

# INTERNATIONAL STANDARD

# IEC 60691

2002

AMENDMENT 1  
2006-09

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Amendment 1

## **Thermal-links – Requirements and application guide –**

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## FOREWORD

This amendment has been prepared by subcommittee 32C: Miniature fuses, of IEC technical committee 32: Fuses.

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

FDIS	Report on voting
32C/395/FDIS	32C/400/RVD

Full information on the voting for the approval of this amendment can be found in the report on voting indicated in the above table.

The committee has decided that the contents of this amendment and the base 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

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- withdrawn,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

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

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### CONTENTS

*Add, after Clause 12, the following new Clause heading:*

13 Manufacturer's validation programme

Page 5

### FOREWORD

*Add the following new paragraphs 7), 8) and 9) to the first part of the Foreword:*

- 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.

*Replace the last paragraph on page 5 by the following:*

The basis for this standard is the harmonization of the USA national standard, UL 1020, fifth edition (withdrawn 2003), and IEC 60691, second edition, together with its amendments 1 and 2.

Page 7

*Replace the first paragraph by the following:*

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date<sup>1)</sup> 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

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

*Add the following footnote to the bottom of page 7:*

1) The National Committees are requested to note that for this publication the maintenance result date is 2009.

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## **2 Normative references**

*Add, after IEC 60065:2001, the following:*

"Amendment 1 (2005)

*Replace the reference to IEC 60085:1984, by the following:*

IEC 60085:2004, *Electrical insulation – Thermal classification*

*Replace the reference to IEC 60112 (including its footnote) by the following:*

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

*Add, after IEC 60664-1, the following:*

Amendment 1 (2000)

Amendment 2 (2002)

*Replace the reference to IEC 60695-10-2:1995 by the following:*

IEC 60695-10-2:2003, *Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test*

*Add, after IEC 60695-11-10:1999, the following:*

Amendment 1 (2003)

*Add, after IEC 60730-1:1999, the following:*

Amendment 1 (2003)

*Delete the reference to UL 1020:1994.*

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### **3 Definitions**

*Replace the existing definition 3.7 by the following:*

#### **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

Page 19

### **5 General notes on tests**

*Replace the existing Clause 5 by the following:*

### **5 General notes on tests**

Unless otherwise specified, all tests 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

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  $(23 \pm 1)$  °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.

NOTE 1 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.

NOTE 2 In the USA the conductive heat ageing test is required to be declared.

**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.											

## 7 Marking

*Replace, on page 25, the penultimate paragraph of Clause 7 (which starts with “The marking in accordance with a), b), c) etc.”) by the following:*

If the thermal-link is small in size, and not intended to be replaced, the markings in accordance with a), b), c) and d) above shall be printed on the packaging, together with a reference to this standard.

Page 25

## 8 Documentation

*Delete all three NOTES in this Clause.*

*Add the following new item e):*

- e) thermal-links small in size and not intended to be replaced.

NOTE 1 In order to avoid possible damage to the thermal-link, the manufacturer should be consulted when the end-use application involves sealing in or the use of cleaning solvents.

NOTE 2 For reasons of safety, it should be made clear in the documentation that a thermal-link is a non-repairable item and that, in case of replacement, an equivalent thermal-link from the same manufacturer and having the same catalogue reference should be used, mounted in exactly the same way.

NOTE 3 Catalogue or reference numbers should define those parameters such as temperature, current and voltage, which together classify a thermal-link.

Page 25

## 9 Mechanical requirements

*Replace, on page 27, the fifth paragraph of Clause 9 by the following:*

For current-carrying parts, temperature limits should be considered according to Table 14.1 of IEC 60730-1.

