



**TÜRK  
STANDARDLARI  
ENSTİTÜSÜ**

**Türk Standardı**

**TS EN 50600-2-3**

**Kasım 2020**

**TS EN 50600-2-3:2014 yerine**

ICS 35.020; 35.110; 35.160

**Bilgi teknolojisi - Veri merkezi tesisleri ve altyapıları -  
Bölüm 2-3: Çevresel kontrol**

Information technology - Data centre facilities and infrastructures - Part 2-3:  
Environmental control

Technologie de l'information - Installation et infrastructures des centres de  
traitement de données - Partie 2-3: Contrôle environnemental

Informationstechnik - Einrichtungen und Infrastrukturen von Rechenzentren -  
Teil 2-3: Regelung der Umgebungsbedingungen



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Bu standard, CLC/TC 215 “Electrotechnical aspects of telecommunication equipment - Telekomünikasyon ekipmanının elektroteknik yönleri” Teknik Komitesi tarafından hazırlanmış, CENELEC tarafından 29.04.2019 tarihinde onaylanmış ve Türk Standardları Enstitüsü Teknik Kurulu'nun 09.11.2020 tarihli toplantısında Türk Standardı olarak kabul edilerek yayımına karar verilmiştir.

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EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN 50600-2-3**

June 2019

ICS 35.020; 35.110; 35.160

Supersedes EN 50600-2-3:2014

English Version

**Information technology - Data centre facilities and infrastructures  
- Part 2-3: Environmental control**

Technologie de l'information - Installation et infrastructures  
des centres de traitement de données - Partie 2-3: Contrôle  
environnemental

Informationstechnik - Einrichtungen und Infrastrukturen von  
Rechenzentren - Teil 2-3: Regelung der  
Umgebungsbedingungen

This European Standard was approved by CENELEC on 2019-04-29. 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.

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

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## European foreword

This document (EN 50600-2-3:2019) 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) 2020-04-29
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2022-04-29

This document supersedes EN 50600-2-3:2014.

The following technical changes have been made:

- a) Clause 5 on environmental control revised, e.g. requirements in 5.2 for environmental control in various data centre spaces;
- b) availability requirements in Clause 6 revised and aligned with EN 50600-1:2019 and EN 50600-2-3:2019, in particular, enhanced Class 4 removed;
- c) measurement requirements for granularity levels in Clause 8 revised;
- d) Annex A and B removed;
- e) new informative Annex A added to summarize requirements for environmental conditions;
- f) minor technical and editorial improvements to the whole document.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association.

## 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 usually 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 environmental footprint) and with respect to economical 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, telecommunications cabling and physical security as well as the operation of the data centre. Effective management and operational information is required to monitor achievement of the defined needs and objectives.

Recognizing the substantial resource consumption, particularly of energy, of larger data centres, it is also important to provide tools for the assessment of that consumption both in terms of overall value and of source mix and to provide Key Performance Indicators (KPIs) to evaluate trends and drive performance improvements.

At the time of publication of this European Standard, EN 50600 series is designed as a framework of standards and technical reports covering the design, the operation and management as well as the key performance indicators for energy efficient operation of the data centre.

The EN 50600-2 series defines the requirements for the data centre design.

The EN 50600-3 series defines the requirements for the operation and the management of the data centre.

The EN 50600-4 series defines the key performance indicators for the data centre.

The CLC/TR 50600-99-X Technical Reports cover recommended practices and guidance for specific topics around data centre operation and design.

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, operators, facility managers, IT managers, project managers, main contractors;
- 2) consulting engineers, architects, building designers and builders, system and installation designers, auditors, test and commissioning agents;
- 3) facility and infrastructure integrators, suppliers of equipment;
- 4) installers, maintainers.

At the time of publication of this European Standard, the EN 50600-2 series comprises the following standards:



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

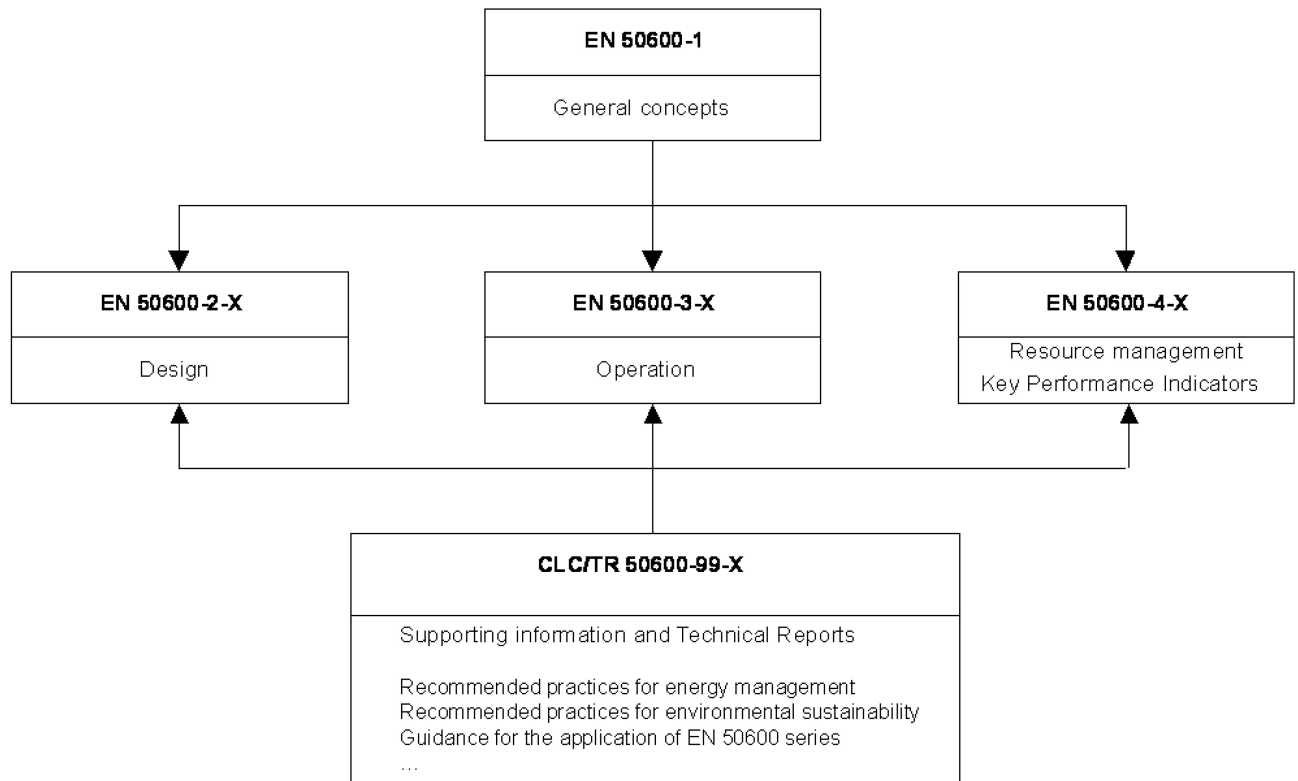
EN 50600-2-2, *Information technology — Data centre facilities and infrastructures — Part 2-2: Power supply and distribution*;

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*;

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



**Figure 1 — Schematic relationship between the EN 50600 standards**

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.

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.

This European Standard addresses the environmental control facilities and infrastructure within data centres together with the interfaces for monitoring the performance of those facilities and infrastructures in line with EN 50600-3-1 (in accordance with the requirements of EN 50600-1).

This European Standard is intended for use by and collaboration between architects, building designers and builders, system and installation designers.

