

# INTERNATIONAL STANDARD

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**Automatic electrical controls -  
Part 2-9: Particular requirements for temperature sensing controls**

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IEC Secretariat  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

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### **Automatic electrical controls - Part 2-9: Particular requirements for temperature sensing controls**

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IEC 60730-2-9 has been prepared by IEC technical committee 72: Automatic electrical controls. It is an International Standard.

This fifth edition cancels and replaces the fourth edition published in 2015, Amendment 1:2018 and Amendment 2:2020. This edition constitutes a technical revision.

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

- a) adoption of IEC 60730-1:2022 with all of its significant changes to IEC 60730-1:2013, IEC 60730-1:2013/AMD1:2015 and IEC 60730-1:2013/AMD2:2020.

The text of this International Standard is based on the following documents:

Draft	Report on voting
72/1534/FDIS	72/1540/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/publications](http://www.iec.ch/publications).

This part 2-9 is intended to be used in conjunction with IEC 60730-1. It was established on the basis of the sixth edition of that standard (2022). Consideration can be given to future editions of, or amendments to, IEC 60730-1.

This part 2-9 supplements or modifies the corresponding clauses in IEC 60730-1, so as to convert that publication into the IEC standard: Particular requirements for temperature sensing controls.

Where this part 2-9 states "addition", "modification" or "replacement", the relevant requirement, test specification or explanatory matter in part 1 should be adapted accordingly.

When a particular subclause of Part 1 is not mentioned in this Part 2, that subclause applies.

In the development of a fully international standard it has been necessary to take into consideration the differing requirements resulting from practical experience in various parts of the world and to recognize the variation in national electrical systems and wiring rules.

The reader's attention is drawn to the fact that Annex R, Annex S and Annex T list all of the "in-some-country" clauses on differing practices of a less permanent nature relating to the subject of this document.

In this publication:

The following print types are used:

- requirements proper: in roman type;
- *test specifications: in italic type;*
- explanatory matter: in smaller roman type;
- Defined terms: **bold type**.

Subclauses, notes or items which are additional to those in Part 1 are numbered starting from 101, additional annexes are lettered AA, BB, etc.

A list of all parts of the IEC 60730 series, under the general title: *Automatic electrical controls*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under [webstore.iec.ch](https://webstore.iec.ch) in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

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## 1 Scope

This clause of Part 1 is replaced by the following:

This document applies to temperature sensing controls

- for use in, on, or in association with equipment for household appliance and similar use, including equipment for heating, air-conditioning and similar applications. The equipment can use electricity, gas, oil, solid fuel, solar thermal energy, etc., or a combination thereof.

NOTE 1 Throughout this document, the word "equipment" means "appliance and equipment" and "controls" means "temperature sensing controls".

- for building automation within the scope of ISO 16484 series and IEC 63044 series (HBES/BACS);

EXAMPLE 1 Independently mounted temperature sensing controls, controls in smart grid systems and controls for building automation systems within the scope of ISO 16484-2.

- for equipment that is used by the public, such as equipment intended to be used in shops, offices, hospitals, farms and commercial and industrial applications;

EXAMPLE 2 Controls for commercial catering, heating and air-conditioning equipment.

- that are **smart enabled controls**;

EXAMPLE 3 Smart grid control, remote interfaces/control of energy-consuming equipment including computer or smart phone.

- that are AC or DC powered controls with a rated voltage not exceeding 690 V AC or 600 V DC;
- used in, on, or in association with equipment that use electricity, gas, oil, solid fuel, solar thermal energy, etc., or a combination thereof;
- utilized as part of a control system or controls which are mechanically integral with multifunctional controls having non-electrical outputs;
- using NTC or **PTC thermistors** and to discrete **thermistors**, requirements for which are contained in Annex J;
- that have electrical circuits and **control** circuits which are, for example, operated by bimetals, magnet coils, memory metals, pressure elements, temperature-sensitive expansion elements or electronic elements.
- as well as manual controls when such are electrically and/or mechanically integral with automatic controls.

