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Information technology — Data centres key performance indicators —

Part 7: Cooling efficiency ratio (CER)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives or www.iec.ch/members_experts/refdocs).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html. In the IEC, see www.iec.ch/understanding-standards.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 39, *Sustainability, IT and data centres*.

A list of all parts in the ISO/IEC 30134 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

Introduction

The global economy is today reliant on information and communication technologies and the associated generation, transmission, dissemination, computation and storage of digital data. All markets have experienced exponential growth in that data, for social, educational and business sectors and, while the internet backbone carries the traffic, there are a wide variety of data centres at nodes and hubs within both private enterprise and shared/collocation facilities.

The historical data generation growth rate exceeds the capacity growth rate of information and communications technology hardware and, with less than half (in 2014) of the world's population having access to an internet connection, that growth in data can only accelerate. In addition, with many governments having "digital agendas" to provide both citizens and businesses with ever-faster broadband access, the very increase in network speed and capacity will, by itself, generate ever more usage (Jevons Paradox). Data generation and the consequential increase in data processing and storage are directly linked to increasing power consumption.

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

Within the ISO/IEC 30134 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.

The cooling efficiency ratio (CER) allows data centre operators to quickly determine the efficiency of their data centre cooling system, compare the results, and determine if energy efficiency improvements need to be made. The impact of operational cooling efficiency is proving to be extremely important in the design, location and operation of current and future data centres.

In order to determine the overall resource efficiency of a data centre, a holistic suite of metrics is required. This document is one of a series of International Standards for such KPIs and has been produced in accordance with ISO/IEC 30134-1, which defines common requirements for a holistic suite of KPIs for data centre resource efficiency. This document does not specify limits or targets for the KPI and does not describe or imply, unless specifically stated, any form of aggregation of this KPI into a combination with other KPIs for data centre resource efficiency. This document presents specific rules on CER's use, along with its theoretical and mathematical development. This document concludes with several examples of site concepts that could employ the CER metric.

Information technology — Data centres key performance indicators —

Part 7: Cooling efficiency ratio (CER)

1 Scope

This document specifies the cooling efficiency ratio (CER) as a key performance indicator (KPI) for quantifying the efficient use of energy to control the temperature of spaces within a data centre (DC).

This document:

a) defines the CER of a DC;

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

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

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

Annex A describes the correlation of the CER and other KPIs.

Annex B provides examples of the usage of the CER.

Annex C introduces the parameters that affect the CER.

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

This document is not applicable to cooling systems that are not powered by electricity (e.g. heat-driven absorption chillers).

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.

ISO/IEC 30134-1, *Information technology — Data centres — Key performance indicators — Part 1: Overview and general requirements*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 30134-1 and the following apply.

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

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

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

3.1.1
cooling efficiency ratio
CER
ratio of total heat removed and electrical energy used by a cooling system

Note 1 to entry: The value of "total heat annual removed" from the DC is measured in kWh.

3.1.2
cooling performance ratio
CPR
ratio of actual heat load and electrical power used by a cooling system

Note 1 to entry: The actual heat load is measured in kW.

3.1.3
energy loss
dissipation of energy caused by electric utilities

Note 1 to entry: The energy loss turned into heat are measured in kWh.

Note 2 to entry: Energy loss is caused, for example. by transformers, uninterruptible power supply (UPS), fans of computer room air handling units (CRAH), pumps, lighting, power cables.

3.2 Abbreviated terms

For the purposes of this document, the terms and definitions given in ISO/IEC 30134-1 and the following apply.

