BS EN 60730-2-9:2010

BSI Standards Publication

Automatic electrical controls for household and similar use

Part 2-9: Particular requirements for temperature sensing controls

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National foreword

This British Standard is the UK implementation of EN 60730-2-9:2010. It is derived from IEC 60730-2-9:2008. It supersedes BS EN 60730-2-9:2002, which will be withdrawn on 1 November 2013.

The CENELEC common modifications have been implemented at the appropriate places in the text. The start and finish of each common modification is indicated in the text by tags [C⟩ ⟨C].

The UK participation in its preparation was entrusted to Technical Committee CPL/72, Electrical control devices for household equipment and appliances.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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

(IEC 60730-2-9:2008, modified)

Dispositifs de commande électrique automatiques à usage domestique et analogue -
Partie 2-9: Règles particulières pour les dispositifs de commande thermosensibles
(CEI 60730-2-9:2008, modifiée)

Automatische elektrische Regel- und Steuergeräte für den Hausgebrauch und ähnliche Anwendungen -
Teil 2-9: Besondere Anforderungen an temperaturabhängige Regel- und Steuergeräte
(IEC 60730-2-9:2008, modifiziert)

This European Standard was approved by CENELEC on 2010-11-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization
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Foreword

The text of the International Standard IEC 60730-2-9:2008, prepared by IEC TC 72, Automatic controls for household use, together with the common modifications prepared by the Technical Committee CENELEC TC 72, Automatic controls for household use, was submitted to the CENELEC Unique Acceptance Procedure.

A draft amendment was prepared by the Technical Committee CENELEC TC 72, Automatic controls for household use. It was submitted to the Unique Acceptance Procedure.

The combined texts were approved by CENELEC as EN 60730-2-9 on 2010-11-01.

This document supersedes EN 60730-2-9:2002 + A1:2003 + A2:2005 + A11:2003 + A12:2004.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2011-11-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2013-11-01

This Part 2-9 is to be used in conjunction with EN 60730-1:2000, *Automatic electrical controls for household and similar use – Part 1: General requirements*, and any subsequent amendments.

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and covers essential requirements of EC Directive 2004/108/EC. See Annex ZZ.

Annexes ZA and ZZ have been added by CENELEC.

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Endorsement notice

The text of the International Standard IEC 60730-2-9:2008 was approved by CENELEC as a European Standard with agreed common modifications.

CONTENTS

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:

〚C〛EN 60216-1, Electrical insulating materials – Properties of thermal endurance – Part 1: Ageing procedures and evaluation of test results (IEC 60216-1) 〚C〛

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.

〔C〉 **2.2.101.2**
non-bimetallic single operation device
single operation device 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 requires complete or partial replacement

NOTE 1 When such parts can be tested separately, they are considered to be thermal links within the scope of EN 60691.

NOTE 2 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 should be representative of the application conditions for which the protective control is intended (see 7.2).

NOTE 3 Non-bimetallic single operation devices provide the equivalent of micro-disconnection. 〈C〉

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

〔C〉 *definitions deleted* 〈C〉

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.

〖C〗 *Note deleted* 〖C〗

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 〖C〗 and a further six for the test of Clause 17.〖C〗

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 [C〉 and at temperatures above -20 °C or at a lower temperature if so declared 〈C] (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.

[C〉**6.7.104** Non-bimetallic SOD for incorporation into appliances for heating or employing liquids or steam.

NOTE Not suitable for use in instantaneous water heaters. 〈C]

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) [C] (17.15.2.2) [C]	2.2.101 11.4.103 [C] 17.15.2.2 [C]	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	[C] Ageing temperature for non-bimetallic SOD [106)]	17.15.2.2.1 17.15.2.2.2	D
116	Rate of rise of temperature for testing non-bimetallic SOD [107)]	17.15.2.2.1 17.15.2.2.2 [C]	D
117	Agricultural thermostat	2.2.107 6.4.3.106 11.4.107 11.6.3.101 Annex DD	D
601	[C] The minimum voltage at which a voltage maintained thermal cut-out will not reset (this shall not be higher than 0,85 times the minimum rated voltage).	11.4.106 [C]	

NOTES

Additional notes

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) [C] *text deleted* [C] 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.

[C] 106) Determined by the control manufacturer based on the opening temperature of the thermal-cut out.

107) Determined by the control manufacturer referring to the actual maximum rate of rise probable in the projected end-use equipment. [C]

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.

〖C〗Insulating material used in non-bimetallic SODs as defined in this standard shall comply with the requirements of EN 60216-1:2001 and be suitable for the application. 〖C〗

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.

〖C〗 *Note deleted* 〖C〗

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

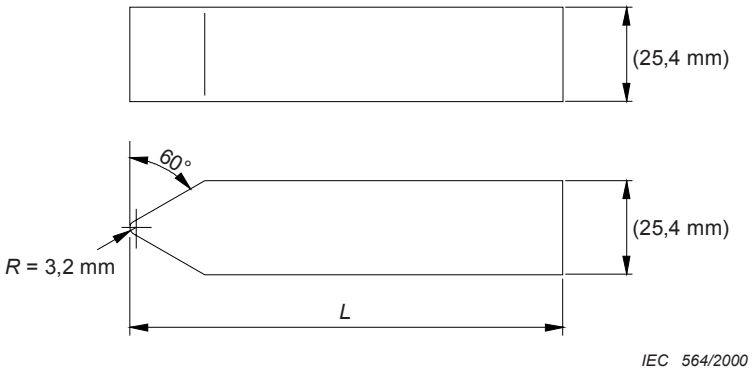
   1) exposed elements attached with at least double spot welding of the bimetal at both of its ends, or

   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.

〖C〉 *Note deleted* 〈C〗

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.

〖C〉 **11.4.106 Voltage maintained thermal cut-out (Type 1.AK or Type 2.AK)**

A voltage maintained thermal cut-out shall be so designed that it does not automatically reset at any temperature higher than -20 °C or any lower temperature declared in Table 7.2, Requirement 111.

Compliance is checked by the following test which is carried out as part of 17.14:

The voltage maintained thermal cut-out shall be maintained, in an operated condition, at - 20 °C or at any lower temperature declared by the manufacturer in Table 7.2, Requirement 111.

The voltage maintained thermal cut-out is connected to the voltage value declared in Table 7.2, Requirement 601, in series with a resistance of a value which will limit the current through the control to not more than the maximum rated current together with a suitable means to detect resetting of the thermal cut-out.

The test will continue for 1 h. The device shall not reset during this period. 〈C〗

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.

〚C〛 *Note deleted* 〚C〛

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 ± 5) °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.*

〚C〛 *Note deleted* 〚C〛

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 × V_R) + 1 000 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.

〖C〗 *text deleted* 〈C〗

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

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:

〖C〗All controls except bimetallic SODs shall be environmentally conditioned as per Clause 16 of EN 60730-1.〖C〗

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.*

〖C〗*Note deleted* 〖C〗

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 °C, six untested samples shall be subjected to an over-voltage* 〚C〛 *test for one cycle under the electrical conditions of Table 17.2-1.* 〚C〛

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 °C, one sample shall be subjected to an over-voltage* 〚C〛 *test of 50 cycles under the electrical conditions of Table 17.2-1.* 〚C〛

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 °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.

〚C〛 17.15.2 Non-bimetallic single operation devices

Non-bimetallic Single Operation Devices are subject to the following tests:

For a non-bimetallic SOD, automatic temperature sensing functions except those for the non-bimetallic part of the control, such as thermostat, temperature limiter and/or the thermal-cut-out, shall comply with 17.16.101, 17.16.103 and 17.16.104 respectively.