NOTE 2 Requirements for manually actuated mechanical switches not forming part of an automatic control are contained in IEC 61058-1-1.

This document applies to

- the inherent safety of automatic electrical controls, and
- functional safety of temperature **sensing controls** and safety related systems,
- controls where the performance (for example the effect of EMC phenomena) of the product can impair the overall safety and performance of the controlled system,
- the operating values, operating times, and operating sequences where such are associated with equipment safety and to the testing of automatic electrical temperature **sensing control** devices used in, or in association with, equipment,

EXAMPLE 4 **Boiler thermostats, fan controls, temperature limiters** and **thermal cut-outs**.

- electrical safety of temperature sensing controls with non-electrical outputs such as refrigerant flow and gas **controls**,
- **single-operation devices** as defined in this document.

This document specifies the requirements for construction, operation and testing of automatic electrical controls used in, on, or in association with an equipment.

This document does not

- apply to automatic electrical temperature **sensing controls** intended exclusively for industrial process applications unless explicitly mentioned in the relevant part 2 or the equipment standard. However, this document can be applied to evaluate automatic electrical controls intended specifically for industrial applications in cases where no relevant safety standard exists.
- take into account the response value of an automatic action of a control, if such a response value is dependent upon the method of mounting the control in the equipment. Where a response value is of significant purpose for the protection of the user, or surroundings, the value defined in the appropriate equipment standard or as determined by the manufacturer will apply.
- address the integrity of the output signal to the network devices, such as interoperability with other devices unless it has been evaluated as part of the control system.

## 2 Normative references

This clause of Part 1 is applicable except as follows:

*Addition:*

IEC 60216-1, *Electrical insulating materials - Thermal endurance properties - Part 1: Ageing procedures and evaluation of test results*

## 3 Terms and definitions

This clause of Part 1 is applicable except as follows:

### 3.2 Definitions of types of controls according to purpose

*Additional definitions:*

#### 3.2.101

**single-operation device**

**SOD**

**control** having a temperature **sensing element** which is intended to operate only once and then requires complete replacement

#### 3.2.102

**bimetallic single-operation device**

**single-operation device (SOD)** having a bimetallic temperature **sensing element**

Note 101 to entry: A **bimetallic single-operation device (SOD)** does not reset above a declared temperature (see 9.4.103).

Note 102 to entry: Requirements for thermal links (which are not allowed to reset) are contained in IEC 60691.

**3.2.103****non-bimetallic single-operation device**

**single-operation device (SOD)** having a temperature **sensing element** which is part of a combination action **control**, the **operation** of which cannot be separated from other functions of the **control** and having a non-bimetallic thermal element that operates only once and then needs complete or partial replacement

Note 101 to entry: When such parts can be tested separately, they are considered to be thermal links within the scope of IEC 60691.

Note 102 to entry: The ageing period and thermal response of the device is dependent on the intended use of the device. As a result, the nature of the testing applicable to the device is representative of the application conditions for which the **protective control** is intended (see 7.2).

Note 103 to entry: **Non-bimetallic SODs** provide the equivalent of **micro-disconnection**.

**3.2.104****room thermostat**

independently mounted or incorporated **thermostat** intended to control the temperature of habitable space

**3.2.105****boiler thermostat**

**thermostat** intended to control boiler/liquid temperature

**3.2.106****voltage maintained thermal cut-out**

**thermal cut-out** which is maintained in its operated condition by the voltage which appears across it in that condition

Note 101 to entry: A **voltage maintained thermal cut-out** control can only be reset if disconnected from the electrical supply.

