



BSI Standards Publication

Automatic electrical controls

Part 1: General requirements

National foreword

This British Standard is the UK implementation of EN 60730-1:2016+A2:2022. It is derived from IEC 60730-1:2013, incorporating corrigenda September 2014 and amendment 1:2015 and amendment 2:2020. It supersedes BS EN 60730-1:2016, which is withdrawn.

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 start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment A1 is indicated by **[A1]** **[A1]**.

The start and finish of text introduced or altered by corrigendum is indicated in the text by tags. Text altered by IEC corrigendum September 2014 is indicated in the text by **[AC1]** **[AC1]**.

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 committee manager.

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Amendments/corrigenda issued since publication

Date	Text affected
31 May 2019	Addition of CENELEC endorsement pages
31 October 2022	Implementation of IEC amendment 2:2020 with CENELEC endorsement A2:2022

English Version

Automatic electrical controls - Part 1: General requirements

Dispositifs de commande électrique automatiques - Partie
1: Exigences générales

Automatische elektrische Regel- und Steuergeräte - Teil 1:
Allgemeine Anforderungen

This European Standard was approved by CENELEC on 2016-03-01. 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 CEN-CENELEC Management Centre 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 CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

This document (EN 60730-1:2016) consists of the text of IEC 60730-1:2013 + corrigendum 1:2014 prepared by IEC/TC 72 "Automatic electrical controls", together with the common modifications prepared by CLC/TC 72 "Automatic controls for household use".

The following dates are fixed:

- latest date by which the document has to be implemented at national level (dop) 2017-01-29
by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) - *

** Justification for no dow:*

This European Standard supersedes EN 60730-1:2011. However, EN 60730-1:2011 remains valid until all the Part 2's which are used in conjunction with it have been withdrawn. No date of withdrawal (dow) has been given pending the updating of all the Part 2's to align with this EN 60730-1:2016. The applicable date of withdrawal is given in each Part 2. It is intended the dow for this Part 1 will be fixed once all the Part 2's have been updated.

This document supersedes EN 60730-1:2011.

EN 60730-1:2016 includes the following significant technical changes with respect to EN 60730-1:2011:

- changes of the title of the Standard into "*Automatic electrical controls – Part 1: General requirements*";
- revisions to Clause H.26 based on changes in technology, applications, and to improve consistency and layout;
- modification to Table H.12 to align with CISPR 22;
- revisions to Annex J to correlate the fault modes of thermistors, and to exempt thermistors used in conjunction with type 1 controls in SELV low power circuits from the tests specified in Annex J;
- new requirements covering battery-powered controls, and the use of batteries in controls;
- revision addressing the relay faults in Table H.24;
- new/updated requirements in Clause 24, for switch mode power supplies;
- revisions covering the allowance of screwless-type clamping units complying with IEC 60999-1;
- new requirements addressing remotely actuated control functions;
- addition of a new/updated leakage current diagram to align the Annex E diagram with the diagram in IEC 60990;
- updated requirements for temperature sensing controls.

This Part 1 is to be used in conjunction with the appropriate Part 2 for a particular type of control, or for controls for particular applications. This Part 1 may also be applied, so far as reasonable, to controls not mentioned in a Part 2, and to controls designed on new principles, in which case additional requirements may be considered to be necessary.

Where, for a particular clause or subclause, the text of Part 2 indicates:

Addition: the Part 1 text applies with the additional requirement indicated in a Part 2;

Modification: the Part 1 text applies with a minor change as indicated in a Part 2;

Replacement: the Part 2 text contains a change which replaces the Part 1 text in its entirety.

Where no change is necessary, the Part 2 indicates that the relevant clause or subclause applies.

NOTE In this standard the following print types are used:

- Requirements proper: in roman type.
- *Test specifications: in italic type.*
- Explanatory matter: in smaller roman type.
- Defined terms: **bold type**.

Some table titles contain reference in brackets to table numbers in IEC 60730-1:1999 (edition 3) for ease of correlation between Parts 2 and the Part 1.

Clauses, subclauses, notes, tables, figures and annexes which are additional to those in IEC 60730-1:2013 are prefixed “Z”.

Special national conditions are listed in Annex ZB (normative) which forms part of this standard.

National deviations are listed in Annex ZC (informative).

Endorsement notice

The text of the International Standard IEC 60730-1:2013 was approved by CENELEC as a European Standard with agreed common modifications.

Foreword to amendment A1

The text of document 72/1017/FDIS, future IEC 60730-1:2013/A1, prepared by IEC/TC 72 "Automatic electrical controls" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60730-1:2016/A1:2019.

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national level by publication of an identical national
standard or by endorsement
- latest date by which the national standards conflicting with (dow) 2022-04-12
the document have to be withdrawn

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

Endorsement notice

The text of the International Standard IEC 60730-1:2013/A1:2015 was approved by CENELEC as a European Standard without any modification.

European foreword to amendment A2

The text of document 72/1226/FDIS, future IEC 60730-1/A2, prepared by IEC/TC 72 "Automatic electrical controls" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60730-1:2016/A2:2022.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2022-11-23
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) -

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

This document has been prepared under a Standardization Request given to CENELEC by the European Commission and the European Free Trade Association.

Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website.

Endorsement notice

The text of the International Standard IEC 60730-1:2013/A2:2020 was approved by CENELEC as a European Standard without any modification.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60664-3	2016	Insulation coordination for equipment within low-voltage systems - Part 3: Use of coating, potting or moulding for protection against pollution	EN 60664-3	2017
IEC 61051-1	-	Varistors for use in electronic equipment - Part 1: Generic specification	EN IEC 61051-1	-
IEC 61051-2	-	Varistors for use in electronic equipment - Part 2: Sectional specification for surge suppression varistors	EN IEC 61051-2	-
IEC 61051-2-2	-	Varistors for use in electronic equipment - Part 2: Blank detail specification for zinc oxide surge suppression varistors - Assessment level E	-	-
IEC 63044-3	-	Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS) - Part 3: Electrical safety requirements	EN IEC 63044-3	-

Annex ZB
(normative)

Special national conditions

Special national condition: National characteristic or practice that cannot be changed even over a long period, e.g. climatic conditions, electrical earthing conditions.

NOTE If it affects harmonization, it forms part of the European Standard.

For the countries in which the relevant special national conditions apply these provisions are normative, for other countries they are informative.

<u>Clause</u>	<u>Special national condition</u>
2.7.2	Austria, Belgium, Denmark, France, Germany, Italy, Norway and United Kingdom Class 0 controls are not allowed.
2.7.3	Austria, Belgium, Denmark, France, Germany, Italy, Norway and United Kingdom Class 01 controls are not allowed.
2.7.5.3	Austria, Belgium, Denmark, France, Germany, Italy, Norway and United Kingdom Class 01 controls are not allowed.
4.3.3.1	Austria, Belgium, Denmark, France, Germany, Italy, Norway and United Kingdom Class 0 and Class 01 controls are not allowed.
4.3.3.3	Austria, Belgium, Denmark, France, Germany, Italy, Norway and United Kingdom Class 0 and Class 01 controls are not allowed.
6.8.2.1	Austria, Belgium, Denmark, France, Germany, Italy, Norway and United Kingdom Class 0 controls are not allowed.
6.8.2.2	Austria, Belgium, Denmark, France, Germany, Italy, Norway and United Kingdom Class 01 controls are not allowed.
6.8.3.1	Austria, Belgium, Denmark, France, Germany, Italy, Norway and United Kingdom Class 0 controls are not allowed.
6.8.3.2	Austria, Belgium, Denmark, France, Germany, Italy, Norway and United Kingdom Class 01 controls are not allowed.

7.4.3 **United Kingdom**

Add to the requirement:

Terminals intended exclusively for a live external conductor shall be indicated by the letter 'L'.

7.4.3.2 **United Kingdom**

Add to the requirement:

The letter 'L' shall not be used except as indicated above.

9.1.1 **Austria, Belgium, Denmark, France, Germany, Italy, Norway and United Kingdom**

Class 01 controls are not allowed.

9.1.2 **Austria, Belgium, Denmark, France, Germany, Italy, Norway and United Kingdom**

Class 01 controls are not allowed.

11.9.4 **Austria, Belgium, Denmark, France, Germany, Italy, Norway and United Kingdom**

Class 01 controls are not allowed.

Table 12 **Austria, Belgium, Denmark, France, Germany, Italy, Norway and United Kingdom**

Table footnote ^d Class 01 controls are not allowed.

16.2.1 **Finland, Norway and Sweden**

In the first dashed paragraph, replace " $(-10 \pm 2) ^\circ\text{C}$ " by " $(-25 \pm 2) ^\circ\text{C}$ ".

Annex ZC
(informative)

A-deviations

A-deviation: National deviation due to regulations, the alteration of which is for the time being outside the competence of the CEN-CENELEC national member.

This European Standard falls under Directives LVD (2006/95/EC), RTTED (1999/5/EC) and EMC (2004/108/EC).