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 addresses environmental control within data centres based upon the criteria and classifications for “availability”, “security” and “energy efficiency enablement” within EN 50600-1.

This document specifies requirements and recommendations for the following:

- a) temperature control;
- b) fluid movement control;
- c) relative humidity control;
- d) particulate control;
- e) vibration;
- f) physical security of environmental control systems.

Safety and electromagnetic compatibility (EMC) requirements are outside the scope of this European Standard and are covered by other standards and regulations. However, information given in this European Standard may be of assistance in meeting these standards and regulations.

## 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 50600-2-2:2019, *Information technology - Data centre facilities and infrastructures - Part 2-2: Power supply and distribution*

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

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

EN 61439-1, *Low-voltage switchgear and controlgear assemblies - Part 1: General rules*

EN 62040-3, *Uninterruptible power systems (UPS) - Part 3: Method of specifying the performance and test requirements*

EN ISO 14644-8, *Cleanrooms and associated controlled environments - Part 8: Classification of air cleanliness by chemical concentration (ACC) (ISO 14644-8)*

EN ISO 16890-1:2016, *Air filters for general ventilation - Part 1: Technical specifications, requirements and classification system based upon particulate matter efficiency (ePM) (ISO 16890-1:2016)*

### 3 Terms, definitions and abbreviations

#### 3.1 Terms and definitions

For the purposes of this document, the terms and definitions 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

##### **access floor**

system consisting of completely removable and interchangeable floor panels that are supported on adjustable pedestals connected by stringers to allow the area beneath the floor to be used by building services

Note 1 to entry: Also known as raised floor.

[SOURCE: EN 50600-2-1:2014, 3.1.1 – modified: added note 1 to entry]

##### 3.1.2

##### **adiabatic cooling**

reducing the temperature of a given medium (usually air) using the principle of evaporative cooling

##### 3.1.3

##### **comfort environmental controls**

controls which produce an environment which is appropriate for the effective performance of personnel in a given space

##### 3.1.4

##### **dew point**

temperature at which the water vapour in a gas begins to deposit as a liquid or ice, under standardized conditions

##### 3.1.5

##### **direct fresh air cooling**

cooling system that uses the external air that might be filtered to cool the IT equipment in the data centre

##### 3.1.6

##### **exhaust air temperature**

temperature of the air leaving the data centre building

##### 3.1.7

##### **heat load**

thermal power that is produced

##### 3.1.8

##### **indirect fresh air cooling**

cooling system that uses the external air to cool the data centre. The external air is passed through a heat exchanger to separate the external from the internal air which passes by the IT equipment

##### 3.1.9

##### **information technology equipment**

equipment providing data storage, processing and transport services together with equipment dedicated to providing direct connection to core and/or access networks

**3.1.10****inlet air temperature**

temperature of the (cold) air entering the rack or IT equipment

**3.1.11****outdoor air temperature**

temperature of the air measured outside of the data centre building

**3.1.12****outlet air temperature**

temperature of the (warm) air leaving the rack or IT equipment

**3.1.13****relative humidity**

ratio, expressed as a percentage, of the vapour pressure of water vapour in moist air to the saturation vapour pressure with respect to water or ice at the same temperature

[SOURCE: IEC 60050-705:1995, 705-05-09]

**3.1.14****return air temperature**

temperature of the (warm) air re-entering the environmental control system e.g. the air handling unit

**3.1.15****supply air temperature**

temperature of the (cold) air leaving the environmental control system e.g. the air handling unit

**3.1.16****ventilation**

supply of air motion in a space by circulation or by moving air through the space

Note 1 to entry: Ventilation can be produced by any combination of natural or mechanical supply and exhaust.

Note 2 to entry: Such systems may include partial treatment such as heating, relative humidity control, filtering or purification, and, in some cases, evaporative cooling.

**3.2 Abbreviations**

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

AHU	Air Handling Unit
CRAC	Computer Room Air Conditioning (Unit)
CRAH	Computer Room Air Handler units
DRUPS	Dynamic Rotary Uninterruptible Power System
IT	Information Technology
ITE	Information Technology Equipment
UPS	Uninterruptible Power System

## 4 Conformance

For a data centre to conform to this European Standard:

- it shall feature an environmental control solution that meets the requirements of Clauses 5 and 6;
- it shall feature an approach to physical security in relation to the environmental control solution that meets the requirements of Clause 7;
- it shall feature an energy efficiency enablement solution that meets the requirements of the relevant Granularity Level of Clause 8;
- local regulations, including safety, shall be met.

The required Class of the Environmental Control system of a data centre is based on the required Availability Class of the data centre.

## 5 Environmental control within data centres

### 5.1 General

#### 5.1.1 Design input

Power supply and distribution and environmental control are important primary facilities and infrastructures of a data centre and have inter-related design aspects (see Figure 2):

- power supplied to IT equipment which is converted to heat output;
- power supplied to the environmental control system to remove the heat output.

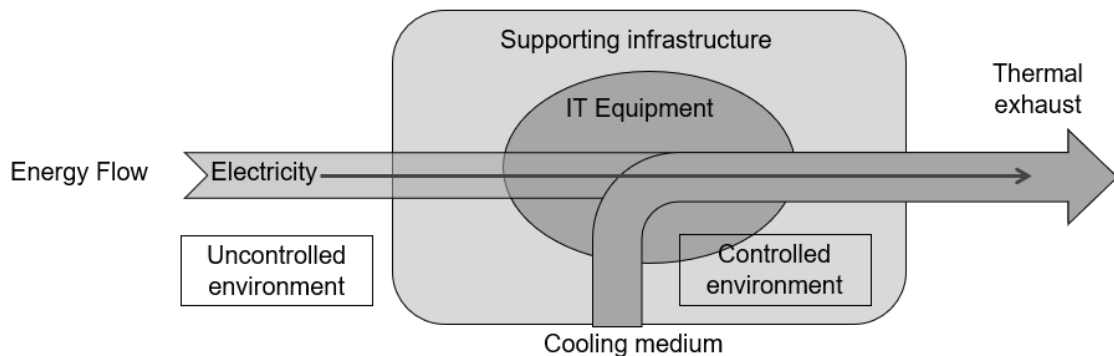


Figure 2 – Logical representation of environmental control of data centre spaces

#### 5.1.2 Functional Elements

The environmental control system is one of the most important parts of the data centre infrastructure. Excessive variations of temperature or relative humidity can directly affect the functional capability of the data centre and its infrastructures.

The functional elements of the environmental control system are divided into supply and distribution elements. The division of environmental control systems into supply and distribution reflects energy efficiency where data centres use multiple cooling sources in various combinations (e.g. cold water from public grids, non- dedicated central cooling plants, geothermal systems, rivers, and compressor systems).

Supply elements relate to the generation of temperature controlled fluids. Distribution elements relate to the distribution of fluids generated by the supply elements. Distribution elements are differentiated in devices (units) and paths. See Table 1 for examples of these elements.

It should be noted that for environmental control systems the electrical energy flow is into the system and the thermal flow is from within the controlled environment outwards to the uncontrolled environment (exhausted from the building).

Some environmental systems combine the function of supply and distribution elements.

**Table 1 — Examples of supply and distribution elements**

Area	Fluid	Functional Element(s)	
		Device / Functional Element	Path / Functional Element
Supply	Water/Refrigerant	External water supply, chiller, pump(s), condensing unit	Pipe System
	Air	Outside air intake, filter(s), heat exchanger	Duct/Plenum System
Distribution	Water/Refrigerant	Pump(s), heat exchanger, CRAH	Pipe System
	Air	CRAC, louvres, AHU (Air Handling Unit)	Duct/Plenum System

### 5.1.3 Requirements

The approach taken for the design of the environmental control system shall take into account available technology, physical security, data centre availability, maintenance, future extension (continuity of service) and operations.

