



UL 60730-1

STANDARD FOR SAFETY

Automatic Electrical Controls for Household and
Similar Use, Part 1: General Requirements

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UL Standard for Safety for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1

Fourth Edition, Dated October 19, 2009

Summary of Topics

UL 60730-1 is an adoption of the fourth edition of IEC 60730-1. The revisions dated March 29, 2013 were issued to reflect the latest ANSI approval date as an American National Standard and to include the following revisions that were proposed March 23, 2012, and August 10, 2012:

- 1. 1.1.1DV.2 was added to allow the evaluation of controls used in commercial and industrial applications where no other standard is available that adequately covers the safety aspects of the product.***
- 2. 2.6.2DV was added to replace the words "Automatic Control" with "Automatic Action" due to an error in the IEC text.***
- 3. Table 7.2DV was deleted and replaced with eleven national differences to Table 1 (renumbered from Table 7.2) as Table 1DV to reflect current practices.***
- 4. 8.1.1DV was revised replace "...higher voltages" with "...higher than 30 V" to add detail to the requirement.***
- 5. 8.1.3DV was revised to replace a reference to Annex D with a reference to the Standard for Polymeric Materials - Use in Electrical Equipment Evaluations, UL 746C to support present practice.***
- 6. 9.2DV was deleted because the text it revised has been deleted in the IEC text.***
- 7. 10.1.1DV.2 was revised to reflect current practices and requirements for field wiring.***
- 8. 10.1.14DV.1.1 was revised to delete "two full threads" to be in alignment with field wiring requirements in other wiring connector standards such as UL 486 and UL 1059.***
- 9. 11.3.5.1DV was revised to add "...unless it can be validated through a failure assessment that a single component fault will not result in a loss of protective function." This is to allow flexibility to innovative designs.***
- 10. 11.13.1DV was added to add clarity to 11.13.1 and to address the reliability of protective circuits/components when used in operating controls.***
- 11. 12.1.6.3DV was added to provide additional details regarding the method, test parameters and compliance criteria for gaskets.***
- 12. Footnote 14) of Table 12DV (previously Table 13.2DV) was revised to "void" since the electric strength requirements in the US are dictated by table 12 DV (13.2 DV).***
- 13. 17.6.2DV was added to delete the following note in the IEC text, "In Canada and the USA the ageing test does not apply." In light of harmonization, devices classified as type 1.M or 2.M are subjected to the ageing test for the declared number of hours since it represents normal operation/condition in the field.***

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14. 24.2.1DV.3.2 was modified by adding the words "or DC Link" to provide additional guidance on the measurement points for this test.

15. H.11.12DV was deleted since the new software requirements of this IEC edition are the same as in UL 1998.

16. Footnote 1 to Table H.11DV (previously Table H.26.2.1DV) was added to cover the entire range of supply frequency variations specified in table H.19 since this is the only applicable test where test level 2 and 3 applies.

17. Table H.26.14.2DV was modified to reflect the correct verbiage used in the horizontal reference standards; namely IEC 61000 series.

18. Annex DVC was revised to add manufacturing date code requirements to reflect current practice.

19. Annex DVE was added to cover the manufacturing and production tests for controls to address electrical and functional safety concerns during manufacturing.

20. 13.2.3 was revised to cover an alternate test potential for the electric strength test contained in 13.2.3.

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The revised requirements are substantially in accordance with Proposal(s) on this subject dated March 23, 2012 and August 10, 2012.

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The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the preface. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

The following table lists the future effective dates with the corresponding reference.

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Future Effective Dates	References
To Be Determined	4th edition of UL 60730-1



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ANSI/UL 60730-1-2013

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UL 60730-1

Automatic Electrical Controls for Household and Similar Use – Part 1:

General Requirements

The previous edition of the Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements was numbered UL 60730-1A.

First Edition – Not Printed
Second Edition – Not Printed
Third Edition – January, 2002

Fourth Edition

October 19, 2009

This ANSI/UL Standard for Safety consists of the Fourth Edition including revisions through March 29, 2013.

The most recent designation of ANSI/UL 60730-1 as an American National Standard (ANSI) occurred on March 29, 2013. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, Preface, or effective date information. The National Difference Page and IEC Foreword are also excluded from the ANSI approval of IEC-based standards.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at <http://csds.ul.com>.

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CONTENTS

Preface (UL)	12
NATIONAL DIFFERENCES	13
FOREWORD	14
1 Scope and normative references	18
1.5 Normative references	19
2 Definitions	26
2.1 Definitions relating to ratings, voltages, currents, frequencies, and wattages	26
2.2 Definitions of types of control according to purpose	27
2.3 Definitions relating to the function of controls	28A
2.4 Definitions relating to disconnection and interruption	31
2.5 Definitions of types of control according to construction	32
2.6 Definitions of type of AUTOMATIC ACTION of a control according to test procedure	33
2.7 Definitions relating to protection against electric shock	33
2.8 Definitions relating to component parts of controls	37
2.9 Definitions of types of terminals and TERMINATIONS of controls	38
2.10 Definitions relating to the connections to controls	39
2.11 Definitions relating to the performance of TYPE 2 ACTIONS	40
2.12 Definitions relating to the requirements for CREEPAGE DISTANCES and CLEARANCES	40
2.13 Miscellaneous definitions	41
2.14 Definitions relating to manufacturer and USER	42
2.15 Definition pertaining to thermistors	42
2.16 Definitions relating to the structure of controls using software	43
2.17 Definitions relating to error avoidance in controls using software	43
2.18 Definitions relating to fault/error control techniques for controls using software	43
2.19 Definitions relating to memory tests for controls using software	43
2.20 Definitions of software terminology – General	43
2.21 Definitions relating to classes of control functions	43
3 General requirement	43
4 General notes on tests	43
4.1 Conditions of test	43
4.2 Samples required	44A
4.3 Instructions for test	45
5 Rating	47
5.1 Maximum RATED VOLTAGE	47
5.2 Maximum RATED CURRENT	47
5.3 Compliance	48
6 Classification	48
6.1 According to nature of supply	48
6.2 According to type of load to be controlled by each circuit of the control	48
6.3 According to their purpose	49
6.4 According to features of AUTOMATIC ACTION	50
6.5 According to the degree of protection and control POLLUTION degree	51
6.6 According to method of connection	52
6.7 According to ambient temperature limits of the SWITCH HEAD	52
6.8 According to protection against electric shock	53
6.9 According to circuit disconnection or interruption:	54
6.10 According to number of cycles of ACTUATION (M) of each MANUAL ACTION	54

