

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Mechanical structures for electrical and electronic equipment – Aisle
containment for it cabinets –
Part 2: Details of air flow, air separation and air cooling requirements**

**Structures mécaniques pour équipements électriques et électroniques –
Confinement d'allées pour les baies informatiques –
Partie 2: Détails des exigences relatives au flux d'air, à la séparation des flux
d'air et au refroidissement par air**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2020 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC -

webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

67 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Mechanical structures for electrical and electronic equipment – Aisle
containment for it cabinets –
Part 2: Details of air flow, air separation and air cooling requirements**

**Structures mécaniques pour équipements électriques et électroniques –
Confinement d'allées pour les baies informatiques –
Partie 2: Détails des exigences relatives au flux d'air, à la séparation des flux
d'air et au refroidissement par air**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 31.240

ISBN 978-2-8322-8510-7

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references	7
3 Terms and definitions	7
4 Determination of the air leak rate.....	9
4.1 Determination of the air leak rate of the individual components of an aisle containment.....	9
4.2 Components and system characteristic curves.....	9
4.2.1 General	10
4.2.2 Equipment requirements.....	11
4.3 Measurement procedure	11
4.3.1 Measurement conditions.....	11
4.3.2 Preparing the elements of the test housing for measurement.....	11
4.3.3 Measurement of the air leak rate	13
4.4 Test report.....	14
4.5 Measurement precision.....	14
5 Air leakage rate of the aisle containment – Creation of an overall system characteristic curve for the aisle containment.....	15
6 Determination of the air leak rate – Determination of the air leak rate of the overall system in operation, including the IT equipment.....	15
Annex A (informative) Aisle containments according to operation mode.....	17
A.1 Allocation of the aisle containments according to operation mode.....	17
A.1.1 General	17
A.1.2 Types of climate control.....	17
A.1.3 Closed-circuit climate control.....	17
A.1.4 In-line climate control.....	17
A.2 Cold aisle containment.....	18
A.2.1 Principle of the cold aisle containment.....	18
A.2.2 Objective of the cold aisle.....	18
A.2.3 Climate control	18
A.3 Hot aisle containment.....	18
A.3.1 Principle of the hot aisle containment.....	18
A.3.2 Objective of the hot aisle	19
A.3.3 Climate control	19
A.4 Cold and hot aisle containment.....	19
A.4.1 Principle of the cold and hot aisle containment.....	19
A.4.2 Objective of the cold aisle in a cold and hot aisle containment.....	20
A.4.3 Climate control	20
Annex B (informative) Thermodynamic variables within aisle containments.....	21
B.1 Air pressure	21
B.1.1 General	21
B.1.2 Minimum differential pressure.....	21
B.1.3 Overpressure in hot aisle containments	21
B.1.4 Negative pressure in hot aisle containments.....	21
B.1.5 Overpressure in cold aisle containments.....	21
B.1.6 Negative pressure in cold aisle containments	21

B.2	Directions of flow	22
B.2.1	Directions of flow "from the front to the back"	22
B.2.2	Direction of flow "to the side"	22
B.3	Flow velocities	22
B.3.1	Closed-circuit climate control	22
B.3.2	In-line climate control	22
B.3.3	Design of the aisle containments	22
B.4	Temperatures and humidity	23
B.4.1	General	23
B.4.2	Temperatures	23
B.4.3	Humidity	23
	Bibliography	24
	Figure 1 – Example of the components – Roof	9
	Figure 2 – Example of the components – Door	10
	Figure 3 – Example of the components – Enclosures	10
	Figure 4 – Sealing the installation level	12
	Figure 5 – Example of a connecting design to the neighbouring enclosure	12
	Figure 6 – Example of a connecting design to the roof	13
	Figure 7 – Example of a connecting design to the end door	13
	Figure 8 – Example of component and system characteristic curves	14
	Figure 9 – Example of a hydraulic addition of individual characteristic curves	15
	Figure 10 – Classification of aisle containment by class factors	16
	Figure A.1 – Example of an in-line climate control	17
	Figure A.2 – Example of a cold aisle containment	18
	Figure A.3 – Example of a hot aisle containment	19
	Figure A.4 – Example of a cold and hot aisle containment	20

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**MECHANICAL STRUCTURES FOR
ELECTRICAL AND ELECTRONIC EQUIPMENT –
AISLE CONTAINMENT FOR IT CABINETS –**

Part 2: Details of air flow, air separation and air cooling requirements

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, accept 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 62966-2 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/722/FDIS	48D/727/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 62966 series, published under the general title *Mechanical structures for electrical and electronic equipment – Aisle containment for its cabinets*, 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

Cabinets of the IEC 60297 and IEC 60917 standard series are used as enclosures of electronic and electrical equipment in many different fields of application. A wide field of application is represented by enclosures equipped with electronic information technology (IT) equipment. They are frequently set up in large numbers in server rooms and data centres. During their operation, the electronic equipment installed generates a considerable amount of heat that will be removed from the equipment by means of cooling air. Precise adjustment of the supply air temperature and a sufficient cooling air flow are indispensable prerequisites for the fail-safe operation of equipment in information technology.

