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colour inside

Thermal-links – Requirements and application guide

Protecteurs thermiques – Prescriptions et guide d'application

IEC 60691:2002-12+AMD1:2006-09+AMD2:2010-02 CSV(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

THERMAL-LINKS – REQUIREMENTS AND APPLICATION GUIDE

FOREWORD

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This Consolidated version of IEC 60691 bears the edition number 3.2. It consists of the third edition (2002-12) [documents 32C/321/FDIS and 32C/329/RVD], its amendment 1 (2006-09) [documents 32C/395/FDIS and 32C/400/RVD] and its amendment 2 (2010-02) [documents 32C/425/FDIS and 32C/429/RVD]. The technical content is identical to the base edition and its amendments.

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendments 1 and 2. Additions and deletions are displayed in red, with deletions being struck through. A separate Final version with all changes accepted is available in this publication.

This publication has been prepared for user convenience.

International Standard IEC 60691 has been prepared by subcommittee 32C: Miniature fuses, of IEC technical committee 32: Fuses.

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

The basis for this standard is the harmonization of the US national standard UL 1020, fifth edition (withdrawn 2003), ~~which deals with thermal cutoffs/thermal links, has served as a basis for the elaboration of this new edition~~ and IEC 60691, second edition, together with its amendments 1 and 2.

The committee has decided that the contents of the base publication and its amendments 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

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- withdrawn,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

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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 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 and object

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 need not be 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.

NOTE 3 Attention is drawn to the fact that the external creepage distances and clearances specified in Table 3 may in some cases be smaller than those required by certain appliance or equipment standards. In such cases, additional means should be provided when a thermal-link is mounted in the equipment in order to adjust the creepage distances and clearances to the values required by the relevant equipment standard.

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.

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 object of this standard is

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 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 60065:2001, *Audio, video and similar electronic apparatus – Safety requirements*
Amendment 1 (2005)

IEC 60085:~~1984~~ 2004, ~~*Thermal evaluation and classification of*~~ *Electrical insulation – Thermal classification*

IEC 60112:2003, ~~*Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions*~~[1] *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60216-1:2001, *Electrical insulating materials – Properties of thermal endurance – Part 1: Ageing procedures and evaluation of test results*

IEC 60664-1:1992, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*
Amendment 1 (2000)
Amendment 2 (2002)

IEC 60695-2-11:2000, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products*

IEC 60695-10-2:~~1995~~ 2003, *Fire hazard testing – Part 10-2: ~~Guidance and test methods for the minimization of the effects of abnormal heat on electrotechnical products involved in fires – Method for testing products made from non-metallic materials for resistance to heat using the ball pressure test~~ Abnormal heat – Ball pressure test*

IEC 60695-10-3:2002, *Fire hazard testing – Part 10-3: Abnormal heat – Mould stress relief distortion test*

IEC 60695-11-10:1999, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*
Amendment 1 (2003)

IEC 60695-11-20:1999, *Fire hazard testing – Part 11-20: Test flames – 500 W flame test methods*

IEC 60730-1:1999, *Automatic electrical controls for household and similar use – Part 1: General requirements*
Amendment 1 (2003)

IEC 61210:1993, *Connecting devices – Flat quick-connect terminations for electrical copper conductors – Safety requirements*

~~UL 1020:1994, *Thermal Cutoffs for Use in Electrical Appliances and Components*~~

3 Definitions

For the purposes of this International Standard, the following 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

[1] ~~A fourth edition of IEC 60112, due to be published in 2003, is being prepared.~~

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 under specified conditions

3.4
homogeneous series (of thermal-links)
series of thermal-links having common overall construction, deviating from each other only in such characteristics that, for a given test, the testing of one or a reduced number of particular thermal-links of that series shall be taken as representative for all the thermal-links of the series

3.5
interrupting current, I_b
value of the current that the thermal-link is capable of interrupting at rated voltage and under specified circuit conditions

3.6
maximum temperature limit, T_m
temperature of the thermal-link stated by the manufacturer, up to which the mechanical and electrical properties of the thermal-link, having changed its state of conductivity, will not be impaired for a given time

3.7
pilot duty
~~class of operation in which the ultimate electrical load is controlled by an auxiliary means such as a relay or contactor~~
rating assigned to a switching device that controls the coil of another electro-mechanical device such as a solenoid, relay or contactor

3.8
portable equipment
equipment which is moved while in operation or which can easily be moved from one place to another while connected to the supply

3.9
rated current, I_r
current used to classify a thermal-link

3.10
rated functioning temperature, T_f
temperature of the thermal-link which causes it to change its state of conductivity with a detection current up to 10 mA as the only load

3.11
rated voltage, U_r
voltage used to classify a thermal-link

3.12
thermal element
metallic or non-metallic fusible material that is part of a thermal-link and is responsive to temperature by a change of state such as from solid to liquid at the temperature for which it is calibrated

3.13
thermal-link
non-resettable device incorporating a thermal element, which will open a circuit once only when exposed for a sufficient length of time to a temperature in excess of that for which it has been designed

3.14
transient overload current, I_p
direct current pulse train which the thermal-link is able to withstand without impairing its characteristics

3.15
type test
conformity testing on the basis of one or more specimens of a product representative of the production

3.16
extended holding temperature, $T_{h\text{-}100}$
maximum temperature at which a thermal-link can be maintained while conducting the rated load current at the rated voltage for a period of 100 weeks which will not cause the thermal-link to open circuit in accordance with extended holding temperature evaluation (see Annex D)

NOTE This is a rating for user consideration during the investigation of the end product.