These tests are conducted on separate samples.

The apparatus used for the tests of 17.15.2.1 and 17.15.2.2 shall be constructed so that heat can be applied to the thermal sensing element of the single operation device whilst taking care that other parts of the control are protected from exposure to temperatures in excess of their intended use.

17.15.2.1 Six untested samples are then to be mounted in a suitable apparatus and the thermal sensing elements are conditioned for an ageing period equal to either 750 h or the result of the specified number of cycles declared by the end product application divided by 4 (calculation value is the number of hours), whichever is greater. The ageing temperature is declared in Table 7.2, Item 115, tolerance of 0 K -5 K. No operation of the single operation devices shall occur during this ageing period. Operation of the devices shall be detected as indicated in 15.5.3.107.

17.15.2.2 At the end of the ageing period, the samples are removed from the apparatus.

The appropriate tests of Clause 15 shall be repeated on six untested samples and the six samples subjected to the conditioning of 17.15.2.1 and the temperatures measured shall be within the declared deviation limits, with the electrical conditions of the test V_{Rmax} and I_{Rmax}.

For non-bimetallic SOD's where any sensing element has a declared reset temperature, the SOD's shall be held at the temperature declared in Table 7.2, the test shall continue for 7 h. The device shall not reset during this period as determined as indicated in 15.5.3.109.

All samples shall then be subjected to the test of Clause 13, carried out at the temperature limits declared in Table 7.2, Requirement 36.

NOTE: The apparatus used for the tests of 17.15.2.1 and 17.15.2.2 shall be constructed so that heat can be applied to the thermal sensing element of the SOD whilst taking care that other parts of the control are protected from exposure to temperatures in excess of their intended use. 〚C〛

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 ± 1) K or ±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.*

〖C〉 *text deleted* 〈C〗

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 [C] Void [C]

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 ± 5) °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 °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 °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 ± 5) °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

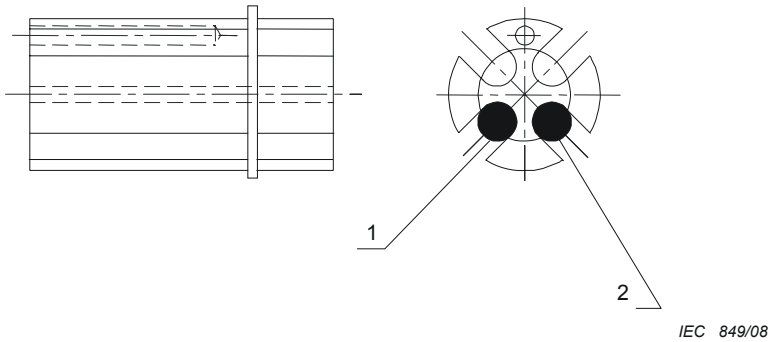
This method is based on a continuously water-cooled oil-filled bath (synthetic oil).

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 ± 5) °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.*

〖C〉 *Note deleted* 〈C〗

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.

〖C〉 *Note deleted* 〈C〗

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.

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	*Addition:* See footnote c of Table H.26.2.101		
	Additional item:		
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
Additional note: [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 〖C〗 Void 〖C〗

H.26.10.5 [C] Void [C]

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

Additon:

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.

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]

〔C〉 *Note deleted* 〈C〉

		Maximum allowable deviation from declared operating value		Maximum allowable drift from initial measured value	
Type of control	**Temperature range** °C	**% 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.

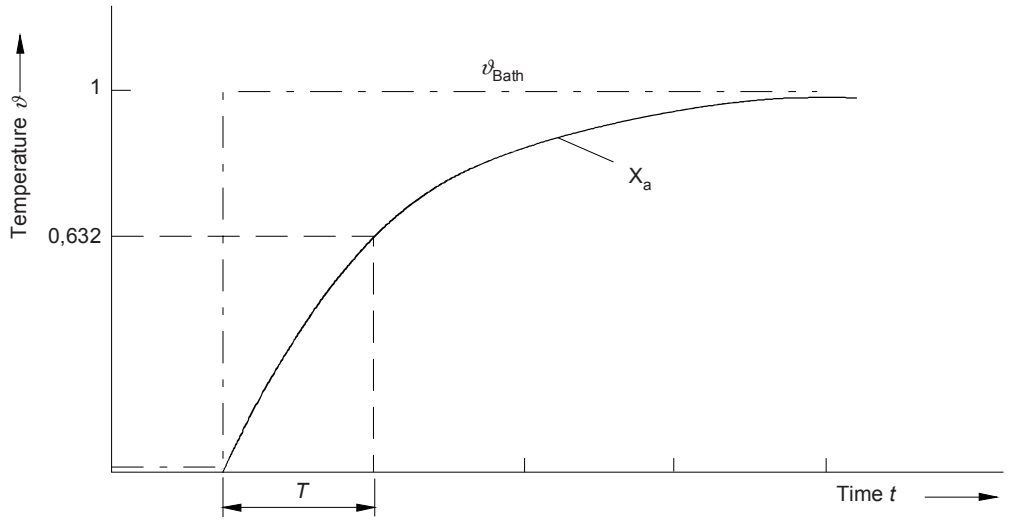
BB.2 Two-bath method

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).