NOTE (from CEN/CENELEC IR Part 2:2011, 2.17) Where standards fall under EU Directives, it is the view of the Commission of the European Communities (OJ No C 59, 1982-03-09) that the effect of the decision of the Court of Justice in case 815/79 Cremonini/Vrankovich (European Court Reports 1980, p. 3583) is that compliance with A-deviations is no longer mandatory and that the free movement of products complying with such a standard should not be restricted except under the safeguard procedure provided for in the relevant Directive.

A-deviations in an EFTA-country are valid instead of the relevant provisions of the European Standard in that country until they have been removed.

<u>Clause</u>	<u>Deviation</u>
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11.1.2	Sweden (Ordinance 1991:1290)
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Mercury is not allowed in switches and controls, such as level switches, thermostats and relays.

11.1.3	United Kingdom (Statutory Instrument 1768:1994)
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Add to the requirement:

These regulations apply to all plugs for domestic use at a voltage of not less than 200 V and in general allow only plugs to BS 1363 to be fitted.

Annex ZD (normative)

EMC immunity for controls

ZD.1 Electromagnetic compatibility (EMC) requirements – Immunity

The tests of Annex ZD apply to **operating controls of Type 1 action** intended to be used as “**free standing controls, independently mounted and/or in-line cord controls**” for EMC immunity instead of Clause H.26. See Figure ZD.1.

Annex ZD may be made applicable to incorporated and/or integrated controls if so requested by their manufacturer.

NOTE For EMC emission, Clause H.23 applies.

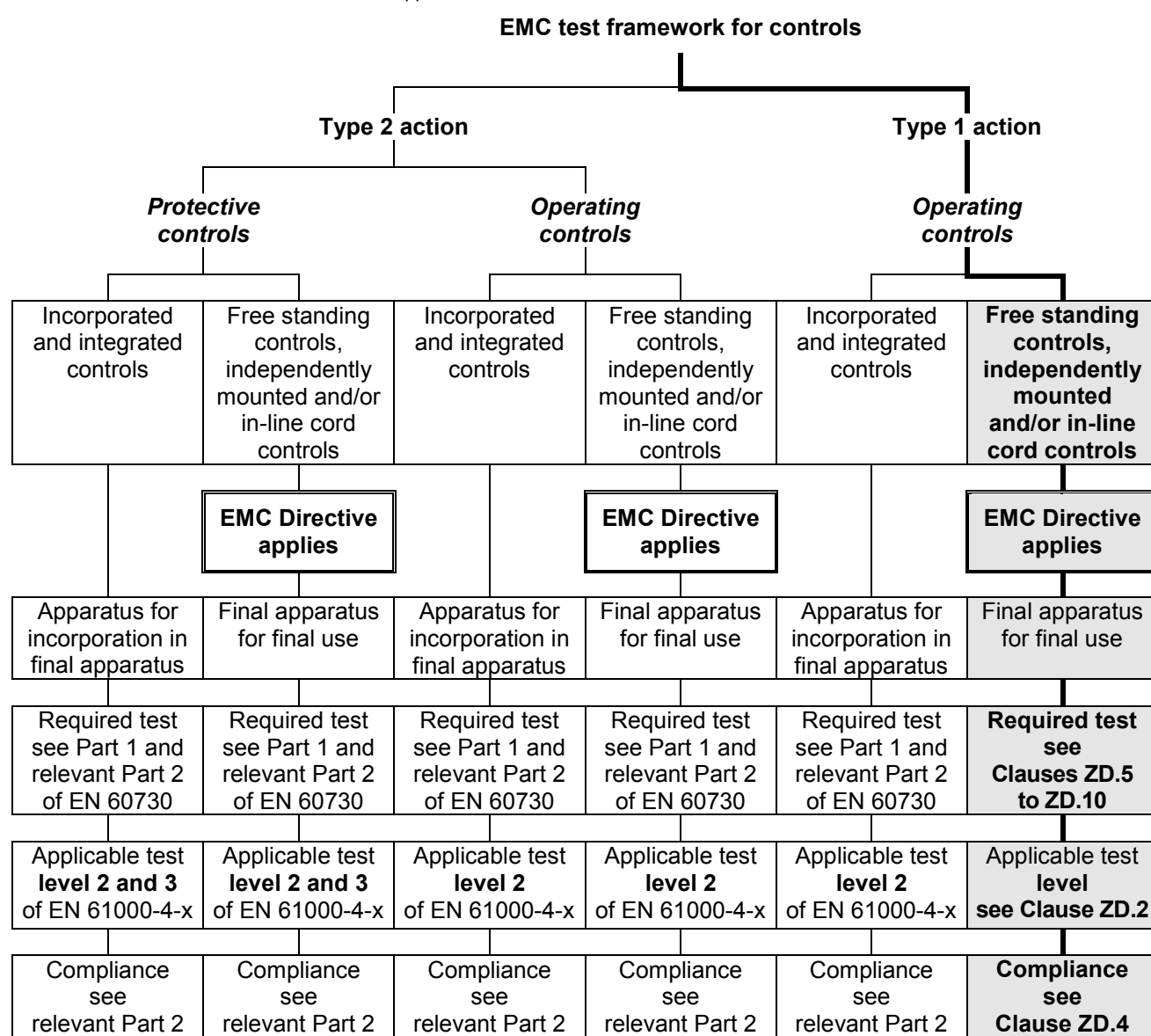


Figure ZD.1 – EMC test framework for controls

ZD.2 Classification of the control

Table ZD.1 – Classification and test overview

Control declaration	Installation and environmental condition									
	ESD		Radiated EMF field			Burst	Surge	Conducted disturbance	Power magnetic field	Voltage dips & interruption
	Environmental class EN 61000-4-2		Environmental class EN 61000-4-3 ^d			Environment class EN 61000-4-4	Installation class ^c EN 61000-4-5	Environment class EN 61000-4-6	Environment class EN 61000-4-8	Environment class EN 61000-4-11
EMC level	Level 2	Level 3	Level 2	Level 2	Level 1	Level 2	Class 2	Level 2	Level 2	Class 2
Residential ^a	Contact discharge	Air discharge	< 1,0 GHz	1,4 GHz ... 2,0 GHz	2,0 GHz ... 2,7 GHz	Protected	Power and signal cables are well separated		Well protected	
EMC level	Level 2	Level 3	Level 3	Level 2	Level 1	Level 3	Class 3	Level 3	Level 4	Class 3
Industrial ^b	Contact discharge	Air discharge	< 1,0 GHz	1,4 GHz ... 2,0 GHz	2,0 GHz ... 2,7 GHz	Typical industrial	Power and signal cables run in parallel		Typical industrial	
^a Residential: Controls are restricted for the use only in residential, commercial and light industrial environment (EN 61000-6-1). ^b Industrial: In addition to residential, controls are also suitable for industrial environment (EN 61000-6-2). ^c Installation classes: see Annex R. ^d EN 61000-4-20 may be used for small EUT's as defined in EN 61000-4-20:2010, 6.1.										

ZD.3 Information

Additional items to Table 1 (7.2 of the previous edition):

Information		Clause or subclause	Method
Z3	According to the electromagnetic environment of one of the two EMC levels	ZD.2	X
Z4	EUT to be tested without primary protection, Table ZD.3, footnote ^a	ZD.5	X
Z5	Cable length up to or equal to 30 m, Table ZD.3, footnote ^b	ZD.5	X
Z6	Data line length < 10 m, Table ZD.3, footnote ^c	ZD.5	X
Z7	Test level (= protection level when upstream protection is not in place), Table ZD.3, footnote ^d	ZD.5	X
Z8	Data line length up to and including 3 m, Table ZD.5	ZD.5	X
Z9	Applicable of test and frequency, Table ZD.9	ZD.9	X

ZD.4 Evaluation of compliance

The compliance criteria are given in Table ZD.2 and are based on the operating conditions and the functional specification of the control during and after the test.

Number of test samples: minimum one sample

After the test, the control shall meet the requirements of Clause 8, 17.5 and Clause 20. If, as a result of the application of the tests defined in Annex ZD, the control becomes dangerous or unsafe, the control shall be deemed to have failed the test.

Table ZD.2 – Compliance criteria

Operating conditions	Compliance criteria		
	A	B	C
Digital inputs/outputs	No deviation on input readings No deviation on output settings (no change of state)	No deviation on input readings No deviation on output settings (no change of state)	Any error, such as a change of state, destruction of data, and loss of a connection is permitted, provided the initial state is restored automatically after the test - Automatic recovery after the test ^b
Analogue inputs/outputs	Deviation as declared in the final product specification is permitted ^a .	Deviation is permitted during test.	
Display, Monitor	Operation shall be possible at reasonable comfort.	Deviation is permitted (e.g. display fault, such as flickering)	
Local operator override / switching	No deviation	Deviation is permitted for analogue values. No change of state for digital values	
Communication ports	No deviation detectable by the user The reduced data transfer rate shall be reasonable for the control operation.	Deviation is permitted. Loss of communication during the test Automatic recovery after the test	
^a The permissible deviation is with respect to the value without electromagnetic interference. This means that any basic deviation is ignored. ^b This compliance criterion is based on the fact that the control operation in the end user application will be unsupervised.			

