

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Automatic electrical controls for household and similar use –
Part 2-9: Particular requirements for temperature sensing controls**

**Dispositifs de commande électrique automatiques à usage domestique et
analogue –
Partie 2-9: Règles particulières pour les dispositifs de commande
thermosensibles**

WITKO2011



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

AUTOMATIC ELECTRICAL CONTROLS FOR HOUSEHOLD AND SIMILAR USE –

Part 2-9: Particular requirements for temperature sensing controls

FOREWORD

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International Standard IEC 60730-2-9 has been prepared by IEC technical committee 72: Automatic controls for household use.

This third edition cancels and replaces the second edition published in 2000, its Amendment 1 (2002) and Amendment 2 (2004) and constitutes a technical revision.

This edition of IEC 60730-2-9 contains a new Annex EE, which is an informative guide to the application of temperature sensing controls. Additionally, a new requirement to 17.3.1 (there is an error in the FDIS document - 17.7.3 should be 17.3.1) was added to address the endurance requirement for temperature sensing devices where the whole control is declared as the sensing element for ambient temperatures below 0° C. This document contains also some editorial changes due to new editions of referenced standards.

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

FDIS	Report on voting
72/763/FDIS	72/767/RVD

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

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

This Part 2-9 is intended to be used in conjunction with IEC 60730-1. It was established on the basis of the third edition of that standard (1999) and its Amendment 1 (2003) and Amendment 2 (2007). Consideration may 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.

Where no change is necessary, this Part 2-9 indicates that the relevant clause or 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 "in some countries" notes regarding differing national practice are contained in the following subclauses:

- 4.1.101
- Table 7.2, note 102
- 11.4.3.101
- 11.4.101
- 11.101
- 12.101.3
- 13.2
- 17.8.4.101
- 17.15.1.3
- 17.15.1.3.1
- 17.16.101
- 17.16.105
- 18.102.3
- 23.101
- Annex AA
- CC.2
- DD.9.2
- EE.3.6

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.

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 for household and similar use*, can be found on the IEC website.

The committee has decided that the contents of this 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.

Withdrawn

AUTOMATIC ELECTRICAL CONTROLS FOR HOUSEHOLD AND SIMILAR USE –

Part 2-9: Particular requirements for temperature sensing controls

1 Scope and normative references

This clause of Part 1 is applicable except as follows:

1.1 Replacement:

This part of IEC 60730 applies to automatic electrical temperature sensing controls for use in, on or in association with equipment for household and similar use, including electrical controls for heating, air-conditioning and similar applications. The equipment may use electricity, gas, oil, solid fuel, solar thermal energy, etc., or a combination thereof.

1.1.1 Replace the explanatory matter with the following new explanatory matter:

Examples of such controls include boiler thermostats, fan controls, temperature limiters and thermal cut-outs.

Throughout this standard, the word "equipment" includes "appliance" and "control system".

1.1.2 Replacement:

This standard also applies to the electrical safety of temperature sensing controls with non-electrical outputs such as refrigerant flow and gas controls.

1.1.3 Not applicable.

Additional subclause:

1.1.101 This standard applies to single operation devices as defined in this standard.

1.5 Normative references

Addition:

IEC 60335 (all parts), *Household and similar electrical appliances – Safety*

IEC 60691:2002, *Thermal links – Requirements and application guide*
Amendment 1 (2006)

IEC 60730-2-4, *Automatic electrical controls for household and similar use – Part 2-4:
Particular requirements for thermal motor protectors for motor-compressors of hermetic and semi-hermetic type*

2 Definitions

This clause of Part 1 is applicable except as follows:

2.2 Definitions of types of control according to purpose

2.2.19

operating control

Add, to the definition, the following explanatory paragraph:

In general, a thermostat is an operating control.

2.2.20

protective control

Add, to the definition, the following explanatory paragraph:

In general, a thermal cut-out is a protective control.

Additional definitions:

2.2.101

single operation device

SOD

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

2.2.101.1

bimetallic single operation device

single operation device having a bimetallic temperature sensing element

NOTE 1 A bimetallic single operation device does not reset above a declared temperature (see 11.4.103).

NOTE 2 Requirements for thermal links (which are not allowed to reset) are contained in IEC 60691.

2.2.101.2

non-bimetallic single operation device

part of a control the operation of which cannot be separated from other functions of the control and having a non-bimetallic sensing element that operates only once and then requires complete or partial replacement

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

2.2.101.2.1

rated functioning temperature

T_f

temperature of the sensing element of a non-bimetallic SOD which causes it to change the state of conductivity of the control when measured under specified conditions as declared by the manufacturer

2.2.101.2.2

holding temperature

T_c

maximum temperature of the sensing element of a non-bimetallic SOD at which it will not cause the control to change its state of conductivity during a specified time under specified conditions as declared by the manufacturer

2.2.101.2.3**maximum temperature limit** T_m

temperature of the sensing element of a non-bimetallic SOD, stated by the manufacturer, up to which the mechanical and electrical properties of the control having changed its state of conductivity will not be impaired for a given time

2.2.102**room thermostat**

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

2.2.103**fan control**

automatic temperature sensing control intended to control the operation of a fan or blower

2.2.104**boiler thermostat**

thermostat intended to control boiler/liquid temperature

2.2.105**modulating thermostat**

thermostat which controls the temperature between two limits by continuously controlling the input to the load

2.2.106**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

2.2.107**agricultural thermostat**

a thermostat intended for use in agricultural confinement buildings

2.3 Definitions relating to the function of controls**2.3.14 Additional definition:****2.3.14.101****time factor**

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

2.5 Definitions of types of control according to construction

Additional definitions:

2.5.101**push-and-turn actuation**

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

2.5.102**pull-and-turn actuation**

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

3 General requirements

This clause of Part 1 is applicable.

4 General notes on tests

4.1 Conditions of test

This clause of Part 1 is applicable except as follows:

4.1.7 Not applicable.

Additional subclauses:

4.1.101 For the purposes of the tests of this standard 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.

In Canada and the USA, the preceding applies only to bimetallic SODs.

4.1.102 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.

4.2 Samples required

4.2.1 Addition:

Six samples of bimetallic SODs are used for the test of Clause 15.

Additional samples are required for the tests of Clause 17.

5 Rating

This clause of Part 1 is applicable.

6 Classification

This clause of Part 1 is applicable except as follows:

6.4 According to features of automatic action

6.4.3 Additional subclauses:

6.4.3.101 – for sensing actions, no increase in the operating value as a result of any leakage from the sensing element, or from parts connecting the sensing element to the switch head (Type 2.N);

6.4.3.102 – an action which operates after a declared thermal cycling test as specified in 17.101 (Type 2.P);

In general, thermal cut-outs for specific applications, such as pressurized water heating systems, may be classified as having Type 2.P action.

