

Thermal-links — Requirements and application guide

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National foreword

This British Standard is the UK implementation of EN 60691:2003+A2:2010. It is identical with IEC 60691:2002, incorporating amendments 1:2006 and 2:2010. It supersedes BS EN 60691:2003 which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags **A1** **A1**. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated by **A1** **A1**.

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English version

**Thermal-links -
Requirements and application guide
(IEC 60691:2002)**

Protecteurs thermiques -
Prescriptions et guide d'application
(CEI 60691:2002)

Temperatursicherungen -
Anforderungen und Anwendungshinweise
(IEC 60691:2002)

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Foreword

The text of document 32C/321/FDIS, future edition 3 of IEC 60691, prepared by SC 32C, Miniature fuses, of IEC TC 32, Fuses, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60691 on 2002-12-01.

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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.

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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*

■_{A1} Amendment 1 (2005) ◊_{A1}

■_{A1} IEC 60085:2004, *Electrical insulation – Thermal classification* ◊_{A1}

■_{A1} IEC 60112:2003, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials* ◊_{A1}

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*

■_{A1} Amendment 1 (2000)

Amendment 2 (2002) ◊_{A1}

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*

■_{A1} IEC 60695-10-2:2003, *Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test* ◊_{A1}

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*

■_{A1} Amendment 1 (2003) ◊_{A1}

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*

■_{A1} Amendment 1 (2003) ◊_{A1}

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

■_{A1} Note deleted ◊_{A1}

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

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

A1 3.7

pilot duty

rating assigned to a switching device that controls the coil of another electro-mechanical device such as a solenoid, relay or contactor **A1**

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-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.

A1 5 General notes on tests A1

- A2** 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. **A2**

- A1** 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 effect 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 45. Out of a total of 45 specimens, 15 are kept as spares in case some of the tests have to be repeated. Out of a total of 45 specimens, 30 are divided into groups assigned an alphabetical letter from A to 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 2 of Table 1.

- A2** NOTE 2 **A2** For optional tests, additional samples will be required per the annexes.

If, in any of the tests carried out in accordance with any clause, a failure is reported, 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.

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

- A2** NOTE 3 **A2** In the USA the conductive heat ageing test is required to be declared. **A1**



Table 1 – Test schedule

Clause or subclause	Test	Specimen groups									
		A	B	C	D	E	F	G	H	I	J
7*	Marking (rub test)	X	X								
9	Mechanical requirements										
9.2*	Tensile force	X									
9.3*	Thrust force		X								
9.4*	Bending/twist force			X							
10	Electrical requirements										
10.1*	Creepage distances and clearances						X	X			
10.2*	Temperature and humidity cycle conditioning	X	X	X			X	X			
12*	Resistance to rusting (ferrous parts only)	X	X	X							
10.3*	Dielectric strength (if applicable)	X	X	X			X	X			
10.4*	Insulation resistance (if applicable)	X	X	X			X	X			
10.5*	Resistance to tracking				X	X					
10.6	Interrupting current						X	X			
10.7*	Transient overload current	X	X						X		
11	Temperature tests										
11.2	Check on T_f	X		X							
11.3	Check on T_m followed by dielectric test and insulation resistance			X	X						
11.4	Ageing		X			X			X	X	X
	step 1 (optional) 21 days										
	step 2 (mandatory) 21 days										
	step 3 (mandatory) 14 days										
	step 4 (mandatory) 7 days										
	step 5 (mandatory) 7 days										
	step 6 (mandatory) 24 h										
10.3	Dielectric strength	X	X			X	X	X	X	X	X
10.4	Insulation resistance	X	X			X	X	X	X	X	X
7*	Marking (visual inspection only)	X	X								
NOTE 1 For homogeneous series, tests marked with an asterisk may be omitted for intermediate ratings.											
NOTE 2 If the conditions of voltage, power and current in c), d) and e) of 10.6.2 are not covered by one test, a minimum of three samples should be tested for each condition.											