ZD.5 Surge immunity test

The control is mounted as specified in 4.1.1, supplied at rated voltage and operated at representative operating conditions. It is tested in accordance with EN 61000-4-5.

The severity levels for the declared installation class are specified in Table ZD.3.

Repetition rate: maximum 1/min

Polarity: positive (+) and negative (-)

Number of pulses: at least five pulses for each polarity are applied at selected points

Phase angle: 0°, 90°, 180° and 270° versus the phase angle of the AC line voltage to the equipment under test, with a tolerance of $\pm 10^\circ$

NOTE Most protectors in common use have low average power capabilities, even though their peak power or peak energy handling can deal with high currents. Therefore, the maximum repetition rate (the time between two surges and the recovery time) depends on the built-in protection devices of the EUT.

Table ZD.3 – Test levels for voltage surges

Control declaration	Test levels											
	kV											
	AC power supply and AC I/O directly connected to mains network		AC power supply and AC I/O not directly connected to mains network		DC power supply and DC I/O directly connected thereto		Unsymmetrical operated circuits/lines ^c		Symmetrical operated circuits/lines ^c		Shielded I/O and shielded communication lines	
	Coupling mode		Coupling mode		Coupling mode		Coupling mode		Coupling mode		Coupling mode	
EMC Level	line to line	line to earth	line to line	line to earth	line to line	line to earth	line to line	line to earth	line to line	line to earth	line to line	line to earth
Residential	1	2,0	NA	NA	NA	NA	0,5	1,0	NA	1,0	NA	0,5
Industrial	1,0	2,0	1,0 ^d	2,0 ^{a,d}	0,5 ^e	0,5 ^e	1,0 ^b	2,0 ^{a,b}	NA	2,0 ^{a,b}	NA	2,0 ^b
^a Normally tested with primary protection unless declared otherwise by the manufacturer (Clause ZD.3, requirement Z4). ^b The test level shall be lowered to the next lower one if the cable length is shorter than or equal to 30 m (Clause ZD.3, requirement Z5). ^c This test is not applicable to interconnection cables used as data lines and a length of up to 10 m (Clause ZD.3, requirement Z6). ^d If protection is specified upstream from the EUT, the test level should correspond to the protection level when the protection is not in place (Clause ZD.3, requirement Z7). ^e Not applicable to input ports intended for connection to a battery or a rechargeable battery that must be removed or disconnected from the apparatus for recharging. Apparatus with a DC power input port intended for use with an AC–DC power adaptor shall be tested on the AC power input of the AC–DC power adaptor specified by the manufacturer or, where none is so specified, using a typical AC–DC power adaptor. DC ports, which are not intended to be connected to a DC distribution network are treated as signal ports.												

Compliance criteria: B (see Table ZD.2)

ZD.6 Electrical fast transient/burst immunity test

The control is mounted as specified in 4.1.1, supplied at rated voltage and operated at representative operating conditions. It is tested in accordance with EN 61000-4-4.

The severity levels for the declared EMC level are specified in Table ZD.4.

Polarity: positive (+) and negative (-)

Duration: one minute for each polarity

Table ZD.4 – Test levels for burst

Control declaration	Open circuit output test voltage and repetition rate of the impulses			
	On power port, PE		On I/O (input/output) signal, data and control ports	
	Voltage peak kV	Repetition rate kHz	Voltage peak kV	Repetition rate kHz
Residential	1	5	0,5	5
Industrial	2	5	1	5

Table ZD.5 – Test application for electrical fast transient burst test

AC power supply and control output for direct connection to the supply	DC power supply and control outputs for direct connection to the supply	Data lines ^a
Direct application via CDN according to EN 61000-4-4 between the reference ground plane and – each power supply line, individually – the nearest protective earth terminal – to all multiple combinations of power supply lines and also earth line	Capacitive clamp ^b	Capacitive clamp
^a Applicable only to lines longer than 3 m, according to the manufacturer's declaration (Clause ZD.3, requirement Z8). ^b Not applicable to lines connected to dedicated non-rechargeable power supplies.		

Compliance criteria B: (see Table ZD.2)

ZD.7 Radio-frequency electromagnetic field immunity

ZD.7.1 Immunity to conducted disturbances

The control is mounted as specified in 4.1.1, supplied at rated voltage and operated at representative operating conditions. It is tested in accordance with EN 61000-4-6, the complete frequency range being swept at least once.

The severity levels for the declared EMC level are specified in Table ZD.6.

Table ZD.6 – Test levels for conducted disturbances on mains, I/O lines and DC power lines

Control declaration EMC level	Frequency ranges: 150 kHz – 80 MHz	
	Voltage level (EMF)	
	U_0 dB μ V	U_0 V
Residential	130 ^{a c d}	3 ^{a c d}
Industrial	140 ^{a b c}	10 ^{a b c}

^a The test level can also be defined as the equivalent current into a 150 Ω load.

^b Except for the ITU broadcast frequency band 47 MHz to 68 MHz, where the level shall be 3 V.

^c For I/O lines only applicable if the total cable length according to the manufacturer's functional specification may exceed 3 m.

^d For input and output DC power port lines only applicable if the total cable length according to the manufacturer's functional specification may exceed 3 m.

Compliance criteria A: (see Table ZD.2)

ZD.7.2 Electrostatic discharge

The control is mounted as specified in 4.1.1, supplied at rated voltage and operated at representative operating conditions. It is tested in accordance with EN 61000-4-2.

The severity levels for the declared EMC level are specified in Table ZD.7.

Number of discharges for direct:	at least 5 discharges in each polarity (+/-)
Number of discharges for indirect horizontal: (Horizontal coupling plane)	at least 5 discharges in each polarity (+/-) for each position opposite the centre point of the horizontal coupling plane
Number of discharges for indirect vertical: (Vertical coupling plane)	at least 5 discharges in each polarity (+/-)

Table ZD.7 – Test levels for electrostatic discharge

Control declaration EMC level		Contact discharge	Air discharge
		Test voltage kV	Test voltage kV
Residential and Industrial	Direct	4	8
	Indirect	4	Not applicable

Compliance criteria B: (see Table ZD.2)

ZD.8 Immunity to radiated electromagnetic fields

The control is mounted as specified in 4.1.1, supplied at rated voltage and operated at representative operating conditions. It is tested in accordance with EN 61000-4-3, the complete frequency range being swept at least once.

The severity levels for the declared EMC level are specified in Table ZD.8.

Table ZD.8 – Test levels for radiated electromagnetic field on enclosure

Control declaration EMC level	Frequency ranges		
	80 MHz to 1 GHz	1,4 GHz to 2 GHz	2,0 GHz to 2,7 GHz
	Field strength V/m	Field strength V/m	Field strength V/m
Residential	3	3 ^a	1 ^a
Industrial	10 ^b	3 ^a	1 ^a

^a The frequency range has been selected to cover the frequencies with the highest potential risk of a disturbance.

^b Except for the ITU broadcast frequency bands 87 MHz to 108 MHz, 174 MHz to 230 MHz, and 470 MHz to 790 MHz, where the level shall be 3 V/m.

Compliance criteria A: (see Table ZD.2)

ZD.9 Immunity to power-frequency magnetic fields

This test is only applicable to controls containing devices susceptible to magnetic fields. (e.g. hall-effect devices) and if declared by the manufacturer (Clause ZD.3, requirement Z9).

Such a control is supplied at rated voltage and operated at representative operating conditions. It is tested in accordance with EN 61000-4-8.

The severity levels for the declared EMC level are specified in Table ZD.9.

Table ZD.9 – Test levels for power-frequency magnetic field on enclosure

Control declaration EMC level	Power A/m	Frequency Hz
Residential	3	50 / 60 ^a
Industrial	30	50 / 60 ^a
^a The test shall be carried out at the frequencies appropriate to the power supply frequency. Equipment intended for use in areas supplied only at one of these frequencies need only be tested at that frequency (Clause ZD.3, requirement Z9).		

Compliance criteria A: (see Table ZD.2)

ZD.10 Test of the influence of voltage dips and voltage interruption in the power supply network

During the test, the control shall be initially operated at its rated voltage. The control is operated at representative operating conditions.

It is tested in accordance with EN 61000-4-11. The test is only applicable to AC power input ports. The test levels for the declared EMC level are specified in Tables ZD.10 and ZD.11.

Table ZD.10 – Voltage dips (50 Hz / 60 Hz)

Control declaration EMC level	Voltage ΔU reduction	Duration in periods 50 Hz/60 Hz	Compliance criteria (see Table ZD.2)
Residential and industrial	30 %	25/30	C
Industrial	60 %	10/12	C
NOTE Voltage shift at zero crossing.			

Table ZD.11 – Voltage interruption (50 Hz / 60 Hz)

Control declaration EMC level	Voltage ΔU reduction	Duration in periods	Compliance criteria (see Table ZD.2)
Residential	100 %	0,5	B
Residential and industrial	100 %	1	B
Residential and industrial	100 %	250/300	C

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

AUTOMATIC ELECTRICAL CONTROLS –

Part 1: General requirements

FOREWORD

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International Standard IEC 60730-1 has been prepared by IEC technical committee 72: Automatic electrical controls.