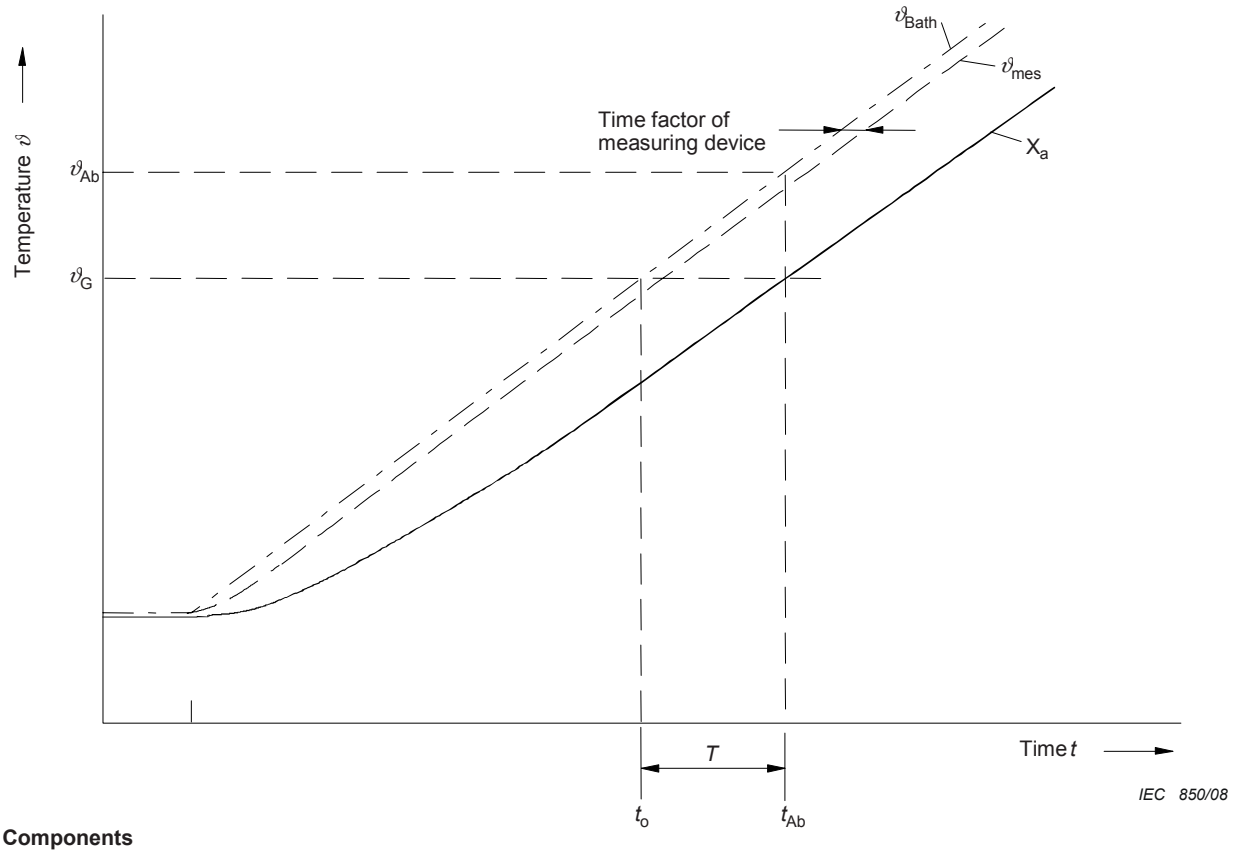
Components

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



Components

ϑ_{Bath} Test-bath temperature
ϑ_{mes} Bath temperature measured
X_a Sample output signal
ϑ_{Ab} Switch-off temperature
ϑ_G Set limit value
t_{Ab} Time of switch-off
t_o Time when $\vartheta_{Bath} = \vartheta_G$
T $t_{Ab} - t_o$ (time factor)

Calculation of switch-off temperature ϑ_{Ab} under test conditions when T and A are known.

$$\vartheta_{Ab}{}^{1)} = T \times A + \vartheta_G$$

where A is the test-bath temperature gradient.

Figure BB.2 – Determination of time factor in the case of a linear rise of test-bath temperature

Table BB.1 – Method to determine and verify time factor values (see 11.101)

	Mode of working	Time factor *T* with working fluid at the sensing device s		
		Water	Air	Oil
Boiler thermostat and boiler temperature limiters	Continuous	130	120	–
Boiler thermostat, boiler temperature limiters and boiler thermal cut-outs	Two-point behaviour	45	120	60
Flue gas temperature limiters	Two-point behaviour	–	45	–

1) When a period of approximately 5 *T* has elapsed since the beginning of the rise in temperature.

Annex CC
(informative)

Number of cycles

CC.1 Number of cycles for independently mounted and in-line cord controls

Temperature sensing controls	Automatic action	Manual action
Thermostats	6 000	600
Room thermostats	100 000	600
Self-resetting thermal cut-outs	1 000	
Non-self-resetting thermal cut-outs	300	
Other manual actions		300

〔C〉 *Table deleted* 〔C〕

Annex DD
(normative)

Controls for use in agricultural confinement buildings

DD.1 Object

The object of this annex is to provide a standard test method for determining the ability of a temperature sensing control to withstand specified severities of chemical compounds associated with use in agricultural confinement building environments. The requirements of this annex are intended to be in addition to the requirements of this standard. Twelve new samples, unless the test of DD.7.7.2 is required, in which case thirteen, are used for the tests of this annex.

Controls declared and intended for use in agricultural confinement buildings are not intended for use in potentially explosive atmospheres within the scope of IEC technical committee 31.

DD.2 Definitions

DD.2.1
agricultural confinement building
farm structure characterised by being heated and/or cooled by artificial means, where accumulation of animal food and waste may 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

DD.3 Test apparatus

Test chambers and sample shelves are of materials known to withstand the corrosive effects of the test medium so as not to introduce additional byproducts of corrosion.

DD.4 Severities

Severities are specified in Clause DD.7.

DD.5 Pre-conditioning

This annex does not prescribe any requirement for pre-conditioning. However, controls provided with openings for the entrance of wiring, fittings and/or cords of the type intended during installation shall be provided and used during testing. The resultant opening for wires or the cut end of cords, if any, shall be sealed to prevent entrance of the test medium into the control. Other openings, if any, are not modified.

DD.6 Initial measurements

This annex does not prescribe any requirement for initial measurements.

DD.7 Testing

For the following tests, if any of the samples exposed for 10 days do not meet the requirements of DD.9.2, the 30 day test may be discontinued to conserve time and test chamber utilization.

DD.7.1 Moist carbon dioxide – sulfur dioxide – air mixture

Two samples are placed in the test chamber, one exposed for 10 days and the other for 30 days. An amount of carbon dioxide equivalent to 1 % of the volume of the test chamber and an equal amount of sulfur dioxide is to be introduced into the test chamber each working day. Prior to the introduction of gas each day, the gas-air mixture from the previous day is purged. The test is run continuously, with the introduction of gas accomplished at least 8 times during the 10 day exposure and 22 times during the 30 day exposure.

A quantity of 10 ml of water per 0,003 m^3 of chamber volume is maintained at the bottom of the chamber for humidity.

The temperature of the test chamber is maintained at (35 ± 2) °C.

DD.7.2 Moist hydrogen sulfide – air mixture

Two samples are placed in the test chamber, one exposed for 10 days and the other for 30 days. An amount of hydrogen sulfide equivalent to 1 % of the volume of the test chamber is to be introduced into the test chamber each working day. Prior to the introduction of gas each day, the gas-air mixture from the previous day is purged. The test is run continuously, with the introduction of gas accomplished at least 8 times during the 10 day exposure and 22 times during the 30 day exposure.

A quantity of 10 ml of water per 0,003 m^3 of chamber volume is maintained at the bottom of the chamber for humidity.

The temperature of the test chamber is maintained at (25 ± 5) °C.

DD.7.3 Moist ammonia – air mixture

Two samples are placed in the test chamber, one exposed for 10 days and the other for 30 days. An ammonium hydroxide-water solution is placed in the bottom of the chamber. The solution is of a concentration which produces a 1 % by volume ammonia vapour above the solution, the remaining vapour being composed of air and water. The solution is not replaced or replenished during the test.

The temperature of the test chamber is maintained at (35 ± 2) °C.

DD.7.4 Urea – water vapour

Two samples are placed in the test chamber, one exposed for 10 days and the other for 30 days. A saturated urea-water solution (excess crystals in 10 ml of water per 0,003 m^3 of chamber volume) is placed in the bottom of the chamber. The solution is not replaced or replenished during the test.

The temperature of the test chamber is maintained at (35 ± 2) °C.

DD.7.5 Warm humid air

Two samples are placed in the test chamber, one exposed for 10 days and the other for 30 days. The humidity of the test chamber is maintained at (98 ± 2) % relative humidity.

The temperature of the test chamber is maintained at (60 ± 1) °C.

DD.7.6 Disinfectant – germicide – water mixture exposure

One sample is exposed to 1 300 cycles of intermittent spraying and drying of disinfectant-germicide-water mixture. The spray-dry cycle consists of 10 min spray followed by 50 min of no spray.

The temperature of the test chamber is maintained at (35 ± 2) °C.

The dairy disinfectant-germicide is mixed at a concentration of 7,8 ml disinfectant-germicide per litre of water. The disinfectant-germicide is composed of 15 % dimethyl ammonium chloride compounds and 85 % inert ingredients.

DD.7.7 Dust exposure

DD.7.7.1 Dust penetration

One sample shall be exposed to the dust test in IEC 60529 for first characteristic numeral 5. Enclosures may be deemed either category 1 or category 2.

DD.7.7.2 Dust heating, abnormal

For controls incorporating heat-producing devices (e.g. transformer, relay, electronic switching device), one sample is mounted and electrically connected as intended in a test chamber. Wheat and corn dust passed through a 0,075 mm mesh width screen is blown into the top of the chamber and allowed to fall vertically onto the sample until the blanket on top of the sample stabilizes. The blower is deenergized.

