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**Thermal-links — Requirements and
application guide**

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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry, through deliberations at the Japanese Industrial Standards Committee in accordance with the Industrial Standardization Act. This edition replaces the previous edition (**JIS C 6691:2016**), which has been technically revised.

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NOTE Based on Article 9 of the Supplementary Provisions to the Unfair Competition Prevention Act etc., procedures such as deliberation by the Japanese Industrial Standards Committee employed under the previous Industrial Standardization Act shall be deemed to have been conducted pursuant to the revised Industrial Standardization Act.

Thermal-links — Requirements and application guide

Introduction

This Japanese Industrial Standard has been prepared based on **IEC 60691** : 2015, Edition 4, and its Amendment 1:2019 with some modifications of the technical contents made corresponding to actual production and application of the product in Japan. The amendment to the said International Standard has been incorporated into this Standard.

The dotted underlines indicate changes from the corresponding International Standard. A list of modifications with the explanations is given in Annex JB. Annex JA is unique to **JIS** and not given in the corresponding International Standard.

1 Scope

This 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. Guidance for application of thermal links is given in Annex A.

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.

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 and movement.

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 and/or wiring leads.

Annex JA of this Standard is applicable to thermal-links for which the manufacturer specifies the median value of functioning temperature as T_f .

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.

The alternative ageing test for thermal-links with T_h greater than 250 °C for use in electric irons is given in Annex B.

NOTE 3 The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

IEC 60691 : 2015 *Thermal-links — Requirements and application guide* and Amendment 1 : 2019 (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. For standards indicated below, only the editions of the indicated year shall be applied and any revisions (including amendments) made thereafter shall not be applied.

JIS C 2134 : 2007 *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

NOTE : Corresponding International Standard : IEC 60112 : 2003 *Method for the determination of the proof and the comparative tracking indices of solid insulating materials* and Amendment 1 : 2009

JIS C 2143-5 : 2013 *Electrical insulating materials — Properties of thermal endurance — Part 5 : Determination of relative thermal endurance index (RTE)*

NOTE : Corresponding International Standard : IEC 60216-5 : 2008 *Electrical insulating materials — Thermal endurance properties — Part 5 : Determination of relative thermal endurance index (RTE) of an insulating material*

JIS C 2809 : 2014 *Connecting devices — Flat quick-connect terminations for electrical copper conductors — Safety requirements*

NOTE : Corresponding International Standard : IEC 61210 : 2010 *Connecting devices — Flat quick-connect terminations for electrical copper conductors — Safety requirements*

JIS C 6065 : 2019 *Audio, video and similar electronic apparatus — Safety requirements*

NOTE : Corresponding International Standard : IEC 60065 : 2014 *Audio, video*

and similar electronic apparatus — Safety requirements

JIS C 6575-2 : 2016 *Miniature fuses — Part 2 : Cartridge fuse-links*

NOTE : Corresponding International Standard : IEC 60127-2 : 2014 *Miniature fuses — Part 2 : Cartridge fuse-links*

JIS C 9730-1 : 2019 *Automatic electrical controls — Part 1 : General requirements*

NOTE : Corresponding International Standard : IEC 60730-1 : 2013 *Automatic electrical controls — Part 1 : General requirements*

JIS C 60664-1 : 2009 *Insulation coordination for equipment within low-voltage systems — Part 1 : Principles, requirements and tests*

NOTE : Corresponding International Standard : IEC 60664-1 : 2007 *Insulation coordination for equipment within low-voltage systems — Part 1: Principles, requirements and tests*

JIS C 60695-2-12 : 2013 *Fire hazard testing — Part 2-12 : Glowing/hot-wire based test methods — Glow-wire flammability index (GWFI) test method for materials*

NOTE : Corresponding International Standard : 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* and Amendment 1 : 2014

JIS C 60695-2-13 : 2013 *Fire hazard testing — Part 2-13 : Glowing/hot-wire based test methods — Glow-wire ignition temperature (GWIT) test method for materials*

NOTE : Corresponding International Standard : 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* and Amendment 1 : 2014

JIS C 60695-10-2 : 2018 *Fire hazard testing — Part 10-2 : Abnormal heat — Ball pressure test method*

NOTE : Corresponding International Standard : IEC 60695-10-2 : 2014 *Fire hazard testing — Part 10-2 : Abnormal heat — Ball pressure test method*

JIS C 60695-11-10 : 2015 *Fire hazard testing — Part 11-10 : Test flames — 50 W horizontal and vertical flame test methods*

NOTE : Corresponding International Standard : IEC 60695-11-10 : 2013 *Fire hazard testing — Part 11-10 : Test flames — 50 W horizontal and vertical flame test methods*

3 Terms and definitions

For the purpose of this Standard, 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 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, 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

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-100}

(This definition has been deleted in JIS since the term is not used in the main body of the corresponding International Standard.)