6.4.3.103 – an action which is initiated only after a push-and-turn or pull-and-turn actuation and in which only rotation is required to return the actuating member to the off or rest position (Type 1.X or 2.X);

6.4.3.104 – an action which is initiated only after a push-and-turn or pull-and-turn actuation (Type 1.Z or 2.Z);

6.4.3.105 – an action which cannot be reset under electrically loaded conditions (Type 1.AK or 2.AK);

6.4.3.106 – an action which operates after declared agricultural environmental exposures (Type 1.AM or 2.AM).

6.7 According to ambient temperature limits of the switch head

Additional subclauses:

6.7.101 Controls for use in or on cooking appliances.

6.7.102 Controls for use in or on ovens of the self-cleaning type.

6.7.103 Controls for use in or on food-handling appliances.

6.8.3 Modification:

Replace the first paragraph by:

For an in-line cord control, a free standing control, an independently mounted control or a control integrated or incorporated in an assembly utilizing a non-electrical energy source:

6.15 According to construction

Additional subclause:

6.15.101 – controls having parts containing liquid metal.

7 Information

This clause of Part 1 is applicable except as follows:

7.2 Methods of providing information

Table 7.2

Addition:

Information		Clause or subclause	Method
101	Maximum sensing element temperature (other than relevant to Item 105) ¹⁰¹⁾	6.7 6.15 14.101	X
102	Time factor with or without sheath ref.	2.3.14.101 11.101 BB.1.2	X
103	SOD reset temperature (either –35 °C or 0 °C)	2.2.101 11.4.103	X
104	Number of cycles for bimetallic single-operation devices with 0 °C reset	17.15.1.3.1	X
105	Maximum sensing element temperature for the test of 17.16.107 (T_e)	6.7.102 17.16.107	D
106	Controls having parts containing liquid metal ¹⁰²⁾	6.15.101 11.1.101 18.102	D
107	Tensile yield strength	11.1.101	X
108	Minimum current for the purpose of the test of 23.101 ¹⁰³⁾	23.101	D
109	$T_{max,1}$ is the maximum ambient temperature in which the control may remain continuously in the operated condition so that Table 14.1 temperatures are not exceeded ¹⁰⁵⁾	14.4.3.1	D
110	Time period, t_1 , is the maximum time during which the ambient temperature can be higher than $T_{max,1}$ after the control has operated ¹⁰⁵⁾	14.4.3.1	D
111	Temperature limit above which automatic reset of a manual reset thermal cut-out or a voltage maintained thermal cut-out shall not occur (not higher than –20 °C)	2.2.105 11.4.106 17.16.104.1 17.16.108	X
112	For Type 2.P controls, the method of test	17.101	X
113	The click rate N or switching operations per minute for the purposes of testing to CISPR 14-1	23	X
114	Rated functioning temperature (T_f)	2.2.101.2.1 17.15.2	C
115	Holding temperature (T_c)	2.2.101.2.2 17.15.2	D
116	Maximum temperature limit (T_m)	2.2.101.2.3 17.15.2	D
117	Agricultural thermostat	2.2.107 6.4.3.106 11.4.107 11.6.3.101 Annex DD	D
NOTES <i>Additional notes</i> 101) This declaration applies only to temperature sensing controls containing liquid metal. For temperature sensing controls used in or on self-cleaning ovens, this declaration is the temperature for the cooking operation. 102) In China, the use of liquid metal in or on cooking or food-handling equipment is not allowed. In Germany, controls using liquid metal are allowed only with a special marking on the control. Documentation (D) shall contain a clear warning of the actual danger that may occur. The following symbol shall be used for marking the control:  103) When no minimum is declared, the test value is 15 mA. 105) Consideration should be given to the provision of information by the equipment manufacturer relating to the minimum time that the appliance has to be disconnected from the supply to allow a voltage maintained thermal cut-out to reset.			

8 Protection against electric shock

This clause of Part 1 is applicable.

9 Provision for protective earthing

This clause of Part 1 is applicable.

10 Terminals and terminations

This clause of Part 1 is applicable.

11 Constructional requirements

This clause of Part 1 is applicable except as follows:

11.1 Materials

Additional subclause:

11.1.101 Parts containing liquid metal

For controls declared under Item 106 of Table 7.2, parts that contain mercury (Hg), 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 a temperature 1,2 times the maximum temperature of the sensing element (T_e).

Compliance is checked by inspection of the manufacturer's declaration and by the test of 18.102.

11.3 Actuation and operation

11.3.9 Pull-cord actuated control

Addition:

The second explanatory paragraph is not applicable to controls classified as Type 1.X or 2.X or Type 1.Z or 2.Z.

11.4 Actions

11.4.3 Type 2 action

Additional subclauses:

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

In Canada and the USA, a capacitor may not be connected across the contacts of a control with a Type 2 action.

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

11.4.13 Replacement:

11.4.13 Type 2.K action

Additional subclauses:

11.4.13.101 A Type 2.K action shall be so designed that in the event of a break in the sensing element, or in any other part between the sensing element and the switch head, the declared disconnection or interruption is provided before the sum of the declared operating value and drift is exceeded.

Compliance is checked by breaking the sensing element. The breaking may be achieved by partly pre-cutting or filing through.

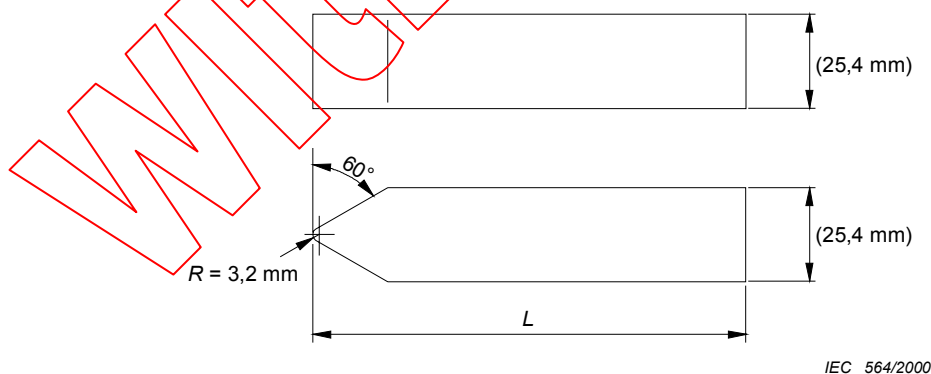
The temperature sensing control is heated to within 10 K of the operating temperature and the temperature then increased at a rate not to exceed 1 K/min. The contacts shall open before the sum of the declared operating value plus drift is exceeded.

11.4.13.102 Type 2.K action may also be achieved by compliance with a) b) or c).

- a) Two sensing elements operating independently from each other and actuating one switched head.
- b) Bimetallic sensing elements with
 - 1) exposed elements attached with at least double spot welding of the bimetal at both of its ends, or
 - 2) elements so located or installed in a control of such construction that the bimetal is not likely to be physically damaged during installation and use.
- c) If the loss of the fluid fill causes the contacts of the control to remain closed or leakage causes upward shift beyond the declared maximum operating temperature, the bulb and capillary of a temperature sensing control which is actuated by a change in the pressure of a fluid confined in the bulb and capillary shall conform to the following.

