

TECHNICAL SPECIFICATION

SPÉCIFICATION TECHNIQUE

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

Structures mécaniques pour équipements électroniques – Gestion thermique pour les armoires conformes aux séries CEI 60297 et CEI 60917 – Partie 2: Guide de conception: Méthode pour la détermination de la structure de refroidissement par ventilation forcée



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**MECHANICAL STRUCTURES FOR ELECTRONIC EQUIPMENT –
THERMAL MANAGEMENT FOR CABINETS IN ACCORDANCE
WITH IEC 60297 AND IEC 60917 SERIES –****Part 2: Design guide: Method for the determination
of forced air-cooling structure**

FOREWORD

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Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC 62610-2 TS Ed.1.0, which is a technical specification, has been prepared by subcommittee 48D: Mechanical structures for electronic equipment, of IEC technical

committee 48: Electromechanical components and mechanical structures for electronic equipment.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
48D/459/DTS	48D/470/RVC

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

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

A list of all parts of IEC 62610 series, under the general title *Mechanical structures for 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 publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,
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INTRODUCTION

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

For a long time convection air cooling was an adequate and reliable solution. Typically, the cooled air entered a system on the bottom and the heated air exits 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 devices such as fans.

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

An improper arrangement of multiple subracks and/or chassis (the equipment) in a cabinet may cause a severe imbalance of airflow and/or unwanted temperature rises preventing effective cooling of the cabinet installed equipment. Two typical undesirable factors may be triggered by such an imbalanced airflow and/or unwanted temperature rise(s) within a cabinet. The required airflow volume to each individual cabinet mounted equipment may fall short. The air-intake temperature of each cabinet mounted subrack and/or chassis may increase as exhaust air of one equipment may increase the air-intake temperature of another equipment. As a result, unwanted temperature rise of components may occur.

The intention of this guide is to educate the subrack and/or chassis system designer and the cabinet integrator to provide for compatible forced air cooling solutions.

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

<https://standards.iec.ch/standards/sis/400/8/26-11b6-458a-ada9-699ea640ab19/iec-ts-62610-2-2011>

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

Part 2: Design guide: Method for the determination of forced air-cooling structure

1 Scope and object

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

This design guide contains the following:

- a) Thermal interfaces of subrack and/or chassis based equipment in a cabinet
 - 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 explanatory indications for determining forced air-cooling structure.

The terminology used complies with IEC 60917-1.

2 Thermal interfaces

2.1 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.

NOTE Standard air as defined for this purpose has a density of $1,2 \text{ kg/m}^3$, a relative humidity of 50 %, a temperature of $20 \text{ }^\circ\text{C}$, a pressure of $1,013 \times 10^5 \text{ Pa}$. A specified heat capacity is $1\,005 \text{ J/kgK}$ at these conditions. These values are aligned with the fan industry specifications, common test practices and electronic industry expectations.

2.2 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 technical specification.

Reference temperature is defined as the temperature of an objective ambient air of the equipment in the cabinet which is a starting point for a rise in internal temperatures of the equipment, and, at the same time, influences internal temperatures of it.

At one typical equipment 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 “reference temperature”. And, “reference temperature” of the equipment cabinet can be considered as equivalent with its intake air temperature, because the heat dissipating path of the forced air-cooling is dependent on ventilation characteristics of the equipment. (see Clause A.2)

The air intake is the initial point of an upstream airflow where air flows into the equipment to cool its inside. The intake air temperature of the equipment (T_{3-nr}) as supplied by the ambient temperature (T_4) could be identical (see Figure 6).

NOTE Generally, the intake air temperature is measured at the positions from 30 mm to 50 mm away from the outline 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.

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

In order to define airflow patterns of subrack and/or chassis based equipment mounted within a cabinet the syntax of the outer surfaces is defined as in Figure 1.

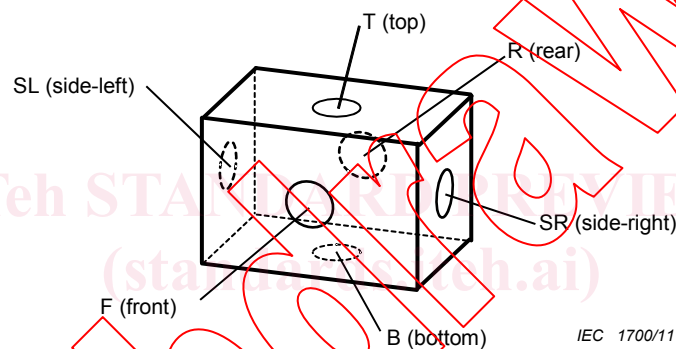


Figure 1 – Syntax of surfaces of a forced air cooled generic subrack or chassis to be mounted into a cabinet