3.17
conductive heat ageing test
CHAT
test to evaluate a thermal-link for use in an appliance (see Annex C)

NOTE If it performs satisfactorily, the thermal-link will be assigned a CHAT rating. This rating is for end-product user consideration during the investigation of the end-use product.

4 General requirements

Adequate protection of the equipment against excessive temperatures not only depends upon the properties of the thermal-link but also to a large extent upon the mounting of the thermal-link in the equipment. Therefore, in addition to good engineering practice, the requirements of the application guide in Annex A shall be considered.

Thermal-links shall have adequate electrical and mechanical strength and shall be constructed so as to withstand all conditions of handling likely to be encountered during mounting and normal use, when used within the requirements of this standard.

When a thermal-link changes its state of conductivity, no arc or flame shall be maintained, nor material expelled that might impair the surrounding area or otherwise create a risk of electric shock or fire.

NOTE For thermal-links using melting strips or wires, care should be taken to prevent molten material from short-circuiting or bridging creepage distances and clearances in air, so as to reduce the risk of impairing the insulation system of the equipment.

After it has functioned, the thermal-link shall not be damaged when subjected to temperatures not exceeding T_m, in such a way that the safety of the equipment with regard to risk of electric shock hazard and electrical breakdown is impaired.

5 General notes on tests

~~Unless otherwise indicated, all tests described in this standard are type tests and shall be carried out under room ambient conditions~~.

Unless otherwise specified, only tests that are not required to be performed inside an environmental chamber and/or test oven shall be carried out under the following atmospheric conditions:

Temperature: 15 °C to 35 °C

Relative humidity: 25 % to 75 %

Air pressure: $8{,}6 \times 10^4$ Pa to $1{,}06 \times 10^5$ Pa

NOTE 1 The required atmospheric conditions during testing can be controlled when carrying out the tests and during the duration of the tests. The required atmospheric conditions do not have to be maintained in a test laboratory when tests are not performed.

Where the above-mentioned conditions have a significant influence, they shall be kept substantially constant during the tests.

If the temperature limits given in this clause are too wide for certain tests, these shall be repeated, in case of doubt, at a temperature of (23 ± 1) °C.

In every test report, the ambient temperature shall be stated. If the standard conditions for relative humidity or pressure are not fulfilled during the tests, a note to this affect shall be added to the report.

If the result of a test is influenced, to an appreciable extent, by the position and method of mounting of the specimen, the most unfavourable condition shall be chosen for the relevant tests and recorded.

If a thermal-link has been specifically designed for use in a special type of equipment and cannot be tested separately, the tests of this standard shall be performed in that equipment or in the relevant part of it, or similar.

When testing a homogeneous series of thermal-links, all the tests shall be applied to thermal-links with the lowest and highest T_f. Thermal-links with intermediate rated functioning temperatures need only be subjected to tests according to 10.6, 11.2, 11.3 and 11.4.

The total number of specimens required is ~~48~~ 45. Out of a total of ~~48~~ 45 specimens, 15 are kept as spares in case some of the tests have to be repeated. Out of a total of ~~48~~ 45 specimens, ~~33~~ 30 are divided into groups assigned an alphabetical letter from A to ~~K~~ J. Each group consists of three specimens. In general, tests shall be performed in the order indicated in Table 1 but, if so required, tests may be repeated, for example the test on marking (see Clause 7). Additional samples may be needed according to Note ~~3~~ 2 of Table 1.

~~No failures are permitted in the tests carried out in accordance with Clauses 10 and 11.~~

NOTE 2 For optional tests, additional samples will be required per the annexes.

If, in any of the tests carried out in accordance with ~~the other~~ any clause~~s~~, ~~one~~ a failure is reported~~, that test shall be repeated on twice the number of specimens and no further failures are allowed~~ the cause of the failure will be identified and corrective action taken. Based on the failure analysis report and the corrective action, at a minimum, that test sequence shall be repeated on twice the number of revised specimens and no further failures are allowed.

The conductive heat ageing test of Annex C is applicable when declared by the manufacturer. ~~This test shall be conducted on thermal-links with a functioning temperature (T_f) rating of 175 °C or above. The conductive heat ageing test is optional for thermal-links with a T_f rating less than 175 °C.~~

Exception: The conductive heat ageing test may be omitted if the thermal-link ~~is of eutectic type and~~ is constructed without contacts.

NOTE 3 In the USA the conductive heat ageing test is required to be declared.