The test chamber temperature is then raised to T_{max} or 40 °C, whichever is greater, and the sample energized at V_r and I_r until chamber temperature stabilizes.

DD.8 Recovery

Samples tested in accordance with DD.7.1 through DD.7.7.1, inclusive, are rinsed with water and allowed to dry at room temperature.

DD.9 Evaluation

DD.9.1 General

Gaskets and other materials intended to seal the enclosure shall not have deteriorated excessively.

External adjustments and other mechanisms, if any, shall remain operable. Compliance is checked by actuation and inspection.

Samples of the control shall complete each of the six corrosive exposure tests without undue corrosion which may affect integrity of the enclosure so as to impair its function within the meaning of this standard. Compliance is checked by inspection.

DD.9.2 For the tests of DD.7.1 through DD.7.6, each sample shall meet the requirements of Clause 8, Subclause 17.5 and Clause 20 after the overvoltage test of 17.1.3.1 conducted at room temperature.

〖C〉 *Note deleted* 〈C〗

DD.9.3 For the test of DD.7.7.1, dust shall not have entered the enclosure. Compliance is checked by inspection.

DD.9.4 For the test of DD.7.7.2, the temperatures specified in Clause 14 shall not be exceeded by more than 15 K.

Annex EE
(informative)

Guide to the application of temperature sensing controls within the scope of IEC 60730-2-9

EE.1 General

EE.1.1 This annex applies to automatic 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.

Its purpose is to provide guidelines for the selection of temperature sensing controls by the user based on the particular application. It is also intended for technical committees to give guidance on the use of the various classifications of IEC 60730-2-9.

EE.1.2 Overview

All temperature sensing controls tested in accordance with IEC 60730-2-9 are tested to determine inherent constructional safety and safe operation. Safety is checked in the areas of protection against electric shock, heating, electric strength, provision for earthing, mechanical strength, endurance and abnormal use, etc. as appropriate.

Also included are requirements for electronic controls, including those incorporating complex electronics and software.

Controls classified as Type 2 are also checked to provide a degree of confidence in terms of their operating temperature. Tests are made to determine that the spread of operating temperature in the new condition is within the manufacturer's declared value, and also to determine that drift of operating temperature is within the manufacturer's declared value after the specified endurance test.

EE.2 Selection of temperature sensing controls within the scope of IEC 60730-2-9

Suitable controls for a specific application are selected based on the classifications and declarations recorded in the relevant test report under Clauses 6 and 7 of the standard. Such classifications and declarations applicable to all automatic controls are contained in IEC 60730-1. Amendments and additions to Part 1 are given in the relevant Part 2, that is IEC 60730-2-9 for temperature sensing controls.

The IEC 60730 series of standards should be regarded as a catalogue of characteristics from which the manufacturer will have specified a set, applicable to his particular control, and the types of application for which he believes it suitable.

It is therefore the responsibility of the user of the control, be it an OEM (Original Equipment Manufacturer) or installer, to select the control, which is suitable for their intended application. Also, equipment product standards should specify minimum requirements for control applications. It is not sufficient to specify simply that a control shall comply with IEC 60730, or IEC 60730-2-9, but rather particular declarations of relevant types and characteristics should be selected.

EE.3 Classifications common to temperature sensing controls

EE.3.1 Nature of supply

Indicates the type of supply voltage for which the control is suitable, a.c. only, d.c. only or a.c. and d.c. There is also the provision for specific types of supply or multiple supplies.

EE.3.2 Type of load

Indicates the type of load, that is,

– resistive only;
– resistive or inductive or a combination of both, for which the inductive element covers loads with a power factor not less than 0,6;
– specific load;
– current less than 20 mA;
– specific motor load;
– pilot load.

Controls for resistive circuits may be used for an inductive load, provided that the power factor is not less than 0,8, and the inductive load does not exceed 60 % of the current rating for the resistive load. Such circuits may also be used for other reactive loads provided that the reactive current does not exceed 5 % of the rated resistive current, and that the load is not greater than 10 VA.

An example of a resistive plus inductive load is a circuit in a fan-heater which incorporates both a heating element and a motor.

Circuits intended for inductive loads only may either be classified under this subclause by declaring that the resistive load is equal to the inductive load, or may be classified as for a declared specific load.

Examples of specific loads are circuits for tungsten filament or fluorescent lamp loads, highly inductive loads with a power factor of less than 0,6, capacitive loads, and contacts intended to be operated off load.

Examples of circuits of less than 20mA are circuits for neon indicators and other signal lamps.

EE.3.3 Types of temperature sensing controls according to their purpose

A temperature sensing control may be classified for more than one purpose.

Thermostat – Cycling temperature sensing control, which is intended to keep a temperature between two particular values under normal operating conditions of the controlled equipment and which may have provision for setting by the user. A thermostat is therefore also classified as an operational control.

Temperature Limiter – Temperature sensing control which is intended to keep a temperature below or above one particular value during normal operating conditions of the controlled equipment and which may have provision for setting by the user. A temperature limiter is therefore also classified as an operational control.

A temperature limiter may be of the automatic or of the manual reset type. It does not make the reverse operation during the normal duty cycle of the appliance.

Thermal cut-out – Temperature sensing control intended to keep a temperature below or above one particular value during abnormal operating conditions of the controlled equipment and which has no provision for setting by the user. A thermal cut-out is therefore also classified as a protective control.

A thermal cut out may be of the automatic or manual reset type.

Normally, a thermal cut out will provide a Type 2 action.

Bimetallic single operation device (SOD) – Control having a bimetallic temperature sensing element, which is intended to operate only once, and then requires complete replacement. A single operation device is therefore also classified as a protective control.

A bimetallic single operation device does not reset above a declared temperature.

A non-metallic single operation device denotes a control having a non-bimetallic sensing device, the operation of which cannot be separated from other functions of the control, and which operates only once and then requires complete replacement. Such a device is classified as a protective control.

If such parts can be tested separately, then they are identified as thermal links, which are not within the scope of IEC 60730-2-9 and are covered by IEC 60691.

EE.3.4 Features of automatic action

EE.3.4.1 Controls are classified either as Type 1 or Type 2

A Type 1 control is tested fully to determine inherent safety, but is not tested to determine operating temperature consistency, either in the new condition, or after the specified endurance test. Type 1 controls are therefore intended to be used in applications where the controlled temperature is not critical, in terms of performance or safety of the controlled equipment.

A Type 2 control is tested for inherent safety and for consistency of operating temperature, both in new condition, to check that the operating temperature is within the manufacturers' declared manufacturing tolerance (manufacturing deviation), and also for the change in operating temperature after the specified endurance (drift).

It should be noted that both manufacturing deviation and drift are declared by the manufacturer of the control. A user of the control should therefore ensure that a control is chosen which is suitable and meets the requirements of the application, allowing for the declared manufacturing deviation and drift.

Type 1 actions and Type 2 actions are further classified according to one or more of the following constructional or operational features as outlined in EE.3.4.2 and EE.3.4.3.

These further classifications are only applicable if the relevant declarations have been made and any appropriate tests completed.

An action providing more than one feature may be classified by a combination of the appropriate letters, for example, Type 1.C.L. or Type 2.A.E.

A manual action is not classified according to this subclause.

EE.3.4.2 Constructional features

The following constructional features can be declared. The incorporation of these features into the design of a control will depend on the intended final use of the control, its application within an equipment, or the type of equipment in which it is incorporated.

– A trip-free mechanism which cannot even momentarily be reclosed against the fault (Type 1.D or 2.D, see 6.4.3.4).