Page 29

### 9.1 Lead secureness tests

*Delete the last paragraph.*

### 9.2 Tensile test

*Replace "10 min" by "1 min".*

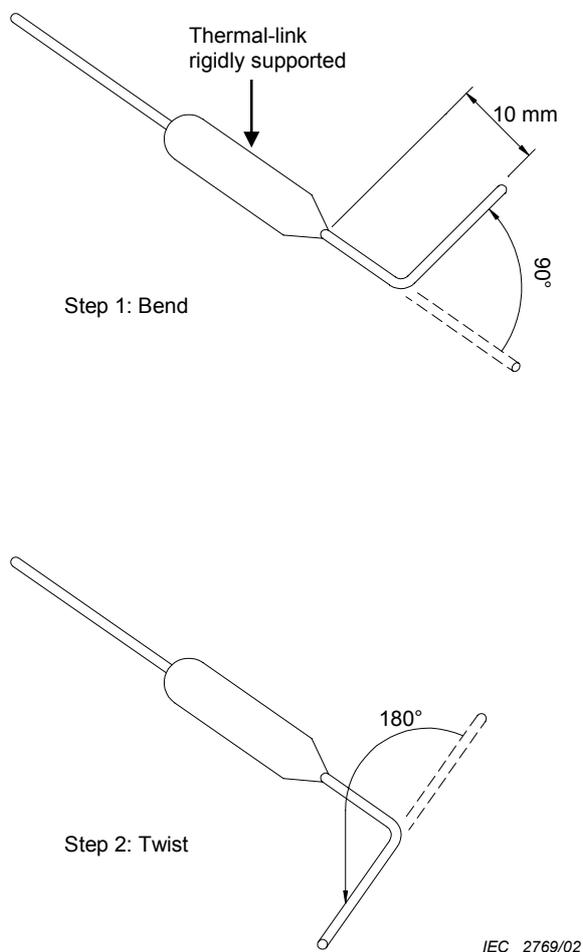
### 9.3 Thrust test

*Replace "10 min" by "1 min".*

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### 9.4 Bending/twist test

Replace the existing Figure 1 by the following new Figure 1:



Page 33

## 10 Electrical requirements

Insert, before Notes 1 and 2, the following new text:

If it is necessary to investigate an insulating material, the following standards shall be used : IEC 60085, IEC 60216-1, IEC 60695-2-11, IEC 60695-10-2, IEC 60695-10-3, IEC 60695-11-10 and IEC 60695-11-20.

Exception: Seals and potting compounds not relied upon for contact alignment or secureness of leads may be subjected to the seal ageing test specified in Annex E.

Page 33

### 10.1 Creepage distances and clearances

*Delete all text from the fourth paragraph inclusive, up to Table 3.*

Page 35

### 10.2 Humidity conditioning

*Replace, in the second sentence, “of 10.2.1 and 10.2.2 below” by “specified below”.*

*Add the following new text:*

For temperature and humidity cycle conditioning, the thermal-link samples shall be subjected to three complete conditioning cycles. Each cycle shall consist of 24 h at  $T_h$  followed immediately (within 15 min) by at least 24 h at  $(35 \pm 5)^\circ\text{C}$  and  $(90 \pm 5)\%$  relative humidity, followed by 8 h at  $(0 \pm 2)^\circ\text{C}$ .

NOTE The dielectric and insulation resistance tests are performed after removal of the samples from the conditioning chamber.

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*Delete the title and text of both 10.2.1 and 10.2.2.*

Page 39

### 10.5 Resistance to tracking

*Delete, after the first two paragraphs, the remaining text in this subclause (where it begins “In order to determine ... etc.”).*

Page 41

## 10.6 Interrupting current

### 10.6.2 Specific conditions

Replace the existing Table 5 by the following new Table 5:

**Table 5 – Test current for interrupting test**

Type of rating	Rated in	Test current	Power factor
Resistive	AC amperes	1,5 times rated current	0,95 – 1,0
Inductive	AC amperes	1,5 times rated current	0,6
	DC amperes	Current	--
Motor	AC locked rotor Amperes (LRA)	6 times full-load current *	0,4 – 0,5
	DC amperes	10 times full-load current	--
Pilot duty	AC volt-amperes	10 times VA	0,35
Electric discharge lamp	AC amperes	4 times rated current	0,4 – 0,5
* Or the specified value, such as horsepower, if locked rotor ampere rating is omitted.			