There shall be no damage to the bulb or capillary to the extent which will permit escape of any of the fill when an impact tool, as illustrated in Figure 11.4.13.102, is dropped once from a height of 0,60 m so that the tapered end of the tool strikes the bulb or capillary in a perpendicular position. For this test, the capillary or the bulb shall be on a concrete surface.

If the capillary is provided with a separate shroud or sleeve, it is to be left in place during the test described above.



Material: Steel, CRS, Break all corners

L to be sized to obtain total mass of 0,454 kg

Figure 11.4.13.102 – Impact tool

Additional subclauses:

11.4.101 Type 2.N action

A Type 2.N action shall be so designed that in the event of a leak in the sensing element, or in any other part between the sensing element and the switch head, the declared disconnection or interruption is provided before the sum of the declared operating value and drift is exceeded.

Compliance is checked by the following test:

The operating value of a Type 2.N control is measured under the conditions of Clause 15 of Part 1. If the control has means for setting, it is set to the highest value.

After this measurement, a hole is artificially produced in the sensing element and the measurement of the operating value is repeated.

No positive drift is allowed above the declared value.

The test can be replaced by theoretical computations of the physical mode of operation.

A separate shroud or sleeve may be employed for protection of the bulb and capillary to achieve conformance with Clause 18.

In Canada and the USA, a Type 2.N action is checked by item c) of 11.4.13.102.

11.4.102 Type 2.P action

A Type 2.P action shall be so designed that it operates in its intended manner after a thermal cycling test.

Compliance is checked by the test of 17.101.

11.4.103 Bimetallic single-operation device

A bimetallic single-operation device shall be so designed that it does not reset above the reset value declared in Table 7.2, Item 103.

Compliance is checked by the test of 17.15.

11.4.104 Type 1.X or 2.X

A Type 1.X or 2.X action shall be so designed that a turn action can only be accomplished after the completion of a push action or a pull action. Only rotation shall be required to return the actuating member of the control to the off or rest position.

Compliance is checked by the tests of 18.101.

11.4.105 Type 1.Z or 2.Z

A Type 1.Z or 2.Z action shall be so designed that a turn action can only be accomplished after the completion of a push action or a pull action.

Compliance is checked by the tests of 18.101.

11.4.106 Voltage maintained thermal cut-out

A voltage maintained thermal cut-out shall be so designed that it does not reset above the reset value declared in Table 7.2, Item 111.

11.4.107 Type 1.AM or 2.AM

A Type 1.AM or 2.AM action shall be so designed that it operates in its intended manner after the declared agricultural environmental exposures.

Compliance is checked by the tests of Annex DD.

11.6 Mounting of controls

11.6.3 Mounting of independently mounted controls

Additional subclause:

11.6.3.101 For agricultural thermostats declared in Table 7.2, Item 117, the mounting method shall be such that the integrity of the protection by the enclosure is not compromised.

Additional subclause:

11.101 Time factor

If a time factor is declared, this shall be checked by one of the applicable determining methods as indicated in Annex BB. The determined value shall not exceed the rated values. See Table BB.1.

In Germany, for temperature sensing controls intended to control boiler water or flue gas temperature in heat generating systems, the maximum values of time factor given in Table BB.1 shall not be exceeded.

12 Moisture and dust resistance

This clause of Part 1 is applicable except as follows:

Additional subclauses:

12.101 Refrigeration controls

Controls which have the switch head and sensing element mounted in the evaporator of refrigeration or similar equipment, producing conditions of overtemperature and of freezing and melting, shall maintain insulation integrity.

12.101.1 *Compliance is checked by the following tests.*

12.101.2 *Controls which use a potting compound are given a softening test. Two samples are heated in a heating chamber at 15 K above the maximum declared operating temperature for 16 h with the potting surface in the most unfavourable position. The potting material shall not unduly soften or distort, crack or deteriorate.*

12.101.3 *The two samples used for the softening tests and one untested sample (three total) are placed in water maintained at $(90 \pm 5)^\circ\text{C}$ for 2 h. The three samples are then immediately transferred to water at a temperature of below 5°C and then frozen in a small, flexible container at -35°C for 2 h. Ten heating-freezing cycles are required.*

In Canada and the USA, if the contact mechanism of defrost controls has the creepage distances and clearances required for refrigeration controllers, one cycle only of heating and freezing is required, otherwise 10 cycles are required.

12.101.4 *Two consecutive heating-freezing cycles are performed in one working day, and then 10 cycles are completed in five consecutive days, with the samples left in water at room temperature for four overnight periods.*

12.101.5 After the last freezing test, the samples are thawed to approximately room temperature in water and the insulation resistance is measured from current-carrying parts to grounded parts and to the surface of potting and/or insulating material; the direct current voltmeter method is used. Insulation resistance shall be at least 50 000 Ω .

12.101.6 While the samples are still moist, a voltage equal to $(2 \times V_R) + 1\,000\text{ V}$ is applied at rated frequency for 1 min between current-carrying parts and grounded parts and the surface of the potting and/or insulating material. No flashover or breakdown of insulation shall occur during the test.

13 Electric strength and insulation resistance

This clause of Part 1 is applicable except as follows:

13.2 Electric strength

Addition:

In Canada and the USA, an independently mounted room thermostat for operation over 50 V, intended for direct control of electric space-heating equipment, shall withstand for 1 min without breakdown, the application of alternating potential of 900 V between the line and load terminals. A piece of insulating material may be placed between the thermostat contacts during the test. There shall be no breakdown either through or across the insulating material supporting the contact and terminal assemblies. This control shall be the control that is designated as "SAMPLE 1" under the tests for compliance in 17.16.102.1 of this standard.

14 Heating

This clause of Part 1 is applicable except as follows:

14.4.3.1 The second paragraph is under consideration.

Addition:

For a voltage maintained thermal cut-out, the heating test of 14.4.3.1 is completed, after which the temperature of the sensing element is raised until the contacts open. At this time, the ambient temperature surrounding the sensing element is reduced to $T_{\max,1}$ in time period t_1 , at a uniform rate. The test of 14.5.1 is then completed.

Table 14.1 Note 13) is under consideration.

Additional subclauses:

14.101 The following is applicable to controls classified under 6.7.101 to 6.7.103 inclusive.

14.101.1 As a means of complying with Note 12) of Table 14.1, if the temperature of insulating parts exceeds that permitted in Table 14.1, then the test of 17.16.101 may be conducted after the conditioning of 14.102 and 14.102.1.