The design of the environmental control system and the selection and installation of functional elements shall take into consideration the effect of vibration on the data centre spaces.

Physical data centre location and external conditions (minimum, median and maximum external temperature and humidity rate) have to be taken into account for the selection of the functional elements.

The design of the environmental control system and the selection and installation of functional elements shall take into consideration the effect of friction and/or obstruction in the pathways for temperature controlled fluids. Operational controls shall be provided to ensure no degradation of fluid flow due to changes in the pathways (see EN 50600-3-1).

During the design phase the requirement for the number of air changes per unit time and air pressure shall be established.

In all data centre spaces the requirements for air quality shall be considered.

In all spaces with a risk of damage to static-sensitive equipment from electro-static discharge the relative humidity shall be maintained in accordance with the instructions of the supplier of the equipment to be accommodated. Where no information exists or where the equipment manufacturer is not specified, a minimum dew point of 5,5 °C shall be maintained.

Where direct fresh air cooling solutions are chosen the requirements analysis and the resulting methodology of monitoring and control is of prime importance. In these circumstances particular consideration shall be given to the control of contaminants.

For guidance on the ventilation requirements of activated gaseous suppression systems that have been discharged see EN 50600-2-5.

An overview of the requirements on environmental conditions is given in Annex A.

#### 5.1.4 Recommendations

Opportunities for reductions in energy consumption exist where wider tolerances of temperature and relative humidity can be accepted in defined data centre spaces (see CLC/TR 50600-99-1).

Clause 8 contains requirements for the measurement of certain parameters with the aim to provide insight, the ability to analyse and ultimately to improve energy efficiency.

Devices of the environmental control system with integrated vibration decoupling for all rotating parts (e.g. fan, compressor) or low vibration parts should be selected.

Where devices of the environmental control system or other external devices with rotating parts are not equipped with integrated vibration decoupling the whole unit should be decoupled.

Where the design of the cooling system relies on the use of “F-gaseous” coolants the long term availability of such coolants and the subsequent effect on the cooling system efficiency should be considered.

NOTE: For “F-gaseous” coolants see REGULATION (EU) No 517/2014.

### 5.2 Environmental control of data centre spaces

#### 5.2.1 Building entrance facilities

No specific requirements.

#### 5.2.2 Personnel entrance(s)

Comfort environmental controls shall be applied to this space.

#### 5.2.3 Docking/loading bay(s)

No specific requirements.

#### 5.2.4 Generator space(s) including fuel storage

##### 5.2.4.1 Generator and Diesel UPS spaces

Temperature shall be maintained in accordance with the instructions of the supplier of the equipment to be accommodated. Where no information exists or where the equipment manufacturer is not specified the temperature shall be maintained above 0 °C and should be above 10 °C.

Adequate ventilation shall be provided for combustion and for radiator cooling.

Where the manufacturer is not known at the time of design the maximum temperature shall be 35 °C.

Anti-condensation measures shall be taken for generator and switchgear.

Air intake of cooling equipment shall not be influenced by exhaust gas.

##### 5.2.4.2 Fuel systems

The fuel system shall be protected against sub-zero ambient temperatures to avoid fuel solidification.

NOTE The availability of generators can be adversely affected by cold (<10 °C) or poor quality fuel and can be improved through the installation of crankcase heaters.

#### 5.2.5 Transformer space(s)

Temperature shall be maintained in accordance with the instructions of the supplier of the equipment to be accommodated unless the system has been de-rated for operation at higher ambient temperatures. Where the manufacturer is not known at the time of design the maximum temperature shall be according to EN 61439-1.



Where necessary, filtration against particulate contamination shall be provided to prevent build-up of dust in accordance with the instructions of the supplier of the equipment to be accommodated. Measures shall be provided to allow inspection and cleaning of the transformer and the transformer space(s).

Forced air cooling of the transformer should be considered at the design phase where this would represent an improvement in transformer efficiency.

Anti-condensation measures shall be taken for switchgear.

#### **5.2.6 Electrical distribution space(s)**

Temperature shall be maintained in accordance with the instructions of the supplier of the equipment to be accommodated. Where no information exists or where the equipment manufacturer is not specified the temperature shall be maintained above 0 °C and should be above 10 °C.

Where practicable, natural ventilation shall be provided.

The maximum ambient temperature shall not exceed the maximum temperature specified by the supplier of the equipment to be accommodated unless the system has been de-rated for operation at higher ambient temperatures. Where the manufacturer is not known at the time of design the maximum temperature shall be 40 °C.

Anti-condensation measures shall be taken.

If required, temperature controlled air extraction shall be provided.

#### **5.2.7 Telecommunication spaces(s)**

Temperature and relative humidity shall be maintained in accordance with the requirements of 5.2.9.

Temperature and relative humidity shall be monitored. Measures addressing gaseous contaminants (see 5.2.9) should be considered.

Where the data centre is supported by a single telecommunications space, or by multiple, non-resilient telecommunications spaces, the space(s) shall have a single path environmental control system (for examples see 6.2.2.2 and 6.2.2.3).

#### **5.2.8 Main Distributor spaces(s)**

The requirements of 5.2.9 shall be applied.

#### **5.2.9 Computer room space(s) and associated testing space(s)**

The computer room space is the most important space from an environmental control perspective. The designer of the environmental control system shall assess the impact of the failure of the system on the data centre infrastructure.

Outside air shall be filtered according to EN ISO 16890-1. Filter class depending on the local air quality and the used IT-equipment. The minimum filter class shall be EN ISO 16890-1:2016; ISO Coarse 90 %.

An analysis examining the balance between energy management and environmental control parameters with reference to the type of IT equipment to be accommodated shall be performed by the owner of the data centre. The results of this analysis shall be compared with the business model for the data centre. CLC/TR 50600-99-1 provides further information to assist with this analysis.

Environmental controls shall be applied that maintain the following parameters within limits defined by the requirements of the analysis described above:

- a) supply air temperature;
- b) supply air relative humidity;
- c) air quality:
  - 1) particulate content;

2) gaseous contaminants;

For the classification of air cleanness by chemical concentration (ACC), EN ISO 14644-8 shall be applied. Where no information exists or where the equipment manufacturer is not specified, a minimum class 8 shall be maintained.

Gaseous contaminants should be measured periodically or monitored continuously according to ANSI/ISA 71.04-2013. Where no information exists or where the equipment manufacturer is not specified, a minimum class G1 should be maintained. Visual inspection of hardware within the space should be performed as part of the maintenance routines to mitigate the potential risk of damage due to corrosion. Additional information as to the nature and concentration of contaminants can be obtained by laboratory analysis of collected dust from the datacentre and/or specimens collected using carbon adhesive tabs.

The supply air temperature shall be monitored with temperature sensors in the supply path near the IT equipment, the number of sensors shall be chosen so as to provide a representative average supply air temperature and shall be in accordance with 8.2. In areas of high heat load additional temperature sensors can be necessary to detect hot spots.

Where air containments are used, it is recommended that the supply air temperature is monitored by temperature sensors in the containment. The number of sensors shall be chosen so as to provide a representative average supply air temperature.

The relative humidity of supply air shall be monitored in the supply path, the number of sensors shall be chosen so as to provide a representative average value.

A combined sensor for temperature and relative humidity is allowed. Depending on the availability class redundant temperature and humidity sensors shall be installed.

It is recommended to install a dew point sensor where relative humidity is measured, or to calculate a dew point from temperature and relative humidity data.