6.11	According to number of automatic cycles (A) of each AUTOMATIC ACTION	55
6.12	According to temperature limits of the mounting surface of the control	56
6.13	According to value of proof tracking index (PTI) for the insulation material used	56
6.13DV.1	According to value of comparative tracking index (CTI) for the insulation material used	56
6.14	According to period of electrical stress across insulating parts supporting LIVE PARTS and between LIVE PARTS and earthed metal	56
6.15	According to construction:	57
6.16	According to ageing requirements (Y) of the equipment in which, or with which, the control is intended to be used	57
6.17	According to use of the THERMISTOR	58
6.18	According to classes of control functions	58
7	Information	58
7.1	General requirements	58
7.2	Methods of providing information	58
7.3	Class II symbol	66
7.4	Additional requirements for marking	66
8	Protection against electric shock	68
8.1	General requirements	68
8.2	ACTUATING MEMBERS and ACTUATING MEANS	72
8.3	Capacitors	73
8.4	COVERS and uninsulated live or hazardous parts	74
9	Provision for protective earthing	74
9.1	General requirements	74
9.3	Adequacy of earth connections	75
9.4	Corrosion resistance	78
9.5	Other requirements	79
10	Terminals and TERMINATIONS	79
10.1	Terminals and TERMINATIONS for external copper conductors	79
10.2	Terminals and TERMINATIONS for INTERNAL CONDUCTORS	86
10.3	Terminals and TERMINATIONS for INTEGRATED CONDUCTORS	88
11	Constructional requirements	88
11.1	Materials	88
11.2	Protection against electric shock	89
11.3	ACTUATION and OPERATION	92
11.4	Actions	94A
11.5	Openings in enclosures	97
11.6	Mounting of controls	98
11.7	Attachment of cords	99
11.8	Size of cords – non-detachable	102
11.9	Inlet openings	103
11.9DV.1	INDEPENDENTLY MOUNTED	103
11.10	Equipment inlets and socket-outlets	104A
11.11	Requirements during mounting, maintenance and SERVICING	104B
11.12	Controls using software	111
11.13	Protective controls and components of protective control systems	111
12	Moisture and dust resistance	112
12.1	Protection against ingress of water and dust	112
12.2	Protection against humid conditions	112B
13	Electric strength and insulation resistance	114
13.1	Insulation resistance	114
13.2	Electric strength	115
14	Heating	119

15	MANUFACTURING DEVIATION and DRIFT	127
16	Environmental stress	129
16.2	Environmental stress of temperature	129
17	Endurance	129
17.1	General requirements	129
17.2	Electrical conditions for the test	131
17.3	Thermal conditions for the tests	134A
17.4	Manual and mechanical conditions for the tests	135
17.5	Dielectric strength requirements	136
17.6	Ageing test	136
17.7	Overvoltage test (or overload test in Canada, the USA, and all countries using an overload test) of AUTOMATIC ACTION at accelerated rate	136
17.8	Test of AUTOMATIC ACTION at accelerated rate	137
17.9	Test of AUTOMATIC ACTION at slow rate	138
17.10	Overvoltage test (or overload test in Canada, the USA, and all countries that use the overload test) of MANUAL ACTION at accelerated speed	138
17.11	Test of MANUAL ACTION at slow speed	139
17.12	Test of MANUAL ACTION at high speed	139
17.13	Test of MANUAL ACTION at accelerated speed	139
17.14	Evaluation of compliance	140
17.15	Void	140
17.16	Test for particular purpose controls	140
18	Mechanical strength	140
18.1	General requirements	140
18.2	Impact resistance	142
18.3	Void	143
18.4	Alternate compliance – Impact resistance	143
18.5	FREE-STANDING CONTROLS	146
18.6	IN-LINE CORD CONTROLS	146
18.7	PULL-CORD ACTUATED CONTROLS	147
18.8	Foot actuated controls	147
18.9	ACTUATING MEMBER and ACTUATING MEANS	148
19	Threaded parts and connections	149
19.1	Threaded parts moved during mounting or SERVICING.	149
19.2	Current-carrying connections	152
20	CREEPAGE DISTANCES, CLEARANCES and distances through solid insulation	153
20.1	CLEARANCES	153
20.2	CREEPAGE DISTANCES	158
20.3	Solid insulation	161
21	Resistance to heat, fire and tracking	162
21.1	General requirement	162
21.2	Integrated, incorporated and IN-LINE CORD CONTROLS	162
21.3	INDEPENDENTLY-MOUNTED CONTROLS	164
22	Resistance to corrosion	165
22.1	Resistance to rusting	165
23	Electromagnetic compatibility (EMC) requirements – emission	166
23.1.1	Test conditions	166
23.1.2	Test procedure	167
24	Components	167
24.2.1DV.3	Overload tests	168
25	Normal OPERATION	169
26	Electromagnetic compatibility (EMC) requirements – immunity	169
27	Abnormal OPERATION	169

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Documents

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27.2 Burnout test	169
27.2.3 Blocked mechanical output test (abnormal temperature test)	170
27.3 Overvoltage and undervoltage test	171
28 Guidance on the use of ELECTRONIC DISCONNECTION	171

Annex A (normative) Indelibility of markings

Annex B (normative) Measurement of CREEPAGE DISTANCES and CLEARANCES in air

Annex C (normative) Cotton used for mercury switch test(not applicable in the countries members of CENELEC)

C.1 Classification	216
C.2 General requirements	216
C.3 Fibre length	216
C.4 Absorbency	216
C.5 Acidity and alkalinity	216
C.6 Residue on ignition	216
C.7 Water soluble material	216
C.8 Fatty material	216
C.9 Dyes	216
C.10 Other foreign matter	216

Annex D (informative) Heat, fire and tracking

Annex E (normative) Circuit for measuring LEAKAGE CURRENT

Annex F (informative) Fire hazard testing

Annex G (normative) Heat and fire resistance tests

G.1 Void	245
G.2 Glow-wire test	245
G.3 Void	245
G.4 Proof tracking test	245
G.5 Ball pressure test	245
G.5.1 Ball pressure test 1	245
G.5.2 Ball pressure test 2	246

Annex H (normative) Requirements for ELECTRONIC CONTROLS

H.2 Definitions	247
H.2.4 Definitions relating to disconnection and interruption	247
H.2.5 Definitions of type of control according to construction	248
H.2.7 Definitions relating to protection against electric shock	248

