

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Thermal-links – Requirements and application guide

Protecteurs thermiques – Exigences et guide d'application



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2015 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
Fax: +41 22 919 03 00
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 corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

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 It also gives information on projects, replaced and withdrawn publications.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 also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

More than 60 000 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.

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: csc@iec.ch.

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.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub

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 aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 15 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

Plus de 60 000 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.

Service Clients - webstore.iec.ch/csc

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

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Thermal-links – Requirements and application guide

Protecteurs thermiques – Exigences et guide d'application

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 29.120.50

ISBN 978-2-8322-2921-7

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	8
4 General requirements	10
5 General notes on tests	11
6 Classification.....	13
6.1 Electrical conditions.....	13
6.2 Thermal conditions.....	14
6.3 Resistance to tracking.....	14
7 Marking	14
8 Documentation	15
9 Constructional requirements.....	15
9.1 General.....	15
9.2 Lead secureness tests	16
9.2.1 General	16
9.2.2 Tensile test.....	16
9.2.3 Thrust test	17
9.2.4 Bending/twist test	17
9.3 Contacts used for the current path	18
9.4 Accessible mounting brackets or metal parts	18
9.5 Insulating materials.....	18
9.6 Resistance to tracking.....	18
9.7 Creepage distances and clearances.....	18
9.8 Temperature and humidity cycle conditioning.....	19
9.9 Terminals and terminations	19
10 Electrical requirements	19
10.1 Dielectric strength.....	19
10.2 Insulation resistance	20
10.3 Interrupting current	21
10.3.1 General	21
10.3.2 Specific conditions.....	21
10.4 Transient overload current	22
10.5 Limited short-circuit test.....	23
10.5.1 General	23
10.5.2 Test method	23
10.5.3 Fuse size (rating).....	23
10.5.4 Compliance	24
11 Temperature tests	24
11.1 General.....	24
11.2 Holding temperature, T_h	24
11.3 Rated functioning temperature, T_f	25
11.4 Maximum temperature limit, T_m	25

11.5 Ageing	25
12 Resistance to rusting	26
13 Manufacturer's validation programme	26
Annex A (normative) Application guide.....	28
Annex B (normative) Alternative ageing test for thermal-links with T_h greater than 250 °C for use in electric irons	29
Annex C (normative) Conductive heat ageing test.....	30
C.1 Conductive heat ageing test.....	30
C.2 Method	30
C.3 Ageing	31
C.4 Results	32
C.5 Dielectric strength test	32
C.6 Test oven.....	32
Annex D (informative) Extended holding temperature evaluation.....	34
D.1 Extended holding temperature conditioning test	34
D.2 Load current interrupt test.....	34
Annex E (normative) Seal ageing test	36
Annex F (normative) Identification requirements	38
Annex G (normative) Indelibility of markings	39
Annex H (normative) Requirements for thermal-link packaged assemblies	40
Bibliography.....	43
Figure 1 – Bending/twist test.....	17
Figure C.1 – Typical test fixture assembly.....	32
Figure C.2 – Typical thermal-link test oven	33
Figure D.1 – Typical terminal block support test fixture	35
Figure E.1 – Conditioning time versus oven temperature for proposed temperature index.....	37
Figure G.1 – Apparatus for testing durability of markings	39
Table 1 – Test schedule.....	13
Table 2 – Strength of leads and terminal parts – Minimum required tensile and thrust test forces.....	17
Table 3 – Creepage distances and clearances (absolute minimum values)	19
Table 4 – Test voltages for dielectric strength.....	20
Table 5 – Test current for interrupting test	21
Table 6 – Limited short-circuit test capacity	23
Table H.1 – Push and pull force	41
Table H.2 – Minimum nominal cross-sectional area of conductor	42

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**THERMAL-LINKS –
REQUIREMENTS AND APPLICATION GUIDE****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 60691 has been prepared by subcommittee 32C: Miniature fuses, of IEC technical committee 32: Fuses.

This fourth edition cancels and replaces the third edition published in 2002, Amendment 1: 2006 and Amendment 2: 2010. This fourth edition constitutes a technical revision.

This fourth edition includes the following significant technical changes with respect to the previous edition:

- a) requirements for thermal-link packaged assemblies;
- b) renew the requirements and definitions for T_h -test;
- c) change starting temperature for interrupt current test;
- d) clarify requirements for marking (packing label);
- e) minimum Proof Tracking Index 175 instead 120.