3.17

conductive heat ageing test, CHAT

test to evaluate a thermal-link for use in an appliance

NOTE 1 If it performs satisfactorily, the thermal-link will be assigned a CHAT rating. This rating is for end-product user consideration during the in-

vestigation of the end-use product.

NOTE 2 Annex C specifies the conductive heat ageing test.

4 General requirements

4.1 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.

4.2 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.

4.3 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. In addition, there shall be no emission of substances (e.g. gasses, liquids, dust, mist, vapour) which could cause a hazard.

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. The thermal-link shall not reclose after it has operated.

4.4 For requirements for thermal-link packaged assemblies, see Annex H.

5 General notes on tests

5.1 The test conditions are as follows.

5.1.1 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 : 8.6×10^4 Pa to 1.06×10^5 Pa.

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.

5.1.2 Where the conditions given in 5.1.1 have a significant influence, they shall be kept substantially constant during the tests.

5.1.3 If the temperature limits given in 5.1.1 are too wide for certain tests, these shall

be repeated, in case of doubt, at a temperature of $(23 \pm 1) ^\circ\text{C}$.

5.2 In every test report, the ambient temperature shall be stated. If the standard conditions for relative humidity or pressure stated in **5.1.1** are not fulfilled during the tests, a note to this effect shall be added to the report.

5.3 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.

5.4 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.

5.5 When testing a homogeneous series of thermal-links, all the tests shall be applied to thermal-links with the lowest and highest rated functioning temperatures, T_L . Thermal-links with intermediate rated functioning temperatures need only be subjected to tests according to **10.3**, **11.3**, **11.4** and **11.5**.

5.6 The number of specimens is as follows.

5.6.1 The total number of specimens required is 48. Out of a total of 48 specimens, 15 are kept as spares in case some of the tests have to be repeated. Out of a total of 48 specimens, 33 are divided into 11 groups assigned by alphabetical letters from A to K. Each group consists of three specimens. 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 Table 1.

For optional tests, additional samples should be required as per the applicable annexes.

5.6.2 If, in any of the tests carried out in accordance with any relevant test 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, as a minimum, the test sequence shall be repeated on twice the number of revised specimens, and no further failures are allowed.

If no corrective actions are necessary, the test should be repeated with double the same size and no further deviation is allowed.

5.6.3 For requirements for thermal-link packaged assemblies, see Annex H.

5.7 The conductive heat ageing test of Annex C is applicable when declared by the manufacturer.

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

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

Table 1 Test schedule

Clause or sub-clause	Test	Specimen groups										
		A	B	C	D	E	F	G	H	I	J	K
7 a)	Marking (Rub test)	×	×	—	—	—	—	—	—	—	—	—
7 a)	Marking (visual inspection only)	×	×	—	—	—	—	—	—	—	—	—
9 Constructional requirements												
9.2.2 a)	Tensile forces	×	—	—	—	—	—	—	—	—	—	—
9.2.3 a)	Thrust force	—	×	—	—	—	—	—	—	—	—	—
9.2.4 a)	Bending/twist force	—	—	×	—	—	—	—	—	—	—	—
9.6 a)	Resistance to tracking	—	—	—	—	—	—	—	—	—	—	×
9.7 a)	Creepage distances and clearances	—	—	—	—	—	×	×	—	—	—	—
9.8	Temperature and humidity cycle conditioning	×	×	×	—	—	×	×	—	—	—	—
10 Electrical requirements												
10.1	Dielectric strength (if applicable)	×	×	×	—	—	×	×	—	—	—	—
10.2	Insulation resistance (if applicable)	×	×	×	—	—	×	×	—	—	—	—
10.3	Interrupting current	—	—	—	—	—	×	×	—	—	—	—
10.4	Transient overload current	×	×	—	—	—	—	—	×	—	—	—
11 Temperature tests												
11.2	Check on T_h	—	—	—	—	—	—	—	—	—	—	×
11.3	Check on T_f	×	—	×	—	—	—	—	—	—	—	—
11.4	Check on T_m followed by dielectric test and insulation resistance	—	—	×	×	—	—	—	—	—	—	—
11.5	Ageing 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 hours	—	×	—	—	×	—	—	×	×	×	—
10.1	Dielectric strength	×	×	—	—	×	×	×	×	×	×	—
10.2	Insulation resistance	×	×	—	—	×	×	×	×	×	×	—
12 Resistance to rusting												
12 a)	Resistance to rusting (ferrous parts)	×	×	×	—	—	—	—	—	—	—	—
If the conditions of voltage, power and current in <u>10.3.2.4</u> , <u>10.3.2.6</u> and <u>10.3.2.7</u> are not covered by one test, a minimum of three samples should be tested for each condition. Note a) For homogeneous series, these tests may be omitted for intermediate ratings.												

