



# INTERNATIONAL STANDARD

---

**Mechanical structures for electrical and electronic equipment – Thermal management for cabinets in accordance with IEC 60297 and IEC 60917 series – Part 6: Air recirculation and bypass of indoor cabinets**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

---

ICS 31.240

ISBN 978-2-8322-8006-5

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references .....	7
3 Terms and definitions .....	8
4 Recirculation level .....	8
5 Determination of recirculation and bypass ratio .....	9
5.1 Cooling airflow in a cabinet.....	9
5.2 Recirculation ratio of a subrack.....	10
5.3 Recirculation ratio of a cabinet.....	11
5.4 Bypass ratio of a cabinet.....	11
6 Measurement of recirculation and bypass .....	11
6.1 Measurement of recirculation of a subrack .....	11
6.2 Measurement of recirculation of a cabinet.....	12
6.3 Measurement of bypass of a cabinet.....	12
6.4 Measurement methods of temperature .....	12
6.4.1 Intake air temperature of a subrack .....	12
6.4.2 Intake air temperature of a subrack group.....	13
6.4.3 Exhaust air temperature of a subrack .....	13
6.4.4 Exhaust air temperature of a subrack group.....	13
6.4.5 Intake air temperature of a cabinet .....	13
6.4.6 Exhaust air temperature of a cabinet .....	13
6.5 Measurement method of recirculation for an empty cabinet.....	14
Annex A (normative) Measurement method of recirculation with dummy thermal loads .....	15
A.1 Purpose .....	15
A.2 Specifications .....	15
A.2.1 DTL .....	15
A.2.2 Cabinet specifications.....	15
A.2.3 Measurement configurations .....	16
A.3 Environmental conditions .....	16
A.4 Measurement positions .....	16
A.4.1 Intake air temperature of DTL .....	16
A.4.2 Exhaust air temperature of DTL .....	16
A.4.3 Intake air temperature of a cabinet .....	16
A.4.4 Exhaust air temperature of a cabinet .....	16
A.4.5 Evaluation of recirculation ratio of a subrack.....	16
A.4.6 Evaluation of recirculation and bypass ratio of a cabinet.....	16
A.5 Case study.....	16
A.6 Relationship between recirculation ratio and intake temperature rise .....	19
Annex B (normative) Derivation of recirculation and bypass in a cabinet.....	21
B.1 General.....	21
B.2 Derivation of recirculation and bypass.....	21
Annex C (informative) Application of recirculation and bypass to outdoor cabinets.....	22
C.1 General.....	22
C.2 Application example.....	22
Bibliography.....	24

Figure 1 – Airflow in a cabinet.....	9
Figure 2 – Diagram of cabinet airflows .....	10
Figure A.1 – Outline drawings of DTL .....	17
Figure A.2 – Experimental setup of a cabinet and DTL.....	17
Figure A.3 – Measurement points of intake air temperature of DTL .....	18
Figure A.4 – Measurement points of exhaust air temperature of DTL .....	18
Figure A.5 – Measurement points of intake air temperature of a cabinet .....	18
Figure A.6 – Measurement points of exhaust air temperature of a cabinet.....	18
Figure A.7 – Recirculation ratio vs intake air temperature rise.....	20
Figure C.1 – Outdoor cabinet airflow schematic .....	23
Figure C.2 – Airflow diagram and air temperature in outdoor cabinet .....	23
Table 1 – Recirculation level.....	9
Table A.1 – Specifications of DTL .....	15
Table A.2 – Specifications of DTL .....	17
Table A.3 – Test result.....	19
Table A.4 – Recirculation and bypass ratio of a cabinet .....	19
Table C.1 – A case study of an outdoor cabinet .....	23

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

**Part 6: Air recirculation and bypass of indoor cabinets**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 62610-6 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:

CDV	Report on voting
48D/700/CDV	48D/715/RVC

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.

## INTRODUCTION

The signal speed and component density of electrical and electronic equipment in the ICT field and the FA field, such as high performance servers, communications equipment, and electronic control equipment have been steadily increasing. As a result, the heat generation density of the integrated circuits, the power consumption of the equipment, and therefore the cooling task has also been increasing. In a computer room common in the ICT field, where many cabinets for mounting subrack and/or chassis-based equipment are installed and high availability is required, it is necessary to pay attention so that the equipment does not experience high temperature problems.