H.2.16	Definitions relating to the structure of controls using software	248
H.2.17	Definitions relating to error avoidance in controls using software	251
H.2.18	Definitions relating to fault/error control techniques for controls using software	252
H.2.19	Definitions relating to memory tests for controls using software	255
H.2.20	Definitions of software terminology – General	257
H.2.21	Void	258
H.2.22	Definitions relating to classes of control functions	258
H.2.23	Definitions relating to functional safety	258
H.4	General notes on tests	259
H.4.1	Conditions of test	259
H.6	Classification	260
H.6.4	According to features of AUTOMATIC ACTION	260
H.6.9	According to circuit disconnection or interruption:	260
H.6.18	According to classes of control functions (see Table 1 (7.2 of the previous edition), requirement 92)	260
H.7	Information	260
H.8	Protection against electric shock	262
H.8.1	General requirements	262
H.11	Constructional requirements	263
H.11.2	Protection against electric shock	263
H.11.4	Actions	264
H.11.12	Controls using software	264
H.13	Electric strength and insulation resistance	279
H.13.2	Electric strength	279
H.17	Endurance	280
H.17.1	General requirements	280
H.17.14	Evaluation of compliance	280A
H.18	Mechanical strength	280A
H.18.1	General requirements	280A
H.20	CREEPAGE DISTANCES, CLEARANCES and distances through insulation	280B
H.20.1	<i>Additional subclauses:</i>	280B
H.23	Electromagnetic compatibility (EMC) requirements – emission	280B
H.23.1.1	Low frequency emission, disturbances in supply systems	280B
H.23.1.2	Radio frequency emission	280C
H.25	Normal OPERATION	280C
H.26	Electromagnetic compatibility (EMC) requirements – immunity	280D
H.26.4	<i>Test of the influence of signal voltages in the power supply networks</i>	280E
H.26.5	Voltage dips and voltage interruptions in the power supply network	280F
H.26.6	Test of influence of voltage unbalance	280H
H.26.7	Test of the influence of d.c. in a.c. networks	281
H.26.8	Surge immunity test	281
H.26.9	Electrical fast transient/burst test	283
H.26.10	Ring wave test	285
H.26.11	Electrostatic discharge test	287
H.26.12	Radio-frequency electromagnetic field immunity	288
H.26.13	Test of influence of supply frequency variations	290
H.26.14	Power frequency magnetic field immunity test	291
H.26.15	Evaluation of compliance	292
H.26.16	Harmonics and interharmonics including mains signaling at a.c. power port, low frequency immunity tests	293
H.27	Abnormal OPERATION	293
H.27.1	Electronic controls – assessment against internal faults	293
H.27.1.2	Protection against internal faults to ensure functional safety	298D

H.28 Guidance on the use of ELECTRONIC DISCONNECTION	298J
H.28.1 Main features of solid-state switching devices	298J
H.28.2 Application of solid-state switching devices	298J

Annex J (normative) Requirements for controls using THERMISTORS

J.1 Scope	300
J.1.1.1 <i>Additional paragraphs:</i>	300
J.2 Definitions	300
J.2.15 Definitions pertaining to THERMISTORS	300
J.4 General notes on tests	301
J.4.3.5 According to purpose	301
J.6 Classification	301
J.6.4 According to features of AUTOMATIC ACTION	301
J.6.15 According to construction	302
J.6.17 According to use of the THERMISTOR	302
J.7 Information	302
J.11 Constructional requirements	303
J.11.4.17 Type 2.AL action	303
J.12 Moisture and dust resistance	303
J.12.2 Protection against humid conditions	303
J.13 Electric strength and insulation resistance	303
J.13.2 Electric strength	303
J.15 MANUFACTURING DEVIATION and DRIFT	303
J.17 Endurance	304

J.17.18 Test conditions	304
J.20 Void	307
J.24 Components	307

Annex K (informative) Nominal voltages of supply systems for different modes of overvoltage control

Annex L (normative) Overvoltage categories

Annex M (informative) Typical usage

Annex N (normative) POLLUTION DEGREES

N.1 POLLUTION	312
N.2 Degrees of POLLUTION in the MICRO-ENVIRONMENT	312

Annex P (normative) Printed circuit board coating performance test

Annex Q (normative) Printed circuit board coating performance test

Annex R (informative) Explanatory notes for surge immunity test

R.1 Different source impedances	319
R.2 Application of the tests	319
R.2.1 Equipment level immunity	319
R.2.2 System level immunity	320
R.3 Installation classification	320
R.3.1 Equipment level immunity of ports connected to the power supply network	321
R.3.2 Equipment level immunity of ports connected to interconnection lines	321

Annex S (informative) Guidance for applying clause 20

Annex T (normative) Requirements for SELV and PELV

T.1 Overview of the requirements for SELV and PELV	328
T.1.1 Protection by SELV	328
T.1.2 Protection by PELV	328
T.2 Protection against electric shock by SELV and PELV	329
T.2.1 SELV	329
T.2.2 PELV	330
T.3 ELV, protective separation, simple separation, protective bonding as elements of SELV and PELV	330
T.3.4 Protective bonding	332

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Annex U (normative) Requirements for relays when used as controls in IEC 60335 appliances

U.2	Definitions	333
U.2.2	Definitions of types of control according to purpose	333
U.4	General notes on tests	333
U.4.3	Instructions for tests	333
U.6	Classification	333
U.6.3	According to their purpose	333
U.6.6	According to method of connection	334
U.6.8	According to protection against electric shock	334
U.7	Information	334
U.14	Heating	335
U.17	Endurance	335
U.17.14	Evaluation of compliance	335
U.17.16	Test of particular purpose controls	335
U.20	Creepage distances, clearances and distances through solid insulation	336
U.23	Electromagnetic compatibility (EMC) requirements – emission	336
U.24	Components	336

Annex DVA (normative) Openings

DVA.1	Ventilating openings	337
DVA.2	Accessibility of LIVE PARTS	338
DVA.3	Other openings	338

Annex DVB (normative) Ratings

DVB.1	General	343
DVB.2	Class 2 power sources and circuits	344

Annex DVC (normative) Markings

DVC.1	General	347
DVC.2	Class 2 power sources and circuits	349
DVC.3	Elevated air temperature	350
DVC.4	Cautionary markings	350
DVC.5	Manufacturing Date Code	352

Annex DVD (normative) Class 2 Power Sources and Circuits

DVD.1	Interconnections	353
DVD.2	Tests for class 2 power sources and circuits	353
DVD.3	Isolated-limited secondary and non-class 2 circuits test	353

Annex DVE (normative) Manufacturing and Production Tests

Bibliography

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Preface (UL)

This UL Standard is based on IEC Publication 60730-1: Third Edition – Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements. IEC publication 60730-1 and its two amendments which are copyrighted by the IEC.