The text of this standard is based on the following documents:

FDIS	Report on voting
32C/512/FDIS	32C/515/RVD

Full information on the voting for the approval of this standard 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.

The basis for this standard is the harmonization of the USA national standard, UL 1020, fifth edition (withdrawn 2003), and IEC 60691:1993, together with its Amendment 1:1995 and Amendment 2:2000.

The following differing practices of a less permanent nature exist in the country indicated below:

- Annex C is required to be declared in the USA;
- Annex E is required in the USA, if applicable;
- Annex F is required to be declared in the USA.

In this standard, the following type is used:

- *compliance statements: in italic type.*

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

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

INTRODUCTION

Thermal-links, defined as non-resettable devices functioning once only without refunctioning, are widely applied for the thermal protection of equipment in which, under fault (abnormal) conditions, one or more parts may reach hazardous temperatures.

As these devices have several aspects in common with miniature fuse-links and are used for obtaining a comparable degree of protection, this standard has endeavoured to lay down a number of basic requirements for such devices.

THERMAL-LINKS – REQUIREMENTS AND APPLICATION GUIDE

1 Scope

This International Standard is applicable to thermal-links intended for incorporation in electrical appliances, electronic equipment and component parts thereof, normally intended for use indoors, in order to protect them against excessive temperatures under abnormal conditions.

NOTE 1 The equipment is not designed to generate heat.

NOTE 2 The effectiveness of the protection against excessive temperatures logically depends upon the position and method of mounting of the thermal-link, as well as upon the current which it is carrying.

This standard may be applicable to thermal-links for use under conditions other than indoors, provided that the climatic and other circumstances in the immediate surroundings of such thermal-links are comparable with those in this standard.

This standard may be applicable to thermal-links in their simplest forms (e.g. melting strips or wires), provided that molten materials expelled during function cannot adversely interfere with the safe use of the equipment, especially in the case of hand-held or portable equipment, irrespective of its position.

Annex H of this standard is applicable to thermal-link packaged assemblies where the thermal-link(s) has already been approved to this standard but packaged in a metallic or non-metallic housing and provided with terminals/wiring leads.

This standard is applicable to thermal-links with a rated voltage not exceeding 690 V a.c. or d.c. and a rated current not exceeding 63 A.

The objectives of this standard are:

- a) to establish uniform requirements for thermal-links,
- b) to define methods of test,
- c) to provide useful information for the application of thermal-links in equipment.

This standard is not applicable to thermal-links used under extreme conditions such as corrosive or explosive atmospheres.

This standard is not applicable to thermal-links to be used in circuits on a.c. with a frequency lower than 45 Hz or higher than 62 Hz.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60065:2014, *Audio, video and similar electronic apparatus – Safety requirements*

IEC 60112:2003, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*
IEC 60112:2003/AMD1:2009

IEC 60127-2:2014, *Miniature fuses – Part 2: Cartridge fuse-links*

IEC 60216-5:2008, *Electrical insulating materials – Thermal endurance properties – Part 5: Determination of relative thermal endurance index (RTE) of an insulating material*

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60695-2-12:2010, *Fire hazard testing – Part 2-12: Glowing/hot-wire based test methods – Glow-wire flammability index (GWFI) test method for materials*
IEC 60695-2-12:2010/AMD1:2014

IEC 60695-2-13:2010, *Fire hazard testing – Part 2-13: Glowing/hot-wire based test methods – Glow-wire ignition temperature (GWIT) test method for materials*
IEC 60695-2-13:2010/AMD1:2014

IEC 60695-10-2:2014, *Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test method*

IEC 60695-11-10:2013, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60730-1:2013, *Automatic electrical controls – Part 1: General requirements*

IEC 61210:2010, *Connecting devices – Flat quick-connect terminations for electrical copper conductors – Safety requirements*

3 Terms and definitions

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

3.1

clearance

shortest distance in air between two conductive parts

3.2

creepage distance

shortest distance along the surface of insulating material between two conductive parts

3.3

holding temperature

T_h

maximum temperature of the thermal-link at which it will not change its state of conductivity during a specified time at the rated current

Note 1 to entry: The minimum permissible value of T_h is 35 °C.

3.4

homogeneous series

series of thermal-links having the same external dimensions and common overall construction, deviating from each other only in such characteristics (including ratings) that, for a given test,