IEC 62610-2

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Mechanical structures for electrical and electronic equipment – Thermal management for cabinets in accordance with IEC 60297 and IEC 60917 series – Part 2: Method for the determination of forced air cooling

Structures mécaniques pour équipements électriques et électroniques – Gestion thermique pour les armoires conformes aux séries IEC 60297 ET IEC 60917 – Partie 2: Méthode pour la détermination du refroidissement par ventilation forcée

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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MECHANICAL STRUCTURES FOR ELECTRICAL AND ELECTRONIC EQUIPMENT – THERMAL MANAGEMENT FOR CABINETS IN ACCORDANCE WITH IEC 60297 AND IEC 60917 SERIES –

Part 2: Method for the determination of forced air cooling

FOREWORD

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International Standard IEC 62610-2 has been prepared by subcommittee 48D: Mechanical structures for electrical and electronic equipment, of IEC technical committee 48: Electrical connectors and mechanical structures for electrical and electronic equipment.

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

FDIS	Report on voting
48D/664/FDIS	48D/673/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 62610 series, published under the general title *Mechanical structures for electrical and electronic equipment – Thermal management for cabinets in accordance with IEC 60297 and IEC 60917 series*, can be found on the IEC website.

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

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- withdrawn,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

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

INTRODUCTION

Power dissipation of high-end servers, telecommunication equipment and electronic controllers has been increasing rapidly. Thermal management for electronic systems has become critical to maintain performance and reliability.

For a long time natural convection air cooling was an adequate and reliable solution. Typically, the cooling air entered a system at the bottom and the heated air exited at the top. However, with increasing packaging density heat dissipation of components required “compartmentalizing” of functions within a cabinet. Individual subracks and chassis require their own individual cooling solutions often enhanced by forced air cooling devices such as fans.

In the absence of any guide, subrack and chassis designers typically solve their cooling problems in a way that is best suited for their specific application leaving the cabinet system integrator to deal with a mix of incompatible subrack and/or chassis cooling concepts.

An improper arrangement of multiple subracks and/or chassis (the equipment) in a cabinet may cause a severe imbalance of airflow within the cabinet. Two typical undesirable factors may be triggered by such an imbalanced airflow. The required airflow volume to each individual cabinet mounted equipment may be inadequate for proper cooling. The temperature of components in a cabinet mounted subrack and/or chassis may increase as the exhaust air of one equipment increases the intake air temperature of other equipment.

This document defines the basic and principal method to implement forced air cooling in electrical and electronic cabinets. This is applied for the thermal design of any electrical/electronic cabinet, as well as for their set-up in machine rooms, such as data centers using aisle containment. Cooling airflow is considered not only inside of the cabinets but also outside of the cabinets. A variable speed fan may be optional in cabinets or subracks/chassis, but is not regarded in this standard.

The intention of this document is to guide the subrack and/or chassis system designer, the cabinet integrator and also the data centre system integrator who deploys equipment cabinets in the machine room to provide for compatible forced air cooling solutions.

This document is based on the mechanical structures as defined in the IEC 60297 and IEC 60917 series of standards.

MECHANICAL STRUCTURES FOR ELECTRICAL AND ELECTRONIC EQUIPMENT – THERMAL MANAGEMENT FOR CABINETS IN ACCORDANCE WITH IEC 60297 AND IEC 60917 SERIES –

Part 2: Method for the determination of forced air cooling

1 Scope

This part of IEC 62610 provides for compatible methods of configuring forced air cooled cabinets assembled with associated subracks and/or chassis in accordance with the IEC 60297 and IEC 60917 series.

This document contains the following:

a) thermal interfaces of subracks and/or chassis-based equipment in a cabinet, described by:
   - reference temperature,
   - preferred airflow conditions,
   - airflow volume conditions,
   - standard air;

b) procedures for determining compatible forced airflow conditions in a cabinet by applying typical thermal interface conditions.