CEF	cooling efficiency factor
CER	cooling efficiency ratio
COP	coefficient of performance
CPR	cooling performance ratio
DC	data centre
EER	energy efficiency ratio
HVAC	heating, ventilation, air conditioning
iCER	interim cooling efficiency ratio
NSenCOP	net sensible coefficient of performance
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
SEER	seasonal energy efficiency ratio
UPS	uninterruptible power supply

3.3 Symbols

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

$E_{cooling}$	cooling system energy consumption (annual) in kWh
$E_{cooling,DC}$	part of $E_{cooling}$ that is attributed to the DC in kWh
$E_{cooling,other}$	part of $E_{cooling}$ that is not attributed to the DC in kWh
$E_{cooling,room}$	part of $E_{cooling}$ that is allocated to one room of the DC in kWh
$E_{cooling,subsystem}$	electrical energy use of the sub-system in kWh
E_{heat}	electrical energy transferred to heat in kWh
$E_{heat,room}$	electrical energy allocated to one room transferred to heat in kWh
$E_{heat,DC}$	electrical energy of the DC that is transferred to heat (annual) in kWh
E_{IT}	IT equipment energy consumption (annual) in kWh
$E_{IT,room}$	IT equipment energy consumption (annual) allocated to one room in kWh
E_{losses}	electrical energy losses (annual) in kWh
$E_{losses,room}$	electrical energy losses (annual) allocated to one room in kWh
$E_{total,room}$	total energy consumption allocated to one room (annual) in kWh
E_{DC}	total DC energy consumption (annual) in kWh
F_{EC}	cooling efficiency factor
$F_{EC,p}$	partial cooling efficiency factor
$P_{cooling}$	actual electrical power of the cooling system in kW
P_{heat}	actual heat load in kW
R_{CE}	cooling efficiency ratio
R_{CP}	cooling performance ratio
$\eta_{U,P,p}$	power usage effectiveness, PUE
$\eta_{U,P}$	partial power usage effectiveness, pPUE

4 Applicable area of the data centre

The CER as specified in this document:

— is associated with the DC infrastructure within its boundaries only;

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

Derivatives of the CER which are useful in certain circumstances are described in Annex D.

5 Definition of the CER

The CER, R_{CE}, is defined according to Formula (1):

$$R_{CE} = \frac{E_{heat}}{E_{cooling}} \tag{1}$$

Both E_{heat} and $E_{cooling}$ shall be measured in kWh and for the same time period.

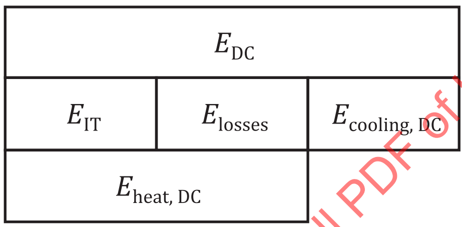
NOTE Within ISO/IEC TS 22237-7:2018, Formula (1) is designated as the energy efficiency ratio (EER). This will be corrected with the revision of ISO/IEC TS 22237-7.

The following applies to dedicated DC infrastructures:

$$E_{heat} = E_{heat,DC}$$

$$E_{cooling} = E_{cooling,DC}$$

Figure 1 shows the relationship between the different energy forms for dedicated DC infrastructures.



where

$E_{DC} = E_{IT} + E_{losses} + E_{cooling,\,DC}$

Figure 1 — Dedicated cooling system

The calculation of the heat load of the DC is based on the assumption that all electrical energy used in the DC is transferred to heat:

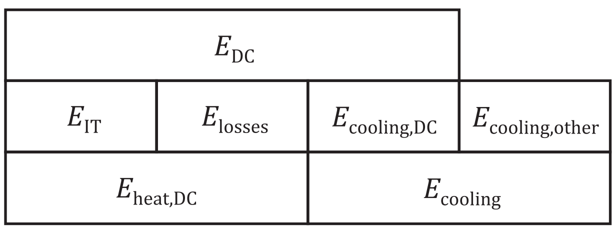
$$E_{heat,DC} = E_{IT} + E_{losses}$$

E_{IT} shall be measured in accordance with ISO/IEC 30134-2.

If available, E_{losses} shall include all other electrical losses, e.g. electrical energy of UPS, energy storage, transformers, power cables or lighting transferred to heat within the DC boundaries.

For shared cooling systems in multi-purpose buildings, which include a DC, the energy consumption of the cooling system is determined from the energy consumption from the shared cooling system.

Figure 2 shows the relationship between the different energy forms for shared cooling systems in multi-purpose buildings including a DC.