This edition constitutes a technical revision. The major changes with respect to the previous edition are as follows.

- modification of the title and scope;
- revisions to Clause H.26 based on changes in technology, applications, and to improve consistency and layout;
- modification to Table H.12 to align with CISPR 22;
- revisions to Annex J to correlate the fault modes of thermistors and to exempt thermistors used in conjunction with type 1 controls in SELV low power circuits from the tests specified in Annex J;
- new requirements covering battery-powered controls, and the use of batteries in controls;
- revision addressing the exclusion of relay faults;
- new/updated requirements in Clause 24, for switch mode power supplies;
- revisions covering the allowance of screwless-type clamping units complying with IEC 60999-1;
- new requirements addressing remotely actuated control functions;
- addition of a new/updated leakage current diagram to align the Annex E diagram with the diagram in IEC 60990;
- updated requirements for temperature sensing controls.

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

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

The “in some countries” notes regarding differing national practices are contained in the following subclauses:

2.1.5	11.11.1.2	17.10.4
2.7.2	11.11.1.3	17.12.5
2.7.3	11.11.1.4	18.1.6
2.14.2	12.1.6	18.1.6.1
4.2.1	12.3	18.1.6.2
6.6.1	Table 12 (13.2.1), footnote a	18.1.6.3
Table 1 (7.2), footnote d	13.3.4	18.4
7.4.3	14.4	19.2.4.1
7.4.3.2	Table 13 (14.7.4), footnote f	19.2.5.1
8.1.1.1	15.1	21.1
8.4	16.2.1	21.4
9.3.2	17.1.3.1	27.2.3.1
9.3.4	17.2.2	Annex C
9.5.2	17.2.3	Annex D
Table 3 (10.1.4), footnote b	17.2.3.1	H.26.10
10.1.4.1	Table 14 (17.2.5)	Table H.18 (H.26.10.4)
10.1.14	Table 15 (17.2.5)	H.27.1.1.3
10.1.16	Table 16 (17.2.5)	Table K.1, footnote b
10.1.16.1	17.5.1	Table K.2, footnote b

Table 6 (10.2.1), footnote b	17.7.7	T.3.2
11.5	17.8.4.1	
Table 10 (11.8.2), footnote b	17.10	

It is envisaged that in the next edition of this standard it will be found possible to remove those differences that are covered by new IEC standards now being prepared by other technical committees.

This part 1 is to be used in conjunction with the appropriate part 2 for a particular type of control, or for controls for particular applications. This part 1 may also be applied, so far as reasonable, to controls not mentioned in a part 2, and to controls designed on new principles, in which cases additional requirements may be considered to be necessary.

Where, for a particular clause or subclause, the text of part 2 indicates:

Addition: the part 1 text applies with the additional requirement indicated in a part 2;

Modification: the part 1 text applies with a minor change as indicated in a part 2;

Replacement: the part 2 text contains a change which replaces the part 1 text in its entirety.

Where no change is necessary, the part 2 indicates that the relevant clause or subclause applies.

NOTE In this standard the following print types are used:

- Requirements proper: in roman type;
- *Test specifications: in italic type;*
- Explanatory matter: in smaller roman type;
- Defined terms: **bold type**.

Some table titles contain reference in brackets to table numbers in IEC 60730-1, edition 3 for ease of correlation between parts 2 and the Part 1.

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

The committee has decided that the contents of the base publication and its amendment will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

AUTOMATIC ELECTRICAL CONTROLS –

Part 1: General requirements

1 Scope and normative references

1.1 Scope

In general, this part of IEC 60730 applies to automatic **electrical controls** for use in, on, or in association with equipment for household and similar use. The equipment may use electricity, gas, oil, solid fuel, solar thermal energy, etc., or a combination thereof.

NOTE 1 Throughout this standard the word "equipment" means "appliance and equipment."

EXAMPLE 1 **Controls** for appliances within the scope of IEC 60335.

This International Standard is applicable to **controls** for building automation within the scope of ISO 16484.

This standard also applies to automatic **electrical controls** for equipment that may be used by the public, such as equipment intended to be used in shops, offices, hospitals, farms and commercial and industrial applications.

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

This standard is also applicable to individual **controls** utilized as part of a **control** system or **controls** which are mechanically integral with multifunctional **controls** having non-electrical outputs.

EXAMPLE 3 Independently mounted water valves, **controls** in smart grid systems and **controls** for building automation systems within the scope of ISO 16484-2.

This standard is also applicable to relays when used as **controls** for IEC 60335 appliances. Additional requirements for the safety and **operating values** of relays when used as **controls** for IEC 60335 appliances are contained in Annex U.

NOTE 2 These requirements are referred to in the scope of IEC 61810-1.

NOTE 3 This standard is intended to be used for the testing of any stand-alone relay which is intended to be used as a **control** of an appliance according to IEC 60335-1. It is not intended to be used for any other stand-alone relay, or to replace the IEC 61810 series of standards.

This standard does not apply to automatic **electrical controls** intended exclusively for industrial process applications unless explicitly mentioned in the relevant part 2 or the equipment standard.

 This standard applies to **controls** powered by primary or secondary batteries, requirements for which are contained within the standard, including Annex V. 

1.1.1 This International Standard applies to the inherent safety, to the **operating values**, **operating times**, and **operating sequences** where such are associated with equipment safety, and to the testing of automatic **electrical control** devices used in, or in association with, equipment.

This standard applies to **controls** using **thermistors**, see also Annex J.

This standard is also applicable to the **functional safety** of **low complexity safety related systems** and **controls**.

1.1.2 This standard applies to automatic **electrical controls**, mechanically or electrically operated, responsive to or controlling such characteristics as temperature, pressure, passage of time, humidity, light, electrostatic effects, flow, or liquid level, current, voltage, acceleration, or combinations thereof.

1.1.3 This standard applies to starting relays, which are a specific type of automatic **electrical control**, intended to switch the starting winding of a motor. Such **controls** may be built into, or be separate from, the motor.

☐ NOTE Starting relays are tested as voltage sensing or current sensing controls. ☐

1.1.4 This standard applies to **manual controls** when such are electrically and/or mechanically integral with **automatic controls**.

NOTE Requirements for manual switches not forming part of an **automatic control** are contained in IEC 61058-1.

1.1.5 This standard applies to a.c. or d.c. powered **controls** with a rated voltage not exceeding 690 V a.c. or 600 V d.c.

1.1.6 This standard does not take into account the **response value** of an **automatic action** of a **control**, if such a **response value** is dependent upon the method of mounting the **control** in the equipment. Where a **response value** is of significant purpose for the protection of the **user**, or surroundings, the value defined in the appropriate household equipment standard or as determined by the manufacturer shall apply.

1.1.7 This standard applies also to **controls** incorporating **electronic devices**, requirements for which are contained in Annex H.

1.1.8 This standard applies also to **controls** using NTC or PTC **thermistors**, requirements for which are contained in Annex J.

☐ **1.1.9** This standard applies to the electrical and **functional safety** of **controls** capable of receiving and responding to communications signals, including signals for power billing rate and demand response.

The signals may be transmitted to or received from external units being part of the **control** (wired), or to and from external units which are not part of the **control** (wireless) under test.

1.1.10 This standard does not address the integrity of the output signal to the network devices, such as interoperability with other devices unless it has been evaluated as part of the **control system**. ☐

1.2 Normative references

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

IEC 60038, *IEC standard voltages*

☐ EN 50525-2-11, *Electric cables – Low voltage energy cables of rated voltages up to and including 450/750 V (U_0/U) – Part 2-11: Cables for general applications – Flexible cables with thermoplastic PVC insulation*

EN 50525-2-21, *Electric cables – Low voltage energy cables of rated voltages up to and including 450/750 V (U_0/U) – Part 2-21: Cables for general applications – Flexible cables with crosslinked elastomeric insulation*

EN 55016-1-1, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus* (CISPR 16-1-1)

EN 60669-1:1999 + A1:2002 + A2:2008, *Switches for household and similar fixed-electrical installations – Part 1: General requirements* (IEC 60669-1:1998, mod. + A1:1999, mod. + A2:2006, mod.)

EN 60730 Series, *Automatic electrical controls for household and similar use* (IEC 60730 series) ☐

IEC 60065:2001, *Audio, video and similar electronic apparatus – Safety requirements*¹
Amendment 1:2005
Amendment 2:2010

IEC 60068-2-75, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*

IEC 60085, *Electrical insulation – Thermal evaluation and designation*

IEC 60099-1, *Surge arresters – Part 1: Non-linear resistor type gapped arresters for a.c. systems*²

IEC 60112:2003, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*³
Amendment 1:2009

IEC 60127-1, *Miniature fuses – Part 1: Definitions for miniature fuses and general requirements for miniature fuse-links*

IEC 60227-1, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 1: General requirements*

IEC 60245-1, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 1: General requirements*

IEC 60269-1, *Low-voltage fuses – Part 1: General requirements*

IEC 60335-1:2010, *Household and similar electrical appliances – Safety – Part 1: General requirements*

IEC 60364 (all parts), *Low-voltage electrical installations*

¹ There exists a consolidated edition 7.2:2011 including IEC 60065:2001 and its Amendments 1:2005 and 2:2010.