The drawings used are not intended to indicate product design. They are only for explanatory indications for determining forced air cooling.

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.

IEC 60917-1, *Modular order for the development of mechanical structures for electronic equipment practices – Part 1: Generic standard*

3 Terms and definitions

For the purposes of this document, terms and definitions of IEC 60917-1 as well as 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
forced air cooling
cooling system in which the air is moved by external power

[SOURCE: IEC 60050-811:1991, 811-22-06]

3.2
reference temperature
initial internal temperature of the equipment

Note 1 to entry: "Reference temperature" of the subrack and/or chassis can be considered as equivalent to its intake air temperature.

3.3
forced air cooling device
device that moves air often called a fan

3.4
standard air
air with density of 1,2 kg/m^3, a relative humidity of 50 %, a temperature of 20 °C, a pressure of 101,3 kPa, and a specific heat capacity of 1 005 J/(kg·K)

Note 1 to entry: These values are aligned with the fan industry specifications, common test practices and electronic industry expectations.

3.5
total airflow volume of equipment
$\sum F_{3-n}$
combined air volume as produced by the forced air cooling devices of the subrack(s) and chassis in the cabinet

Note 1 to entry: F_3 means an airflow volume of a subrack or chassis. The suffix "n" means an identifier of a subrack or chassis in the cabinet.

3.6
airflow volume of the cabinet
F_4
airflow volume produced by the empty cabinet mounted forced air cooling devices

3.7
ambient temperature
average temperature of air or another medium in the vicinity of the equipment

Note 1 to entry: For this standard, equipment is subracks and/or chassis-based equipment.

4 Thermal conditions

4.1 Baseline thermal conditions

In order to enable reproducible and comparable values, standard air is defined at the air inlet to be used for the determination of the thermal capability and requirement parameters of products.

4.2 Reference temperature

The thermal operating temperature of subrack and chassis in the cabinet should be defined at the air inlet, and this temperature is called reference temperature in this document.

Reference temperature is defined as a starting point for the rise in the internal temperature of the subracks and/or chassis-based equipment, and is equivalent to the intake air temperature of the subrack and/or chassis. The reference temperature will influence the temperature of the equipment in the subrack and/or chassis.

For a typical configuration, which consists of a subrack and a forced air cooling device, temperatures of internal air and inside components of the subrack are determined as certain values from the reference temperature. And the reference temperature of the subrack can be considered as equivalent to its intake air temperature, because the heat dissipating path of the forced air cooling is dependent on ventilation characteristics of the subrack (see Annex A).

The air intake is the initial point of an upstream airflow where airflows into the subrack and/or chassis to cool its inside. The intake air temperature of the subrack and/or chassis($T_{3\text{-}nr}$) as supplied by the ambient temperature (T_4) could be identical (see Figure 6). Generally, the intake air temperature is measured at a position 30 mm to 50 mm away from the casing of the equipment to avoid the influence of heat radiation. At the air intake opening, if the temperature is not considered as homogeneous because the opening is so wide, several positions (3 to 5) should be defined as reference temperature positions, and the average temperature should be taken as the intake air temperature.

4.3 Syntax of surfaces of a generic subrack, chassis or cabinet

In order to define airflow patterns of equipment, the syntax of the outer surfaces of a subrack and/or chassis-based equipment mounted within a cabinet is shown in Figure 1 and the syntax of the outer surfaces of a forced air cooling generic cabinet is shown in Figure 2.