#### **5.2.10 Electrical space(s)**

See 5.2.15, if the electrical space contains UPS equipment.

Anti-condensation measures shall be taken.

Where practicable, natural ventilation shall be provided.

The maximum ambient temperature shall not exceed the maximum temperature specified by the supplier of the equipment to be accommodated unless the system has been de-rated for operation at higher ambient temperatures. Where the manufacturer is not known at the time of design the maximum temperature shall be according to EN 61439-1.

Temperature and relative humidity should be monitored.

#### **5.2.11 Mechanical space(s)**

If the mechanical space accommodates electrical equipment then the requirements of 5.2.10 apply otherwise temperature and humidity shall be maintained in accordance with the instructions of the supplier of the equipment to be accommodated.

#### **5.2.12 Control room space(s)**

Comfort environmental controls shall be applied to this space.

#### **5.2.13 Office space(s)**

Comfort environmental controls shall be applied to this space.

#### **5.2.14 Storage and holding space(s)**

Basic environmental controls should be applied (temperature and relative humidity); temperature should be monitored. Measures addressing gaseous contaminants (see 5.2.9) should be considered.

## 5.2.15 Accommodation of UPS equipment

### 5.2.15.1 Static and DRUPS

Temperature shall be maintained in accordance with the instructions of the supplier of the equipment to be accommodated. Where no information exists or where the UPS equipment is not specified the temperature shall be maintained between 15 °C and 35 °C (non-condensing); where storage batteries are included in the UPS space the requirements of 5.2.15.3 shall be applied.

Air conditioning, rated for the maximum heat output of the UPS system, shall be provided if the external ambient conditions preclude the use of filtered fresh air.

Monitoring for temperature shall be provided.

Waste heat should be used to pre-heat standby generator plant of the UPS system where possible.

### 5.2.15.2 Diesel UPS

The environmental controls required for the accommodation of diesel UPS are stated in 5.2.4.1.

### 5.2.15.3 Batteries

Where batteries are located away from the UPS equipment that they serve, temperature shall be controlled in accordance with the manufacturer's instructions to maintain planned batterie lifetime. Where no information exists or where the equipment is not specified the temperature shall be maintained at  $(20 \pm 2)^\circ\text{C}$ .

If required, a resilient fresh air ventilation shall be provided to avoid hydrogen accumulation.

It is recommended that Hydrogen monitoring is provided.

See EN 50272-2 for further information.

## 6 Availability

### 6.1 General

The environmental control system shall be designed to support the Availability Class chosen following the risk assessment undertaken in accordance with the availability classification defined in EN 50600-1.

This standard defines four Classes of Environmental Control Systems of increasing availability (Class 1, Class 2, Class 3 and Class 4).

### 6.2 Availability Class design options

#### 6.2.1 General

To maximize the utilization of capital plant, and to minimize energy standing losses, the designer shall take into account the increased redundancy for running at partial load when choosing how to specify the configuration.

In systems with multiple paths it is permissible to utilize different technologies for each path.

For examples of current recommended practices for environmental control see CLC/TR 50600-99-1.

Scalable design options are not available for rooms other than described in 6.2.2 and 6.2.3.

Four design options of increasing Availability Class are specified:

#### a) Class 1: Single path solution

A Class 1 solution is appropriate where the outcome of the risk assessment deems it acceptable that:

- a single fault in a functional element can result in loss of functional capability;

- planned maintenance can require the load to be shut-down.

b) Class 2: Single path solution with redundancy

A Class 2 solution is appropriate where the outcome of the risk assessment deems it necessary that:

- a single fault in a device shall not result in loss of functional capability of that path (via redundant devices);
- routine planned maintenance of a redundant device shall not require the load to be shut down.

NOTE Failure of the path can result in unplanned load shutdown and routine maintenance of non-redundant devices can require planned load shutdown.

c) Class 3: Multiple paths providing a concurrent repair/operate solution

A Class 3 solution is appropriate where the outcome of the risk assessment deems it necessary that:

- a fault of a functional element shall not result in loss of functional capability;
- planned maintenance shall not require the load to be shut-down;
- although a failure of a path can result in unplanned load shutdown, maintenance routines shall not require planned load shutdown as the passive path serves to act as the concurrent maintenance enabler as well as reducing the recovery of service time (minimizing the mean downtime) after the failure of a path.

All paths shall be designed to sustain the maximum load.

d) Class 4: fault tolerant solution except during maintenance

A Class 4 solution is appropriate where the outcome of the risk assessment deems it necessary that:

- a fault of a functional element shall not result in loss of functional capability;
- a failure of one path shall not result in unplanned load shutdown;
- planned maintenance shall not require the load to be shut-down.

All paths shall be designed to sustain the maximum load.

## 6.2.2 Computer room and telecom space(s)

### 6.2.2.1 General

The designer of systems which require an additional primary supply (e.g. water) shall consider that the continuity of the primary supply has to meet the requirements of the chosen availability class.

Environmental control systems shall be able to restart automatically after disruption to their power supply. The designer of the system shall consider the effect of power supply disruption and the duration of the restart time following power supply disruption on the environmental conditions within the controlled space. The designer shall also consider delayed operation time in the design of the environmental control system, e.g. sizing of buffer tanks.

When environmental control systems are connected to a UPS the UPS should be separated from the UPS for the IT equipment.

It should be noted that the examples given below are non-exclusive.

### 6.2.2.2 Class 1 - Supply: Single path system

#### 6.2.2.2.1 General

Figure 3 shows a Class 1 cooling supply system with a single supply sub-system and a single path to the distribution sub-system. Examples of a Class 1 cooling supply sub-system are:

- a) a single compressor based chiller and a pump;
- b) an inlet fan and a cooling coil.

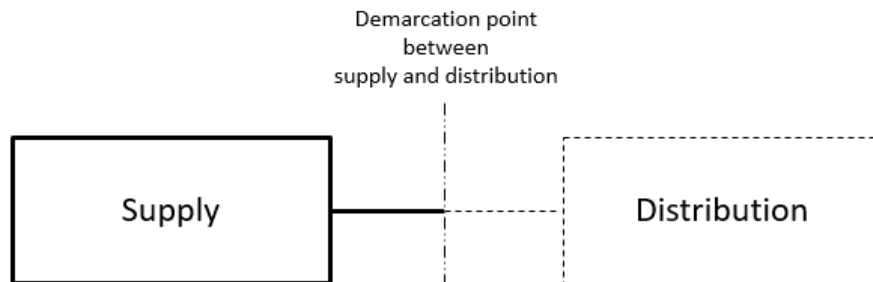


Figure 3 — Class 1 cooling supply sub-system

#### 6.2.2.2.2 Power supply

The environmental control system shall be fed from a power supply system that meets the requirements of EN 50600-2-2:2019 Class 1 (or better).

#### 6.2.2.2.3 Power Distribution

The designer of the system shall determine the power connection requirements (e.g. unprotected or protected) of control and other functional elements of the environmental control system along with any required management routines such that the design objectives of 6.2.2.1 are met.

### 6.2.2.3 Class 1 - Distribution: Single path system

#### 6.2.2.3.1 General

Figure 4 shows a Class 1 cooling system with a single distribution sub-system and a single path from the supply sub-system. An example of a Class 1 cooling distribution sub-system is a single air conditioning module.