14.102 A previously untested sample of the control is conditioned for 1 000 h in an oven maintained at a temperature between $1,02 T_1 + 20\text{ K}$ and 1,05 times that temperature where T_1 is the maximum measured temperature on the insulating part during the test of Clause 14. The control shall not be energized during this test.

14.102.1 If the elevated temperature is localized, such as at or near a terminal, the 1 000 h conditioning is conducted with the control between $T_{\max}$ and $T_{\max} + 5\%$ for normal conditions, but with the contacts closed and non-cycling. If necessary, the contacts may be forced closed to provide the most arduous temperature conditions. A bimetal heater across the mains is energized at 1,1 times rated voltage. A series bimetal heater shall conduct at 1,1 times rated current.

15 Manufacturing deviation and drift

This clause of Part 1 is applicable except as follows:

15.1 Addition:

The values of manufacturing deviation and drift shall be according to Annex AA unless otherwise declared by the manufacturer.

The explanatory matter is not applicable.

15.4 Addition:

Alternatively, the declared manufacturing deviation and drift may be expressed separately as a tolerance value to the declared operating value.

15.5.3 Additional subclauses:

15.5.3.101 *Controls intended for setting by the user shall be set at the maximum operating temperature unless otherwise declared by the manufacturer.*

15.5.3.102 *Controls utilizing a bimetallic or similar sensing mechanism or that portion of a control intended to be exposed to a controlled ambient shall be placed in a circulating air oven to determine the operating value.*

15.5.3.103 *For bimetallic and similar type controls, the temperature shall be determined by mounting a 0,25 mm thermocouple wire to the sensing portion of an identical control not electrically connected and mounted adjacent to the control under test in a circulating air oven.*

15.5.3.104 *For fluid expansion type controls, a maximum 0,25 mm thermocouple shall be attached to the sensing portion, using a suitable adhesive.*

15.5.3.105 *For fluid expansion or contraction type controls, the complete control or, if so intended in use, the bulb portion, or that length of a sensing portion of a control declared by the manufacturer as being a minimum sensing dimension shall be placed in either a circulating air oven or a liquid bath.*

15.5.3.106 *The temperature of the oven or bath may be rapidly increased to 10 K below or decreased to 10 K above the expected operating temperature of the control until conditions of equilibrium have been achieved. The rate of temperature change shall then be reduced to a maximum of 0,5 K/min or to the declared rate of change, whichever is the lowest.*

15.5.3.107 *The operation of the control shall be sensed by a suitable device with a sensing current not exceeding 0,05 A.*

The circuit voltage may be any convenient value that will give reliable indication of the function being monitored.

15.5.3.108 *The operating value of the control shall be recorded.*

15.5.3.109 *For bimetallic SODs, after the contacts have operated, satisfactory disconnection is determined by subjecting each bimetallic SOD device to the voltage specified in Table 13.2, with no prior humidity treatment.*

15.5.4 and 15.5.5 Not applicable.

15.5.6 Addition:

Alternatively, the manufacturing deviation shall be according to Annex AA.

16 Environmental stress

This clause of Part 1 is applicable except as follows:

Addition:

This clause is not applicable to SODs.

17 Endurance

This clause of Part 1 is applicable except as follows:

17.3.1 Addition:

- for controls in which the whole control is declared as the sensing element and for which the minimum operating temperature declared in Table 7.2, Item 48, is less than 0 °C, the test of Subclause 17.8 is carried out on a further set of three samples at the minimum declared operating temperature with a tolerance of +5 K, –0 K, the number of cycles being 5 % of the number declared in Table 7.2, Item 27.

17.8.4 Additional subclause:

17.8.4.101 *The number of automatic and manual cycles for independently mounted and in-line cord controls shall be as indicated in Clause CC.1, unless a higher number is declared by the manufacturer.*

In Canada and the USA, the number of cycles is as indicated in Clause CC.2.

17.15 *This subclause of Part 1 is replaced as follows:*

17.15 Single operation devices**17.15.1 Bimetallic single operation devices**

Bimetallic single operation devices shall be subjected to the following tests:

17.15.1.1 *After the appropriate tests of Clause 15, the same six samples shall be maintained at –35 °C or 0 °C as declared in Table 7.2, Item 103, for 7 h. The devices shall not reset during this period, which is determined by the test of 15.5.3.109.*

17.15.1.2 *Six untested bimetallic single operation devices are conditioned for 720 h at a temperature which is the lower of either:*

- 90 % of the declared operating value ± 1 K,
- or (7 ± 1) K below the declared operating value.

17.15.1.2.1 *During this conditioning, the bimetallic single operation device shall not operate. Operation of the bimetallic single operation device shall be detected as indicated in 15.5.3.107.*

17.15.1.2.2 *The appropriate tests of Clause 15 shall be repeated on the six samples subjected to the conditioning of 17.15.1.2 and the temperature measured shall be within the declared deviation limits.*

17.15.1.3 For bimetallic single operation devices with a declared reset temperature of $-35\text{ }^{\circ}\text{C}$, six untested samples shall be subjected to an over-voltage (or overload in Canada, China, and the USA) test for one cycle under the electrical conditions of Table 17.2-1 or Table 17.2-2, as appropriate.

The test of 15.5.3.109 shall be repeated.

17.15.1.3.1 For bimetallic single operation devices with a declared reset temperature of $0\text{ }^{\circ}\text{C}$, one sample shall be subjected to an over-voltage (or overload in Canada, China, and the USA) test of 50 cycles under the electrical conditions of Table 17.2-1 or Table 17.2-2, as appropriate.

The sample is then subjected to the number of cycles declared in Table 7.2, Item 104, at rated current and voltage.

NOTE The purpose of the tests of 17.15.1.3.1 is to evaluate the device under unintended operation caused by exposure to temperatures below $0\text{ }^{\circ}\text{C}$. In order to achieve cycling, it is suggested that the test be conducted in a test chamber which permits decrease of the ambient temperature to the declared reset value and increase of the ambient temperature to the normal operating value.

After the test of 17.15.1.3.1, the appropriate tests of Clause 15 shall be repeated and the temperature measured shall be within the declared deviation limits.

17.15.2 Non-bimetallic single operation devices

The temperature sensing element of the non-bimetallic single operation devices shall be subjected to the tests of Clause 11 of IEC 60691, except that a suitable test apparatus shall be used to heat the sensing element of the sample, and care shall be taken to prevent other parts of the control becoming exposed to temperatures in excess of their intended use.

17.16 Test for particular purpose controls

Additional subclauses:

17.16.101 Thermostats

- 17.1 to 17.5 inclusive are applicable.
- 17.6 is applicable to actions classified as Type 1.M or Type 2.M, the value of "X" being $(5 \pm 1)\text{ K}$ or $\pm 5\%$ of the original activating quantity, whichever is greater.
- 17.7 is applicable.
- 17.8 is applicable.
- 17.9 is applicable, but only to slow-make, slow-break automatic actions.
- 17.9.3.1 is not applicable.
- 17.10 to 17.13 inclusive, are applicable, but only to those thermostats which have a manual action (including an actuating means providing setting by the user).
- 17.14 is applicable.
- 17.15 is not applicable.

