

# TECHNICAL SPECIFICATION



---

**Mechanical structures for electronic equipment – Thermal management for cabinets in accordance with IEC 60297 and IEC 60917 series –  
Part 3: Design guide: Evaluation method for thermoelectrical cooling systems  
(Peltier effect)**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

PRICE CODE

U

---

ICS 31.240

ISBN 2-8318-1071-6

## CONTENTS

FOREWORD.....	3
INTRODUCTION.....	5
1 Scope and object.....	6
2 Normative references .....	6
3 Abbreviations, symbols and indices .....	6
3.1 Abbreviations .....	6
3.2 Symbols .....	7
3.3 Indices .....	7
4 Theory of the thermoelectrical cooling system .....	7
4.1 The Peltier element .....	7
4.2 Thermoelectrical cooling systems.....	8
5 Measurement setup.....	12
6 Interpretation and evaluation .....	13
Annex A (informative) Sample calculation .....	17
Bibliography.....	30
Figure 1 – Principles of the thermoelectrical cooling system .....	9
Figure 2 – Thermal resistances.....	10
Figure 3 – Thermodynamic system boundaries of a thermoelectrical cooling system attached to a closed cabinet .....	11
Figure 4 – Measurement setup.....	12
Figure 5 – Results of the measurement.....	14
Figure 6 – Example for a specification sheet of a thermoelectrical cooling system (Peltier) .....	16
Figure A.1 – Mollier h-x-diagram for humid air .....	20
Figure A.2 – Principles of the Peltier effect .....	21
Figure A.3 – Illustration for Z dependent on the number of charge carrier .....	22
Figure A.4 – Influence of the Figure of Merit ZT on the efficiency of the Peltier device.....	22
Figure A.5 – Thermodynamic system boundaries of a Peltier device .....	23
Figure A.6– Thermal resistance of a thermoelectrical cooling system.....	24
Figure A.7 – Typical temperature curve of a thermoelectrical cooling system .....	25
Figure A.8 – Example for the thermal resistance between air and a heat sink as a function of the air velocity .....	26
Figure A.9 – Temperature distribution of a common heat sink for given boundary conditions .....	26
Figure A.10 – Illustration of the importance of the Thermal Interface Material (TIM).....	27
Figure A.11 – Dependency of the effective cooling power $Q_C$ on the difference $\Delta T$ between inside temperature and ambient temperature .....	28
Table A.1 – Measurement dataset.....	17

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**MECHANICAL STRUCTURES FOR ELECTRONIC EQUIPMENT –  
THERMAL MANAGEMENT FOR CABINETS IN ACCORDANCE  
WITH IEC 60297 AND IEC 60917 SERIES –****Part 3: Design guide: Evaluation method  
for thermoelectrical cooling systems (Peltier effect)**

## 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.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- The subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

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

IEC 62610-3, 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/401/DTS	48D/414/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 the IEC 62610 series can be found, under the general title *Mechanical structures for electronic equipment – Thermal management for cabinets in accordance with IEC 60297 and IEC 60917 series*, on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

**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

Besides the conventional compressor cooling there are several alternatives for cooling, for example: absorption cooling, thermoelectric cooling (Peltier), magneto caloric cooling, CO<sub>2</sub> cooling and others.

For the design of thermoelectrical cooling systems, values of the dissipation loss depending on the ambient temperature and internal temperature are necessary.

Thermoelectrical cooling systems performance is a function of ambient temperature, hot and cold side heat exchanger (heat sink) performance, thermal load, of the design of the Peltier device and of Peltier electrical parameters.

Therefore an evaluation method has to be developed. This design guide allows a comparison of thermoelectrical cooling systems.

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

**Part 3: Design guide: Evaluation method  
for thermoelectrical cooling systems (Peltier effect)**

## **1 Scope and object**

This part of IEC 62610 provides an evaluation method for thermoelectrical cooling systems (Peltier effect). With this design guide it is possible to calculate the efficiency of the thermoelectrical cooling system (Peltier effect) and its cooling power depending on the ambient temperature and internal temperature. This design guide can also be used to appraise thermoelectrical cooling systems by its efficiency.

## **2 Normative references**

The following referenced documents are indispensable for the application 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 62194:2005, *Method of evaluating the thermal performance of enclosures*