² Withdrawn.

³ There exists a consolidated edition 4.1:2009 including IEC 60112:2003 and its Amendment 1:2009

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IEC 60384-14, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*

IEC 60384-16, *Fixed capacitors for use in electronic equipment – Part 16: Sectional specification: Fixed metallized polypropylene film dielectric d.c. capacitors*

IEC 60384-17, *Fixed capacitors for use in electronic equipment – Part 17: Sectional specification: Fixed metallized polypropylene film dielectric a.c. and pulse capacitors*

IEC 60417 (all parts), *Graphical symbols for use on equipment*

IEC 60423, *Conduit systems for cable management – Outside diameters of conduits for electrical installations and threads for conduits and fittings*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP code)*⁴
Amendment 1:1999

IEC 60539 (all parts), *Directly heated negative temperature coefficient thermistors*

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

Ⓐ² IEC 60664-3:2016, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution* Ⓐ²

IEC 60664-4, *Insulation coordination for equipment within low-voltage systems – Part 4: Consideration of high-frequency voltage stress*

IEC 60695-2-10, *Fire Hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60695-2-11:2000, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products*

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

IEC 60738-1, *Thermistors – Directly heated positive temperature coefficient – Part 1: Generic specification*

IEC 60738-1-1, *Thermistors – Directly heated positive step-function temperature coefficient – Part 1-1: Blank detail specification – Current limiting application – Assessment level EZ*

⁴ There exists a consolidated edition 2.1:2001 including IEC 60529:1989 and its Amendment 1:1999.

IEC 60947-1:2007, *Low-voltage switchgear and controlgear – Part 1: General rules*

IEC 60998-2-2, *Connecting devices for low-voltage circuits for household and similar purposes – Part 2-2: Particular requirements for connecting devices as separate entities with screwless-type clamping units*

IEC 60998-2-3, *Connecting devices for low-voltage circuits for household and similar purposes – Part 2-3: Particular requirements for connecting devices as separate entities with insulation-piercing clamping units*

IEC 60999-1, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm² up to 35 mm² (included)*

IEC 61000 (all parts), *Electromagnetic compatibility (EMC)*

IEC 61000-3-2, *Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)*

IEC 61000-3-3:2008, *Electromagnetic compatibility (EMC) – Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection*

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-6, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61000-4-11, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*

IEC 61000-4-13:2002, *Electromagnetic compatibility (EMC) – Part 4-13: Testing and measurement techniques – Harmonics and interharmonics including mains signalling at a.c. power port, low frequency immunity tests*
Amendment 1:2009

IEC 61000-4-28, *Electromagnetic compatibility (EMC) – Part 4-28: Testing and measurements techniques – Variation of power frequency, immunity test*

A2 IEC 61051-1, *Varistors for use in electronic equipment – Part 1: Generic specification*

IEC 61051-2, *Varistors for use in electronic equipment – Part 2: Sectional specification for surge suppression varistors*

IEC 61051-2-2, *Varistors for use in electronic equipment – Part 2: Blank detail specification for zinc oxide surge suppression varistors. Assessment level E **A2***

IEC 61058-1, *Switches for appliances – Part 1: General requirements*

IEC 61210, *Connecting devices – Flat quick-connect terminations for electrical copper conductors – Safety requirements*

IEC 61249 (all parts), *Materials for printed boards and other interconnecting structures*

IEC 61558-2-6, *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V – Part 2-6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers*

IEC 61558-2-16, *Safety of transformers, reactors, power supply units and similar products for voltages up to 1 100 V – Part 2-16: Particular requirements and tests for switch mode power supply units and transformers for switch mode power supply units*

IEC 61643-11, *Low-voltage surge protective devices – Part 11: Surge protective devices connected to low-voltage power systems – Requirements and test methods*

A1 IEC 62151, *Safety of equipment electrically connected to a telecommunication network **A1***

IEC 62326 (all parts), *Printed boards*

A1 IEC 62368-1, *Audio/video, information and communication technology equipment – Part 1: Safety requirements **A1***

A2 IEC 63044-3, *Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS) – Part 3: Electrical safety requirements **A2***

CISPR 11, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*

CISPR 14-1:2005, *Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission⁵*
Amendment 1:2008

CISPR 22:2008, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*

ISO 16484-2, *Building automation and control systems (BACS) – Part 2: Hardware*

⁵ There exists a consolidated edition 5.1:2009 including CISPR 14-1:2005 and its Amendment 1:2008

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

Where the terms "voltage" and "current" are used, they imply the r.m.s. values, unless otherwise specified.

2.1 Definitions relating to ratings, voltages, currents, frequencies, and wattages

2.1.1

rated voltage, current, frequency or wattage

voltage, current, frequency or wattage assigned to a **control** by the manufacturer

Note 1 to entry: For three phase supply, the rated voltage is the line voltage.

2.1.2

rated voltage, current, frequency or wattage range

voltage, current, frequency or wattage ranges assigned to the **control** by the manufacturer and expressed by lower and upper values

2.1.3

working voltage

highest r.m.s. value of the a.c. or d.c. voltage across any particular insulation which can occur when the equipment is supplied at rated voltage

Note 1 to entry: **Transient overvoltages** are disregarded.

Note 2 to entry: Open-circuit conditions and normal operating conditions are taken into account.



2.1.4

extra-low voltage

ELV

voltage not exceeding the maximum values of 50 V AC (RMS), 70,7 V AC (peak) or 120 V DC (ripple-free) between conductors and between conductors and earth which is permitted to be maintained indefinitely under normal and single-fault conditions

Note 1 to entry: Ripple-free is conventionally defined as an RMS ripple voltage of not more than 10 % of the DC component.

Note 2 to entry: The use of **ELV** other than in **SELV system** or **PELV system** is not a protective measure against electric shock, this is in line with IEC 61140:2001.

2.1.5

safety extra-low voltage

SELV

voltage for use in **SELV system** or **PELV system** between simultaneously **accessible part(s)** and between any **accessible part** and earth, not exceeding the limits of 30 V AC (RMS), 42,4 V AC (peak) or 60 V DC (ripple free) under normal and single-fault condition, which is provided by an independent source (such as safety isolating transformers, motor generators, and batteries) or when obtained from higher voltage is obtained by a **safety isolating transformer** or a converter with separate windings providing equivalent insulation

Note 1 to entry: The voltage limits are based on the assumption that the **safety isolating transformer** is supplied at its rated voltage. For the purpose of the output test in 24.1.1, the secondary output voltage limit shall be increased as specified in 17.2.2.

Note 2 to entry: Transformers used in converters that have separate windings and provide equivalent insulation are covered under IEC 61558-2-6 and IEC 61558-2-16.

Note 3 to entry: **SELV** limits are defined regardless of any special condition which may occur in installation. Different requirements may be specified in the relevant electrical installation standards (e.g. IEC 60364 (all parts)) or in the applicable local regulations.

Note 4 to entry: Ripple-free is conventionally defined as an RMS ripple voltage of not more than 10 % of the DC component.

Note 5 to entry: **SELV** limits may be different in other product or system standards. In case a control is designed exclusively for use in applications governed by a different standard, the limits set by the application standard apply (e.g. controls to be used exclusively in household appliances according IEC 60335 set of standards or connected to HBES/BACS systems according to IEC 63044-3 accept different **SELV** voltage limits).

2.1.6

safety isolating transformer

transformer, the input winding of which is electrically separated from the output winding by an insulation at least equivalent to **double insulation** or **reinforced insulation**, and which is intended to supply **safety extra-low voltage** circuits

2.1.7

same polarity

relationship between **live parts** such that an interconnection between them allows a flow of current through a load, and which current is thus limited by the load

2.1.8 Void

2.1.9

isolated limited secondary circuit

circuit from an isolated secondary winding of a transformer having a maximum capacity of 100 VA and an open-circuit secondary voltage rating not exceeding 1 000 V

2.1.10

pilot duty

class of **operation** in which the ultimate electrical load is controlled by an auxiliary means such as a relay or contactor

2.1.11

transient overvoltage

short duration overvoltage of few milliseconds or less, oscillatory or non-oscillatory, usually highly damped

[SOURCE: IEC 60050-604:1987, 604-03-13]

2.1.12

rated impulse voltage

impulse withstand voltage assigned by the manufacturer to the equipment or to a part of it, characterizing the specified withstand capability of its insulation against overvoltages

2.1.13

overvoltage category

numeral characterizing a **transient overvoltage** condition

Note 1 to entry: Overvoltage categories I, II, III, and IV are used. See Annex L.

2.1.14

exposed-conductive-part

conductive part of equipment, which can be touched and which is not normally live, but which can become live when **basic insulation** fails

Note 1 to entry: A conductive part of a **control** which can only become live through contact with an **exposed-conductive-part** which has become live, is not considered to be an **exposed-conductive-part** itself.