  This type of mechanism may be required by some equipment standards, where even a very short reclosure of the contacts while the equipment is in a fault condition could result in an escalation of the fault condition. An example is where such reclosure could result in the operation of a safety valve allowing steam to escape.

– A trip-free mechanism in which the contacts cannot be prevented from opening or maintained closed against a continuation of the fault (Type 1.E or 2.E, see 6.4.3.5).

  An example is a current-sensing control which has to be reclosed or can be reclosed momentarily to detect that the excess current fault still exists. A mechanism of this type would be acceptable in applications where a very short reclosure would not seriously affect the fault conditions in the controlled equipment, for example an electric room heater.

– An action which can only be reset by the use of a tool (Type 1.F or 2.F, see 6.4.3.6).

  This type of action is necessary when, for example, servicing by a skilled person is necessary after a particular type of fault.

– An action which is not intended to be reset under electrically loaded conditions (Type 1.G or 2.G, see 6.4.3.7).

  This type of action might be used to allow a lower contact specification, or where an equipment needs to be restarted from an ‘off’ state.

– A trip-free mechanism in which the contacts cannot be prevented from opening and which may automatically be reset to the "closed" position after normal operation conditions have been restored if the reset means is held in the "reset" position (Type 1.H or 2.H, see 6.4.3.8).

– 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 (Type 1.J or 2.J, see 6.4.3.9).

EE.3.4.3 Operational features

The following operational features can be declared. The incorporation of these features into the design of a control will depend on the intended final use of the control, its application within an equipment, or the type of equipment in which it is incorporated.

– For sensing actions, no increase in the operating value as the result of a breakage in the sensing element, or in parts connecting the sensing element to the switch head (Type 1.K or 2.K, see 6.4.3.10).

  This type of design can be used to prevent excessive temperature/pressure conditions after breakage of a temperature sensing element, for example in a pressurised water heater.

– An action so designed that in the case of failure of the electrical supply, it performs its intended function independently of any external auxiliary energy source or electrical supply (Type 1.L or 2.L, see 6.4.3.11).

– An action which operates after a declared ageing period (Type 1.M or 2.M, see 6.4.3.12).

  This type of action may be required for a protective control which spends the majority of its life at a normal working temperature, and is then required to operate without fail, when an equipment fault condition is sensed, e.g. self-cleaning ovens.

EE.3.5 Control pollution situation

The control is classified according to the degree of protection provided by its enclosure against harmful ingress of water and solid objects (dust). These classifications are in accordance with IEC 60529 and are known as IP ratings. A control rated as IP00 has no enclosure and therefore relies on the protection afforded by the equipment in which it is installed for protection against the ingress of water and dust.

A control intended for use in a particular environment may be used for a different environment if the appropriate provisions, if any, are made in the equipment.

EE.3.6 Method of connection

Control with at least one terminal intended for the connection of fixed wiring.

〖C〉 *text deleted* 〈C〗

Control with at least one terminal intended for the connection of a flexible cord.

Fixed wiring and flexible cords are defined as external conductors.

A control may be classified for both the above types of terminal.

Control without any terminals intended for the connection of an external conductor.

This type of control is intended for the connection of only integrated or internal conductors.

External conductor is a conductor, a part of which is external to an in-line cord control, an independently mounted control or to an equipment in or on which a control is mounted.

Internal conductor is a conductor which is neither an external conductor, nor an integrated conductor. This includes conductors external to a control but within an equipment.

Integrated conductor is a conductor inside a control, or is used to permanently interconnect terminals or terminations of a control.

EE.3.7 Ambient temperature limits of the switch head

The switch head is defined as all parts of the control other than the temperature sensing element. If by construction it is impossible to distinguish between the switch head and the temperature sensing element, then the whole control is considered to be the sensing element.

If no declaration of ambient temperature is made, the ambient temperatures are assumed to be between the minimum value (T_{min}) of 0 °C, and a maximum value (T_{max}) of 55 °C. Other values may be declared, but no less than a maximum value (T_{max}) of 30 °C or a minimum value (T_{min}) of 0 °C.

Preferred values of T_{max} are 30 °C, 55 °C, 70 °C, 85 °C, 105 °C, 125 °C, 150 °C. Preferred values of T_{min} are 0 °C, –10 °C, –20 °C, –30 °C, and –40 °C.

Values differing from these preferred values are allowed.

EE.3.8 Protection against electric shock

This classification covers the method of providing protection against electric shock, that is the combination of earthing, and/or insulation or extra low voltage, used to provide the necessary protection.

There are five types of protection, known as class 0, class 0I, class I, class II and class III. The definitions for these classes are detailed in 2.7.2 to 2.7.6 of IEC 60730-1.

This classification differs for the following various types of control.

An integrated control is not classified but takes the classification of the equipment with which it is integrated.

An incorporated control is classified for use in an equipment of class 0I, class 0, class I, class II or class III.

An in-line cord control, a freestanding control, or an independently mounted control is classified as class 0I, class 0, class I, class II or class III.

EE.3.9 Circuit disconnection or interruption

Contact separation is classified according to one of the following types;

– full-disconnection;
– micro-disconnection;
– micro-interruption;
– all-pole disconnection;
– electronic disconnection, see Clause H.28.

Some equipment standards may require full-disconnection, others may permit either full-disconnection or micro-disconnection; some may only require micro-interruption.

Different actions of a control may provide different circuit disconnections or interruptions.

• Full disconnection – A contact separation in all supply poles other than earth, which provide the equivalent of basic insulation between the supply mains and those parts intended to be disconnected.

This type of disconnection is intended for situations where electrical isolation is required. In some equipment standards, a physical contact gap of 3 mm is required for situations where the disconnected part can be touched during servicing etc.

• Micro-disconnection – Provides adequate contact separation in at least one pole so as to provide functional security.

Micro-disconnection denotes that for non-sensing controls the function controlled by the disconnection is secure, and for sensing controls is secure between the limits of activating quantity declared in Item 36 of Table 7.2.

This type of disconnection is not intended to provide electrical isolation, and flashover may occur during transient over voltage conditions.

Where the number of poles on the control is equal to the number of supply poles of the equipment to which it is connected, full-disconnection provides all-pole disconnection.

• Micro-interruption – Interruption of a circuit by contact separation, by a cycling action or a non-cycling action, and which does not provide full-disconnection or micro-disconnection.

This type of interruption would normally be applicable, for example, to a thermostat without a marked OFF position.

• All-pole disconnection – For single-phase a.c. appliances and for d.c. appliances, disconnection of both supply conductors by a single switching action or, for appliances to be connected to more than two supply conductors, disconnection of all supply conductors, except the earthed (grounded) conductor, by a single switching action.

The protective earthing conductor is not considered to be a supply conductor.

All pole disconnection may provide either full-disconnection or micro-disconnection.

• Electronic disconnection – A non-cycling disconnection by an electronic device of a circuit for functional disconnection and which provides a disconnection other than by means of an air gap by satisfying certain electrical requirements in at least one pole.

Electronic disconnection is similar to micro-disconnection in application, but may not be suitable for some types of application, where conduction of one half cycle of the supply waveform while in the “OFF” condition could result in a hazard.

EE.3.10 Number of cycles of actuation (M) of each manual action

Preferred values are:

– 100 000 cycles;
– 30 000 cycles;
– 10 000 cycles;
– 6 000 cycles;
– 3 000 cycles [2)];
– 300 cycles [3)];
– 30 cycles [3)].

EE.3.11 Number of automatic cycles (A) of each automatic action

Preferred values are:

– 300 000 cycles;
– 200 000 cycles;
– 100 000 cycles;
– 30 000 cycles;
– 20 000 cycles;
– 10 000 cycles;
– 6 000 cycles;

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2) Applicable only to actions of controls for specific equipment and applications such as voltage-tap controls, summer/winter controls for water heaters and where permitted by the appropriate equipment standard.