Where

$E_{cooling,DC}$ is the part of the energy use for the entire shared cooling system to remove the DC related heat loads;

$E_{cooling,other}$ is the part of the energy use for the entire shared cooling system to remove non-DC related heat loads.

Figure 2 — Shared cooling system

6 Measurement of CER

6.1 General

The calculation of CER requires the recording and documenting of total heat removed and electrical energy used for cooling over a coincident period of 12 months. This document does not specify the frequency of measurements of total heat removed and electrical energy used for cooling, since CER is calculated on an annual timeframe. However, the frequency of measurement employed will define the timing of subsequent CER calculations on a rolling annual basis.

6.2 Requirements

The measurement of CER requires the measurement of the total heat removed and the electrical energy used in the same period.

In order to measure the heat removed, the volume of the coolant and its heat capacity shall be measured. In cases like direct free cooling, every parameter influencing the heat capacity (like humidity) shall be measured for an acceptable accuracy of the calculation of the heat removed. In case of redundant pipes, every pipe shall be measured.

For the electrical energy use all components of the cooling infrastructure (like pumps) valves etc., shall be measured and included in the energy used. Electrical metering shall be based on kWh, not on power in kW. In the case of energy reuse, the energy consumption of additional systems for distributing the reused heat in the building shall not be part of the electrical energy consumption. Annex B shall apply.

In cases where it is necessary to describe versions of the CER for measurement periods of less than 12 months or for DC subsystems, the measurements described in Annex D shall be used.

6.3 Recommendations

DCs should implement meters with remote reading and data history storage capabilities.

7 Application of CER

CER can be used by DC managers to report the efficiency of the cooling system used to control the temperature of the spaces within the DC. This KPI can be used independently, but to achieve a more holistic picture of the resource efficiency of the DC, other KPIs described in the ISO/IEC 30134 series should be considered. When using CER, the PUE in particular should be considered. Where CER is reported, the corresponding PUE value should also be reported.

8 Reporting of CER

8.1 Requirements

8.1.1 Standard construct for communicating CER

For a reported CER to be meaningful, the reporting organization shall provide the following information:

a) the DC under inspection;

b) the CER value [or cooling performance ratio (CPR) value; see D.4];

c) the termination date of the period of measurement using the format of ISO 8601-1 (e.g. yyyy-mm-dd).

8.1.2 Data for public reporting of CER

8.1.2.1 Required information

The following data shall be provided when publicly reporting CER data:

a) contact information;

NOTE 1 Only the organization's name or contact are recommended to be displayed in public inquiries.

b) DC location information (address, county or region);

NOTE 2 Only state or local region information is required to be displayed in public inquiries.

c) measurement results: CER with appropriate nomenclature;

d) use case: dedicated DC infrastructures or shared cooling systems in multi-purpose buildings including a DC.

8.1.2.2 Required supporting evidence

Information on the DC which shall be available upon request as a minimum includes:

a) organization's name, contact information and regional environmental description;

b) measurement results: CER with appropriate nomenclature;

c) measurement(s) start dates and assessment completion dates;

d) E_{IT} value;

e) report on the size of the computer room, telecom room and control room spaces;

f) external environmental conditions consisting of minimum, maximum and average temperature, humidity and altitude;

g) corresponding PUE value and category.

NOTE The IEC 62052 series and the IEC 62053 series provide a reference for the measurement of electrical energy.

8.1.2.3 Example of reporting CER values

Using the construct of 8.1.1, examples of specific CER designations and their interpretation are given as follows.

Sample CER designation:

DC X: CER (2018-12-31) = 3,5

Interpretation: In the year 2018 the CER value of DC X was 3,5.

8.2 Recommendations

The following information can potentially be useful in tracking the CER trends within a DC:

a) DC size (facility m^2);

b) total DC design load for the facility (e.g. 10 MW);

c) name of the possible auditor and method used for auditing;

d) DC contact information;

e) DC environmental conditions;

f) DC location and region;

g) DC's mission;

h) DC archetype percentages (e.g. 20 % web hosting, 80 % email);

i) DC commissioned date;

j) numbers of servers, routers, and storage devices;

k) average and peak server CPU utilization;

l) percentage of servers using virtualization;

m) average age of IT equipment by type;

n) average age of facility equipment by type (cooling and power distribution equipment);

o) DC availability objectives (see ISO/IEC 30134-1:2015, Annex A);

p) cooling and air-handling details.