[SOURCE: IEC 60050-195:1998, 195-06-10, modified – Note 1 to entry has been added.]

2.1.15

(conductive) screen

 *Text deleted* 

conductive part that encloses or separates electric circuits and/or conductors

[SOURCE: IEC 60050-195:1998, Amendment 1:2001, 195-02-38]

2.1.16

(electrically) protective screen

 *Text deleted* 

conductive screen used to separate an electric circuit and/or conductors from hazardous-live-parts

[SOURCE: IEC 60050-195:1998, Amendment 1:2001, 195-06-17]

2.1.17

(electrically) protective screening

 *Text deleted* 

separation of electric circuits and/or conductors from **hazardous live parts** by an **electrically protective screen** connected to the protective **equipotential bonding system** and intended to provide protection against electric shock

[SOURCE: IEC 60050-195:1998, Amendment 1:2001, 195-06-18]

2.1.18

simple separation

separation between circuits or between a circuit and earth by means of **basic insulation**

[SOURCE: IEC 61140:2001, 3.23]

2.1.19

(electrically) protective separation

separation of one electric circuit from another by means of:

- **double insulation**, or
- **basic insulation** and **electrically protective screening (shielding)**, or
- **reinforced insulation**

[SOURCE: IEC 60050-195:1998, Amendment 1:2001, 195-06-19]

2.1.20

SELV system

electrical system in which the voltage cannot exceed **ELV**:

- under normal conditions, and
- under single-**fault** conditions, including earth **faults** in other circuits

[SOURCE: IEC 61140:2001, 3.26.1]

2.1.21

PELV system

electrical system in which the voltage cannot exceed **ELV**:

- under normal conditions, and
- under single-**fault** conditions, except earth **faults** in other circuits

[SOURCE: IEC 61140:2001, 3.26.2]

2.2 Definitions of types of control according to purpose

2.2.1

electrical control

device used in, on or in association with an equipment for the purpose of varying or modifying the output from such equipment, and which embodies the aspects of **initiation**, **transmission** and **operation**

Note 1 to entry: Hereinafter, electrical control is referred to as "**control**".

Note 2 to entry: At least one of these aspects shall be electrical or electronic.

2.2.2

manual control

control in which the **initiation** is by **actuation** and in which the **transmission** and the **operation** are both direct and without any intentional time delay

2.2.3

automatic control

control in which at least one aspect is non-manual

2.2.4

sensing control

automatic control in which **initiation** is by an element sensitive to the particular **activating quantity** declared, for example, temperature, current, humidity, light, liquid level, position, pressure or velocity

2.2.5

thermally operated control

automatic control in which the **transmission** is by a thermal **prime mover**

2.2.6

thermostat

cycling temperature **sensing control**, which is intended to keep a temperature between two particular values under normal operating conditions and which may have provision for **setting by the user**

2.2.7

temperature limiter

temperature **sensing control** which is intended to keep a temperature below or above one particular value during normal operating conditions and which may have provision for **setting by the user**

Note 1 to entry: 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.

2.2.8

thermal cut-out

temperature **sensing control** intended to keep a temperature below or above one particular value during abnormal operating conditions and which has no provision for **setting by the user**

Note 1 to entry: A **thermal cut-out** may be of the automatic or of the manual reset type.

Note 2 to entry: Normally a **thermal cut-out** will provide a **type 2 action**.

2.2.9 Void

2.2.10

energy regulator

self-cycling **control** which alters the energy to a load and which may incorporate means for **setting by the user** to change the average energy supplied

Note 1 to entry: The ratio of the on-time, to the on-plus-off-time, determines the average energy supplied.

2.2.11

time-based control

automated **control** in which the **transmission** is effected by a time-based **prime mover** or a time-based electrical circuit

2.2.12

electrically operated control

automatic control in which the **transmission** is effected by an electrical **prime mover** and in which the **operation** controls an electric circuit, and is without intentional significant time-delay

Note 1 to entry: An example is a relay.

Note 2 to entry: A slugged-relay may be either an **electrically operated control**, or a **time-based control** by agreement between testing authority and manufacturer.

2.2.13

timer

time-based control which requires **actuation** before the next cycle can take place

Note 1 to entry: During a cycle, it may require an external electrical or mechanical signal before moving from a rest position to allow the cycle to continue. An example is a programmer.

2.2.14

time switch

time-based control which continues with a subsequent cycle when the preceding one has been completed

Note 1 to entry: An example is a 24 h **control** on a storage heater.

2.2.15

motor protector

automatic control that is specifically intended to protect the windings of an electric motor from overheating

2.2.16

thermal motor protector

automatic control, built-in or on a motor, that is specifically intended to protect the motor against overheating due to running overload and failure to start

Note 1 to entry: The **control** carries motor current and is sensitive to motor temperature and current.

Note 2 to entry: The **control** is capable of being reset (either manually or automatically) when its temperature falls to the reset value.

2.2.17

electrically operated valve

automatic control in which the **transmission** is effected by an electrical **prime mover** and in which the **operation** controls the flow of a liquid or a gas

2.2.18

electrically operated mechanism

automatic control in which the **transmission** is effected by an electrical **prime mover** in which the **operation** controls a mechanical device

Note 1 to entry: An example is an electrically operated interlock for a spin dryer lid.

Note 2 to entry: An electric motor is not included in this definition.

2.2.19

operating control

control which starts or regulates the equipment during normal **operation**

2.2.20

protective control

control, the **operation** of which is intended to prevent a hazardous situation during abnormal **operation** of the equipment

2.2.21

multipurpose control

electrical control that can be classified and used for more than one purpose

Note 1 to entry: An example of a **multipurpose control** is a **thermostat** that can also be used as a **temperature limiter**.

2.2.22

multifunctional control

electrical control which incorporates more than one function

Note 1 to entry: An example of a **multifunctional control** is the combination of a **thermostat** and a humidistat.

2.2.23

system

control and **control** sensors and actuators as applied to an application or processes

2.3 Definitions relating to the function of controls

2.3.1

initiation

alteration to that aspect of a **control** which is required to produce **transmission** and **operation**

2.3.2

transmission

essential coupling between **initiation** and **operation** which is required to enable the **control** to fulfil its purpose

Note 1 to entry: This includes, but is not limited to, the use of:

- a) communication lines/protocols;
- b) additional hardware and/or software;
- c) IR/RF **transmission**; or

all combinations of a) to c) via Internet using, for example, modems, portable telephones, etc.

2.3.3

operation

change in that aspect of a **control** which modifies the input to the equipment or part of the equipment

2.3.4

automatic action

that action of an **automatic control** in which the **transmission** and **operation** are produced by **initiation** which is not the result of **actuation**

2.3.5

slow-make slow-break automatic action

mode of **operation** where the rate of contact make and/or break is directly proportional to the rate of change of the **activating quantity**, or to the speed of movement of a **prime mover**

Note 1 to entry: This action may be applicable to either the make, or the break, or both.

2.3.6

manual action

that action of an **automatic control** or of a **manual control** in which the **transmission** and **operation** are produced by **initiation** which is the result of **actuation**

2.3.7

actuation

movement of the **actuating member** of the **control** by the **user**, by hand, by foot or by any other human activity

2.3.8

located position

position of the **actuating member** to which it will return if it is released after being moved slightly

2.3.9

intermediate position

any position of any **actuating member** which is adjacent to a **located position**, and in which the **actuating member** will remain and in which the **operation** of the **control** is intermediate

2.3.10

activating quantity

physical characteristic of a medium, the variation or stability of which is being sensed

2.3.11

operating value

value of the relevant temperature, pressure, current, etc. at which a **sensing control** operates on a rise or fall of the **activating quantity**

2.3.12

operating time

duration of time, or the difference of time, between any two functions, electrical or mechanical, occurring during the **automatic action** of a **time-based control**

2.3.13

operating sequence

intended sequence, order or pattern in which the **operation** of the electrical or mechanical functions of a **control** are intended to occur as a result of either an **automatic** or a **manual action** of a **control**

Note 1 to entry: It includes the pattern of opened or closed contacts in any **located position**, **intermediate position** or position of **setting by the equipment manufacturer** or **setting by the user**.