To prevent high temperature problems with the electronic equipment, it is important that the air conditioning installed in a computer room effectively contributes to the cooling of the cabinet for mounting subrack and/or chassis-based equipment. Indicators relating to airflow such as recirculation and bypass, are used to judge the effectiveness of the air conditioning system. Recirculation is the ratio at which the cabinets in the computer room suck in their own exhaust air, which affects the thermal problems of the equipment as it raises the intake air temperature. Bypass is the ratio at which the cooled supply air does not pass through the cabinets in the computer room, and affects the energy efficiency as it increases the air conditioning energy. If these ratios, especially the recirculation ratio, are kept low, the airflow of the computer room can be regarded as effectively cooling the cabinets. Conversely, if air recirculation or bypass occurs, the temperature of subracks and/or chassis-based equipment in the cabinet rises. Therefore it is necessary to provide similar indices to measure the effectiveness of the cooling airflow for the equipment in the cabinet.

The existing standard for forced air cooling, IEC 62610-2, introduces a method for determining the ideal airflow for a forced air cooled cabinet assembled with associated subrack and/or chassis-based equipment. The standard also defines qualitative guidelines for avoiding recirculation in such cabinets and a server(computer) room. However, concrete numerical values and the evaluation method of the recirculation have not been defined. It was impossible to judge in advance whether the cabinet for mounting subrack and/or chassis-based equipment satisfies the environmental conditions, or whether the empty cabinet has sufficient cooling when subrack and/or chassis-based equipment are mounted.

This document defines a method for easily measuring the recirculation ratio (RC) and the bypass ratio (BP) of the airflow in a cabinet and provides performance levels of recirculation on effectiveness of the cooling airflow in such cabinets. This can be regarded as the degree of conformity with respect to behaviour of the airflow in the cabinet in the computer room. Alternatively, even for an outdoor cabinet including a heat exchanger and an air conditioner, this method can be effectively utilized as an index for knowing the degree of airflow appropriately contributing to cooling the internal space in which the equipment is mounted.

The purpose of this document is to provide:

- for the equipment integrator and development designer of the cabinet the criteria for efficiently and correctly determining the specification, and
- for the supplier of the cabinet the measuring and classifying method for the airflow recirculation rate of the subrack and/or chassis-based equipment installed in the cabinet.

This document is addressed to the mechanical structures in accordance with IEC 60297 and IEC 60917 series.

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

## Part 6: Air recirculation and bypass of indoor cabinets

### 1 Scope

This part of IEC 62610 which deals with thermal management for cabinets in accordance with IEC 60297 and IEC 60917 series, provides compatible measurement methods of recirculation ratio and bypass ratio which are indicators for defining quality of airflow in the forced air cooling that can be commonly applied to indoor cabinets for mounting subrack and/or chassis-based equipment.

NOTE 1 Both recirculation and bypass represent leakage airflows, i.e. detrimental phenomena in terms of cooling efficiency; their measurement is obviously aimed at their mitigation.

This document contains the following:

- a) the definition of recirculation and bypass flow rates in the cooling of the cabinet,
- b) the levels of the recirculation ratio  $RC$ ,
- c) the definition of the formula for the recirculation ratio  $RC_s$  of forced air cooling subrack and/or chassis-based equipment installed in the cabinet,
- d) the definition formula of recirculation ratio  $RC_r$  and bypass rate  $BP_r$  of the entire cabinet,
- e) the requirements of the measuring method of each temperature necessary for calculating the recirculation ratio  $RC_s$ ,  $RC_r$  and bypass ratio  $BP_r$ .

NOTE 2 This document includes the definition of measuring bypass ratio, but excludes the definition of levels of bypass ratio.

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

The recirculation and bypass measurement methods dealt with in this document are assumed to be applied to a cabinet installed indoors. The cooling air inlet is at the front or the bottom of the cabinet and the heated air is exhausted to the rear or the top. These methods are also applicable to a cabinet that is installed outdoors and has a cooling device such as a heat exchanger or an air conditioner on the front or the back (see Annex C).

The recirculation ratio of a subrack or a cabinet is defined for each individual subrack or chassis-based equipment mounted in the cabinet or for the entire cabinet. The bypass ratio of a cabinet is defined for the entire cabinet.

### 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 60297-3-100, *Mechanical structures for electronic equipment – Dimensions of mechanical structures of the 482,6 mm (19 in) series – Part 3-100: Basic dimensions of front panels, subracks, chassis, racks and cabinets*

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