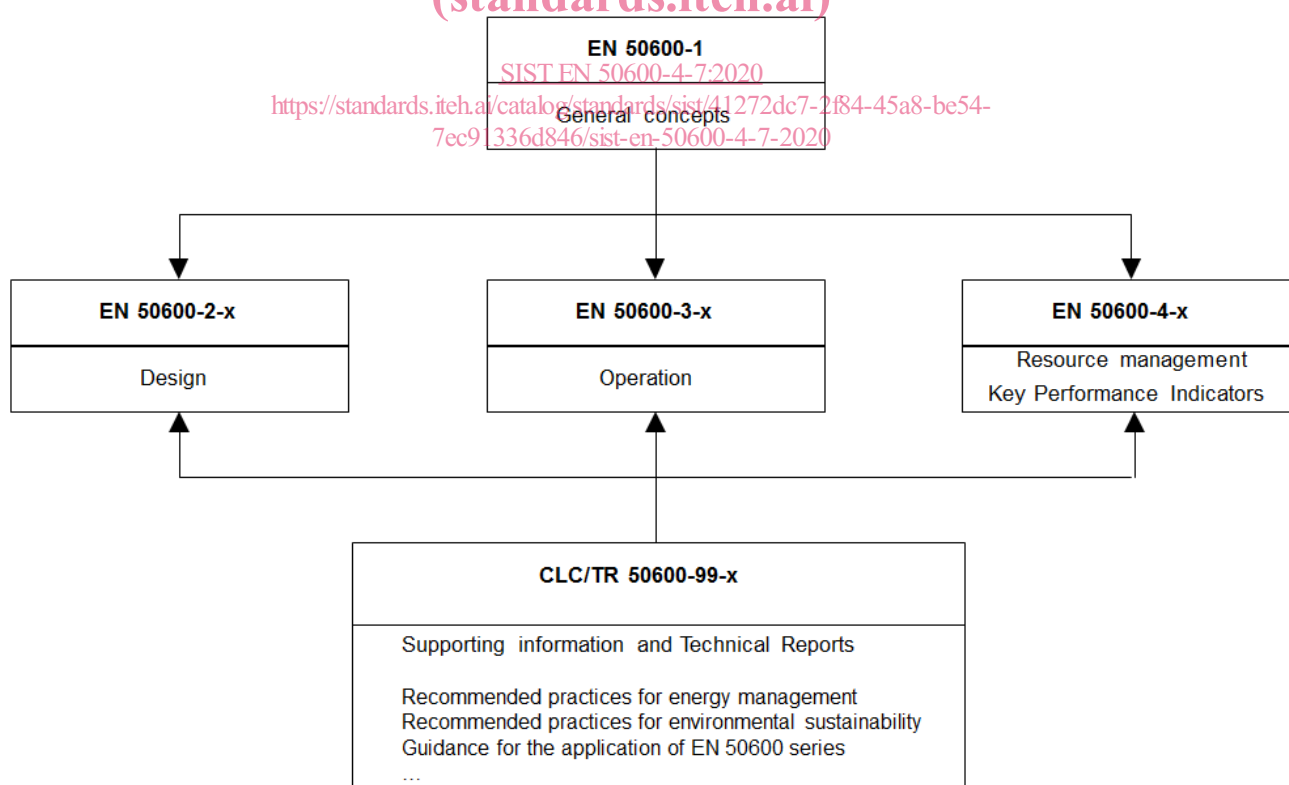
Figure 1 — Schematic relationship between the EN 50600 series of documents

EN 50600-2-X standards specify requirements and recommendations for particular facilities and infrastructures to support the relevant classification for "availability", "physical security" and "energy efficiency enablement" selected from EN 50600-1.

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EN 50600-3-X documents specify requirements and recommendations for data centre operations, processes and management.

EN 50600-4-X documents specify requirements and recommendations for key performance indicators (KPIs) used to assess and improve the resource usage efficiency and effectiveness, respectively, of a data centre.

In today's digital society data centre growth, and power consumption in particular, is an inevitable consequence and that growth will demand increasing power consumption despite the most stringent energy efficiency strategies. This makes the need for key performance indicators that cover the effective use of resources (including but not limited to energy) and the reduction of CO_2 emissions essential.