NOTE Other KPIs within the ISO/IEC 30134 series can assist in the recording of the above information.

In general, the CER should be reported to one decimal place. However, depending on the accuracy of both measurements, the heat removed and the electrical usage, more than one decimal place may be reported.

Reporting of CER for external communication should be accompanied by additional cooling conditions, like usage of direct free cooling or water. Where KPIs exist for these conditions, they should be determined and reported together with the CER.

For usage in energy management and verification of measures of improvement, a report of interim cooling efficiency ratio (iCER; see D.1) can be plotted against the outside air temperature and humidity, if applicable. As there is a strong dependency of the iCER from outside air temperature and other conditions like humidity for most energy efficient cooling systems, every improvement can be detected in a shift of the iCER value at the same outside air temperature.

Annex A
(informative)

Correlation of CER and other KPIs

A.1 General

Cooling is one of the most important aspects of energy use in a DC, and one with the largest potential for optimization of energy efficiency. The partial PUE (pPUE) of the cooling infrastructure provides insight into that potential in comparison to the other parts of the infrastructure, but it is less helpful in energy management to verify the effect of improvements of the cooling infrastructure, as the value of a pPUE in general is between 1 and the PUE of the DC, as shown in Formula (A.1):

$$1 < \eta_{U,P,p} < \eta_{U,P} \quad \text{(A.1)}$$

where

$\eta_{U,P,p}$ is the power usage effectiveness, PUE;

$\eta_{U,P}$ is the partial power usage effectiveness, pPUE;

See ISO/IEC 30134-2 for the definition and further information on the usage of PUE and pPUE.

Measuring the heat removed divided by the electrical energy used by the cooling infrastructure provides a much more sensitive KPI.

A.2 Discussion of existing terms for performance rating

There are already multiple terms defined for performance rating of machines (e.g. heat pumps and cooling equipment) as one part of the entire cooling system, e.g. in Reference [6] and Reference [10]; see Table A.1. All terms in Table A.1 only deal with machine characteristics, defined under fixed conditions.

There is currently no term of efficiency for the entire cooling system based on real life measurements during DC operation. CER and CPR close this gap: both are based on measurements under real conditions in DC operation. CPR refers to COP and CER refers to SEER.

Table A.1 — Terms of efficiency of cooling machines

Term	Abbreviated term	Infrastructure	Comments
Coefficient of performance	COP	Heat pumps	Machine characteristic, defined under fixed conditions
Energy efficiency ratio	EER	Cooling machines	Machine characteristic, defined under fixed conditions
Seasonal EER	SEER	Cooling machines	Defined for the period of one year
Net Sensible Coefficient of Performance	NSenCOP	Computer room air conditioners	Includes allowances for outdoor heat rejection fans and fluid pumps

The coefficient of performance (COP) is a value based on actual heat load and electrical power. It describes the performance under controlled, optimal conditions, thus giving a maximum value for performance, not a realistic one for operation in a real DC. Furthermore, it is defined for heat pumps, not for cooling infrastructure.

According to References [6] and [10], the EER is a ratio of the cooling capacity to the power input value at any given set of rating conditions. It also describes the performance under controlled conditions, but it already acknowledges the influence of part load operation of a cooling infrastructure.

According to Reference [6], the SEER is the total heat removed from the conditioned space during the annual cooling season divided by the total electrical energy consumed by the air conditioner or heat pump during the same season. It describes the performance of a cooling infrastructure under real conditions based on a period of a full year. It therefore accounts for the dependency of the EER on climate conditions, or, to be more precise, on the outside air temperature.