In Canada and the USA, the following requirements are applicable for room thermostats:

17.16.102 Independently mounted room thermostats for operation above 50 V which include a resistance load rating and which are intended for direct control of electric space-heating equipment shall meet the requirements of 17.16.102.1 to 17.16.102.3 inclusive.

17.16.102.1 Two samples of a room thermostat intended for direct control of electric space-heating equipment (designated "SAMPLE 1" and "SAMPLE 2") shall be subjected to an over-current test consisting of making and breaking for 50 cycles of operation, at a rate of 6 cycles/min, a value of current described in Table 17.2-2.

17.16.102.2 SAMPLE 1 (see 13.2) and SAMPLE 2 shall be subjected to an endurance test consisting of 6 000 cycles at the rate of not more than one cycle/min and at 110 % of both the rated current and rated voltage. The "on" time shall be (50 ± 20) % and operation is to be by thermal means. There shall be no electrical or mechanical failure of either thermostat, and there shall be no undue burning or pitting of the contacts of SAMPLE 1 (see 17.3).

17.16.102.3 The thermostat designated SAMPLE 2 shall be subjected to an additional 30 000 cycles under the conditions described in 17.4, except that rated voltage and current shall be used. The test may be discontinued if the thermostat becomes inoperative due to the contacts not opening or closing. There shall be no indication of a fire or shock hazard.

17.16.103 Temperature limiters

- 17.1 to 17.5 inclusive are applicable.
- 17.6 is applicable to actions classified as Type 1.M or Type 2.M, the value of "X" being (5 ± 1) K, or ± 5 % of the original activating quantity, whichever is greater.
- 17.7 and 17.8 are applicable, except that, where necessary, the reset operation, if required, is obtained by actuation.

This actuation shall be as specified in 17.4 for accelerated speed, as soon as permitted by the mechanism, or as declared by the manufacturer in Table 7.2 Item 37.

- 17.9 is applicable, but only to temperature limiters with slow-make, slow-break automatic actions, the same conditions for manual reset as specified above for 17.7 and 17.8 being used.
- 17.9.3.1 is not applicable.
- 17.10 to 17.13 inclusive, do not apply to the normal reset manual action, which is tested during the automatic tests of 17.7 to 17.9 inclusive. If the temperature limiter has other manual actions which are not tested during the automatic tests, then these subclauses are applicable.
- 17.14 is applicable.
- 17.15 is not applicable.

17.16.104 Thermal cut-outs

- 17.1 to 17.5 inclusive are applicable.
- 17.6 is applicable to actions classified as Type 1.M or Type 2.M, the value of "X" being (5 ± 1) K, or ± 5 % of the original activating quantity, whichever is greater.
- 17.7 and 17.8 are applicable, except that, where necessary, the reset operation, if required, is obtained by actuation.

This actuation shall be as specified in 17.4 for accelerated speed, as soon as permitted by the mechanism, or as declared by the manufacturer in Table 7.2, Item 37.

- 17.9 is applicable, but only to thermal cut-outs with slow-make, slow-break automatic actions, the same conditions for manual reset as specified above for 17.7 and 17.8 being used.
- 17.9.3.1 is not applicable.
- 17.10 to 17.13 inclusive do not apply to the normal reset manual action, which is tested during the automatic tests of 17.7 to 17.9 inclusive. If the thermal cut-out has other manual actions which are not tested during the automatic tests, then these subclauses are applicable.
- 17.14 is applicable.
- 17.15 is not applicable.

17.16.104.1 For voltage maintained thermal cut-outs, the test of 17.16.108 is applicable.

17.16.105 In Canada and the USA, if a control has two or more electrical ratings (for example, inductive and resistive or different currents at different voltages), it may be tested for not less than 25 % of its declared endurance (if equal to or greater than 30 000 cycles) at each rating, but the total number of cycles on any one sample is not to be more than its declared endurance.

However, at least one sample shall be tested for a total number of cycles equal to its declared endurance.

17.16.106 Evaluation of materials

The following tests are conducted as indicated in 14.101.1.

The control is subjected to the tests of 17.7 for 50 operations and 17.8 for 1 000 operations. The tests of 17.7 and 17.8 are conducted at an ambient temperature of $(20 \pm 5) ^\circ\text{C}$.

After these tests, the control shall comply with 17.5.

17.16.107 Over-temperature test of sensing element

For controls declared under Item 105 of Table 7.2, the sensing element portion of a previously untested sample is exposed to 250 thermal cycles.

The test ambient temperature is varied between $40 ^\circ\text{C}$ and T_e at the maximum rate of temperature change declared in Table 7.2, Item 37. The extremes of temperature are maintained for 30 min.

After the test, the control shall comply with 17.14.

17.16.108 Voltage maintained thermal cut-out

Six untested voltage maintained thermal cut-outs are conditioned for 7 h at a temperature of $-20 ^\circ\text{C}$ (or lower, if declared).

During and at the conclusion of the conditioning, none of the six samples shall have operated.

Operation of the voltage maintained thermal cut-outs shall be detected as indicated in 15.5.3.107.

These requirements apply to a voltage maintained thermal cut-out in the operated condition with the voltage across it.

Additional subclauses:

17.101 Type 2.P cycling test

Temperature sensing controls of Type 2.P action shall be tested as follows:

17.101.1 Following the appropriate tests of 17.16 and the evaluation of 17.14, the control is subjected to a thermal cycling test of 50 000 cycles at a temperature maintained between 50 % and 90 % of the switch-off temperature recorded in 17.14. During this test, the switch head is maintained at $(20 \pm 5) ^\circ\text{C}$.

The manufacturer shall declare whether the method of 17.101.2 or 17.101.3 is to be used.

The test shall be carried out in accordance with the manufacturer's declaration in Item 112 of Table 7.2.

17.101.2 Two-bath method

The two baths are filled with synthetic oil, water or air (two chambers). The first bath is maintained at a temperature equal to 90 % of the switch-off temperature (°C) recorded in 17.14. The second bath is maintained at a temperature equal to 50 % of the switch-off temperature recorded in 17.14.

If a medium different from that used in Annex BB is selected for this test, then an appropriate conversion factor shall be applied to the time factor indicated in the following paragraph.

The temperature sensing element (see 2.8.1 and Table 7.2, Item 47) is immersed in the first bath for a period of time equal to at least five times the time factor. The temperature sensing element is then immersed in the second bath for the same period of time.

The transfer between baths is carried out as quickly as possible but care should be taken to avoid mechanical stress to the temperature sensing element.