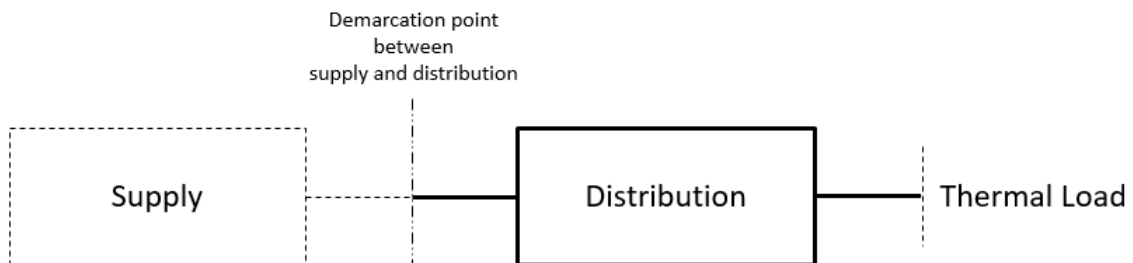


Figure 4 — Class 1 cooling distribution sub-system

#### 6.2.2.3.2 Power supply

The environmental control system shall be fed from a power supply system that meets the requirements of EN 50600-2-2:2019 Class 1 (or better).

### 6.2.2.3.3 Power Distribution

The designer of the system shall determine the power connection requirements (e.g. unprotected or protected) of control and other functional elements of the environmental control system along with any required management routines such that the design objectives of 6.2.2.1 are met.

### 6.2.2.4 Class 2 - Supply: Single path system

#### 6.2.2.4.1 General

Figure 5 shows a Class 2 cooling system with redundant supply sub-system and a single path to the distribution sub-system. Examples of a Class 2 supply sub-system are:

- a) a redundant compressor based chiller array and pumps;
- b) a redundant array of inlet fans and cooling coils.

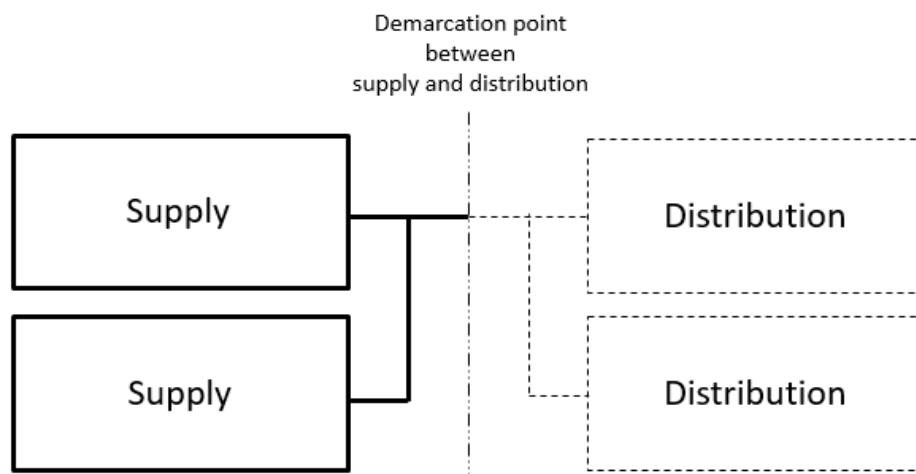


Figure 5 — Class 2 cooling supply sub-system

#### 6.2.2.4.2 Power supply

The environmental control system shall be fed from a power supply system that meets the requirements of EN 50600-2-2:2019 Class 2 (or better).

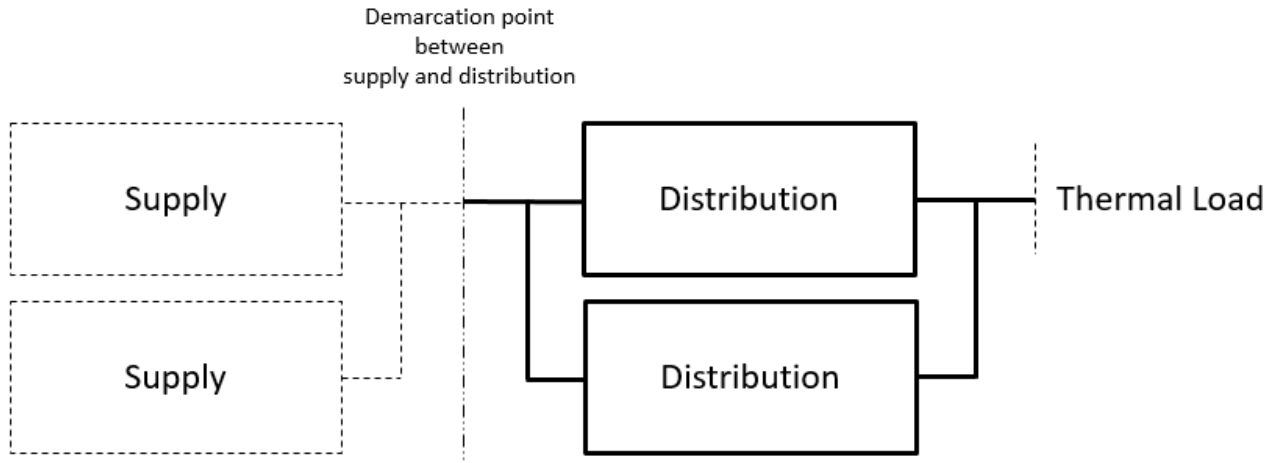
#### 6.2.2.4.3 Power Distribution

The designer of the system shall determine the power connection requirements (e.g. unprotected, protected or short-break) of control and other functional elements of the environmental control system such that the design objectives of 6.2.2.1 are met.

### 6.2.2.5 Class 2 - Distribution: Single path system

#### 6.2.2.5.1 General

Figure 6 shows a Class 2 cooling system with redundant distribution devices and a single path from the supply sub-system. An example of a Class 2 cooling distribution sub-system are redundant air-conditioning modules.



**Figure 6 — Class 2 cooling distribution sub-system**

#### 6.2.2.5.2 Power supply

The environmental control system shall be fed from a power supply system that meets the requirements of EN 50600-2-2:2019 Class 2 (or better).

#### 6.2.2.5.3 Power Distribution

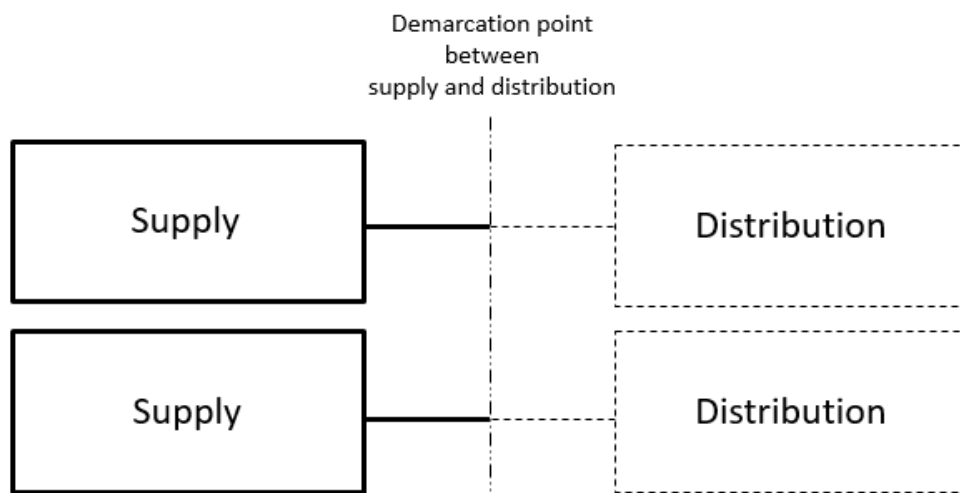
The designer of the system shall determine the power connection requirements (e.g. unprotected, protected or short-break) of control and other functional elements of the environmental control system such that the design objectives of 6.2.2.1 are met.