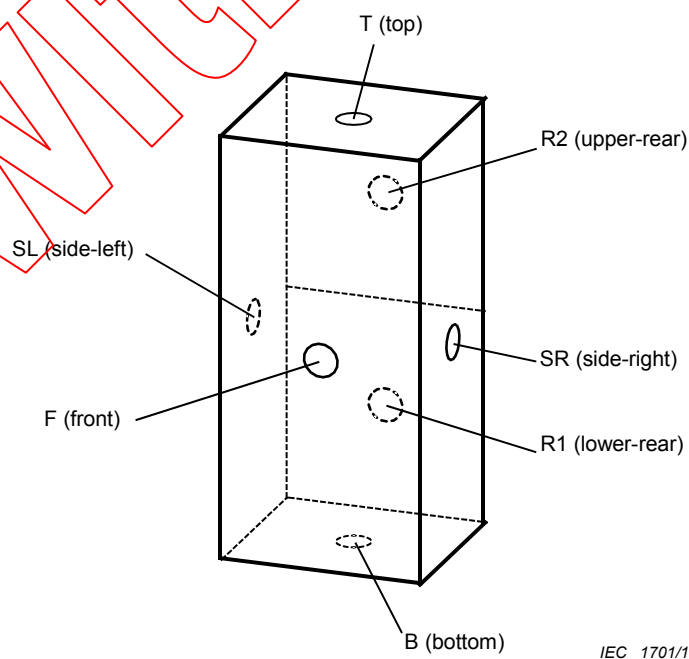


Figure 2 – Syntax of surfaces of a forced air cooled generic cabinet

2.4 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 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.