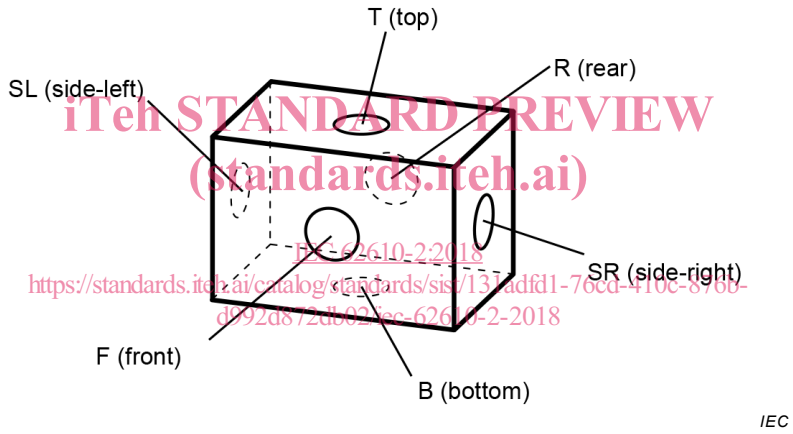


Figure 1 – Syntax of surfaces of a forced air cooled generic subrack or chassis to be mounted into a cabinet

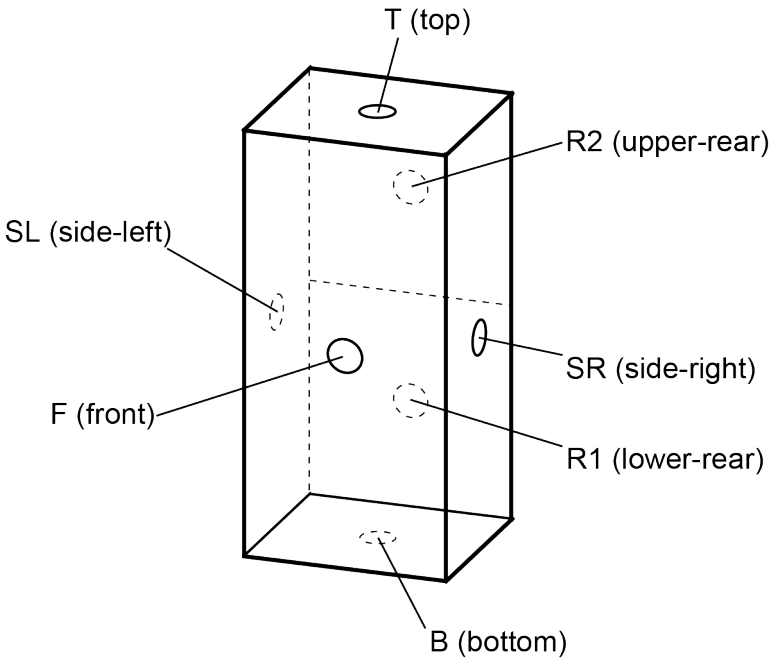


Figure 2 – Syntax of surfaces of a forced air cooled generic cabinet

4.4 Preferred airflow conditions

In order to facilitate an efficient cabinet airflow design, it is necessary to define the preferred airflow pattern of the cabinet mounted equipment. It is important that the cold air entry is not contaminated by the hot air exit (separation of the air entry path and the air exit path). The essential principles of the cooling airflow direction are front to rear and bottom to top.

The complete syntax of airflow pattern in Table 1 is as follows:

Intake definition [+ additional intake definition] → exhaust definition [+ additional exhaust definition]

The intake and exhaust definition corresponds to the syntax of the surfaces as shown in Figure 1 and Figure 2.