17.101.3 Temperature change method

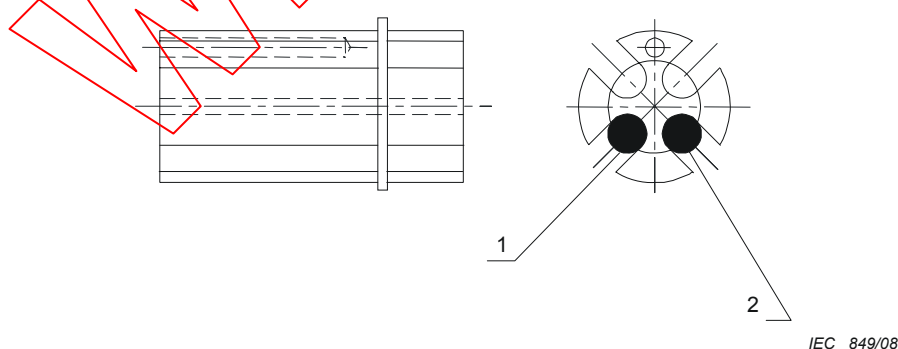
This method is based on a continuously water-cooled oil-filled bath (synthetic oil).

An aluminum cylinder (see figure 17.101.3) is immersed in this bath. The cylinder contains the temperature sensing element under test and a temperature sensing element to control temperature cycling between 50 % and 90 % of the switch-off temperature (°C) recorded in 17.14.

The aluminium cylinder is wrapped with a resistance wire to heat the temperature sensing element. To eliminate the difficulties resulting from the difference between the time factor of the temperature sensing element under test and the temperature sensing element which is controlling the test temperature range, the temperature sensing element of a second identical test sample is used.

The two membrane positions of the second sample, calculated at 50 % and 90 % of the switch-off temperature (°C) are measured by a position sensor and used to switch the current through the resistance wire (heat) on and off.

Unless otherwise declared by the manufacturer in Table 7.2, Item 37, the rate of change of temperature rise/fall shall be (35 ± 10) K/min.



Key

- 1 Temperature sensing element
- 2 Temperature sensing element to control the temperature cycle between 0,5 and 0,9 times the switch-off temperature

Figure 17.101.3 – Aluminium cylinder for temperature change method

17.101.4 After this test, for controls other than bimetallic SODs, an additional 20 cycles are carried out by increasing the temperature from $(20 \pm 5) ^\circ\text{C}$ to 1,1 times the switch-off temperature.

During this test, any manual reset mechanism shall not be reset. The other conditions of 17.101.1 are unchanged.

The purpose of this test is to stress the operating mechanism (for example, membrane, bellows, etc.).

17.101.5 *After thoroughly degreasing the switch head, the operating temperature(s) is re-checked under the conditions of Clause 15 and the measured value(s) shall still be within the declared limits of deviation and drift.*

18 Mechanical strength

This clause of Part 1 is applicable except as follows:

Additional subclauses:

18.101 Push-and-turn or pull-and-turn actuation

18.101.1 Controls with actions classified as Type 1.X or 2.X or Type 1.Z or 2.Z shall be subjected to the tests of 18.101.2 and 18.101.3.

One new sample is used for the tests. After these tests, the control shall comply with the requirements of 18.1.5.

18.101.2

Controls with actions classified as Type 1.X or 2.X or Type 1.Z or 2.Z shall be subjected to the following tests.

- The axial force required to push or pull the actuating member shall be not less than 10 N.
- An axial push or pull force of 140 N applied to the actuating member shall not affect compliance with 18.1.5.
- For a control intended for use with a knob having a grip diameter or length of 50 mm or less, the means preventing rotation of the shaft prior to the push or pull actuation shall withstand, without damage, or effect on control function, a torque of 4 Nm.
- Alternatively, if the means preventing rotation of the shaft is defeated when a torque of at least 2 Nm is applied, the effect shall be such that either
 - the means is not damaged, but overridden to close the contacts, in which case subsequent actuation at a torque less than 2 Nm shall require both push-and-turn or pull-and-turn to operate the contacts, or
 - no operation of the contacts occurs nor can be made to occur.
- The torque required to reset the control to the initial contact condition, if necessary after the application of the push or pull, shall not be greater than 0,5 Nm.
- A torque of 6 Nm is applied to the setting means. Any breakage or damage to the means preventing rotation of the shaft shall not result in failure to comply with the requirements of Clauses 8, 13 and 20.
- For controls intended for use with a knob having a grip diameter or length greater than 50 mm, the values of torque are increased proportionally.

18.101.3 Controls with actions classified as Type 1.X or 2.X or Type 1.Z or 2.Z shall be actuated for the declared number of manual cycles.

After this test, the control shall comply with the requirements of 18.101.2. For the case in which the means preventing rotation is not damaged but is overridden to operate the contacts, the first 1/6th of the declared manual cycles shall be performed without first pushing or pulling the actuating member.

18.102 Parts containing liquid metal

18.102.1 Parts of all controls containing sodium (Na), potassium (K), or both, and parts of controls classified under 6.7.101 to 6.7.103 inclusive that contain mercury (Hg) shall withstand for 1 min, without leakage or rupture, a hydraulic pressure equal to five times the maximum internal pressure achieved during operation.

18.102.1.1 The method of test and the number of samples required shall be agreed between the manufacturer and the test authority.

It may be necessary for the manufacturer to provide special samples for the purpose of this test (for example, without mercury). Any suitable fluid may be used in lieu of the liquid metal, provided that the test fluid and test method exert the intended stress on all fluid-containing parts.

18.102.1.2 *After the test of 18.102.1, the hydraulic pressure is to be increased until rupture occurs. The rupture shall occur at the bellows or diaphragm or other part that is within the switch head or control enclosure.*

18.102.2 *The control shall not leak or rupture when heated to 1,2 times the maximum temperature of the sensing element.*

A separate sample is used for this test.

18.102.3 *Additionally, when the bellows or diaphragm of a separate sample is deliberately punctured with a sharp, pointed metal rod, the following shall occur:*

- *sodium, potassium, or mercury shall be contained in the switch head or control enclosure.*

In Canada and the USA, mercury is allowed to escape from the switch head or control enclosure, in which case the control shall be declared as requiring evaluation in the appliance to determine if mercury enters an oven or food-handling compartment, contacts food-handling equipment, or the like.

The acceptability of the location of the rupture shall be evaluated in the appliance.

19 Threaded parts and connections

This clause of Part 1 is applicable.

20 Creepage distances, clearances and distances through solid insulation

This clause of Part 1 is applicable.

21 Fire hazard testing

This clause of Part 1 is applicable.

22 Resistance to corrosion

This clause of Part 1 is applicable.

23 Electromagnetic compatibility (EMC) requirements – emission

This clause of Part 1 is applicable except as follows:

Additional subclauses:

23.101 Thermostats shall be so constructed that they do not generate radio interference for a time period exceeding 20 ms.