2.3.14

response value

operating value, the **operating time** or the **operating sequence** which relates a **control** to a particular equipment

2.3.15

trip-free

automatic action, with a reset **actuating member**, in which the **automatic action** is independent of manipulation or position of the reset mechanism

2.3.16

leakage current

all currents, including capacitively coupled currents, which may be conveyed between exposed conductive surfaces of a device and earth or other exposed conductive surfaces of a device

2.3.17

setting

mechanical positioning of a part of a **control** in order to select an **operating value**

2.3.18

setting by the control manufacturer

any **setting** carried out by the **control manufacturer** which is not intended to be altered by the **equipment manufacturer**, the **installer** or the **user**

2.3.19

setting by the equipment manufacturer

any **setting** carried out by the **equipment manufacturer** which is not intended to be altered by the **installer** or the **user**

2.3.20

setting by the installer

any **setting** carried out by the **installer**, as instructed by the **equipment manufacturer** or the **control manufacturer**, and which is not intended to be altered by the **user**

2.3.21

setting by the user

any selection of an **operating value** by **actuation** performed by the **user**

2.3.22

set point

value selected by **setting**

2.3.23

adjustable set point

multiple values, within a declared range of values, which can be selected by **setting**

2.3.24

duty cycle

all automatic and **manual actions** involved in one start-to-finish **operation** of the controlled equipment

2.3.25

cycle of contact operation

one contact make and one subsequent contact break action, or one contact break and one subsequent contact make action

2.3.26

operating differential

difference between the upper and lower values of the **operating value**

2.3.27

adjustable differential

ability to change or alter the **operating differential** within rated limits by **operation** of a manually actuated mechanism

2.3.28

fixed differential

operating differential which cannot be changed from the manufacturer's **setting**

2.3.29

maximum working pressure

maximum rated pressure

declared maximum line or **system** working pressure to which the **control** or parts thereof may be subjected

$T_{\max}$

declared maximum continuous ambient temperature to which the **switch head** is intended to be exposed during normal **operation**

2.3.31

remotely actuated control function

function providing any **operation** by **control** devices through external means

Note 1 to entry: This includes, but is not limited to, the use of:

- a) communication lines/protocols;
- b) additional hardware and/or software;
- c) IR/RF **transmission**; or

all combinations of a) to c) via Internet using, for example, modems, portable telephones, etc.

2.3.32

safety shut-down

change in the state of all electrical outputs so that all safety critical electrical outputs of the **control** will proceed to a safe condition including shut-down



2.3.33

mounting surface temperature

$T_s \max$

declared maximum temperature to which the mounting surface of the control is intended to be exposed including any likely overshoot once a control has operated 

2.4 Definitions relating to disconnection and interruption

Some **controls** may incorporate more than one form of circuit disconnection or interruption.

2.4.1

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

Note 1 to entry: The protective earthing conductor is not considered to be a supply conductor.

2.4.2

full disconnection

contact separation in all supply poles other than earth so as to provide the equivalent of **basic insulation** between the supply mains and those parts intended to be disconnected

Note 1 to entry: There are electric strength and dimensional requirements.

Note 2 to entry: Where the number of poles on the **control** is equal to the number of supply poles of the appliance to which it is connected, **full disconnection** provides **all-pole disconnection**.

Note 3 to entry: See also Annex H.

2.4.3

micro-disconnection

adequate contact separation in at least one pole so as to provide functional security

Note 1 to entry: There is a requirement for the electric strength of the contact gap but no dimensional requirement.

Note 2 to entry: **Micro-disconnection** denotes that for non-**sensing controls** the function controlled by the disconnection is secure, and that for **sensing controls** is secure between the limits of **activating quantity** declared in requirement 36 of Table 1.

Note 3 to entry: See also Annex H.

2.4.4

micro-interruption

interruption of a circuit by contact separation, by a cycling action or by a non-cycling action which does not provide **full disconnection** or **micro-disconnection**

Note 1 to entry: There are no electric strength or dimensional requirements for the contact gap.

Note 2 to entry: See also Annex H.

2.4.5

OFF position

position providing a visible or implied indication of a **full disconnection** or **micro-disconnection**

2.4.6 See Annex H.

2.5 Definitions of types of control according to construction

2.5.1

integrated control

control which is dependent on its correct mounting and fixing in an equipment, and which can only be tested in combination with the relevant parts of the equipment

Note 1 to entry: The equipment may use electricity, gas, oil, solid fuel or a combination thereof.

Note 2 to entry: **Integrated control** also denotes a **control** which is part of a more complex **control** (electrical or non-electrical).

2.5.2

incorporated control

control intended for incorporation in, or on, an equipment, but which can be tested separately

Note 1 to entry: The fact that an **incorporated control** can be tested separately does not imply that it may not be tested in an equipment as specified in 4.3.1.1.

Note 2 to entry: The equipment may use electricity, gas, oil, solid fuel or a combination thereof.

Note 3 to entry: **Incorporated control** also denotes a **control** intended for incorporation in or on a more complex **control** (electrical or non-electrical).

2.5.3

in-line cord control

separately cased **control** intended to be connected to the supply and to the equipment by means of flexible cords, equipment inlets or socket-outlets, and is intended to be manually actuated

Note 1 to entry: A fuse in the plug is not regarded as a part of the **control**.

2.5.4

free-standing control

in-line cord control intended to stand on a table or on the floor

Note 1 to entry: It may be actuated by hand, by foot or by other similar human activity.

2.5.5

independently mounted control

control intended for permanent connection to **fixed wiring**, but intended to be mounted away from the controlled equipment

Note 1 to entry: It may be either:

- for surface mounting such as on to a wall;

- for flush mounting, such as into a wall cavity, when installation shall be possible from the front;
- for panel mounting, such as onto or into a **control** panel, when installation may be from the rear.

2.5.6

pull-cord actuated control

control intended to be mounted in, or on, an equipment and actuated by means of a **pull-cord**

2.5.7 to 2.5.10 See Annex H.

2.5.11

two-step actuation

sequential performance of two distinct movements of the **actuating member**

2.6 Definitions of type of automatic action of a control according to test procedure

2.6.1

type 1 action

automatic action for which the **manufacturing deviation** and the **drift** of its **operating value**, **operating time** or **operating sequence** have not been declared and tested under this standard

Note 1 to entry: A **type 1 action** is subclassified as specified in 6.4.

2.6.2

type 2 action

automatic action for which the **manufacturing deviation** and the **drift** of its **operating value**, **operating time** or **operating sequence** have been declared and tested under this standard

Note 1 to entry: A **type 2 action** is subclassified as specified in 6.4.

2.7 Definitions relating to protection against electric shock

2.7.1

live part

conductive part intended to be energized in **normal use**, including a neutral conductor, but by convention not a PEN conductor

2.7.1.1

hazardous live part

live part which, under certain conditions of external influences, can give an electric shock

2.7.2

class 0 control

control in which protection against electric shock relies upon **basic insulation**

Note 1 to entry: This implies that there are no means for the connection of accessible conductive parts, if any, to the **protective conductor** in the **fixed wiring** of the installation; reliance in the event of a **failure** of the **basic insulation** is placed upon the **environment**.

Note 2 to entry:  See Annex ZB. 

Note 3 to entry: An earthing terminal is only allowed if it is for continuity or functional (as distinct from protective) purposes.

2.7.3

class 0I control

in-line cord control having at least **basic insulation** throughout and provided with an earthing terminal but with a **non-detachable cord** without earthing conductor, and a plug without earthing contact which cannot be introduced into a socket-outlet with earthing contact

Note 1 to entry:  See Annex ZB. 

Note 2 to entry: An earthing terminal is only allowed if it is for continuity (as distinct from protective) purposes.

2.7.4

class I control

control in which protection against shock does not rely on **basic insulation** only, but which includes an additional safety precaution in such a way that means are provided for the connection of accessible conductive parts to the protective (earthing) conductor in the **fixed wiring** of the installation in such a way that accessible conductive parts cannot become live in the event of a **failure** of the **basic insulation**

Note 1 to entry: This provision includes a **protective conductor** as part of the flexible cord or cable. When **class I controls** are fitted with a two-core flexible cord or cable; provided that it is fitted with a plug which cannot be introduced into a socket-outlet with earthing contact, the protection is then equivalent to that of class 0, but the earthing provisions of the equipment in all other respects should fully comply with the requirements of class I.

Note 2 to entry: **Class I controls** may have parts with **double insulation** or parts that provide protection against electric shock by **SELV** or **PELV**.

2.7.5

class II control

control in which protection against electric shock does not rely on **basic insulation** only, but in which additional protective precautions, such as **double insulation** or **reinforced insulation**, are provided, there being no provision for protective earthing or reliance upon installation conditions

Note 1 to entry: Such a **control** may be one of the types defined in 2.7.5.1 to 2.7.5.3.

Note 2 to entry: **Class II controls** may have parts that provide protection against electric shock by use of **SELV**.

Note 3 to entry: **Class II controls** cannot have parts that provide protection against electric shock by use of **PELV**, as such circuits require connection to an earthing terminal.

2.7.5.1

insulation-encased class II control

control having a durable and substantially continuous enclosure of insulation material which envelopes all metal parts, with the exception of small parts, such as name plates, screws and rivets, which are isolated from **live parts** by insulation at least equivalent to **reinforced insulation**

2.7.5.2

metal-encased class II control

control having a substantially continuous metal enclosure in which **double insulation** is used throughout, except for those parts where **reinforced insulation** is used, because the application of **double insulation** is manifestly impracticable

2.7.5.3

combination insulation-encased/metal-encased class II control

control which is a combination of the types described in 2.7.5.1 and 2.7.5.2

Note 1 to entry: The enclosure of an all-insulated **class II control** may form a part or the whole of the **supplementary insulation** or of the **reinforced insulation**. If a **control** with **double insulation** and/or **reinforced insulation** throughout has an earthing terminal or earthing contact, it is deemed to be of class 0I or class I construction.