6 Classification

6.1 Electrical conditions

With regard to electrical conditions, the following terms are used :

- a) voltage
 - 1) AC
 - 2) DC
- b) current
 - 1) resistive
 - 2) inductive
- c) motor
- d) pilot duty
- e) electric discharge lamp
- f) special

6.2 Thermal conditions

With regard to thermal conditions, the following symbols and abbreviations are used :

- a) rated functioning temperature : T_f
- b) holding temperature : T_h
- c) maximum temperature limit : T_m
- d) conductive heat ageing test : CHAT
- e) ---

6.3 Resistance to tracking

With regard to resistance to tracking, the following ranges are used :

- a) proof tracking index : 175 to 249
- b) proof tracking index : greater than or equal to 250

NOTE These ranges are based on test methods for surface tracking laid down in **JIS C 2134** : 2007.

7 Marking

7.1 Each thermal-link shall be marked with the following :

- a) type name, catalogue number or reference number;
- b) manufacturer's name or trade mark;
- c) rated functioning temperature T_f with or without the symbol T_f followed by the number of degrees Celsius (marked with °C or C);
- d) date of manufacture or date code which identifies the date of manufacture and which does not repeat for at least 10 years, and a factory location or code.

If there is only one factory, the factory location or code specified in **d)** may be omitted.

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

7.2 The rated functioning temperature T_f specified in **7.1 c)** may be omitted if a different type or catalogue reference is employed for each different functioning temperature.

7.3 Marking shall be indelible and legible.

Compliance with the requirements for indelibility of markings is checked by the test in Annex G using the apparatus shown in Figure G.1 or a manual rubbing test of similar effect. Legibility is checked by visual inspection. After the ageing tests of **11.5**, compliance is checked by visual inspection.

NOTE A “manual rubbing test of similar effect” refers to a test performed e.g. by lightly rubbing the marking for 15 s with a dampened cloth.

7.4 The marking in accordance with **a)** to **d)** in **7.1** shall be printed additionally on the packing, together with a reference to this Standard.

7.5 If the thermal-link is small in size, and not intended to be replaced, the markings in accordance with **b)** to **d)** in **7.1** shall be printed on the packaging, together with a reference to this Standard.

Compliance is checked by visual inspection.

8 Documentation

The manufacturer shall provide in the technical documentation, catalogues or instructional leaflets the following information, in addition to that required in Clause **7** :

- a) classification in accordance with Clause **6**;
- b) for each of the classifications:
 - 1) characteristic temperature : rated functioning temperature, T_f , holding temperature, T_h and maximum temperature limit, T_m
 - 2) characteristic currents : rated current, I_r , interrupting current, I_b , and transient overload current (pulse current), I_p
 - 3) rated voltage, U_r
- c) suitability for sealing in, or use with impregnating fluids or cleaning solvents;
- d) information for mounting the thermal-link in the equipment;
- e) thermal-links small in size and not intended to be replaced.

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.

- f) the position of the metal screen, if it is located at a distance other than 12.7 mm away from the live parts in the case of a thermal-link having an exposed element.

9 Constructional requirements

9.1 General

9.1.1 Thermal-links shall have adequate mechanical strength and stability so as to withstand the stresses likely to be encountered during handling, normal use and fault conditions of the relevant end-use equipment.

9.1.2 Tab terminals shall be constructed in accordance with **JIS C 2809 : 2014** and the maximum permissible temperature of the used tab materials shall be in accordance with Table A.1 of **JIS C 2809 : 2014**.

9.1.3 Current-carrying parts shall be constructed in such a way that contact pressure is not transmitted through non-metallic material other than ceramic, or any material considered as having sufficient dimensional stability over the range of temperatures to be expected, unless there is sufficient resilience in the corresponding metal parts to compensate for any shrinkage or distortion of the non-metallic material.

Current-carrying parts shall have the necessary mechanical strength, be capable of carrying the rated current, I_r , and shall be of a material that is acceptable for the particular application.

For current-carrying parts, temperature limits should be considered according to Table 13 of **JIS C 9730-1 : 2019**.

9.1.4 Friction shall not be used to secure uninsulated live parts (including terminals) to supporting surfaces if there is a risk of such parts turning or shifting their position, resulting in the reduction of creepage distances and clearances to less than those required in **9.7**. The security of contact assemblies shall be such that alignment of contacts is maintained.

9.1.5 Leads and terminal parts shall be secured so that stress on them during installation and normal use does not impair operation of the thermal-link. Thermal-links using seals with formed leads for use in appliances or components shall not be bent less than 3 mm from the thermal-link seal.

Leads may be bent less than 3 mm from the seal if :

- a) the thermal-link manufacturer's bending fixture and procedure does not transmit stress to the thermal-link operating mechanism, and if;
- b) formed test samples shall be subjected to the bending/twist lead secureness test of **9.2.4** and the rated functioning temperature test of **11.3**.

9.1.6 Thermal-links with leads smaller than 0.21 mm² shall be provided with application instructions that instruct the user how to mount the device in equipment, taking into consideration the device's temperature response. The instructions shall also include guidance on the effects that movement and vibration in the equipment may have on the thermal-link's terminals, connections and other mounting components.