In Canada and the USA, this test is not applicable.

Compliance is checked by the test of 23.101.1 and 23.101.2.

23.101.1 Test conditions

Three previously untested samples are subjected to the test.

The electrical and thermal conditions are as specified in 17.2 and 17.3, except as follows.

- The test is conducted at the lowest declared voltage and lowest declared current (Table 7.2, Item 108).
- The rates of temperature change are α_1 and β_1 . If these have not been declared, the following are used:
 - 1 K/15 min for sensing elements in gases;
 - 1 K/min for sensing elements in other media.
- For controls declared for use with inductive loads, the power factor is 0,2. For controls declared for use with purely resistive loads, the power factor is 1,0.

23.101.2 Test procedure

The control is subjected to five cycles of operation with the contacts opening and five cycles of operation with the contacts closing.

The duration of radio interference is measured by an oscilloscope connected to the control so as to measure the voltage drop across the contacts.

For the purpose of this test, radio interference is any observed fluctuation of voltage across the contacts which is superimposed upon the supply waveform as a result of contact operation.

24 Components

This clause of Part 1 is applicable.

25 Normal operation

This clause of Part 1 is applicable.

26 Electromagnetic compatibility (EMC) requirements – immunity

This clause of Part 1 is applicable.

27 Abnormal operation

This clause of Part 1 is applicable.

28 Guidance on the use of electronic disconnection

This clause of Part 1 is applicable.

Withdrawn

Annexes

The annexes of Part 1 are applicable except as follows:

Annex H (normative)

Requirements for electronic controls

Replacement:

This annex of Part 1 is applicable except as follows:

H.6 Classification

H.6.18 According to software class

H.6.18.2 *Add the following explanatory paragraph:*

In general, thermal cut-outs using software have functions classified as software class B or C.

H.6.18.3 *Add the following explanatory paragraph:*

In general, thermal cut-outs used on closed water heater systems will have functions classified as software class C.

H.7 Information

Modification to Table 7.2:

Information		Clause or subclause	Method
58a	<i>Addition:</i> See footnote c of Table H.26.2.101 <i>Additional item:</i>		
109	The output condition of thermal cut-outs, Type 2 thermostats and Type 2 temperature limiters after operation ¹⁰⁴⁾	H.26.2.103 H.26.2.104 H.26.2.105	X
117	Conditions of test when requested by the manufacturer for integrated and incorporated electronic controls.	H.23.1.2	X
<i>Additional note:</i> ¹⁰⁴⁾ For example, conducting or non-conducting, as applicable.			

H.11 Constructional requirements

H.11.12 Controls using software

H.11.12.8 *Replace the explanatory paragraph by the following:*

The values declared in Table 7.2, Item 71, may be given in the applicable appliance standard

H.11.12.8.1 *Add, at the end of this subclause, the following explanatory paragraph:*

The values declared in Table 7.2, Item 72, may be given in the applicable appliance standard.

H.23 Electromagnetic compatibility (EMC) requirements – emission

H.23.1.2 Radio frequency emission

Addition:

Integrated and incorporated controls are not subjected to the tests of this subclause, as the results of these tests are influenced by the incorporation of the control into the equipment and the use of measures to control emissions used therein. They may, however, be carried out under declared conditions if so requested by the manufacturer.

H.26 Electromagnetic compatibility (EMC) requirements – immunity

H.26.2 Additional subclauses:

After each test, one or more of the following criteria shall apply, as permitted in Table H.26.2.101.

H.26.2.101 The control shall remain in its current condition and thereafter shall continue to operate as declared within the limits verified in Clause 15, if applicable.

H.26.2.102 The control shall assume the condition declared in Table 7.2, Item 109 and thereafter shall operate as in H.26.2.101.

H.26.2.103 The control shall assume the condition declared in Table 7.2, Item 109, such that it cannot be reset automatically or manually. The output waveform shall be sinusoidal or as declared in item 53 of Table 7.2 for normal operation.

H.26.2.104 The control shall remain in the condition declared in Table 7.2, Item 109. A non-self-resetting control shall be such that it can only reset manually. After the temperature which caused cut-out to occur is removed, it shall operate as in H.26.2.101 or shall remain in the declared condition as in H.26.2.103.

H.26.2.105 The control may return to its initial state and thereafter shall operate as in H.26.2.101.

If a control is in the condition declared in Table 7.2, Item 109, it may reset but shall resume the declared condition again if the temperature which caused it to operate is still present.

H.26.2.106 The output and functions shall be as declared in Table 7.2, Item 58a or 58b and the control shall comply with the requirement of 17.5.

Table H.26.2.101 – Compliance criteria

Applicable Clause H.26 tests	Compliance criteria permitted					
Thermal cut-outs, Type 2 thermostats and Type 2 temperature limiters	H.26.2.101	H.26.2.102	H.26.2.103	H.26.2.104	H.26.2.105	H.26.2.106 ^c
H.26.4 to H.26.14 inclusive	b	b	b	a	a	x
Other temperature sensing controls	H.26.2.101	H.26.2.102	H.26.2.103	H.26.2.104	H.26.2.105	H.26.2.106 ^c
H.26.8, H.26.9	x				x	x
x = Permitted for other than thermal cut-outs a = Permitted when the disturbance is applied after operation b = Permitted when the disturbance is applied before operation c = This compliance criterion is permitted only for integrated or incorporated controls, since the acceptability of the output must be judged in the appliance.						

H.26.5 Voltage dips and voltage interruptions in the power supply network

H.26.5.4 Voltage variation test

Replacement:

H.26.5.4.3 The control is subjected to each of the specified voltage test cycles three times with 10 s intervals between each test cycle. For a control declared under Item 109 of Table 7.2, each test cycle is performed three times when the control is in the declared condition and three times when it is not.

H.26.8 Surge immunity test

H.26.8.3 Test procedure

Additional subclause:

H.26.8.3.101 For controls declared under Item 109 of Table 7.2, three of the tests are performed when the control is in the declared condition and two are performed when it is not.

H.26.9 Electrical fast transient/burst immunity test

Additional subclause:

H.26.9.3.101 Test procedure

The control is subjected to five tests. For controls declared under Item 109 of Table 7.2, three tests are performed when the control is in the declared condition and two are performed when it is not.

H.26.10 Ring wave test

H.26.10.5 Test procedure

Additional subclause:

H.26.10.5.101 For controls declared under Item 109 of Table 7.2, three of the tests are performed when the control is in the declared condition and two are performed when it is not.

H.26.12 Radio-frequency electromagnetic field immunity

H.26.12.2 Immunity to conducted disturbances

H.26.12.2.2 Test procedure

Addition:

For controls declared under Item 109 of Table 7.2, sweeping is performed when the control is in the declared condition and when it is not.

H.26.12.3 Radiated electromagnetic fields immunity evaluation

Addition:

H.26.12.3.101 For controls declared under Item 109 of Table 7.2, sweeping is performed when the control is in the declared condition and when it is not.