**3.2.107****agricultural thermostat**

**thermostat** intended for use in **agricultural confinement buildings**

**3.2.108****agricultural confinement building**

farm structure characterized by being heated and/or cooled by artificial means, where accumulation of animal food and waste can result in concentrations of corrosive compounds not normally found in freely ventilated farm buildings (e.g. barns) and periodically disinfected prior to subsequent similar use

**3.3 Definitions relating to the function of controls**

*Additional definition:*

**3.3.101****time factor**

transient response of temperature **sensing controls** by defined change of the **activating quantity**

**3.5 Definitions of types of control according to construction**

*Additional definitions:*

**3.5.101****push-and-turn actuation**

**two-step actuation** accomplished by first pushing, then rotating the **actuating member** of the control

**3.5.102****pull-and-turn actuation**

**two-step actuation** accomplished by first pulling, then rotating the **actuating member** of the control

**3.101****permanent operation**

continuous monitoring of the protective function during the **operation** of the appliance or system for longer than 24 h

Note 101 to entry: 24 h is considered the typical time interval between a first and a second **fault**.

**3.102****non-permanent operation**

continuous monitoring of the protective function during the **operation** of the appliance or system for less than 24 h

Note 101 to entry: 24 h is considered the typical time interval between a first and a second **fault**.

**4 General**

This clause of Part 1 is applicable except as follows:

**4.2 General requirements**

*Additional note:*

NOTE 101 Annex EE can be used as a guide for selecting and carrying out relevant tests as well as establishing test levels and compliance criteria.

**4.3 General notes on tests****4.3.2 Conditions of test**

*Additional subclauses:*

**4.3.2.101** For the purposes of the tests of this document and unless otherwise indicated, ambient temperature excursions beyond  $T_{\max}$  during abnormal **operation** as a precursor to the **operation** of a manual reset **thermal cut-out** or a **bimetallic SOD** are ignored.

**4.3.2.102** For manual reset **thermal cut-outs** and **bimetallic SODs** which have an **operating value** above  $T_{\max}$ , the temperature at the **sensing element** is raised, as necessary, to achieve any cycling required during the tests.

**4.3.3 Samples required****4.3.3.1 Addition:**

Six samples of **bimetallic SODs** are used for the test of Clause 17 and a further six for the test of Clause 19.

## 5 Required technical information

This clause of Part 1 is applicable except as follows:

### 5.2 Methods of providing technical information

**Table 1 – Required technical information and methods of providing these information**

	Information	Clause or subclause	Method
<i>Additional items:</i>			
101	Maximum <b>sensing element</b> temperature (other than relevant to requirement 105) <sup>101</sup> Controls for use in or on cooking appliances Controls for use in or on ovens of the self-cleaning type Controls for use in or on food-handling appliances Controls having parts containing liquid metal	16.101	X
102	<b>Time factor</b> with or without sheath	3.3.101 9.101 BB.2.2	X
103	<b>SOD</b> reset temperature (either –35 °C or 0 °C)	3.2.101 9.4.103 19.15.106.1.2	X
104	Number of cycles for <b>bimetallic SOD</b> with 0 °C reset	19.15.106.1.5	X
105	Maximum <b>sensing element</b> temperature in °C of controls used in self-cleaning ovens ( $T_e$ )	19.15.104	D
106	<b>Controls</b> having parts containing liquid metal <sup>102</sup>	20.102	D
107	Tensile yield strength	9.1.101	X
108	Minimum current for the purpose of the test of 23.2.2 <sup>103</sup>	23.2.2	D
109	$T_{max.1}$ is the maximum ambient temperature in which the <b>control</b> may remain continuously in the operated condition so that Table 17 temperatures are not exceeded <sup>104</sup>	16.4.101	D
110	Time period $t_1$ is the maximum time during which the ambient temperature can be higher than $T_{max.1}$ after the <b>control</b> has operated <sup>104</sup>	16.4.101	D
111	Temperature limit above which automatic reset of a manual reset thermal cut-out or a <b>voltage maintained thermal cut-out</b> shall not occur (not higher than –20 °C)	3.2.106 9.4.106 19.15.105	X
112	For type 2.P <b>controls</b> , the method of test	19.101	X
113	The click rate $N$ or switching <b>operations</b> per minute for the purposes of testing to CISPR 14-1	23	X
114	Rated functioning temperature ( $T_f$ ) <sup>107</sup> of the <b>sensing element</b> , which causes a <b>non-bimetallic SOD</b> to change state of conductivity	19.15.106.2	C
115	Ageing temperature for <b>non-bimetallic SOD</b> <sup>105,107</sup>	19.15.106.2.2	D
116	Rate of rise of temperature for testing <b>non-bimetallic SOD</b> <sup>106,107</sup>	19.15.106.2.2	D
117	<b>Agricultural thermostat</b>	3.2.107 9.4.107 9.6.3.101 Annex DD	D