Annex B
(normative)

Examples of usage of CER

B.1 Determining PUE in data centres with different computer rooms using CER

Operators of DCs with multiple rooms that have different characteristics (e.g. in energy density of the racks or air flow strategies) can wish to compare the energy efficiency of these rooms. The calculation of a PUE value for each room (pPUE) can be a challenge when infrastructure is shared within the DC. On the power trail, this issue can be solved by an appropriate set of sub-meters providing the ability to account for IT energy and the electrical energy losses (e.g. from UPS, energy storage, etc.).

Accounting for the usage of electrical energy for a central cooling infrastructure requires the calculation of the heat load of every room using Formula (B.1):

$$E_{\text{heat,room}} = E_{\text{IT,room}} + E_{\text{losses,room}} \tag{B.1}$$

The total energy used by each room can be calculated based on the CER of the cooling infrastructure and the value of E_{heat} for each room, as shown in Formula (B.2):

$$\begin{aligned} E_{\text{total,room}} &= E_{\text{IT,room}} + E_{\text{losses,room}} + E_{\text{cooling,room}} = \\ E_{\text{heat,room}} + E_{\text{cooling,room}} &= E_{\text{heat,room}} * \left(1 + \frac{1}{R_{\text{CE}}}\right) \end{aligned} \tag{B.2}$$

where

$R_{\text{CE,room}} = E_{\text{heat,room}} / E_{\text{cooling,room}} = R_{\text{CE}} = E_{\text{heat}} / E_{\text{cooling}}$

NOTE Symbols with the index "room" stand for values that refer to a specific room.

Since the IT energy for each room is known, a PUE value can be determined for each room without room-based heat measurements.

The calculated PUE in this clause ignores potential advantages of the different air flow strategies. Enclosed environments usually lead to a higher temperature spreading over IT and lead to higher temperatures at the HVAC inlet and thus to a higher temperature of the cooling fluid. When routes of cooling pipes of different computer rooms with different temperatures are combined, the temperature before the cooling system is a mixture of these temperatures. As this clause concerns a situation with multiple rooms using a shared cooling infrastructure, it remains a valid approach to compare different rooms in this special DC. It does not provide a general PUE value for the different air flow strategies.

B.2 Determining CER in cases of energy re-use

Re-use of energy is an important strategy for overall energy efficiency. DCs can contribute significantly to energy re-use by providing heat to premises that need heat. Therefore, heat transferred beyond the border of a DC can be measured and accounted for in the KPI energy re-use factor (see ISO/IEC 30134-6).

CER is a KPI used to characterize the efficiency of a DC sub-system, i.e. the cooling infrastructure. The infrastructure to distribute heat in a building is not considered as a part of the DC. Therefore, all energy needed to transfer the heat out of the borders of the DC shall be accounted for in the denominator of CER formula. Any additional systems to distribute heat in the building and their energy use shall be accounted for in building management and its related KPI.

Annex C
(informative)

Parameters influencing CER

C.1 Adjustment of temperature

Air handling units, if technically capable, can be configured regarding two important parameters:

a) fan speed, defining the amount of air circulated in the computer room;

b) lower temperature of the coolant, defining the cooling power.

While the first parameter has a major impact on the partial PUE of the HVAC, the latter one has impact on CER.

The higher the lower temperature for the air handling units, the lower their cooling power. But for part load operation, a lower cooling power can be sufficient. Rising the lower temperature is beneficial for systems using free cooling, as the period of sufficient difference of outside air temperature to lower temperature can be extended. Using free cooling over a longer period throughout the year leads to a higher CER for a full year.

Therefore, adjusting lower temperature for coolant in air handling units influences CER.

C.2 Demand of cooling

Inside the cooling infrastructure, a set of pumps ensures the flow of coolant through the pipes to the air handling units. A reduction of the volume of coolant down to the demand of cooling avoids unnecessary pumping. This directly improves the value of CER as less electrical energy is used by the cooling infrastructure, serving the same IT load and thus heat load.

Annex D
(normative)

Derivatives of CER

D.1 Purpose of CER derivatives

It can be necessary to describe versions of CER for measurement periods of less than 12 months or for DC subsystems. Derivative CER terms are designated for this purpose. They provide the value as a variant of CER to describe a specific situation or set of conditions. Each derivative shall be accompanied with specific information that describes the specific situation.