#### 6.2.2.6 Class 3 - Supply: Multi path resilience and concurrent repair/operate solution

##### 6.2.2.6.1 General

Figure 7 shows a Class 3 cooling system with redundant supply sub-system and a redundant path to the distribution sub-system. Examples of a Class 3 supply sub-system are:

- a) a redundant compressor based chiller array and redundant pumps;
- b) a redundant array of inlet fans and cooling coils.



**Figure 7 — Class 3 cooling supply sub-system**

A passive delivery path (with automatic or manual changeover switches) shall be provided. All passive sub-systems (e.g. the chilled water piping) shall have path redundancy where a failure in such an element can result in a loss of cooling albeit with a rapid (manual) substitution of the active path with the passive path.

#### 6.2.2.6.2 Power supply

The environmental control system shall be fed from a power supply system that meets the requirements of EN 50600-2-2:2019 Class 3 (or better).

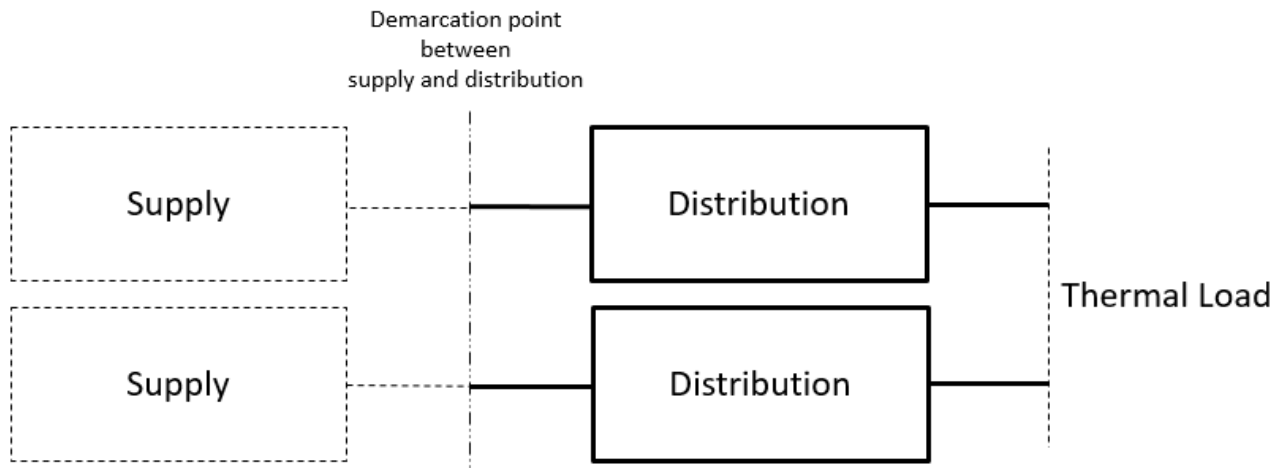
#### 6.2.2.6.3 Power Distribution

The designer of the system shall determine the power connection requirements (e.g. unprotected, protected or short-break) of control and other functional elements of the environmental control system such that the design objectives of 6.2.2.1 are met.

#### 6.2.2.7 Class 3 - Distribution: Multi path resilience and concurrent repair/operate solution

##### 6.2.2.7.1 General

Figure 8 shows a Class 3 cooling system with redundant distribution devices and a redundant path from the supply sub-system. An example of a Class 3 cooling distribution sub-system are redundant air-conditioning modules.



**Figure 8 — Class 3 cooling distribution sub-system**

A passive delivery path (with automatic or manual changeover switches) shall be provided. All passive sub-systems (e.g. the chilled water piping) shall have path redundancy where a failure in such an element can result in a loss of cooling albeit with a rapid (manual) substitution of the active path with the passive path, e.g. closed circular pipeline including a sufficient number of shut-off valves.

#### 6.2.2.7.2 Power supply

The environmental control system shall be fed from a power supply system that meets the requirements of EN 50600-2-2:2019 Class 3 (or better).

#### 6.2.2.7.3 Power Distribution

The designer of the system shall determine the power connection requirements (e.g. unprotected, protected or short-break) of control and other functional elements of the environmental control system such that the design objectives of 6.2.2.1 are met.

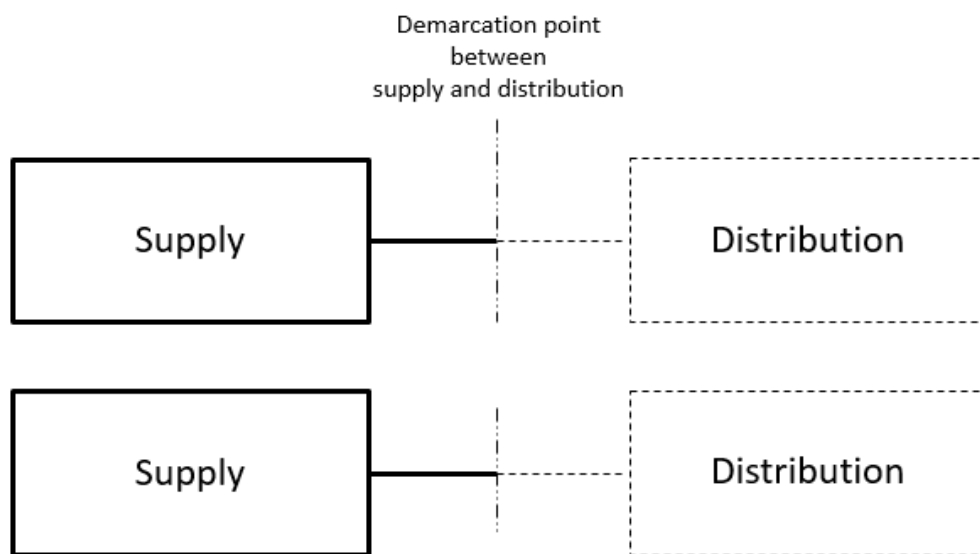


### 6.2.2.8 Class 4 - Supply: Multi path resilience, concurrent repair/operate, and fault tolerant solution

#### 6.2.2.8.1 General

Figure 9 shows a Class 4 active/active cooling supply sub-system. It comprises two segregated, compartmentalized and entirely separate supply sub-systems including separated paths. Examples of a Class 4 supply sub-system are:

- a) redundant compressor based chiller arrays and pumps;
- b) redundant arrays of inlet fans and cooling coils;
- c) redundant compressor based chiller arrays with pumps and redundant arrays of inlet fans and cooling coils.



**Figure 9 — Class 4 cooling supply sub-system**

#### 6.2.2.8.2 Power supply

The environmental control system shall be fed from a power supply system that meets the requirements of EN 50600-2-2:2019 Class 2 (or better).