<i>Additional footnotes:</i>	
101	This declaration applies only to temperature sensing controls containing liquid metal. For temperature <b>sensing controls</b> used in or on self-cleaning ovens, this declaration is the temperature for the cooking <b>operation</b> .
102	Metal is an inclusive term that encompasses chemically metallic elements such as sodium (Na), potassium (K), and others. Mercury (Hg) is generally not allowed.
103	When no minimum is declared, the test value is 15 mA.
104	Consideration should be given to the provision of information by the <b>equipment manufacturer</b> relating to the minimum time that the appliance has to be disconnected from the supply to allow a <b>voltage maintained thermal cut-out</b> to reset.
105	Determined by the <b>control manufacturer</b> based on the opening temperature of the <b>thermal-cut-out</b> .
106	Determined by the <b>control manufacturer</b> referring to the actual maximum rate of rise probable in the projected end-use equipment.
107	<b>Non-bimetallic SODs</b> are limited for use in appliances for heating or employing liquids or steam. They are not suitable for instantaneous water heaters and storage water heaters

### 5.3 Class II symbol

#### 5.3.1 Addition:

The symbol for class II shall be used on controls of class II integrated or incorporated in an assembly utilizing a non-electrical energy source.

## 6 Protection against electric shock

This clause of Part 1 is applicable.

## 7 Provision for protective earthing

This clause of Part 1 is applicable.

## 8 Terminals and terminations

This clause of Part 1 is applicable.

## 9 Constructional requirements

This clause of Part 1 is applicable except as follows:

### 9.1 Materials

*Additional subclauses:*

#### 9.1.101 Parts containing liquid metal

**Controls** containing liquid metal declared under Table 1, requirement 106, and parts of any **control** that contain sodium (Na), potassium (K), or both, shall be constructed of metal that has a tensile yield strength at least four times the circumferential (hoop) or other stress on the parts at 1,2 times the maximum temperature of the **sensing element** ( $T_e$ ) in °C.

*Compliance is checked by inspection of the manufacturer's declaration and by the test of 20.102.*

### 9.1.102 Material for non-bimetallic SODs

Insulating material used in **non-bimetallic SODs** as defined in this document shall comply with the requirements of IEC 60216-1 and be suitable for the application.

## 9.3 Actuation and operation

### 9.3.9 Pull-cord actuated control

*Additional note:*

NOTE 101 The Note is not applicable to **controls** classified as type 1.X or 2.X or type 1.Z or 2.Z.

## 9.4 Actions

### 9.4.3 Type 2 action

*Addition:*

Capacitors shall not be connected across the contacts of a thermal cut-out.

Constructions requiring a soldering operation to reset thermal cut-outs are not permitted.

**9.4.11 Type 1.H or 2.H action (a trip-free mechanism in which the contacts cannot be prevented from opening and which can automatically be reset to the "closed" position after normal operation conditions have been restored if the reset means is held in the "reset" position)**

*Modification:*

Replace the compliance criteria with the following:

*Compliance is checked by inspection and by the tests as given in 9.4.11.101 to 9.4.11.106.*

*Additional subclauses:*

**9.4.11.101** For this test, the reset mechanism of the **control** will be held in the reset position for the duration of the test from 9.4.11.102 to 9.4.11.104. The verification of the automatic non-resetting above  $-35\text{ °C}$  will be carried out by 9.4.11.105 to 9.4.11.106. For **SOD**, the verification of the automatic non-resetting above either  $+0\text{ °C}$  or  $-35\text{ °C}$  will be carried out by 9.4.11.105 to 9.4.11.106, as declared in item 103 of Table 1.