Replace, on page 43, the existing item g) by the following new item g):

- g) Compliance is checked by the following test. For thermal-links rated 249 °C or lower, the sample shall be placed in a test oven, stabilized at a temperature of  $T_f - 12$  K or as declared by the manufacturer, but not higher than 2 K below the lowest tolerance. For thermal-links rated at 250 °C or higher, and a tolerance of  $T_f - 20$ , the sample shall be placed in a test oven, stabilized at a temperature of  $T_f - 22$  K, or as declared by the manufacturer, but not higher than 2 K below the lowest tolerance. The temperature of the oven shall then re-stabilize. All thermal links, rated 249 °C or lower, and 250 °C or higher, shall then be energized and the oven temperature increased at the rate of  $(2 \pm 1)$  K/min and the test shall be continued until the thermal-link functions or the oven temperature reaches 30 K above  $T_f$ .

NOTE 1 The thermal-link may operate immediately after being energized, in which case the temperature increase of  $(2 + 1)$  K is not necessary and the test may be stopped.

Add the following new note at the end of 10.6.2:

NOTE 2 The main purpose of this test is to evaluate the mechanical and electrical integrity of the thermal-link to interrupt a certain load.

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### 10.8.2 Method

Replace, in line 8, “.. of the appropriate size.” by “.. having a cross-sectional area as indicated in Table 10.2.1 of IEC 60730-1.”

Page 47

### 11.2 Rated functioning temperature, $T_f$

*Replace the existing subclause by the following:*

Thermal-links shall be exposed, in the test oven or oil bath, to  $T_f - 12$  K or as declared by the manufacturer but not higher than 2 K below the lowest tolerance for devices rated less than 250 °C, until the temperature has stabilized shown when two consecutive readings taken 5 min apart are within 1 K of each other. For devices rated 250 °C or higher, the thermal-links shall be exposed to  $T_f - 22$  K, or as declared by the manufacturer, but not higher than 2 K below the lowest tolerance. The temperature shall then be stabilized, shown when two consecutive readings taken 5 min apart are within 1 K of each other. The temperature shall then be increased steadily with a rate of rise between 0,5 K/min to 1 K/min, until all specimens have functioned. The individual functioning temperature of thermal-links, rated less than 250 °C, shall be recorded and they shall be not less than as declared by the manufacturer, or  $T_f - 10$  K if no declaration is made. For thermal-links rated at 250 °C or higher, the recorded temperature shall be not less than that declared by the manufacturer, or  $T_f - 20$  K if no declaration is made. For thermal-links rated lower than 250 °C, or higher than 250 °C, the temperature shall not be greater than  $T_f$ .

NOTE The equipment recommended for the tests of 11.2 is shown in Clause C.6.

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### 11.3 Maximum temperature limit, $T_m$

*Replace the first paragraph of 11.3 by the following:*

The specimens shall be subjected to  $T_{m-5}^0$  °C for a period of 10 min. With the samples maintained at  $T_{m-5}^0$  °C, a dielectric test per 10.3, and an insulation resistance test per 10.4, shall be conducted.

*Replace the word "NOTE" at the end of 11.3 by "NOTE 1" and add a new NOTE 2 as follows:*

NOTE 2 The  $T_f$  and  $T_m$  tests may be conducted in separate equipment and samples may cool down during transfer from the  $T_f$  to  $T_m$  test.

## 12 Resistance to rusting

*Replace, on page 51, the penultimate paragraph of Clause 12 by the following:*

Compliance is checked by inspecting specimens of Groups A, B and C after the temperature and humidity cycle conditioning test of 10.2.

*Add a new Clause 13 as follows:*

### **13 Manufacturer's validation programme**

The manufacturer shall conduct regular inspections for production control and tests for validating performance per 13.1 and 13.2.

**13.1** The manufacturer shall test three samples each, for all temperature ratings for thermal-links, once every two years for 10.6 (Interrupting current), 11.2 (Rated functioning temperature) and 11.3 (Maximum temperature limit) followed by the tests of 10.3 (Dielectric strength) and 10.4 (Insulation resistance). The pre-conditioning tests of Clause 9 (Mechanical requirements) may be omitted.

**13.2** The tests of 10.6 shall be conducted on

- a) the highest voltage rating,
- b) the highest current rating,
- c) both a) and b) on the resistive and inductive ratings.

Non-compliance in any of the tests shall be subject to a review and repetition as per Clause 5.

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#### **C.2.2 Temperature setting**

*Replace the last sentence as follows:*

The test oven shall be rated 10 A, 120 V a.c. or 230 V a.c.

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