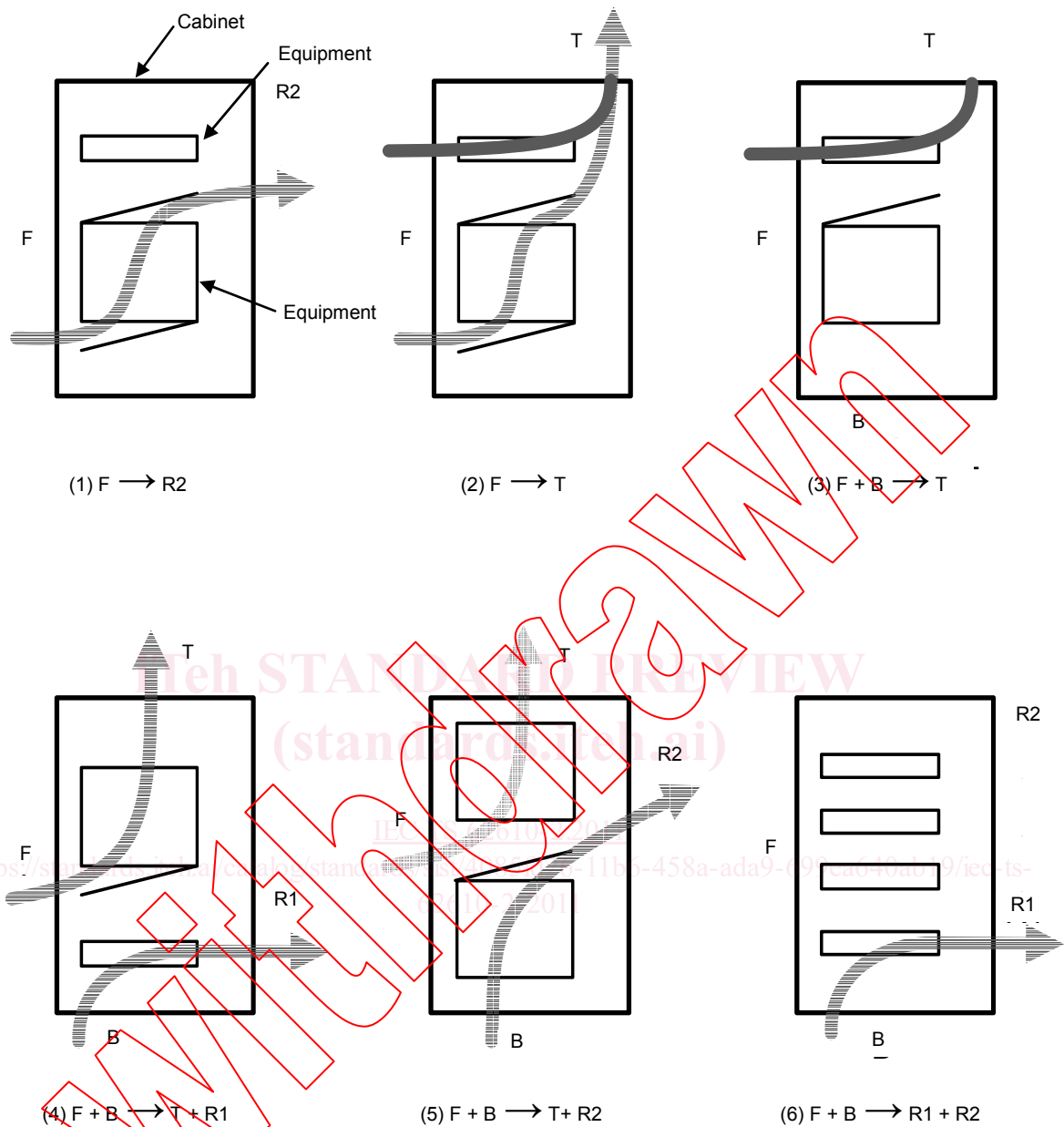
Table 1 – Preferred airflow pattern

Airflow pattern within subrack or chassis-based equipment ^a	Airflow pattern within cabinet ^b
F → R F+B → R	F → T, F → R2 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 technical specification 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 in a cabinet as per Table 1.

The arrangements shown in this figure are typical only.



IEC 1702/11

Figure 3 – Preferred air flow patterns

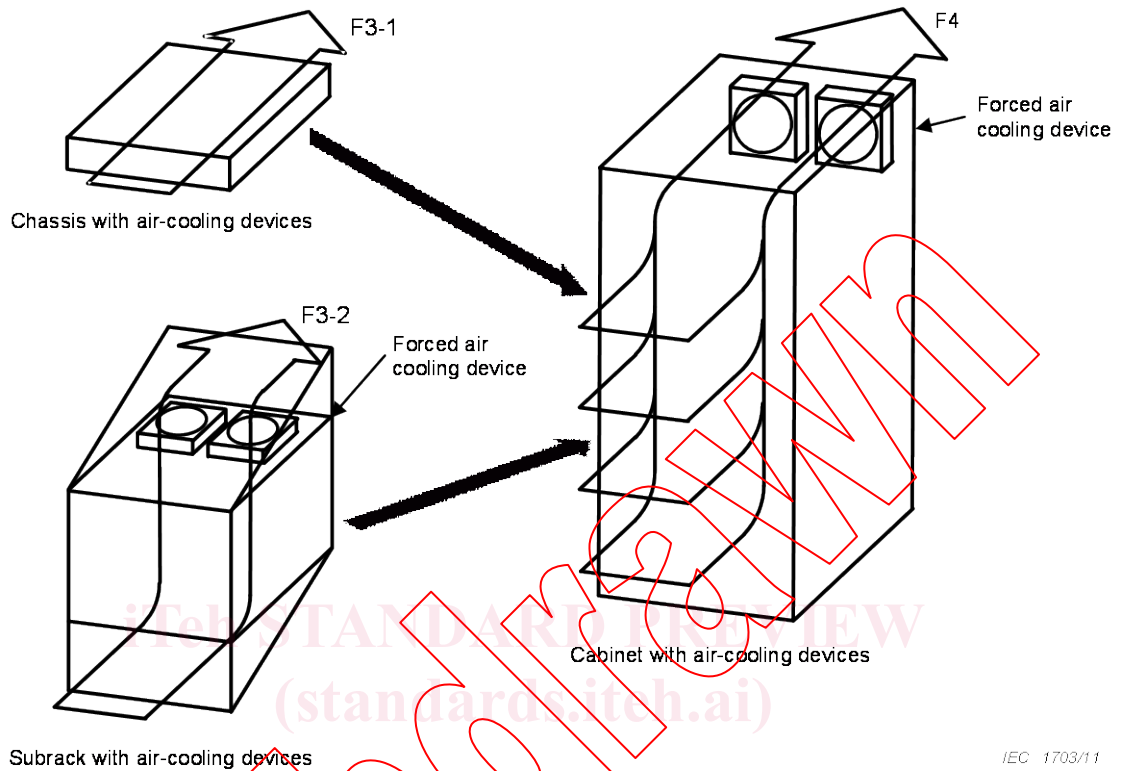
2.5 Cabinet airflow volume and temperature rise management

The cabinet with forced air-cooling devices should have enough cooling capability for power dissipation in order to maintain the cooling capacities of various types of subracks or chassis with air-cooling devices in it.

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

The airflow volume of the cabinet mounted forced air devices (F4) shall be sized to match the combined air volume as produced by the forced air devices of the subrack(s) (F3-2) and chassis (F3-1) in the cabinet.

Total airflow volume of equipments: $\Sigma F_{3-n} \leq$ Airflow volume of the cabinet: F_4



- F3-n Airflow volume of equipments
- F4 Airflow volume of cabinet

Figure 4 – Air flow volume management

NOTE The power dissipation of air-exit fans should be considered to evaluate the exhaust air temperature rise of the equipped cabinet.

3 Forced air thermal flow chart for cabinet equipment

3.1 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.