For controls with more than one manual action, a different value may be declared for each. If a control has more than one intended "OFF" position, then a cycle of actuation shall be regarded as a movement from one "OFF" position to the next "OFF" position.

– 3 000 cycles [3];
– 1 000 cycles [3] [4];
– 300 cycles [5] [5];
– 30 cycles [4] [6];
– 1 cycle [5].

For controls having more than one automatic action, a different value may be declared for each.

EE.3.12 Temperature limits of the mounting surface of the control

Controls may be classified as:

– control suitable for mounting on a surface which is not more than 20 K above the ambient temperature classified in 6.7;
– control suitable for mounting on a surface which is more than 20 K above the ambient temperature classified in 6.7.

An example of such a control is one mounted on a compressor unit in a refrigerator, where the mounting surface may be 150 °C, although the sensing element is at a temperature of –10 °C, and the ambient temperature is only 30 °C.

EE.3.13 Value of proof tracking index (PTI) for the insulation material used

Values for PTI are:

– material of material group IIIb with a PTI of 100 and up to but excluding 175;
– material of material group IIIa with a PTI of 175 and up to but excluding 400;
– material of material group II with a PTI of 400 and up to but excluding 600;
– material of material group I with a PTI of 600 and over.

EE.3.14 Period of electrical stress across insulating parts supporting live parts and between live parts and earthed metal

Electrical stress across the insulated parts is classified according to the following:

– short period;
– long period.

Long periods of electrical stress are considered to exist if the control is used in equipment for continuous use; and also for the supply side of a control in any other equipment unlikely to be disconnected from the supply by the removal of a plug or by the operation of a control providing full disconnection.

At the present time, this classification is not used and no tests are specified.

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3) Not applicable to thermostats or to other fast cycling actions.

4) Applicable only to manual reset.

5) Applicable only to actions which require the replacement of a part after each operation.

6) Can only be reset during manufacturer servicing.

EE.3.15 Construction

Construction is classified according to the following types:

– integrated control;
– incorporated control;
– in-line cord control;
– free-standing control;
– independently mounted control for:
  – surface mounting;
  – flush mounting;
  – panel mounting.

EE.3.16 Ageing requirements of the equipment in which the control is intended to be used

Preferred values are:

– 60 000 h;
– 30 000 h;
– 10 000 h;
– 3 000 h;
– 300 h;
– 15 h.

Controls which operate during the heating or endurance tests of the equipment standard are not classified according to this subclause.

EE.4 Specific types of temperature sensing control

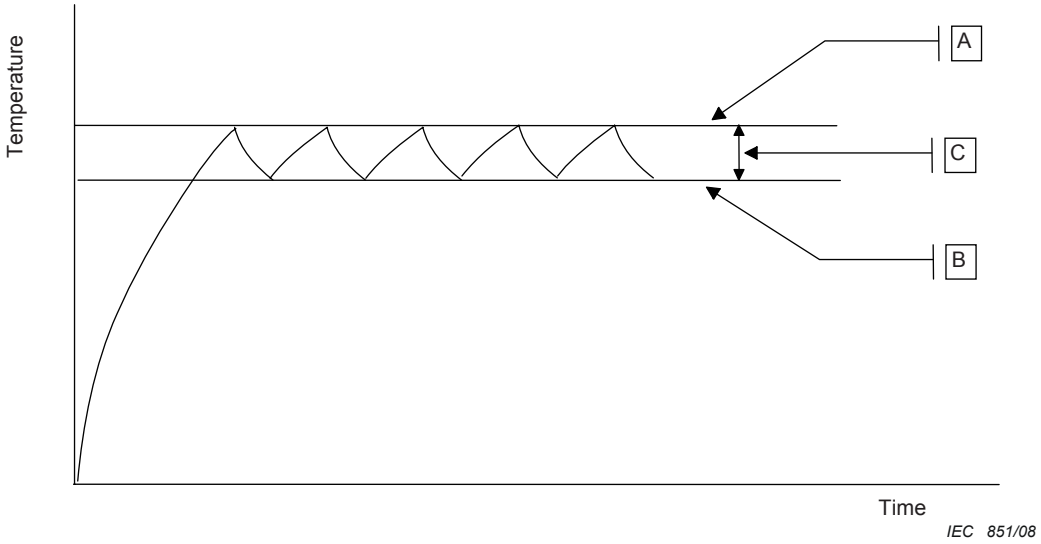
A detailed guide to the application of the various types of temperature sensing controls is given below.

EE.4.1 Thermostats

EE.4.1.1 Function

As defined, a thermostat is intended to operate automatically to keep the temperature of the controlled medium, air, water, oil, solid material or surface, between an upper and lower temperature, the difference being called the differential.

The type of controlled output is shown graphically in Figure EE.1.



Key

A Upper temperature

B Lower temperature

C Differential

Figure EE.1 – Thermostat

A thermostat can either be fixed setting or can have an actuating member for setting of the controlled temperature by the end user. For thermostats intended for integration or incorporation into equipment, means may also be provided for initial setting by the OEM or installer.

A thermostat is intended to operate during the normal operation of equipment, and the number of operations specified in Subclauses 6.10 and 6.11 should be selected to cover the expected number of operations during the estimated life of the equipment. This is primarily to determine its safe operation during the life of the equipment, and for Type 2 controls, to provide confidence that the operating temperature will be maintained within specified limits.

The failure of a thermostat to operate due to, for example, welded contacts, is normally protected against in equipment by provision of a thermal cut out, or a single operation device.

EE.4.1.2 Examples of operation

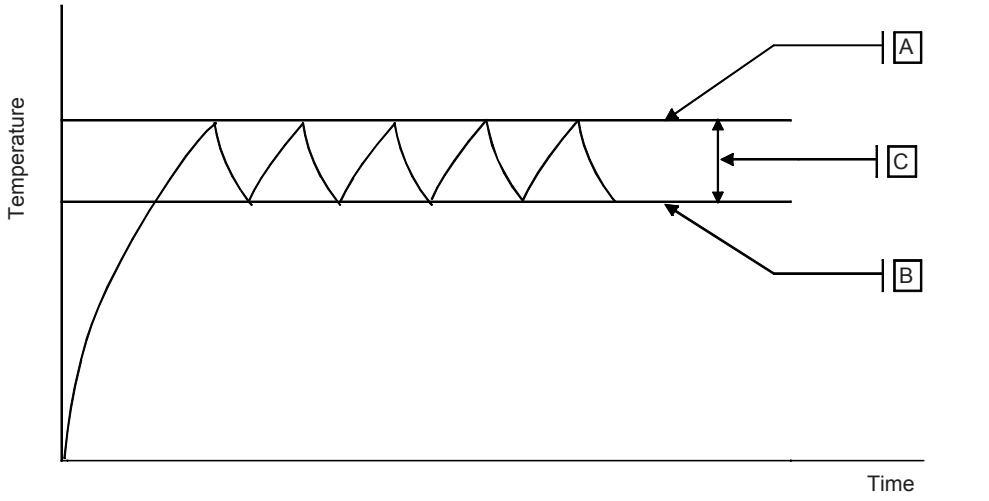
Refer to Table EE.1.

EE.4.2 Temperature limiter

EE.4.2.1 Function

As defined, a temperature limiter is intended to operate to keep the temperature of the controlled medium, air, water, oil, solid material or surface, above or below the set temperature.

The type of controlled output is shown graphically in Figures EE.2 and EE.3.