#### 6.2.2.8.3 Power Distribution

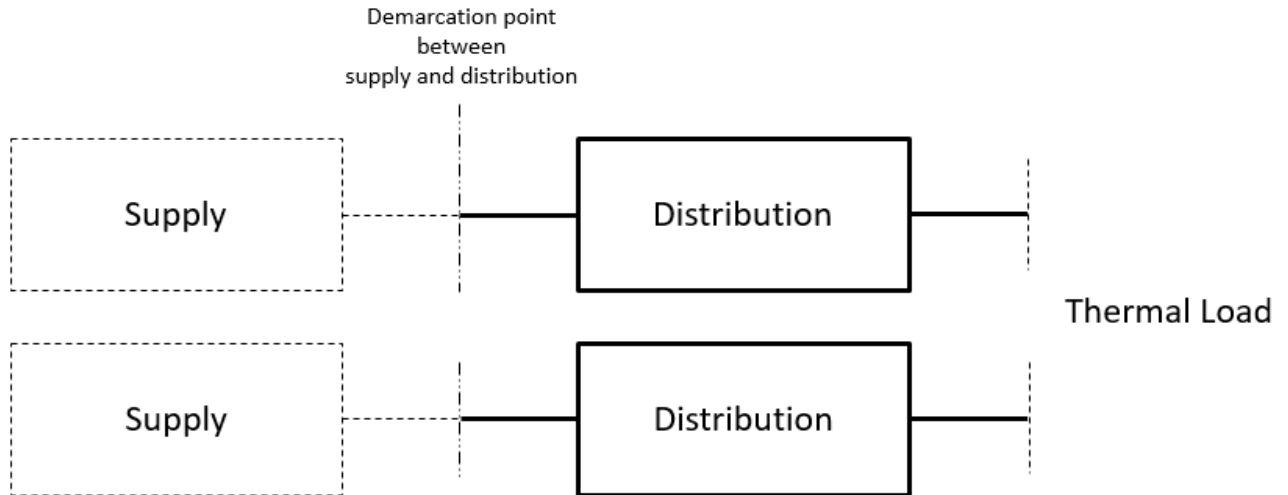
The designer of the system shall determine the power connection requirements (e.g. unprotected, protected or short-break) of control and other functional elements of the environmental control system such that the design objectives of 6.2.2.1 are met.

### 6.2.2.9 Class 4 - Distribution: Multi path resilience, concurrent repair/operate, and fault tolerant solution

#### 6.2.2.9.1 General

Figure 10 shows a Class 4 active/active cooling distribution sub-system. It comprises two segregated, compartmentalized and entirely separate distribution sub-systems including separated paths. Examples of a Class 4 cooling distribution sub-systems are:

- a) redundant air-conditioning modules;
- b) redundant air-conditioning modules and adiabatic spray modules with optional powered louvers.



**Figure 10 — Class 4 cooling distribution sub-system**

#### **6.2.2.9.2 Power supply**

The environmental control system shall be fed from a power supply system that meets the requirements of EN 50600-2-2:2019 Class 2 (or better).

#### **6.2.2.9.3 Power Distribution**

The designer of the system shall determine the power connection requirements (e.g. unprotected, protected or short-break) of control and other functional elements of the environmental control system such that the design objectives of 6.2.2.1 are met.

### **6.2.3 UPS space**

#### **6.2.3.1 General**

The requirements of this clause apply where the UPS equipment is not accommodated in the computer room space.

#### **6.2.3.2 Class 1: Single path (no resilience)**

The UPS space shall be cooled by a supply and distribution system class 1 or better that is rated to supply the cooling capacity equal to the maximum possible power losses in the UPS and not exceed the temperature supported by the chosen UPS. If no vendor data exists EN 62040-3 shall be applied. A single failure in the cooling plant exposes the UPS to over-temperature and shut-down/bypass with associated risk to the critical load.

#### **6.2.3.3 Class 2: Single path (resilience provided by redundancy of devices)**

The UPS space shall be cooled by a supply and distribution system class 2 or better that is rated to supply the cooling capacity equal to the maximum possible power losses in the UPS and not exceed the temperature supported by the chosen UPS. If no vendor data exists EN 62040-3 shall be applied. A single failure in a device does not expose the UPS to over-temperature and shut-down/bypass with associated risk to the critical load.

#### **6.2.3.4 Class 3: Multi path resilience and concurrent repair/operate solution**

In case one UPS room is planned the UPS space shall be cooled by a supply and distribution system class 3 or better that is rated to supply the cooling capacity equal to the maximum possible power losses in the UPS and not exceed the temperature supported by the chosen UPS. If no vendor data exists EN 62040-3 shall be applied. A single failure in the cooling system shall not expose the UPS to over-temperature and shut-down/bypass with associated risk to the critical load.

In case two separate and redundant UPS rooms are used, the Availability Class 1 or better shall be chosen for the cooling system of each room and the cooling system shall be connected to the same primary power distribution system as the UPS it is supporting.

#### **6.2.3.5 Class 4: Multi path resilience, concurrent repair/operate, and fault tolerant solution**

There is no "Class 4 UPS room", as in a Class 4 system UPS's will be in 2 separate rooms each with a Class 1 environmental control system or better, which are supported by two individual Class 2 electrical power supply systems. For the power distribution the designer of the system shall determine the power connection requirements (e.g. unprotected, protected or short-break) of control and other functional elements of the environmental control systems such that the design objectives of 6.2.2.1 are met.

### **6.3 Environmental control system capacity planning with respect to expansion**

During the design phase the use of modular solutions providing capacity for the expected load with respect to time shall be considered.

### **6.4 Environmental control system capacity planning with respect to resilience**

Where resilience is provided by multiple CRACs consideration shall be given to the number of CRACs and the fan speed at which each CRAC is operated.

The design of the system shall accommodate an operating point where all CRACs run at minimum fan speed.

The control system shall be set up in such a way that it complies with the separation and redundancy equal to the classes for supply and distribution elements. All devices in the system shall operate on a standalone basis, no central control is required. Central control system can be used for monitoring and manual adjustment. If the central control system fails, the components of the system will operate in a fail-safe mode so that the operation of the datacentre is not disrupted. For classes 3 and 4, this can also be achieved with a redundant control system.

## **7 Physical security**

### **7.1 General**

Based on the security classification following the risk assessment undertaken in accordance with EN 50600-1, this document provides requirements and recommendations (with optional implementations as required) in relation to the following aspects with the design, planning and installation of the environmental control facilities and infrastructures.

### **7.2 Protection against unauthorized access**

All controls and equipment comprising the environmental control system shall be in areas of Protection Class 3 or above as specified in EN 50600-2-5.

Where pathways are routed in areas of a lower Protection Class they shall be monitored for unauthorized access. See EN 50600-2-5.

## **8 Energy efficiency enablement**

### **8.1 General**

Based on the energy efficiency enablement granularity level defined in accordance with EN 50600-1, this clause provides requirements and recommendations (with optional implementations as required) in relation to the following aspects with the design, planning and installation of the environmental control facilities and infrastructures. 8.2 and 8.3 define requirements and recommendations for measurement by parameter.

## 8.2 Measurement of temperature

### 8.2.1 External temperature

In all cases external temperature shall be measured and monitored. An external temperature sensor shall be used, located away from any building exhausts and from direct sunlight. The output from this sensor shall be fed into the control system for the data centre. For data centres of Availability Class 2 and above the feedback from the external temperature sensor shall be automatic.

A single sensor is required for Level 1.

For Level 2 and above an additional sensor should be employed to provide resilience.

### 8.2.2 Computer room temperature

Computer room temperature shall be monitored. In an air-cooled environment air temperature varies by location. Where liquid-cooled enclosures are used the temperature of the liquid coolant shall be monitored. Where liquid-cooled IT equipment is used the temperature of the liquid coolant shall be monitored. Temperature sensors should not be placed in areas of high turbulence and should be so placed as to establish thermal gradient.

The purpose of a data centre cooling system is to deliver the correct volume of air within the accepted environmental conditions to the inlet of the IT equipment. Temperature sensors located as close to the IT equipment air intakes as possible (e.g. attached to rails / inside rack door) will help to determine how effectively this is achieved. Where sufficient air volume is delivered and the hot and cold air streams are effectively segregated, the measurement of temperature in the cold aisle outside of the rack provides a suitable proxy location. The number of sensors and placement of sensors should give a representative picture of the computer room. It can be desirable to install more than one sensor per rack to understand any deficiencies in cold air delivery (particularly in non-contained systems), for example in front of a live device at one third and two thirds of the rack height.