This revision has been issued to satisfy UL Standards policy and for ANSI approval of the fourth edition of UL 60730-1 which includes the revisions the IEC adopted in the fourth edition of IEC 60730-1.

Efforts have been made to synchronize the UL edition number with that of the corresponding IEC standard with which this standard is harmonized. As a result, one or more UL edition numbers have been skipped to match that of the IEC edition number.

This is the UL Standard for Safety for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements. This UL part 1 is to be used in conjunction with the appropriate UL parts, which contain clauses to supplement or modify the corresponding clauses in part 1, to provide relevant requirements for each type of product.

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The previous version of UL 60730-1 included national differences to the following IEC requirements: Clauses: 7.2.1DV, 9.2DV, 11.3.5DV, 14.1.1DV, H.2.21.2DV, H.2.21.3DV, H.11.12DV, H.12DV.1, H.26.10.2DV, and H.27.1.3DV; and Tables 7.2DV, 13.2DV, 14.1DV, 17.2.2DV, 17.2.3DV, 18.4.1DV, 18.4.2DV, H.11.12.6DV, H.26.2.1DV and H.27.1DV. These national differences were deleted in this version of UL 60730-1.

Effective Date

The effective date for the fourth edition is "To Be Determined."

A UL effective date is one established by Underwriters Laboratories Inc. and is not part of the ANSI approved standard.

NATIONAL DIFFERENCES

GENERAL

National Differences from the text of International Electrotechnical Commission (IEC) Publication 60730-1, Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, copyright 2010 are indicated by notations (differences) and are presented in bold text.

There are five types of National Differences as noted below. The difference type is noted on the first line of the National Difference in the standard. The standard may not include all types of these National Differences.

DR – These are National Differences based on the **national regulatory requirements**.

D1 – These are National Differences which are based on **basic safety principles and requirements**, elimination of which would compromise safety for consumers and users of products.

D2 – These are national differences from IEC requirements based on existing **safety practices**. These requirements reflect national safety practices, where empirical substantiation (for the IEC or national requirement) is not available or the text has not been included in the IEC standard.

DC – These are National Differences based on the **component standards** and will not be deleted until a particular component standard is harmonized with the IEC component standard.

DE – These are National Differences based on **editorial comments or corrections**.

Each national difference contains a description of what the national difference entails. Typically one of the following words is used to explain how the text of the national difference is to be applied to the base IEC text:

Addition / Add - An addition entails adding a complete new numbered clause, subclause, table, figure, or annex. Addition is not meant to include adding select words to the base IEC text.

Modification / Modify - A modification is an altering of the existing base IEC text such as the addition, replacement or deletion of certain words or the replacement of an entire clause, subclause, table, figure, or annex of the base IEC text.

Deletion / Delete - A deletion entails complete deletion of an entire numbered clause, subclause, table, figure, or annex without any replacement text.

INTERNATIONAL ELECTROTECHNICAL COMMISSION

AUTOMATIC ELECTRICAL CONTROLS FOR HOUSEHOLD AND SIMILAR USE – Part 1: General requirements

FOREWORD

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

This fourth edition cancels and replaces the third edition published in 1999, amendment 1 (2003) and amendment 2 (2007).

The main technical modifications of this standard since this previous publication are listed below:

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- changes to the low temperature test requirements for in-line cords;
- revision to the pollution degree for the environment surrounding contacts;
- addition of the use of screwless terminals on printed circuit boards and revisions to creepage distances;
- additions of CISPR 11 EMC requirements;
- incorporation of EMC test levels from IEC 60335 series;
- additional testing for flexible cords;
- revisions to the requirements for resistance to heat, fire and tracking including replacement of Clause 21 and Annexes F and G;
- new Annex T for additional requirements for non-SELV supplied sensor cable or cord;
- new requirements in H.27.1 for first and second fault approach to ensure functional safety;
- incorporation of software techniques from IEC 61508-3 in H.11.12;
- replacement of Annex D (Canada and USA) with a reference to UL 746C;
- updates to the references and bibliography;
- the keyword index was deleted as unnecessary due to the availability of search functions for electronic editions of the standard.

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

FDIS	Report on voting
72/789/FDIS	72/790/RVD

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

A list of all parts of the IEC 60730 series, under the general title: Automatic controls for household and similar use, 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	11.5	17.8.4.1
2.7.2	Table 10 (11.8.2), Note 1	17.10
2.7.3	11.11.1.2	17.10.4
2.14.2	11.11.1.3	17.12.5

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Table Continued on Next Page



Documents

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Table Continued

4.2.1	11.11.1.4	17.14
6.6.1	12.1.6	
Table 1 (7.2), note 9	12.3	18.1.6
7.4.3	Table 12 (13.2.1), note 14	18.1.6.1
7.4.3.2	13.3.4	18.1.6.2
8.1.1	Table 13 (14.7.4), notes 1, 7	18.1.6.3
8.4	14.1.1	18.4
9.3.2	14.4	19.2.4.1
9.3.4	15.1	19.2.5.1
9.5.2	16.2.1	20
Table 3 (10.1.4), note 1	17.1.3.1	21.1
10.1.4.2	Table 14 (17.2.5)	21.4
10.1.4.3	17.2.2	27.2.3.1
10.1.14	Table 15 (17.2.5)	Annex C
10.1.16	17.2.3	Annex D
	17.2.3.1	H.26.10
	Table 16 (17.2.5)	Table H.16 (H.26.10.4)
10.1.16.1	17.5.1	Table H.21 (H.26.27.1), Note 7
Table 6 (10.2.1), note 1	17.6.2	Table K.1
	17.7.7	Table K.2
		R.1
		T.3.2

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.

See also 4.3.5.2 and 4.3.5.3.

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.

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

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

DV.1 Modification to the Notes:

– Words in SMALL ROMAN CAPITALS in the text are defined in clause 2.

DV.2 Addition:

The numbering system in the standard uses a space instead of a comma to indicate thousands and uses a comma instead of a period to indicate a decimal point. For example, 1 000 means 1,000 and 1,01 means 1.01.

AUTOMATIC ELECTRICAL CONTROLS FOR HOUSEHOLD AND SIMILAR USE – Part 1: General requirements

1 Scope and normative references

1.1 In general, this international standard applies to automatic ELECTRICAL CONTROLS for use in, on, or in association with equipment for household and similar use, including 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 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, household or similar equipment.

This standard is also applicable to controls for building automation systems within the scope of ISO 16484-2.

This standard is also applicable to controls for appliances within the scope of IEC 60335-1.

Throughout this Standard the word "equipment" means "appliance and equipment."

This standard does not apply to automatic ELECTRICAL CONTROLS intended exclusively for industrial applications unless explicitly mentioned in the relevant part 2.