NOTE   Within the EN 50600-4-X series, the term "resource usage effectiveness" is more generally used for KPIs in preference to "resource usage efficiency", which is restricted to situations where the input and output parameters used to define the KPI have the same units.

In order to enable the optimum resource effectiveness of data centres a suite of effective KPIs is needed to measure and report on resources consumed in order to develop an improvement roadmap.

These standards are intended to accelerate the provision of operational infrastructures with improved resource usage effectiveness.

This document specifies Cooling Efficiency Ratio to determine the efficient utilization of energy resources to provide the temperature control required by spaces of the data centre.

Additional standards in the EN 50600-4-X series will be developed, each describing a specific KPI for resource usage effectiveness or efficiency.

The EN 50600-4-X series does not specify limits or targets for any KPI and does not describe or imply, unless specifically stated, any form of aggregation of individual KPIs into a combined nor an overall KPI for data centre resource usage effectiveness or efficiency.

This document is intended for use by and collaboration between data centre managers, facility managers, ICT managers, and main contractors.

This series of European Standards does not address the selection of information technology and network telecommunications equipment, software and associated configuration issues.

1 Scope

This document specifies the Cooling Efficiency Ratio (CER) as a Key Performance Indicator (KPI) to quantify the efficient use of energy to control the temperature of the spaces within the data centre.

This document:

a) defines the Cooling Efficiency Ratio (CER) of a data centre;

b) describes the relationship of this KPI to a data centre's infrastructure, information technology equipment and information technology operations;

c) defines the measurement, the calculation and the reporting of the parameter;

d) provides information on the correct interpretation of the CER.

Annex A describes the correlation of CER and other KPIs.

Annex B provides examples of the application of CER.

Annex C introduces the parameters that affect CER.

Annex D describes requirements and recommendations for derivatives of KPIs associated with CER.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

EN 50600-1, *Information technology - Data centre facilities and infrastructures - Part 1: General concepts*

EN 50600-4-1, *Information technology - Data centre facilities and infrastructures - Part 4-1: Overview of and general requirements for key performance indicators*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 50600-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
Cooling Efficiency Ratio
ratio of total heat removed and electrical energy used by a cooling system

3.1.2
Cooling Performance Ratio
ratio of actual heat load and electrical power used by a cooling system

3.2 Abbreviations

For the purposes of this document, the abbreviations given in EN 50600-1, EN 50600-4-1 and the following apply.

CEF   Cooling Efficiency Factor

CER   Cooling Efficiency Ratio

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CPR	Cooling Performance Ratio
HVAC	Heating, Ventilation, Air Conditioning
iCER	interim Cooling Efficiency Ratio
KPI	Key Performance Indicator
PUE	Power Usage Effectiveness
pCEF	partial Cooling Efficiency Factor
pPUE	partial Power Usage Effectiveness
pPUE$_{HVAC}$	partial Power Usage Effectiveness for heating, ventilation and air conditioning systems

3.3 Symbols

For the purposes of this document, the following symbols apply.

$E_{Cooling}$	Electrical Energy used by cooling systems
E_{CoolDC}	Part of $E_{Cooling}$ that is accounted to the data centre
E_{heat}	Electrical Energy transferred to heat
$E_{HVAC,DC}$	Electrical Energy used by air conditioning systems
E_{IT}	Electrical Energy used by IT equipment
$E_{UPSloss}$	Electrical Energy loss in UPS
E_{total}	Total energy used by the data centre calculated from CER
Q	actual heat load from data centre
$Q_{removed}$	heat quantity removed by the cooling system
$P_{Cooling}$	actual electrical power of the cooling systems

4 Applicable area of the data centre

Cooling Efficiency Ratio (CER) as specified in this document:

a) is associated with the data centre infrastructure within its boundaries only;

b) describes the efficiency of a cooling system with respect to its electrical energy use.

Derivatives of CER which are useful in certain circumstances are described in Annex D (Cooling Performance Ratio (CPR), interim CER (iCER)).