 Note 2 to entry: See Annex ZB. 

2.7.6

class III control

control relying on limitation of voltage to **ELV** values as provision against electric shock for basic protection and

– with no provision for **fault** protection;

- which for supply are only connected to a **SELV system** or a **PELV system**, to form part of that **system**;
- where internal circuits do not operate at a higher level than **ELV**;
- where in case of a single **fault** within the **control** no steady state touch voltage may appear or be generated exceeding **ELV** level; and
- not provided with a means of connection for a **protective conductor**

2.7.7

detachable part

part which can be removed or opened without the aid of a **tool** and which does not comply with the test of 11.11.1.5

2.7.8

accessible part or accessible surface

part or surface which can be touched by the test finger of Figure 2, when the **control** is mounted as in **normal use**, and after **detachable parts** have been removed

2.7.9

functional insulation

insulation between **live parts** which have a potential difference between them, and which insulation is necessary for the correct **operation** of the **control** or controlled equipment (L-L)

Note 1 to entry: In 2.7.9 through 2.7.12, the following abbreviations are used:

L **live part**;

A **accessible part** (either conductive or an insulating surface);

I intermediate part.

2.7.10

basic insulation

insulation applied to **live parts** to provide basic protection against electric shock (L-A or L-I)

Note 1 to entry: **Basic insulation** includes insulation between **live parts** and:

- intermediate conductive parts or metal foil over intermediate insulating surfaces (class II situation);
- accessible conductive parts (class 0, 0I, I situations);
- conductive parts connected to accessible conductive parts (class 0, 0I, I situations);
- metal foil over accessible insulating surfaces (class 0 situation).

Note 2 to entry: This was formerly part of that insulation referred to as **functional insulation**.

2.7.11

supplementary insulation

independent insulation applied in addition to **basic insulation** in order to provide protection against electric shock in the event of a **failure** of **basic insulation** (I-A)

Note 1 to entry: It includes insulation between intermediate conductive parts, or metal foil over intermediate insulating surfaces and:

- accessible conductive parts (class II situation);
- conductive parts connected to accessible conductive parts (class II situation);
- metal foil over accessible insulating surfaces (class II situation).

2.7.12

reinforced insulation

single insulation **system** applied to **live parts**, which provides a degree of protection against electric shock equivalent to **double insulation** under the conditions specified in this standard (L-(I)-A)

Note 1 to entry: It includes insulation between **live parts** and:

- accessible conductive parts (class II situation);
- conductive parts connected to accessible conductive parts (class II situation);
- metal foil over accessible insulating surfaces (class II situation).

Note 2 to entry: The term "insulation system" does not imply that the insulation must be one homogeneous piece. It may comprise several layers which cannot be tested singly as **supplementary insulation** or **basic insulation**.

2.7.13 double insulation

insulation comprising both **basic insulation** and **supplementary insulation** (class II situation)

2.7.14 See Annex H.

2.7.15 equipotential bonding

provision of electric connections between conductive parts, intended to achieve equipotentiality

Note 1 to entry: The effectiveness of the **equipotential bonding** depends on the frequency of the current in the bonding.

Equipotential bonding is used to connect any conductive part of a building not forming part of the electrical installation and liable to introduce an electrical potential, generally the electric potential of the local earth (extraneous-conductive part) and any conductive part of **controls** or equipment or components in the installation which can be touched and which is not normally live but which can become live when **basic insulation** fails (**exposed-conductive-part**) to a main **equipotential bonding terminal** in the form of a bar, in order to bring these parts to the same potential. Parts to be connected to the **equipotential bonding system** include, for example, **protective conductors**, **PE** conductors, **PEN** conductors, earthing conductors, protective earthing terminals of **controls** or equipment, all conductive parts in a building, for example, metal tubing for water (drinking and waste), metallic bathtubs, the central heating system piping, any internal gas tubing (which is also required to be isolated from external gas tubing), earth connectors for antennas and telecommunication systems, all metal parts of the building used for construction like mats and iron, and conductors for lightning protection and depending on the installation system, the earth electrode. Requirements for **equipotential bonding** can be found in the IEC standards for the installation of buildings. These may be relevant for the installation of **controls** which consist of several component-parts (for example, sensors, actors, central **control** element, interface elements) connected in parallel to or via the fixed installation of the building.

[SOURCE: IEC 60050-195:1998, 195-01-10]

2.7.15.1 protective-equipotential-bonding equipotential bonding for purposes of safety (protection against electric shock)

Note 1 to entry: Functional **equipotential bonding** is defined in [IEV 195-01-16].

[SOURCE: IEC 60050-195:1998, 195-01-15, modified – (protection against electric shock) has been added.]

2.8 Definitions relating to component parts of controls

2.8.1 sensing element

that part of the **control** which is intended to be exposed to the influences of the **activating quantity** to which the **automatic action** of a **sensing control** responds

2.8.2 switch head complete **control**, except for any **sensing element**

Note 1 to entry: If by construction it is impossible to distinguish between the **switch head** and the **sensing element**, then the whole **control** is considered to be the **sensing element**.

2.8.3

actuating member

that part which is manually moved, pulled, pushed or turned to cause **initiation** of a **control** action, or for **setting by the user**

Note 1 to entry: The term "**actuating member**" does not include any device such as a set-screw used for **setting by the control manufacturer** if such a device is adequately locked against further movement, or if a **tool** is required for such **setting by the control manufacturer**.

2.8.4

actuating means

any part which connects the **actuating member** to the mechanism of the **control**

2.8.5

pull-cord

flexible **actuating member** which is pulled to cause **actuation**

2.8.6

prime mover

any device used to produce the mechanical energy required to provide the **transmission** for an **automatic control**, such as an **electrically operated control**, an **electrically operated valve**, an **electrically operated mechanism** or a **time-based control**

Note 1 to entry: It may be a mechanical storage device (for example, a clockwork spring), an electro-magnetic device (for example, an electric motor, or stepping solenoid), an electro-thermal device (for example, the heating element of an **energy regulator**) or any other mechanism producing mechanical energy.

2.8.7

clutch

mechanical device by which an **actuating member** can override either a **prime mover** or an **activating quantity**, causing or allowing the **initiation** or cancellation of an action

2.8.8

cover

cover plate

part which is accessible when the **control** is mounted as in **normal use** and which can be removed only with the aid of a **tool**

Note 1 to entry: It shall not require the use of a **special purpose tool** for its removal.

2.8.9

screwless fixed part (or component)

accessible part (or component) which, after attachment, installation, mounting or assembly into or onto an equipment or another component, or to a specially prepared support, is retained in position by positive means which do not depend on screws

Note 1 to entry: Disassembly or removal may require the use of a **tool**, either applied directly to the part (or component), or to obtain access to the retaining means.

Note 2 to entry: The following are some examples of parts which are not regarded as **screwless fixed parts or components**:

- parts of components fixed permanently by rivets, glueing or similar means;
- flat, push-on connectors;
- **screwless terminals**;
- standard plugs and socket-outlets;
- standard appliance couplers, even if such have additional latching devices to prevent a single action uncoupling;
- the replacement of a lamp in a bayonet type lampholder;
- twist-lug construction;
- friction-fit construction.

2.9 Definitions of types of terminals and terminations of controls

2.9.1

pillar terminal

terminal in which the conductor is inserted into a hole or cavity, where it is clamped under the shank of the screw or screws

Note 1 to entry: The clamping pressure may be applied directly by the shank of the screw, or through an intermediate clamping member to which pressure is applied by the shank of the screw (see Figure 11).

2.9.2

screw terminal

terminal in which the conductor is clamped under the head of the screw

Note 1 to entry: The clamping pressure may be applied directly by the head of the screw, or through an intermediate part, such as a washer, a clamping plate or an anti-spread device (see Figure 10).

2.9.3

stud terminal

terminal in which the conductor is clamped under a nut

Note 1 to entry: The clamping pressure may be applied directly by a suitably shaped nut, or through an intermediate part, such as a washer, a clamping plate or an anti-spread device (see Figure 10).

2.9.4

screwless terminal

terminal in which the connection of the conductor is achieved directly or indirectly by means of springs, wedges, eccentrics, cones or the like

Note 1 to entry: The following are not regarded as **screwless terminals**:

- terminals requiring the fixing of special devices to the conductors before clamping them in the terminal, for example, **flat push-on connectors**;
- terminals requiring wrapping of the conductors, for example, those with wrapped joints;
- terminals providing direct contact to the conductors by means of edges or points penetrating the insulation.

2.9.5

flat push-on connector

assembly of a **tab** and a **receptacle** enabling the connection, at will, of a core or conductor to a **control** or to another core or conductor

2.9.6

receptacle

female part of a **flat push-on connector** intended to be permanently attached to a core or conductor (see Figure 16)

2.9.7

tab

male part of a **flat push-on connector** (see Figures 14 and 15)

2.9.8

in-line tab

tab intended to be permanently attached to a core or conductor

2.9.9

tab forming part of a control

tab permanently attached to, or an integral part of, a **control**