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.

Automatic ELECTRICAL CONTROLS for equipment not intended for normal household use, but which nevertheless may be used by the public, such as equipment intended to be used by laymen in shops, in light industry and on farms, are within the scope of this standard.

See also annex J.

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 1 These requirements are referred to by IEC 61810-1, Scope.

NOTE 2 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.

1.1.1DV.1 DE Modification of 1.1.1 by adding the following after the first paragraph:

In IEC terminology, "safety" is defined as an acceptable level of risk. This is consistent with the intention of UL requirements to reduce the risk of fire, shock or injury to persons.

1.1.1DV.2 D2 Modification of the fourth paragraph of 1.1.1 by adding the following text:

This standard also applies to automatic ELECTRICAL CONTROLS used in commercial and industrial applications where no other standard currently covers the product or when specifically restricted within the scope of a relevant part 2 standard.

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.

1.1.4 This Standard applies to MANUAL CONTROLS when such are electrically and/or mechanically integral with AUTOMATIC CONTROLS.

Requirements for manual switches not forming part of an AUTOMATIC CONTROL are contained in IEC 61058-1.

1.2 This standard applies to controls with a RATED VOLTAGE not exceeding 690 V and with a RATED CURRENT not exceeding 63 A.

1.2DV.1 DR Modification of 1.2 by adding the following text:

The maximum voltage is 600 V. The maximum current is unlimited.

1.3 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.

1.4 This standard applies also to controls incorporating ELECTRONIC DEVICES, requirements for which are contained in annex H.

This standard applies also to controls using NTC OR PTC THERMISTORS, requirements for which are contained in annex J.

1.5 Normative references

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.

IEC 60038,
IEC standard voltages

IEC 60065: 2001,
Audio, video and similar electronic apparatus – Safety requirements²⁾
Amendment 1 (2004)

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

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IEC 60085: 2007,
Electrical insulation – Thermal evaluation and designation

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

IEC 60112: 2003,
Method for the determination of the proof and the comparative tracking indices of solid insulating materials

IEC 60127-1: 2006,
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: 2006,
Household and similar electrical appliances – Safety – Part 1: General requirements³⁾
Amendment 1 (2004)
Amendment 2 (2006)

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

IEC 60384-14,
Fixed capacitors for use in electronic equipment – Part 14: Sectional specification: Fixed capacitors for electromagnetic 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

IEC 60664-3: 2003,
Insulation coordination for equipment within low-voltage systems – Part 3: Use of coatings, potting or moulding for protection against pollution

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 step-function 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

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 60998-2-3:2002,
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 61000 (all parts),
Electromagnetic compatibility (EMC)

IEC 61000-3-2:2005,
Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)
Amendment 1 (2008)
Amendment 2(2009)⁵⁾

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 61000-4-3:2008,
Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test

IEC 61000-4-4: 2004,
Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test.

IEC 61000-4-5: 2005,
Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test

IEC 61000-4-6:2008,
Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields

IEC 61000-4-8:1993,
Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test⁶⁾

IEC 61000-4-11: 2004,
Electromagnetic compatibility (EMC) – Part 4-11: Testing and measuring techniques – Voltage dips, short interruptions and voltage variations immunity tests

IEC 61000-4-13: 2002,
Electromagnetic compatibility (EMC) – Part 4-13: Testing and measuring techniques – Harmonics and interharmonics including mains signaling at a.c. power port, low frequency immunity tests⁷⁾
Amendment 1 (2009)

IEC 61000-4-28: 1999,
Electromagnetic compatibility (EMC) – Part 4-28: Testing and measuring techniques – Variation of power frequency, immunity tests⁸⁾
Amendment 1 (2001)
Amendment 2(2009)

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 supply 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 62326 (all parts),
Printed boards

CISPR 11:2009,
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: Emission⁹⁾
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

²⁾There exists a consolidated edition 7.1 including IEC 60065:2001 and its Amendment 1 (2004).

³⁾There exists a consolidated edition 4.2 including IEC 60335-1:2001 and its Amendments 1 (2004) and 2 (2006).

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

⁵⁾There exists a consolidated edition 3.2 including IEC 61000-3-2:2005 and its Amendments 1 (2008) and 2 (2009).

⁶⁾There exists a consolidated edition 1.1 including IEC 61000-4-8:1993 and its Amendment 1 (2000).

⁷⁾There exists a consolidated edition 1.1 including IEC 61000-4-13:2002 and its Amendment 1 (2009).

⁸⁾There exists a consolidated edition 1.1 including IEC 61000-4-28:1999 and its Amendments 1 (2001) and 2 (2009).

⁹⁾There exists a consolidated edition 5.1 including CISPR 14-1:2005 and its Amendment 1 (2008).

1.5DV D2 Addition of the following to 1.5:

The following UL Standards are referenced in this Standard:

UL 20
Switches, General Use Snap

UL 44
Wires and Cables, Thermoset-Insulated

UL 50
Enclosures for Electrical Equipment, Non-Environmental Considerations

UL 50E
Enclosures for Electrical Equipment, Environmental Considerations

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UL 62***Flexible Cords and Cables*****UL 83*****Wire and Cables, Thermoplastic-Insulated*****UL 94*****Plastic Materials for Parts in Devices and Appliances, Tests for Flammability of*****UL 157*****Gaskets and Seals*****UL 224*****Tubing, Extruded Insulated*****UL 248 series*****Low-Voltage Fuses*****UL 310*****Terminals, Electrically Quick-Connect*****UL 372*****Automatic Electrical Controls for Household and Similar Use – Part 2: Particular Requirements for Burner Ignition Systems and Components*****UL 429*****Valves, Electrically-Operated*****UL 467*****Grounding and Bonding Equipment*****UL 486 series*****Wire Connectors*****UL 498*****Attachment Plugs and Receptacles*****UL 508*****Industrial Control Equipment*****UL 510*****Tape, Polyethylene, and Rubber Insulating Tape*****UL 514A*****Metallic Outlet Boxes*****UL 514B*****Fittings, Conduit, Tubing and Cable*****UL 514C*****Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers***