**9.4.11.102** With the reset mechanism held in the reset position at room temperature, continuity across contacts is observed by a low-energy circuit, 0,05 A maximum.

**9.4.11.103** The **control's sensing element** is then installed in an air circulating chamber or a liquid bath and the **control's switch head** is installed as in 16.5 a). When the whole control is declared as the **sensing element**, the whole control is placed in an air-circulating chamber. The **control** or the **control's sensing element** is adjusted for the maximum set point temperature. The chamber or liquid bath temperature shall be determined by positioning a thermocouple wire adjacent to the **control** under test. The chamber or liquid bath temperature is then raised from room temperature and held at approximately 10 K below the set point until temperatures stabilize. The chamber or liquid bath temperature is then raised at a rate of not more than 0,5 K per minute until the contact operates. Indication of contact separation is observed by applying the method of 9.4.11.104.

**9.4.11.104** After the **control** has operated and with the reset mechanism still held in the reset position, the temperature of the chamber or liquid bath is then reduced to determine if the **control** automatically resets. Verification of contact closure is done by applying the method in 9.4.11.102.

**9.4.11.105** The whole **control** or the **control's** sensing element is then installed in an air circulating chamber or liquid bath again and the **control's** **switch head** (if applicable) is installed as in 16.5 a) with the reset mechanism in its normal condition. The chamber or liquid bath temperature shall be determined by positioning a thermocouple wire adjacent to the control under test. The chamber or liquid bath temperature is raised from room temperature and held at approximately 10 K below the set point until temperatures stabilize. The chamber or liquid bath temperature is then raised at a rate of not more than 0,5 K per minute until the contact operates. Indication of contact separation is observed by applying the method of 9.4.11.102.

**9.4.11.106** After the **control** has operated, the temperature of the chamber is allowed to cool down to either +0 °C or –35 °C. Indication of contact separation is observed by applying the method of 9.4.11.102.

**9.4.12 Type 1.J or 2.J action (a trip-free mechanism in which the contacts cannot be prevented from opening and the control is not permitted to function as an automatic reset device if the reset means is held in the "reset" or "on" position)**

*Modification:*

Replace the compliance criteria with the following:

*Compliance is checked by inspection and by the tests as given in 9.4.12.101 to 9.4.12.106.*

*Additional subclauses:*

**9.4.12.101** For this test, the reset mechanism of the **control** will be held in the reset position for the duration of the test from 9.4.12.102 to 9.4.12.104. The verification of the automatic non-resetting above –35 °C will be carried out by 9.4.12.105 to 9.4.12.106. For **SOD**, the verification of the automatic non-resetting above either +0 °C or –35 °C will be carried out by 9.4.12.105 to 9.4.12.106, as declared in item 103 of Table 1.

**9.4.12.102** With the reset mechanism held in the reset position at room temperature, contact separation is observed by a low-energy circuit, 0,05 A maximum.

**9.4.12.103** The **control's** **sensing element** is then installed in an air circulating chamber or liquid bath and the **control's** **switch head** is installed as in 16.5. When the whole control is declared as the **sensing element**, the whole **control** is placed in an air-circulating chamber. The control or the **control's** **sensing element** is adjusted for the maximum set point temperature. The chamber or liquid bath temperature shall be determined by positioning a thermocouple wire adjacent to the control under test. The chamber or liquid bath temperature is raised from room temperature and held at approximately 10 K below the set point until temperatures stabilize. The chamber or liquid bath temperature is then raised at a rate of not more than 0,5 K per minute until 10 K over the operation temperature. Indication of contact separation is still observed by applying the method of 9.4.12.102.

**9.4.12.104** After the **control** has operated and with the reset mechanism still held in the reset position, the temperature of the chamber or liquid bath is then reduced to determine if the control automatically resets. Verification of contact closure is done by applying the method in 9.4.12.102.