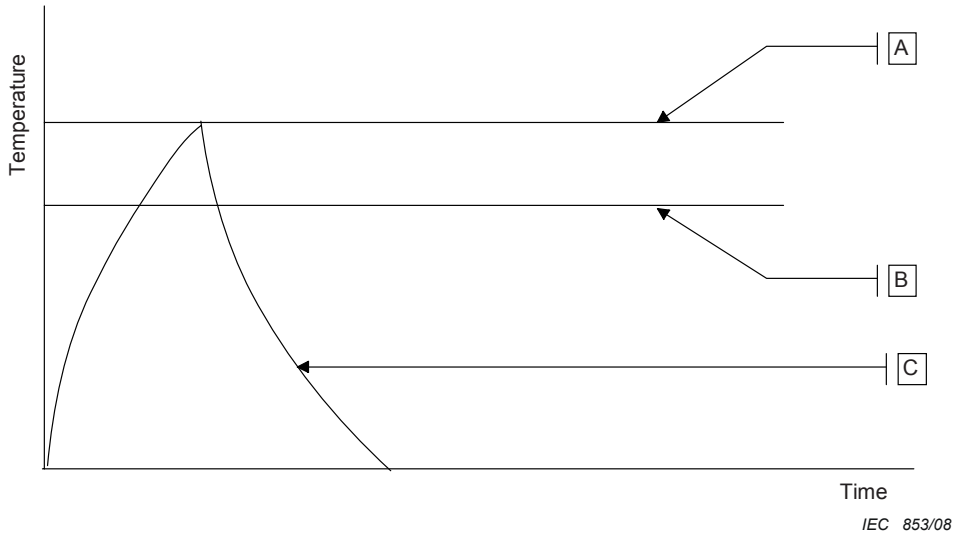
Key

A Upper temperature

B Lower temperature

C Differential (usually much larger than a thermostat)

Figure EE.2 – Self-resetting temperature limiter



Key

A Set temperature

B Reset temperature

C Requires manual reset

Figure EE.3 – Non-self-resetting temperature limiter

A temperature limiter can either be fixed setting or can have an actuating member for setting of the temperature by the end user. For temperature limiters intended for integration or incorporation into equipment, means may also be provided for initial setting by the OEM or installer.

A temperature limiter is intended to operate during the normal operation of an equipment and the number of operations specified in 6.10 and 6.11 should be selected to cover the expected number of operations during the estimated life of the equipment. This is primarily to determine its safe operation during the life of the equipment, and for Type 2 controls, to provide confidence that the operating temperature will be maintained within specified limits.

The failure of a temperature limiter to operate due to, for example, welded contacts, is normally protected against in an equipment by provision of a thermal cut out, or single operation device.

The construction of an automatic reset temperature limiter can be identical to a thermostat, differing only in the manner in which it has been tested, although frequently it will have a larger differential between the upper and lower operating temperature.

EE.4.2.2 Examples of operation

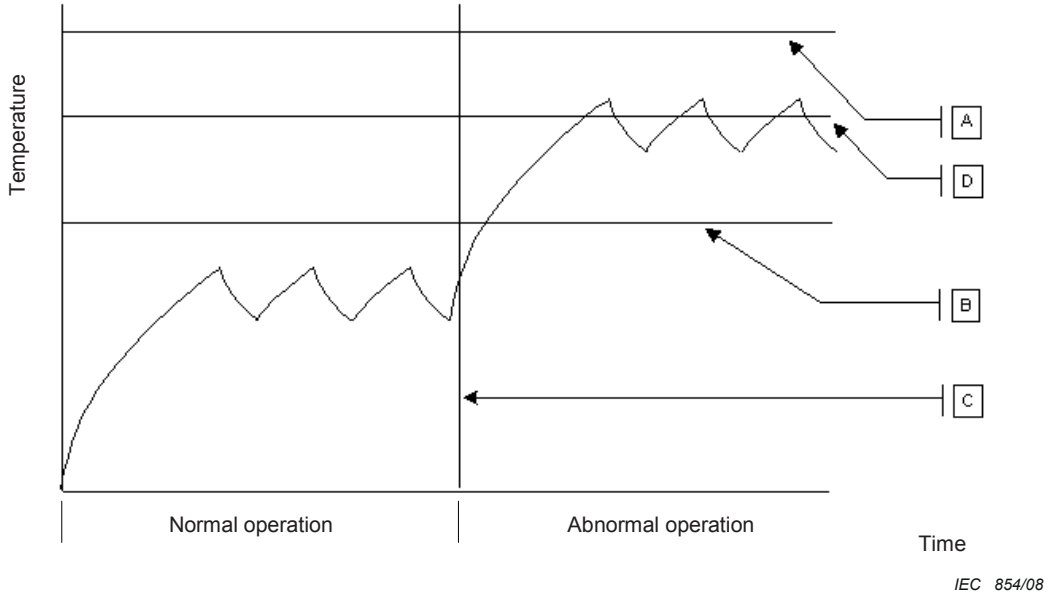
Refer to Table EE.1.

EE.4.3 Thermal cut-out

EE.4.3.1 Function

As defined, a thermal cut-out is intended to keep the temperature of the controlled medium, air, water, oil, solid material or surface, above or below the set temperature, during abnormal operation of an equipment.

The type of controlled output is shown graphically in Figures EE.4 and EE.5.



Key

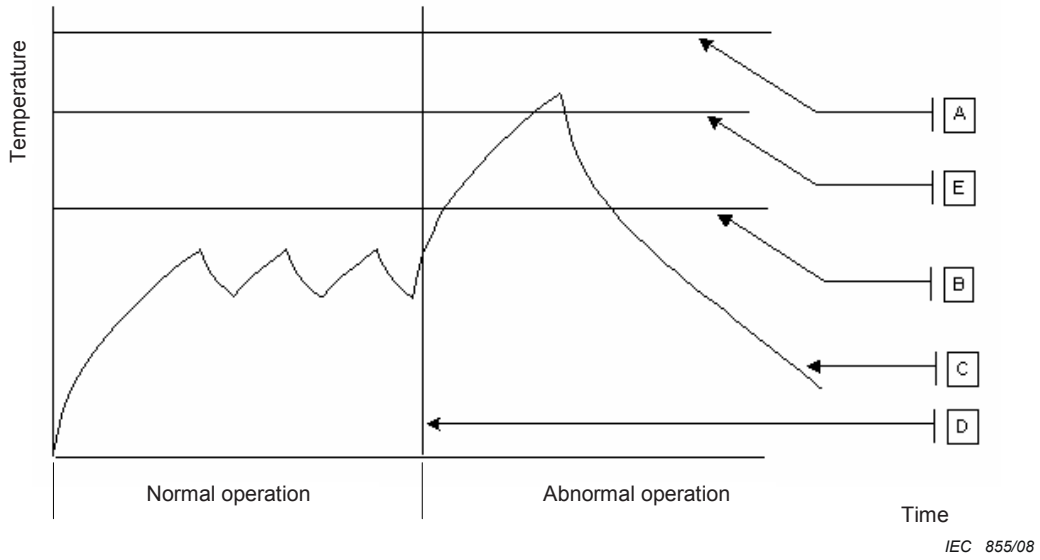
A Hazard temperature

B Maximum temperature during normal use

C Fault condition

D Thermal cut-out temperature

Figure EE.4 – Self-resetting thermal cut-out



Key

A Hazard temperature

B Maximum temperature during normal use

C Requires manual reset

D Fault condition

E Thermal cut-out temperature

Figure EE.5 – Manual reset thermal cut-out

A thermal cut-out can be either automatic or manual reset, and does not incorporate an actuating member for setting of the controlled temperature by the end user. For thermal cut outs intended for integration or incorporation into an equipment, means may also be provided for initial setting by the OEM or installer.