D.2 Using CER derivatives

CER reporting shall be consistent with PUE reporting. The boundary conditions of the PUE report shall be the same for CER reporting. For reporting CER, if there is a derivative PUE, a derivative CER with the same boundary conditions shall be provided.

Combined use of the terms is permitted to describe specific situations and values. An example use of these derivatives is:

interim pCER (2021-08-01:2021-08-31) = 3,1 [ref. jjj]

[jjj]: [boundaries of the DC, shared cooling, space, physical security]

40 % IT load, environmental conditions, etc.

D.3 Interim CER

The definition of CER clearly indicates that it is an annual figure and requires continuous measurement of IT energy and total heat removed from the DC for at least one year. Reporting requires accompanying every CER value with its category and the period of measurement (see 6.2).

For energy management purposes, it can be useful to measure and report periods smaller than a full year. These values shall be designated as iCER. They shall also be accompanied by the period of measurement, and the other context and reporting information required for annualized CER.

D.4 Determination of CPR

D.4.1 Calculation of CPR

For small periods, iCER evolves into the direction of a COP for cooling infrastructure, but under real operation conditions as a parameter dependent on the load and the outside air temperature.

The CPR is defined according to Formula (D.1):

$$R_{\mathrm{CP}} = \frac{P_{\mathrm{heat}}}{P_{\mathrm{cooling}}} \tag{D.1}$$

Both nominator and denominator shall be measured at the same period.

D.4.2 Measurement of CER

D.4.2.1 Requirements

Determining CPR requires determination of heat load and power usage on a small timeframe. The size of this timeframe depends on the intended use of CPR, e.g. in the process of capacity management, and the technical capabilities of the meters and the monitoring infrastructure.

For an acceptable accuracy of the CPR, it is necessary to ensure a precise alignment of the measurement period of both factors of the CPR, i.e. the heat removed and the electrical usage.

D.4.2.2 Recommendations

DCs should implement automation of meter reading and data processing in order to cope with the expected amount of data.

D.4.3 Reporting of CER

D.4.3.1 Requirements

Reporting of CPR requires the point in time of determination, e.g. “2019-07-15 at 13:30 h CPR was 2,3” or “2019-01-12, at 5:15 h CPR was 12,7”. In general, the CPR shall be reported to one decimal place. However, depending on the accuracy of the measurement of CPR, more than one decimal place may be reported, but not more decimal places than reported for CER.

As the CPR depends greatly on outside air temperature and other conditions, like humidity, for most energy efficient cooling systems, reporting of CPR shall contain these conditions.

D.4.3.2 Recommendations

For usage in capacity management, CPR should be plotted against outside air temperature and humidity, if applicable. The minimum of CPR is usually a better indication for the maximum power requirement of the cooling infrastructure than the data given on the name plates of all components.

D.4.4 Using CPR in capacity management

Determining the utilization of main power supply and generators requires knowledge of maximum power demand of all infrastructure sub-systems. While peak load of UPS systems can be monitored and related to IT load, maximum load of the cooling infrastructure depends on IT load and outside air temperature. Machine characteristics provided by vendors can deviate from power demand in a real DC. Therefore, a metric is required to determine power demand of a cooling infrastructure under individual, real operating conditions. This metric can be provided by CPR.

According to D.4.3.2, a plot of CPR against outside air temperature and humidity (if applicable) leads to a better understanding of the real power demand of a cooling infrastructure. Typical values of CPR for compressor-based cooling systems are in the range of 2 to 3. At moderate outside air temperature, optimized systems can achieve values well above 3, as do all free cooling systems.

At higher outside air temperatures, the values of CPR can fall below 2 and for low-part loads even below 1, e.g. the cooling infrastructure requires more electrical energy then the amount of heat it removes. Although this ought not to occur at higher loads and does not put the total capacity of a DC at risk, CPR should be monitored at different IT loads to verify the development of CPR to higher values at higher IT loads.