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UL 635
Insulating Bushings

UL 746A
Polymeric Materials – Short Term Property Evaluations

UL 746B
Polymeric Materials – Long Term Property Evaluations

UL 746C
Polymeric Materials – Use in Electrical Equipment Evaluations

UL 746D
Polymeric Materials – Fabricated Parts

UL 796
Printed-Wiring Boards

UL 810
Capacitors

UL 817
Cord Sets and Power-Supply Cords

UL 863
Time-Indicating and -Recording Appliance

UL 917
Switches, Clock Operated

UL 969
Marking and Labeling Systems

UL 1004-1
Rotating Electrical Machines – General Requirements

UL 1054
Switches, Special Use

UL 1059
Terminal Blocks

UL 1077
Protectors, Supplementary, for Use in Electrical Equipment

UL 1310
Class 2 Power Units

UL 1414
Capacitors, and Suppressors for Radio- and Television-Type Appliances

UL 1434
Thermistor-type Devices

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UL 1441
Sleeving, Coated Electrical

UL 1446
Systems of Insulating Materials – General

UL 1998
Software in Programmable Components

UL 2111
Overheating Protection for Motors

UL 4248
Fuseholders series

UL 5085-1
Low Voltage Transformers – Part 1: General Requirements

UL 5085-2
Low Voltage Transformers – Part 2: General Purpose Transformers

UL 5085-3
Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers

UL 60691
Thermal-Links – Requirements and Application Guide

UL 60950
Information Technology Equipment Safety – Part 1: General Requirements

UL 61058-1
Switches for Appliances – Part 1: General Requirements

2 Definitions

For the purpose 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. 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:** the 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 – TRANSIENT OVERVOLTAGES are disregarded.

NOTE 2 – Open circuit conditions and normal operating conditions are taken into account.

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2.1.4 **EXTRA-LOW VOLTAGE(ELV):** nominal voltage not exceeding 50 V between conductors and between conductors and earth, or for three-phase connection not exceeding 50 V between line conductors and 29 V between line conductors and neutral

NOTE 1 These values were derived from IEC 60335-1, definition 3.4.1.

NOTE 2 In this standard **ELV-levels** for use in a specific application as specified in the relevant application standard may be declared for controls used in or with such applications for environmental conditions as specified by the application standard.

2.1.5 **SAFETY EXTRA-LOW VOLTAGE (SELV):** nominal voltage for use in a SELV-SYSTEM or PELV-SYSTEM between conductors and between conductors and earth, not exceeding 42 V between conductors, or in the case of three phase circuits, not exceeding 24 V between conductors and neutral, the no load voltage of the circuit not exceeding 50 V and 29 V, respectively, and which when obtained from higher voltage is provided by a safety isolating transformer or a converter with separate windings.

The voltage limits are based on the assumption that the safety isolating transformer is supplied at its rated voltage.

NOTE 1 Converters with separate windings providing equivalent insulation are dealt with in IEC 61558-2-6 and IEC 61558-2-16

NOTE 2 In Canada and the USA, the limit for safety extra low voltage is 30 V.

Also see 2.1.20 SELV SYSTEM and 2.1.21 PELV SYSTEM.

2.1.5DV D1 Modification of Note 1 of 2.1.5 by adding the following:

Replace IEC 61558-2-6 with UL 5085-1 and UL 5085-3. Transformers used in Switch-mode power supplies are evaluated to the applicable requirements of this standard.

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 or REINFORCED INSULATION, and which is intended to supply SAFETY EXTRA-LOW VOLTAGE circuits

2.1.6DV DR Addition of the following text:

A Class 2 transformer which is considered a safety isolating transformer is defined as a step-down transformer of the low-voltage secondary type (No-load voltage 30 volts or 42.4 V_{pk} or 60 Vdc or less) in accordance with Article 725 of the National Electrical Code, NFPA 70.

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

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2.1.11 TRANSIENT OVERVOLTAGE: a short duration overvoltage of a few milliseconds or less, oscillatory or non-oscillatory, usually highly damped [IEV 604-03-13]

2.1.12 RATED IMPULSE VOLTAGE: an 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: a numeral characterizing a TRANSIENT OVERVOLTAGE condition

NOTE – 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. [IEV 195-06-10]

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.

2.1.15 (CONDUCTIVE) SCREEN: (CONDUCTIVE) SHIELD (US):

conductive part that encloses or separates electric circuits and/or conductors [IEV 195-02-38]

2.1.16 (ELECTRICALLY) PROTECTIVE SCREEN: (ELECTRICALLY) PROTECTIVE SHIELD (US):

conductive screen used to separate an electric circuit and/or conductors from hazardous-live-parts [IEV 195-06-17]

2.1.17 (ELECTRICALLY) PROTECTIVE SCREENING: (ELECTRICALLY) PROTECTIVE SHIELDING (US):

separation of electric circuits and conductors from hazardous live parts by an electrically protective screen (shield) connected to the PROTECTIVE-EQUIPOTENTIAL-BONDING system and intended to provide protection against electric shock [IEV 195-06-18]

2.1.18 SIMPLE SEPARATION: separation between circuits or between a circuit and earth by means of basic insulation [IEC 61140, definition 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 [IEV 195-06-19]

2.1.20 SELV SYSTEM: an electrical system in which the voltage cannot exceed ELV:

- under normal conditions, and
- under single-fault conditions, including earth faults in other circuits [IEC 61140, definition 3.26.1]

2.1.21 PELV SYSTEM: an electrical system in which the voltage cannot exceed ELV:

- under normal conditions, and

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– under single-fault conditions, except earth faults in other circuits [IEC 61140, definition 3.26.2]

2.1.21DV DR Addition: Add the following paragraph to 2.1.21:

A PELV circuit supplied from a transformer where the supply system is less than 150 V to ground may be earthed for functional reasons, and are used in applications where SELV is not required. A PELV circuit that is supplied from a transformer where the supply system exceeds 150 V to ground, the PELV circuit shall be grounded.

2.2 Definitions of types of control according to purpose

2.2.1 ELECTRICAL CONTROL(hereinafter referred to as "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. 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

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

A THERMAL CUT-OUT may be of the automatic or of the manual reset type.

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

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

An example is a relay.

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 an ACTUATION before the next cycle can take place

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

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. The control carries motor current and is sensitive to motor temperature and current

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

An example is an electrically operated interlock for a spin dryer lid.

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

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

An example of a multifunctional control is the combination of a thermostat and a humidistat.

2.2.23 SYSTEM: The 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 fulfill its purpose

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

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

It includes the pattern of opened or closed contacts in any LOCATED POSITION, INTERMEDIATE POSITION or position of SETTING by manufacturer or 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

2.3.30 T_{MAX} : the declared maximum continuous ambient temperature to which the SWITCH HEAD is intended to be exposed during normal OPERATION

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

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

There are electric strength and dimensional requirements.

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.

See also annex H.

2.4.3 MICRO-DISCONNECTION: adequate contact separation in at least one pole so as to provide functional security

There is a requirement for the electric strength of the contact gap but no dimensional requirement.