A thermal cut-out is intended to operate only during abnormal operation of an equipment, and the number of operations specified in 6.10 and 6.11 is dependent on the type and usage pattern of the equipment. Equipment standards normally specify the number of operations required for protective controls, such as thermal cut-outs.

Thermal cut-outs will normally be classified as Type 2 controls, but this is dependent on customer requirements, and/or the requirements specified in the relevant equipment standard.

The number of operations specified is therefore normally to determine its safe operation during the life of the equipment, and to provide confidence that the operating temperature will be maintained within specified limits.

The operation of a thermal cut out is usually the final protective control against a hazard or fault condition within equipment.

The construction of thermal cut-outs can be identical to thermostats or temperature limiters, differing only in the manner in which they have been tested.

EE.4.3.2 Examples of operation

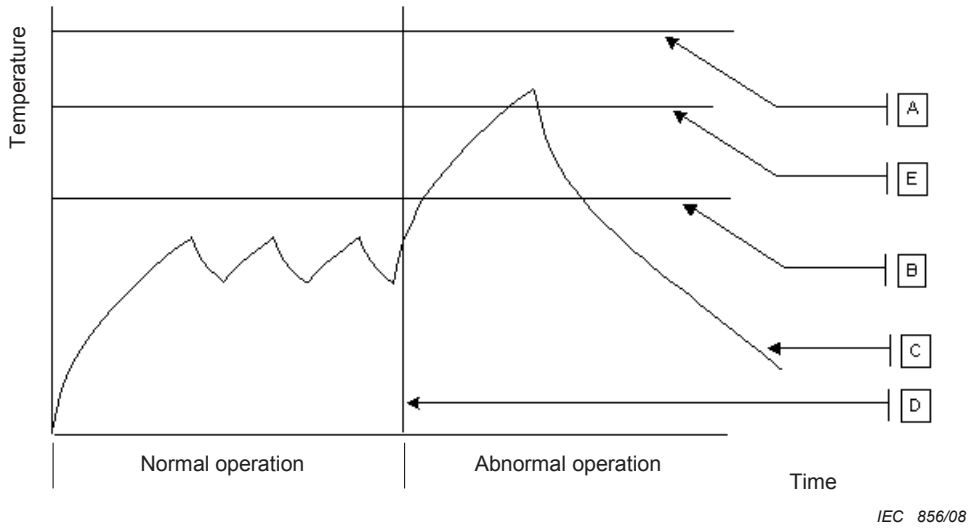
Refer to Table EE.1.

EE.4.4 Single operation device

EE.4.4.1 Application

As defined, a single operation device is intended to keep the temperature of the controlled medium, air, water, oil, solid material or surface, below the set temperature, during abnormal operation of equipment.

The type of controlled output is shown graphically in Figure EE.6.



Key

A Hazard temperature

B Maximum temperature during normal use

C Requires replacement of the control or part

D Fault condition

E Single operation device cut out temperature

Figure EE.6 – Single operation device

A single operation device has no means of temperature setting after manufacture and is intended to be non-resettable, i.e. a thermal fuse, requiring complete replacement of the control or a part of the control.

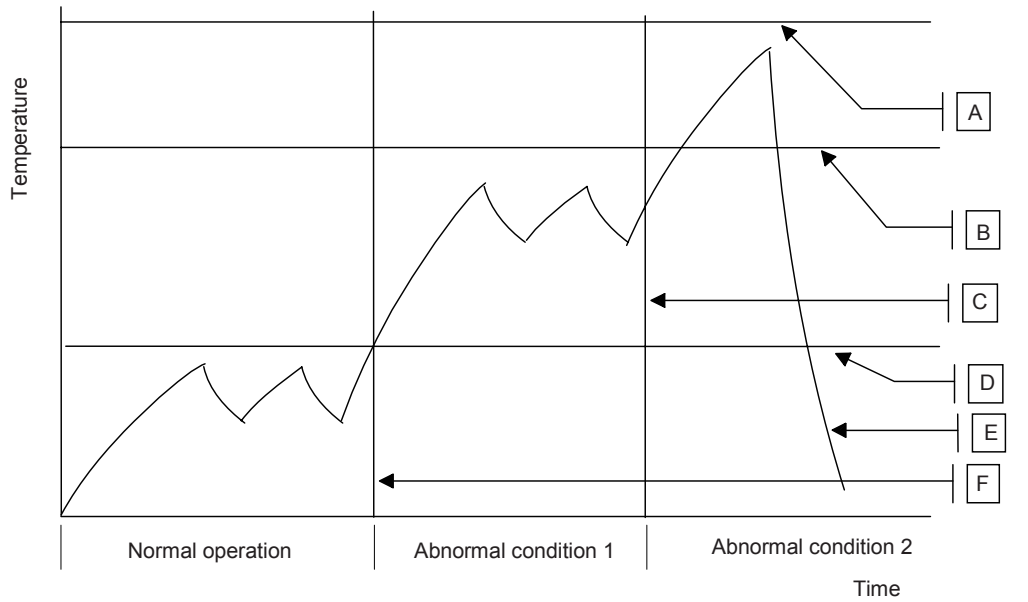
Bimetallic types do however exist which can be reset with specialist equipment.

EE.4.4.2 Examples of operation

Refer to Table EE.1.

Single operation devices are sometimes used in a three-stage control system, comprising a thermostat, a thermal cut out and a single operation device.

Such a system is shown graphically in Figure EE.7.



Key

A Final hazard temperature (abnormal condition 2)

B Interim hazard temperature (abnormal condition 1)

C Failure of thermal cut-out, or abnormal condition to which the thermal cut-out is not responsive

D Maximum temperature during normal use

E Requires replacement of control or part

F Fault condition

Figure EE.7 – Three-stage control system

EE.4.4.3 Examples of application

Refer to Table EE.1.

Table EE.1 – Typical examples of the classification of temperature sensing controls in accordance with IEC 60730-2-9

Classification	Declaration/Action																	
	Type 1	Type 2	A	B	C	D	E	F	G	H	J	K	L	M	N	P	X	Z
Control Application																		
Thermostat in room heaters		X		X	X								X					
Manual reset thermal cut-out in room heaters (small)		X		X		X		X		X		X	X	X		X		
Thermal cut-out for electric kettles		X		X				X										
Temperature limiter in electric kettles	X		X	X														
Auto reset thermal cut-out in space heaters (dwelling)		X		X														
Manual reset thermal cut-out in space heaters		X		X	X	X			X									
Thermal cut-out for refrigerator compressor control (for thermal motor protector, refer to IEC 60730-2-4)		X			X													
Thermal cut-out for room heaters		X			X													
Thermal cut-out for hair dryers		X			X													
Thermal cut-out for transformers		X			X													
Thermal cut-out for fans		X			X													

———————

〈C〉 Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60216-1	-	Electrical insulating materials - Properties of thermal endurance - Part 1: Ageing procedures and evaluation of test results	EN 60216-1	-
IEC 60335	series	Household and similar electrical appliances - Safety	EN 60335	series
IEC 60691 + A1	2002 2006	Thermal-links - Requirements and application guide	EN 60691 + A1	2003 2007
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 〈C〉	EN 60730-2-4	-

[C〉 Annex ZZ
(informative)

Coverage of Essential Requirements of EC Directives

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and within its scope the standard covers all relevant essential requirements as given in Article 1 of Annex I of the EC Directive EMC (2004/108/EC).

Compliance with this standard provides one means of conformity with the specified essential requirements of the Directive concerned.

WARNING: Other requirements and other EC Directives may be applicable to the products falling within the scope of this standard. 〈C]

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