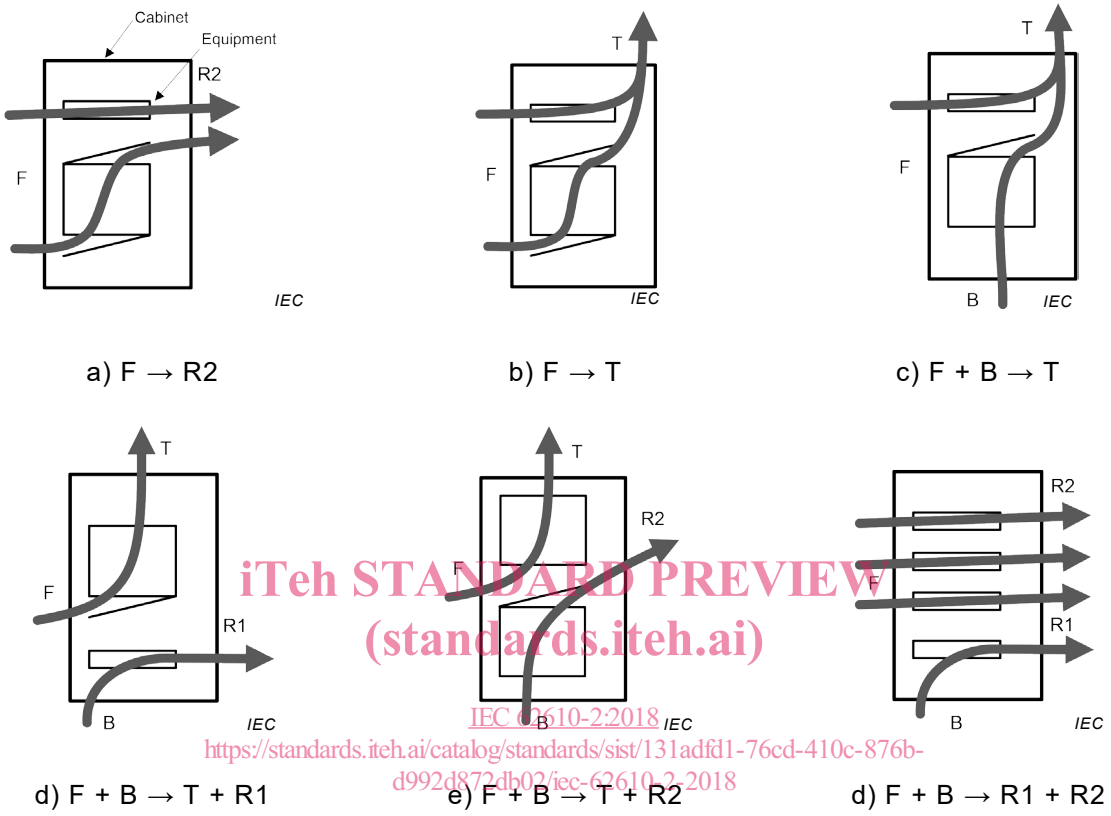
Table 1 – Preferred airflow pattern

Airflow pattern within subrack or chassis-based equipment [a]	Airflow pattern within cabinet [b]
F → R F+B →R	F →R2 F→T F+B → T F+B → T+R1 F+B → T+R2 F+B → R1+R2
[a] Subracks or chassis with forced air cooling devices. [b] Cabinets with forced air cooling devices.	

Subracks and chassis which do not comply to the preferred airflow pattern as described in this document should provide for additional airflow management devices such as deflectors. These additional deflectors should bring the equipment in line with a preferred airflow pattern.

The following figures illustrate preferred airflow patterns within a cabinet as per Table 1.

The arrangements shown in Figure 3 are typical only.



a) F → R2 b) F → T c) F + B → T

d) F + B → T + R1 e) F + B → T + R2 d) F + B → R1 + R2

Figure 3 – Preferred cabinet airflow patterns

4.5 Cabinet airflow volume and temperature rise management

A cabinet with forced air cooling devices shall have enough airflow volume to maintain the cooling capacities of various types of cabinet mounted subracks or chassis that contain their own forced air cooling devices.

The cabinet with one or more such subracks and/or chassis shall have an exhaust air ventilation capacity more than or equal to the sum of subracks' and/or chassis' airflow volumes. This means that the cabinet does not impede the respective subracks' or chassis' ventilation capacities.

The airflow volume of the cabinet mounted forced air cooling devices (F_4) shall be sized to match the combined air volume as produced by the forced air cooling devices of the subrack(s) ($F_{3\text{-}2}$) and chassis ($F_{3\text{-}1}$) in the cabinet (see Figure 4).