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 (7.2 of the previous edition).

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

There are no electric strength or dimensional requirements for the contact gap.

See also annex H.

2.4.5 OFF POSITION: position providing a visible or implied indication of a FULL-DISCONNECTION OR MICRO-DISCONNECTION.

2.4.5DV D2 Modification of 2.4.5 by adding the following text after the word "MICRO-DISCONNECTION":

"that is mechanically secured (see 11.4.16DV)."

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

The equipment may use electricity, gas, oil, solid fuel or a combination thereof.

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

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.

The equipment may use electricity, gas, oil, solid fuel or a combination thereof.

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

2.5.4 FREE-STANDING CONTROL: IN-LINE CORD CONTROL intended to stand on a table or on the floor. 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. 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 on to 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 See annex H.

2.5.8 See annex H.

2.5.9 See annex H.

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

A TYPE 1 ACTION is subclassified as specified in 6.4.

2.6.2 TYPE 2 ACTION: AUTOMATIC CONTROL 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

A TYPE 2 ACTION is subclassified as specified in 6.4.

2.6.2DV DE Modification of 2.6.2 by replacing the words "AUTOMATIC CONTROL" with "AUTOMATIC ACTION."

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: A 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. 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

In Austria, Belgium, Denmark, France, Germany, Italy, Norway, and the United Kingdom CLASS 0 CONTROLS are not allowed.

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

In Austria, Belgium, Denmark, France, Germany, Italy, Norway, and the United Kingdom CLASS 0I CONTROLS are not allowed.

An earthing terminal is only allowed if it is for continuity (as distinct from protective) purposes.

2.7.3DV DR Modification of 2.7.3 by adding the following text after the notes:

CLASS 0I is not applicable.

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

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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.

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. Such a control may be one of the following types:

CLASS II CONTROLS may have parts that provide protection against electric shock by use of SELV.

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: a 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. Such a control is called an INSULATION-ENCASED CLASS II CONTROL

2.7.5.2 METAL-ENCASED CLASS II CONTROL: a 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. Such a control is called a METAL-ENCASED CLASS II CONTROL

2.7.5.3 COMBINATION INSULATION-ENCASED/METAL-ENCASED CLASS II CONTROL: a control which is a combination of the types described in 2.7.5.1 and 2.7.5.2

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 01 OR CLASS I construction.

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 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

2.7.8DV D2 Modification of 2.7.8:

Replace "Figure 2" with "Figure DVA.3.2.2."

2.7.9 OPERATIONAL 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)

This was formerly part of that insulation referred to as functional insulation.

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). 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)

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). 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). It includes insulation between LIVE PARTS and:

- accessible conductive parts (class II situation);
- conductive parts connected to accessible conductive parts (class II situation);

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- metal foil over accessible insulating surfaces (class II situation)

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 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 [IEV 195-01-10]

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 e.g. protective conductors, PE conductors, PEN conductors earthing conductors, protective earthing terminals of controls or equipment, all conductive parts in a building (e.g. 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 (e.g. sensors, actors, central control element, interface elements) connected in parallel to or via the fixed installation of the building.

2.7.15DV DR Modification: Replace the second from last sentence of 2.7.15 with the following:

Requirements for EQUIPOTENTIAL BONDING can be found in the National Electrical Code (NEC), NFPA 70 for the installation of buildings.

2.7.15.1 PROTECTIVE-EQUIPOTENTIAL-BONDING: equipotential bonding for purposes of safety (protection against electric shock) [IEV 195-01-15, modified]

Functional equipotential bonding is defined in [IEV 195-01-16].

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

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

The term "ACTUATING MEMBER" does not include any device such as a set-screw used for SETTING by the manufacturer if such a device is adequately locked against further movement, or if a TOOL is required for such SETTING by the 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

It may be a mechanical storage device (for example a clock-work 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 OR 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. 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. 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

The following are some examples of parts which are not regarded as SCREWLESS FIXED PARTS OR COMPONENTS:

- parts of components fixed permanently by rivets, gluing 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. 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. 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. 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

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

2.9.10 TERMINATION: part by which a conductor can be connected to a control in such a way that its replacement requires either a SPECIAL PURPOSE TOOL, a special process or a specially prepared end of the conductor

Soldering requires a SPECIAL PURPOSE TOOL. Welding requires a special process. A cable lug attached to a conductor is a specially prepared end.

2.9.11 SOLDER TERMINATION: TERMINATION in which the conductor is secured by a mechanical means, and the circuit continuity is assured by solder

2.9.12 SADDLE TERMINAL: terminal in which the conductor is clamped under a saddle by means of two or more screws or nuts (see figure 13A)

2.9.13 LUG TERMINAL: SCREW TERMINAL OR STUD TERMINAL, intended to clamp a cable lug or bar by means of a screw or nut (see figure 13B)

2.9.14 MANTLE TERMINAL: terminal in which the conductor is clamped against the base of a slot in a threaded stud by means of a nut. The conductor is clamped against the base of the slot by a suitably shaped washer under the nut, by a central peg if the nut is a cap nut or equally effective means for transmitting the pressure from the nut to the conductor within the slot (see figure 12)

2.9.15 EQUIPOTENTIAL BONDING TERMINAL: terminal provided on equipment or on a device and intended for the electrical connection with the EQUIPOTENTIAL BONDING system [IEV 195-02-32]

2.9.16 PROTECTIVE BONDING TERMINAL: terminal intended for PROTECTIVE-EQUIPOTENTIAL-BONDING purposes

Examples are a protective screen- or PE-terminal of a control or equipment.

2.9.17 PROTECTIVE CONDUCTOR: PE

conductor provided for purposes of safety (protection against electric shock) [IEV 195-02-09], modified

2.10 Definitions relating to the connections to controls

2.10.1 EXTERNAL CONDUCTOR: any cable, flexible cord, core or 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

Such a conductor may be a supply lead, a function cord or interconnecting cord between different parts of an equipment; or it may form part of the FIXED WIRING.

2.10.2 FIXED WIRING: any EXTERNAL CONDUCTOR which is permanently secured to the fabric of the building such that, in NORMAL USE at the point at which the conductor enters the equipment or control, there is no likelihood of any strain being applied to the conductor

Such securing to the fabric of the building may be, for example, by the enclosing of conductors in conduit, burying cables in walls, adequately fixing cables or cords to walls or other surfaces, etc.

2.10.3 INTERNAL CONDUCTOR: any cable, flexible cord, core or conductor which is neither an EXTERNAL CONDUCTOR, nor an INTEGRATED CONDUCTOR

An example is a conductor inside the equipment, to interconnect the control and the equipment.