5 Determination of Cooling Efficiency Ratio

5.1 Definition of CER

The Cooling Efficiency Ratio (CER) is defined as follows:

$$CER = \frac{Q_{removed}}{E_{cooling}}$$

(1)

Where

$Q_{removed}$ = total heat removed from data centre in kWh

E_{cooling} = energy consumption (annual) of the cooling systems in kWh

Both Q_{removed} and E_{cooling} shall be measured in kWh and for the same period T.

NOTE   In EN 50600-3-1:2016, Formula (1) is designated as EER. This will be corrected with the revision of EN 50600-3-1.

5.2   Determining total energy use in multi-purpose buildings using CER

Calculation of PUE for data centres located in multi-purpose can be a challenge, when parts of the infrastructure are shared between the data centre and e.g. the office building. Separating electrical energy use can be easily arranged with sub-meters in the power trail. When the offices are equipped with UPS secured sockets, UPS losses need to be split up for offices and data centre. This can be accomplished by determination of the UPS loss with a meter before the UPS and meters on every line behind the UPS. For a large data centre in a small office building the loss attributed to the offices may even be ignored.

The major challenge is to account for the electrical energy for cooling when the cooling infrastructure is shared between data centre and offices as shown schematically in Figure 2. In most cases, the piping system is not separated between data centre and offices. Therefore, the heat loads of data centre and offices cannot be separated and measured. In addition, the heat load in offices strongly depends on the weather conditions and thus is much more variable than the heat load of the data centre.
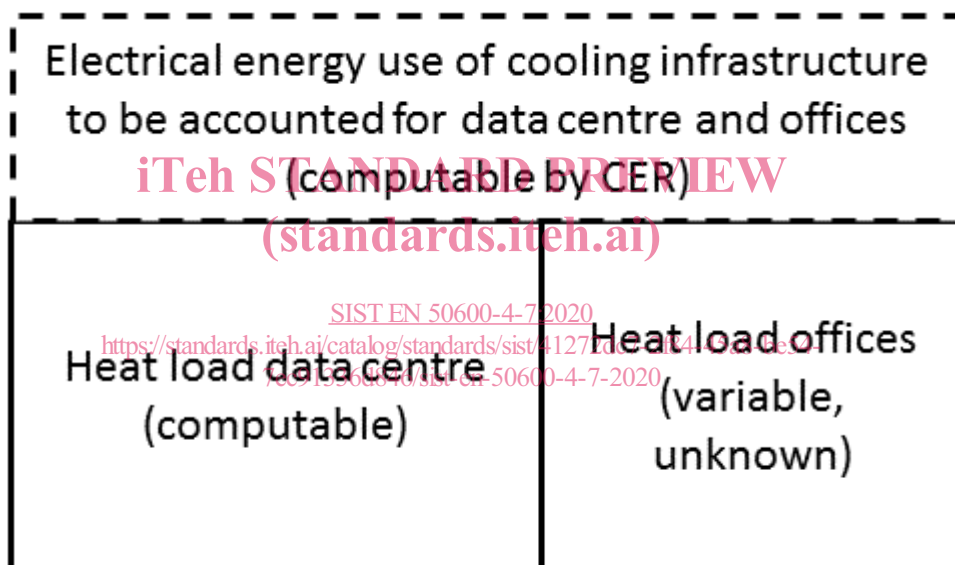

Figure 2 — Heat loads in multipurpose buildings and energy used for cooling

The calculation of the heat load of the data centre is based on the assumption that all electrical energy used in the data centre is transferred to heat: IT energy, UPS losses, and electrical energy for HVAC.

$$E_{\text{heat}} = E_{\text{IT}} + E_{\text{UPSloss}} + E_{\text{HVAC,DC}} \tag{2}$$

Provided that the CER of the cooling infrastructure is known, i.e. the total heat removed and the electrical energy used by the cooling infrastructure is measured, the electrical energy used to remove heat can be calculated as follows:

$$E_{\text{cooling}} = \frac{Q_{\text{removed}}}{CER} \tag{3}$$

To calculate the electrical energy used for cooling of the data centre, the heat removed in the formula above needs to be replaced by E_{heat}.

$$E_{\text{cooling}} = \frac{E_{\text{heat}}}{CER} = E_{\text{coolDC}} \tag{4}$$