To understand and optimize the air flow demand from the IT equipment and load on the cooling units, it is useful to know the delta T across both. The cooling units usually report supply and return temperature. Where they do not, additional sensors can be installed to provide this information. As the return temperature can vary across the intake of the cooling unit, an average of three readings is recommended.

The IT equipment outlet temperature will vary according to device type and workload. To measure IT equipment delta T, additional sensors would be required at the IT equipment outlet. Similar to the IT equipment air inlet sensors, this needs to be as close to the equipment outlet as possible. Any sensors used for this purpose should be paired with an IT equipment inlet air sensor. An average delta T can then be calculated across the IT devices where the inlet and outlet temperatures are measured.

An alternative to installing permanent sensors is to undertake a periodic survey of temperatures.

Table 2 summarizes the measurement requirements by Granularity Level.

**Table 2 — Measurement requirements by Granularity Level**

Requirement	Granularity Level		
	Level 1	Level 2	Level 3
Inlet Air Temperature	Single sensor in proximity to IT equipment	One sensor per cold aisle	One sensor per 10 cabinets or racks (5 on each side of the aisle)
Return Air Temperature	Single sensor in proximity to intake of return air to the cooling equipment	One sensor at the air intake per CRAH	One sensor at the air intake per CRAH

If no air containments are used, the number of sensors can be increased.

### 8.3 Measurement of relative humidity

#### 8.3.1 External relative humidity

In all cases external relative humidity shall be measured and monitored. An external relative humidity sensor should be used, located away from any building exhausts and from direct sunlight. The relative humidity sensor should be co-located with the temperature sensor (see 8.2.1). The output from this sensor shall be fed into the control system for the data centre. For data centres of Class 2 and above the feedback from the external relative humidity sensor shall be automatic.

A single sensor is required for Level 1.

For Level 2 and above an additional, combined relative humidity and temperature sensor should be employed to provide resilience.

#### 8.3.2 Computer room relative humidity

Computer room relative humidity shall be measured with

- 1 sensor per room for Level 1;
- 2 sensors per room for Level 2; and
- 1 sensor per cold aisle for Level 3.

It is recommended to install a dew point sensor where relative humidity is measured, or to calculate a dew point from temperature and relative humidity data.

### 8.4 Measurement of air pressure

Where an access floor is installed, the design of the environmental control system shall consider the requirements for the maintenance of static pressure and/or positive air flow under the access floor.

If one part of the cooling concept is the securing of a constant pressure under the access floor through fan speed control of the CRAC unit fans, the differential pressure between the room and the access floor shall be measured. The associated sensors shall be positioned in locations where reasonable values can be obtained and shall ensure that all areas of the access floor are monitored.

### 8.5 Coolant flow rates

Where the design of the environmental control system relies on the movement of fluids, coolant flow meters shall be installed.

It is recommended that coolant mass flow in combination with temperature sensors is measured in order to use the data for monitoring and thus improve the operation of the system.

The location of these sensors shall be determined in accordance with the design requirements of the system.

### 8.6 Heat removal

The design of the environmental control system shall determine the requirement to measure or calculate the heat removed in order to use the data for monitoring and optimization of the cooling units.

Additionally the design shall determine the requirement to quantify total energy use of the cooling system.

### 8.7 Outside air

Where outside air is drawn into the data centre space(s) for environmental control purposes, sensors for temperature and relative humidity shall be placed at the air inlet.

Note that air quality would also be measured at this point in support of contamination protection (see 5.2.9).

## Annex A (informative)

### Overview of the requirements for environmental conditions

Table A.1 provides a summary of the requirements for environmental conditions of this standard.

**Table A.1 – Summary of environmental conditions by space type**

Sub-clause	What	Where	Dp °C	Minimal T °C	Maximal T °C	Type	Condition
5.2.15.3	air	Accommodation Batteries		18	22	M	Where batteries are located away from the UPS equipment that they serve where no information exists or where the equipment manufacturer is not specified
5.2.15.1	air/humidity	Accommodation Static and DRUPS	Anti Condensation	15	35	M	Where the manufacturer is not known
5.2.15.1	air	Accommodation Static and DRUPS		15	35	M	Where no information exists or where the equipment manufacturer is not specified.
5.1.3	humidity	all spaces where there is a risk of damage to static-sensitive	5,5			M	Where no information exists or where the equipment manufacturer is not specified
5.2.9	supply air temperature/humidity	Computer room space(s) and associated testing space(s)	CLC/TR 50600-99-1	CLC/TR 506 00-99-1	CLC/TR 506 00-99-1	M	
5.2.12	temperature/humidity	Control room space(s)	Comfort	Comfort	Comfort	M	Comfort environmental
5.1.4	temperature/humidity	defined data centre spaces	CLC/TR 506 00-99-1	CLC/TR 506 00-99-1	CLC/TR 506 00-99-1	R	reductions in energy consumption
5.2.6	air	Electrical distribution space(s)		0	40	M	Where no information exists or where the equipment manufacturer is not specified
5.2.6	air	Electrical distribution space(s)		10		R	Where no information exists or where the equipment manufacturer is not specified
5.2.6	humidity	Electrical distribution space(s)	Anti condensation			M	generators and switchgear
5.2.10	humidity	Electrical space(s)	Anti condensation			M	
5.2.10	air	Electrical space(s)		EN 61439-1	EN 61439-1	M	Where the manufacturer is not known
5.2.4.2	fuel temperature	Fuel storage systems		0		M	be protected against continuous sub-zero
5.2.4.2	fuel temperature	Fuel storage systems		10		R	

5.2.4.1	air	Generator and Diesel UPS spaces		0	35	M	Where no information exists or where the equipment manufacturer is not specified
5.2.4.1	air	Generator and Diesel UPS spaces		10		R	Where no information exists or where the equipment manufacturer is not specified
5.2.4.1	humidity	Generator and Diesel UPS spaces	Anti condensation			M	for generators and switchgear
5.2.11	air	Mechanical space(s)	Anti condensation	EN 61439-1	EN 61439-1	M	Electrical equipment and where the manufacturer is not known
5.2.13	temperature/humidity	Office space(s)	Comfort	Comfort	Comfort	M	Comfort environmental
5.2.14	temperature/humidity	Storage and holding space(s)	Basic control	Basic control	Basic control	M	
5.2.15.1	humidity	Static and DRUPS	Anti condensation			M	Where the manufacturer is not known
5.2.7	temperature/humidity	Telecommunication spaces → computer room spaces	5.2.9, CLC/TR 506 00-99-1	5.2.9, CLC/TR 506 00-99-1	5.2.9, CLC/TR 506 00-99-1	M	
5.2.15.1	air	Static and DRUPS		18	22	M	Where the storage batteries where no information exists or where the equipment manufacturer is not specified
5.2.5	air	Transformer space(s)		EN 61439-1	EN 61439-1	M	Where the manufacturer is not known
5.2.15.3	air	batteries		18	22	M	Where no information exists or where the equipment manufacturer is not specified
6.2.3.2	air	UPS Class 1		EN 62040-3	EN 62040-3	M	Where the UPS equipment is not accommodated in the computer room and if no vendor data exists
6.2.3.3	air	UPS Class 2		EN 62040-3	EN 62040-3	M	Where the UPS equipment is not accommodated in the computer room and if no vendor data exists
6.2.3.4	air	UPS Class 3		EN 62040-3	EN 62040-3	M	Where the UPS equipment is not accommodated in the computer room and if no vendor data exists

M = requirement (mandatory)

R = recommendation

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