2.10.4 INTEGRATED CONDUCTOR: conductor which is inside a control, or is used to permanently interconnect terminals or TERMINATIONS of a control

2.10.5 DETACHABLE CORD: flexible external cord connected to a control or equipment by means of an equipment inlet, or plug and socket arrangement

2.10.6 NON-DETACHABLE CORD: flexible EXTERNAL CONDUCTOR connected to, or assembled to, a control according to one of the following methods

2.10.6.1 TYPE X ATTACHMENT: method of attachment such that the cord can be easily replaced without SPECIAL-PURPOSE TOOLS, using standard cords without any special preparation

2.10.6.2 TYPE M ATTACHMENT: method of attachment such that the cord can be easily replaced without SPECIAL PURPOSE TOOLS, but is intended to use only a special cord, such as one with a moulded-on cord guard, or one with special prepared ends

This attachment method does not apply if it is possible to fit a standard cord during SERVICING unless such is permitted by a particular equipment standard.

2.10.6.3 TYPE Y ATTACHMENT: method of attachment of the supply cord such that any replacement is intended to be made by the manufacturer, its service agent or a similar qualified person

2.10.6.4 TYPE Z ATTACHMENT: method of attachment such that the flexible cable or cord cannot be replaced without breaking or destroying a part of the control

2.10.7 FLYING LEAD (PIGTAIL): wire or wires intended for the connection of the control, with one end permanently connected to the control by the CONTROL MANUFACTURER

2.11 Definitions relating to the performance of TYPE 2 ACTIONS

2.11.1 MANUFACTURING DEVIATION: maximum difference of OPERATING VALUE, OPERATING TIME OR OPERATING SEQUENCE which is claimed between any two controls, supplied by the manufacturer to a UNIQUE TYPE REFERENCE, when tested as submitted and in the same manner

The difference may be related to an absolute value if permitted by the appropriate subclause of clause 15.

2.11.2 DRIFT: maximum alteration of OPERATING VALUE, OPERATING TIME OR OPERATING SEQUENCE of any one sample which can occur when it is tested under the conditions specified in this standard

The alteration may be related to an absolute value, or combined with the MANUFACTURING DEVIATION, if permitted by the appropriate subclause of clause 15.

2.12 Definitions relating to the requirements for CREEPAGE DISTANCES and CLEARANCES

2.12.1 CLEARANCE: shortest distance through air between two conductive parts, or between a conductive part and a metal foil in contact with a surface of insulating material

The method of measurement is detailed in annex B and figure 17.

2.12.2 CREEPAGE DISTANCE: shortest distance along the surface of the insulating material between two conductive parts, or between a conductive part and a metal foil in contact with any ACCESSIBLE SURFACE of insulating material

The method of measurement is detailed in annex B and figure 17.

2.12.3 Void

2.12.4 Void

2.12.5 Void

2.12.6 Void

2.12.7 Void

2.12.8 POLLUTION: any addition of foreign matter, solid, liquid, or gaseous that can result in a reduction of electric strength or surface resistivity of the insulation

2.12.9 ENVIRONMENT

2.12.9.1 MACRO-ENVIRONMENT: the ENVIRONMENT of the room or other location in which the equipment is installed or used

2.12.9.2 MICRO-ENVIRONMENT: the immediate ENVIRONMENT of the insulation which particularly influences the dimensioning of the CREEPAGE DISTANCES

2.12.9.3 POLLUTION DEGREE: a numeral characterizing the expected POLLUTION of the MICRO-ENVIRONMENT

Note – POLLUTION DEGREES 1, 2, 3, and 4 are used. See annex N.

2.13 Miscellaneous definitions

2.13.1 UNIQUE TYPE REFERENCE: marking such that by quoting it in full to the manufacturer of the control, a replacement can be supplied which will be fully interchangeable with the original, electrically, mechanically, dimensionally and functionally

2.13.2 TOOL: screwdriver, a coin or any other object which may be used to operate a nut, a screw or similar part

2.13.3 SPECIAL-PURPOSE TOOL: TOOL which is unlikely to be readily available in a normal household, for example, a key for a hexagonal socket-headed screw. TOOLS such as coins, screwdrivers and spanners intended to operate square, or hexagonal nuts, are not SPECIAL-PURPOSE TOOLS

2.13.4 NORMAL USE: use of the control, or its associated equipment, for the purpose for which it was made, and in the manner intended by the manufacturer

NORMAL USE includes any overload, or abnormal operating conditions specified in the equipment standard.

NORMAL USE does not include any process which is necessary to maintain the control or equipment in good order, even though this may be carried out by the USER according to the manufacturer's instructions.

2.13.5 USER MAINTENANCE: any periodic process necessary to maintain the control, or equipment, in good order, for which details are given in the manufacturer's instructions to the USER

2.13.6 SERVICING: any process necessary to maintain a control, or equipment, in good order, that would be done by a competent person, such as in a workshop, by an electrician or by a service organization. This includes replacing a flexible cord, thermal link or the like

2.13.7 **MANUFACTURER SERVICING:** SERVICING which can only be done by the manufacturer, or his accredited serviceman. This may be due to the need for special TOOLS, or special instrumentation, and includes the SETTING by the manufacturer

2.13.8 **FAILURE:** termination of the ability of an item to perform a required function [IEV 191-14-01]

2.13.9 **FAULT:** state of an item characterised by its inability to perform a required function, excluding the inability during preventive maintenance or other planned actions, or due to lack of external resources [IEV 191-05-01]

EXPLANATORY NOTE 1 “Failure” is an event, as distinguished from “fault”, which is a state

EXPLANATORY NOTE 2 After failure the item has a fault

EXPLANATORY NOTE 3 This concept as defined does not apply to items consisting of software only.

EXPLANATORY NOTE 4 A fault is often the result of a failure of the item itself, but may exist without prior failure.

2.14 Definitions relating to manufacturer and USER

2.14.1 **CONTROL MANUFACTURER:** manufacturer of the CONTROL

2.14.2 **EQUIPMENT MANUFACTURER:** manufacturer of equipment in which, on which, or together with which the CONTROL is used

In Canada and the USA, the EQUIPMENT MANUFACTURER is indicated as the OEM (original EQUIPMENT MANUFACTURER). The OEM receives controls from CONTROL MANUFACTURERS for integration or incorporation into equipment.

2.14.3 **INSTALLER:** person qualified to install the CONTROL and possibly the associated equipment

2.14.4 **USER:** one who uses the CONTROL with the aid of documentation (USER MAINTENANCE) during its normal life. The USER is considered a layman.

2.15 Definition pertaining to thermistors

See annex J.