H.26.13 Test of influence of supply frequency variations

H.26.13.3 Test procedure

Addition:

For controls declared under Item 109 of Table 7.2, the test shall be performed when the control is in the declared condition and when it is not.

H.26.14 Power frequency magnetic field immunity test

H.26.14.3 Test procedure

Addition:

For controls declared under Item 109 of Table 7.2, the test shall be performed when the control is in the declared condition and when it is not.

H.26.15 Evaluation of compliance

H.26.15.2

Addition:

See Table H.26.2.101 for compliance criteria.

H.26.15.4

Addition:

See Table H.26.2.101 for compliance criteria.

H.27 Abnormal operation

H.27.1.2 *Replace the first line by:*

The control shall be operated under the following conditions. In addition, controls declared under Item 109 of Table 7.2 shall be tested when the control is in the declared condition and when it is not.

Withdrawn

Annex J (normative)

Requirements for controls using thermistors

Replacement:

This annex of Part 1 is applicable except as follows:

J.4 General notes on tests

J.4.3.5 According to purpose

Additional subclause:

J.4.3.5.101 For the purpose of declaring the number of endurance cycles in Table 7.2, Item 64, thermistors are evaluated for the function performed in the control.

For example, the same number of cycles would be declared in Item 64 as in Item 27 for a thermistor used as the sensing element of a control with Type 2 action in which one cycle of control operation occurs with each cycle of thermistor operation, or vice versa.

J.7 Information

Addition to Table 7.2:

Add to Item 64 a reference to J.4.3.5.101.

Additional annexes:

Annex AA (informative)

Maximum manufacturing deviation and drift ^{a, b}

In Canada and the USA, Annex AA is normative.

Type of control	Temperature range °C	Maximum allowable deviation from declared operating value		Maximum allowable drift from initial measured value	
		% of declared operating value	K	% of declared operating value	K
Storage water heater thermostat	≤77 ^e	–	3	–	6
	>77	–	4	–	6
Storage water heater thermal cut-out	Any	–	3	5	6
Thermal cut-outs for duct heaters, warm air furnaces and boilers	<150	–	8	5	–
	≥150	5	–	5	–
Thermal cut-outs for electric base-board heaters	Any	–	8	+2 ^d	–
Appliance thermal cut-outs other than the above ^c	<150	–	6	6	6
	150 ≤ t ≤ 204	4	–	5	–
	>204	5	–	5	–

^a Where both the per cent and K variations are indicated, the greater value may be used.

^b When the per cent of the declared operating value is used, the following values are to be added to the maximum deviation or drift calculated using the table.

- For 5 %: 0,9 K
- For 4 %: 0,7 K
- For 2 %: 0,4 K

^c For appliance thermal cut-outs, the downward drift may be 20 % of the declared operating value plus 4 K. The acceptability of this drift must be determined in the application, taking into account such conditions as the possibility of user tampering, overlapping performance with a thermostat and other similar conditions that might result in a fire, shock or casualty hazard.

^d The downward drift is not limited for thermal cut-outs for electric baseboard heaters.

^e Controls for household use have a manufacturer setting ≤60 °C. Deviation and drift are checked at 60 °C or at the maximum set point.

Annex BB (informative)

Time factor

BB.0 Introduction

The time factor shall be determined by one of the following methods:

- sudden temperature change (Clause BB.2);
- linear rise of temperature (Clause BB.3).

Normally, the time factor can be described by an exponential function of first order.

In the case of exponential functions of higher order, the dead time has to be taken into consideration.

BB.1 The characteristics and switching points for the determination of the time factor T shall be checked in a steady state.

BB.1.1 The time factor is determined by means of an appropriate test device (for example, the two-bath or gradient method) for gaseous or liquid activating media. Should the test medium not correspond to the working medium, the respective conversion factors shall be specified.

BB.1.2 The time factor shall be measured with or without sheath or bulb well as declared by the manufacturer.

BB.1.3 The velocity of the test medium shall be:

0,2 m/s to 0,3 m/s for fluids;

1,0 m/s to 1,5 m/s for air.

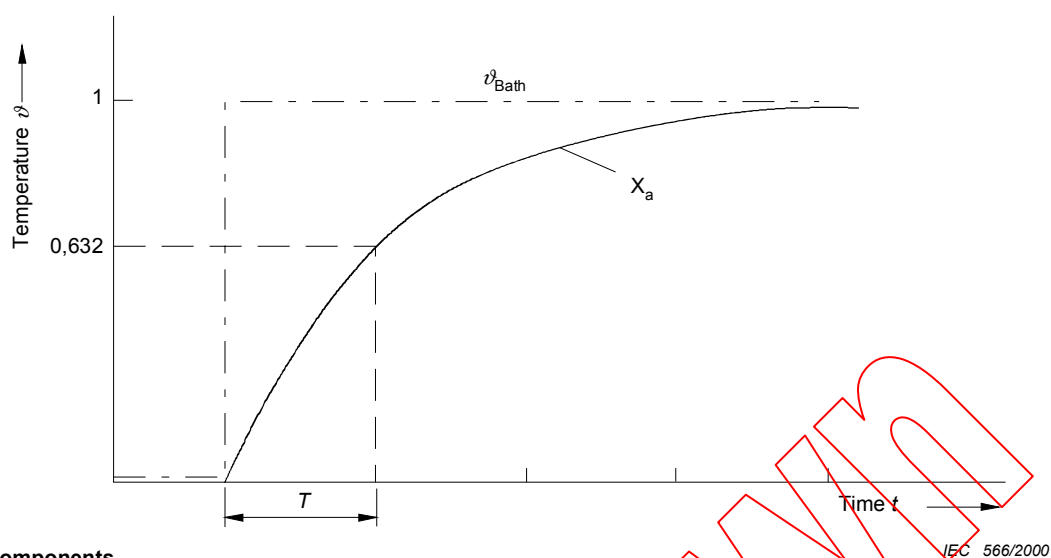
BB.2 Two-bath method

The temperature sensor is subjected to a sudden temperature rise after a steady-state temperature has been reached. The time at which a value of the output signal is reached which is equal to 63,2 % of the sudden temperature rise is determined as time factor T (see Figure BB.1).

In case of thermostats of the continuous type, the time factor shall be determined by this method alone.

BB.3 Gradient method

The temperature sensor is subjected to a bath temperature which rises at constant gradient. Time factor T is determined as a time delay at which the sensor temperature runs approximately parallel to the temperature of the bath. This occurs when a period of $+5 T$ has elapsed since the beginning of the rise in temperature. The time factor of the measuring device shall be taken into account here (see Figure BB.2).



Components

- θ_{Bath} Test-bath temperature
- X_a Sample output signal
- T Time factor

Figure BB.1 – Determination of time factor in the case of a sudden temperature change