The power dissipation of air-exit fans should be considered to evaluate the exhaust air temperature rise of the equipped cabinet in order to measure the airflow volume.

$$\sum F_{3-n} \leq F_4$$

where

$\sum F_{3-n}$ is the total airflow volume of equipment;

F_4 is the airflow volume of the cabinet.

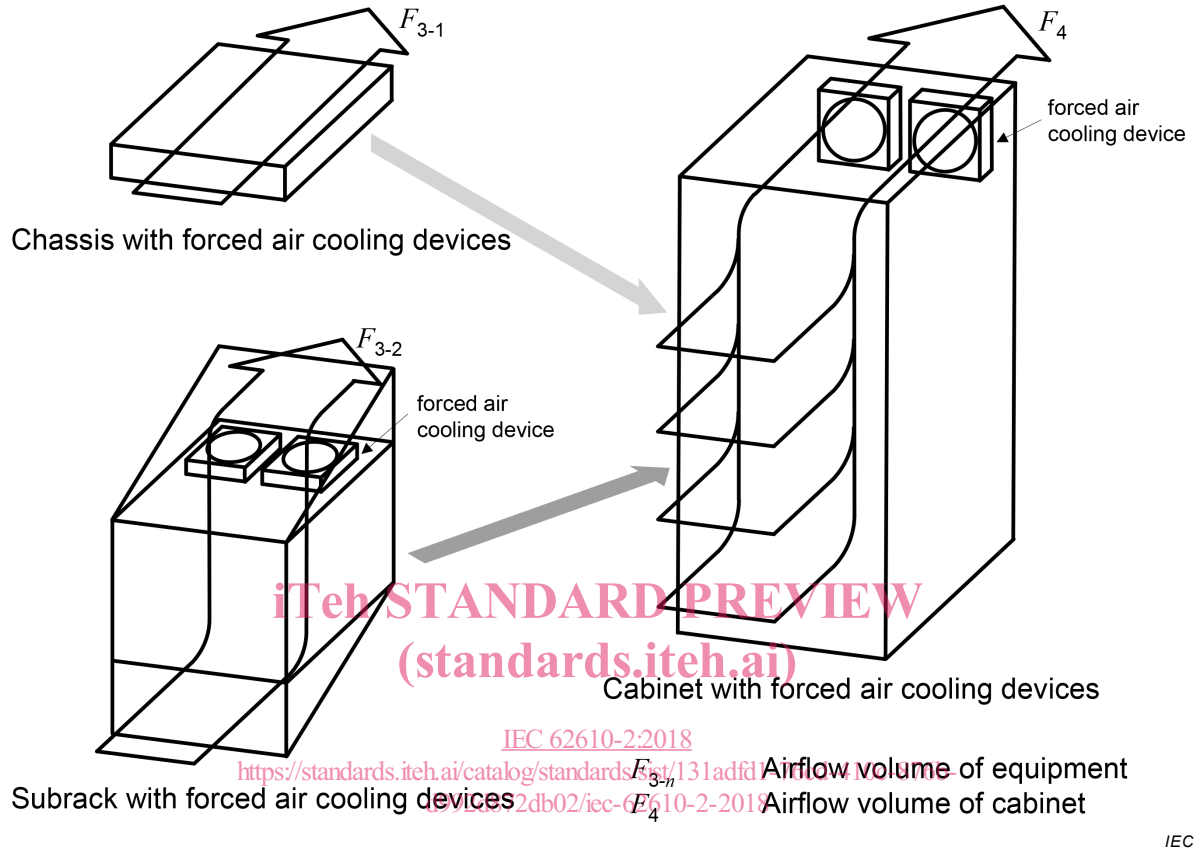


Figure 4 – Airflow volume management

5 Forced air thermal flow chart for cabinet equipment

5.1 General

The flow chart as shown in Figure 5 identifies the forced airflow procedure for cabinet equipment.

The details of each step in the flow chart are explained in the following subclauses.