It is a common practice to set up cabinets in rows. The server cabinets along the row are usually arranged in such a way that surfaces with cold supply air inlets face each other across an aisle, and surfaces with hot exhaust air outlets also face each other across an aisle. This row configuration is generally known as hot aisle/cold aisle configuration. Moreover, air is supplied and discharged exclusively via the front and rear panels of the server cabinet, which are frequently perforated doors. It is assumed that inside the IT equipment, the cooling air is moved in a horizontal direction, taking it in at the front and discharging it at the rear.

This part of IEC 62966 specifies the quantification of the air separation, in particular the air leak rate that describes the content of the volumetric flow not used for cooling in the aisle containment for information technology (IT) cabinets. The objective of this document is to stipulate properties and requirements of aisle containment ensuring an effective installation, energy-efficient and user-friendly operation of IT equipment in data centres server rooms.

The fan pressurization method (overpressure at the system and elements) is used to categorize the air tightness of the aisle containment. In doing so, it is used to quantify the air tightness, in order to compare aisle containments with regard to their air tightness. It is also useful for finding leaks, or to determine the improvement due to improving the air tightness. The fan pressurization method cannot measure the air leak rate, but serves as a basis for determining the air leak rate by calculation. The method can be used to determine air leak rates of the aisle containment at low-pressure and overpressure on the inside compared with the surroundings. Thus, this allows a categorization of the elements of an aisle containment – the enclosure – to be determined.

For this purpose, aisle containment is dismantled into typical individual elements, for example enclosures, doors and roof covers. The corresponding characteristic curves of these components are recorded separately and added to the system characteristic curve of the aisle containment.

The quality of the resulting aisle containment is then classified using a differential pressure measurement.

The IEC 62966 series, *Mechanical structures for electrical and electronic equipment – Aisle containment for IT cabinets*, is subdivided into the following parts:

- IEC 62966-1: *Dimensions and mechanical requirements*
- IEC 62966-2: *Details of air flow, air separation and air cooling requirements*
- IEC 62966-3: *Aspects of operational safety of IT equipment and users of aisle containment*

IEC 62966-1 defines geometric dimensions and mechanical properties ensuring undisturbed, energy-efficient and user-friendly operation of the data centre.

IEC 62966-2 provides the methods and process to get the aisle containment air leakage and define the classification (evaluation) system on the aisle containment air leakage, for designers and users of aisle containments for IT cabinets based on the IEC 60297 and IEC 60917 series.

IEC 62966-3 deals with aspects of safely operating IT equipment in aisle containment, with respect to special fire-protection and fire-fighting issues. It also describes the nature of the doors for access to the aisle containment and possible access control.

MECHANICAL STRUCTURES FOR ELECTRICAL AND ELECTRONIC EQUIPMENT – AISLE CONTAINMENT FOR IT CABINETS –

Part 2: Details of air flow, air separation and air cooling requirements

1 Scope

This part of IEC 62966, dedicated to aisle containment techniques for information technology (IT) equipment typically used in data centres, describes the quantification of its air tightness, in particular the air loss ratio that describes the content of the volumetric flow not used for cooling the IT equipment. This ratio provides an index of efficiency, being inversely proportional to efficiency (the lower this ratio, the higher the efficiency). This document provides methods to measure an aisle containment air leakage rate and defines a classification system for aisle containment leakage.

This document defines:

- the measurement of the air leakage of the individual components of an aisle containment;
- a method for calculating the air leakage of an aisle containment based on its individual components;
- a method for calculating the air leakage rate of an aisle containment in relation to the utilised IT equipment;
- a classification system for aisle containment leakage.

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 62966-1, *Mechanical structures for electrical and electronic equipment – Aisle containment for IT equipment – Part 1: Dimensions and mechanical requirements*

ISO 9972, *Thermal performance of buildings – Determination of air permeability of buildings – Fan pressurization method*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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

air leak rate

ratio of the volumetric air flow not used for cooling to the total volumetric air flow