UL 60730-1

STANDARD FOR SAFETY

Automatic Electrical Controls – Part 1: General Requirements

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UL Standard for Safety for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1

Fifth Edition, Dated August 3, 2016

Summary of Topics

This revision of ANSI/UL 60730-1 dated October 18, 2021 includes the following changes in requirements:

– Addition of the second amendment to IEC 60730-1; 1.2, 2.1.4, 2.1.5, 2.3.33, 2.4.5DV, 2.13.4, 2.13.12, Table 1, 8.1.1, 8.1.1.1, 11.1.4, 11.4.11, 11.4.12, Table 12, 14.5.1, Table 15, Table 16, Section 20, 24.1, 24.5, H.7, H.11.2.5, H.11.12.4.1.3.2, Table H.11, H.11.12.4.3.6, H.26, H.26.8.3, H.26.9.2, H.27.1.1.2, H.27.1.1.7, H.27.1.1.8, J.4.3.5.4.1, Annex Q, T.3.1, T.3.2, Bibliography

– Deletion of SMPS test method; 24.2.1DV.2 – 24.2.1DV.3.11

– Revise Table H.14 for the voltage dips and interruptions test to include 60 Hz frequency; Table H.14

– Revisions to add clarity, reflect current practices and/or corrections; Table 1DV, 1.2DV, 6.4.3.101DV, 9.3.4DV, 11.4.101DV, 11.10.3DV.1, 12.1.1DV, Table 12.1DV.1, Table 15DV, 21.1DV.1, 24.1DV, 27.5.101DV, H.23.1DV, H.27.1.1.2DV, Annex P, DVB.1.3, DVE.1, DVE.2, DVE.3

– Revisions to the DV's covering the grounding and bonding requirements; 2.7.15.1DV, 2.7.15.2DV, and 9.3.4DV.1 – 9.3.4DV.7

UL 60730-1 adopts IEC 60730-1, Edition 5.2, issued by the IEC December, 2020. Please note that the national difference document incorporates all of the U.S. national differences for UL 60730-1.

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 new and revised requirements are substantially in accordance with Proposal(s) on this subject dated April 16, 2021 and August 13, 2021.

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Preface (UL)

This UL Standard is based on IEC Publication 60730-1: Fifth Edition – Automatic Electrical Controls, Part 1: General Requirements, as revised by Amendments 1 and 2 and corrigendum 1. IEC publication 60730-1 is copyrighted by the IEC.

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, Part 1: General Requirements. This UL part 1 is to be used in conjunction with the appropriate UL Part 2 standards, which contain clauses to supplement or modify the corresponding clauses in Part 1, to provide relevant requirements for each type of product.

These materials are subject to copyright claims of IEC and UL. No part of this publication may be reproduced in any form, including an electronic retrieval system, without the prior written permission of UL. All requests pertaining to the Automatic Electrical Controls, Part 1: General Requirements, UL 60730-1 Standard should be submitted to UL.

Note – Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.

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NATIONAL DIFFERENCES

GENERAL

National Differences from the text of International Electrotechnical Commission (IEC) Publication 60730-1, Automatic Electrical Controls, Part 1: General Requirements, copyright 2020 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.

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FOREWORD

INTERNATIONAL ELECTROTECHNICAL COMMISSION

AUTOMATIC ELECTRICAL CONTROLS – Part 1: General requirements

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.

3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.

4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.

5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.

6) All users should ensure that they have the latest edition of this publication.

7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.

8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

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

This Consolidated version of IEC 60730-1 bears the edition number 5.2. It consists of the fifth edition (2013-11) [documents 72/899/FDIS and 72/928/RVD] and its corrigendum 1 (2014-09), and its amendment 1 (2015-12) [documents 72/1017/FDIS and 72/1026/RVD] and its amendment 2 (2020-04) [documents 72/1226/FDIS and 72/1237/RVD]. The technical content is identical to the base edition and its amendment.

This Final version does not show where the technical content is modified by amendments 1 and 2. A separate Redline version with all changes highlighted is available in this publication.

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.

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– 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 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.

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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 amendments 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

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• 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.

DV1 ***Modification to the Notes:***

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

DV2 ***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.

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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.

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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.

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.

1.1.7DV.1 D2 ***Modification of 1.1.7 by adding the following text:***

This standard applies to discrete THERMISTORS and also to controls using NTC or PTC THERMISTORS, requirements for which are contained in Annex J

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.

1.1.101DV DR ***Addition to the Scope by adding the following text:***

CONTROLS intended to be installed in air handling spaces or in other environmental air space (plenums) are covered under the scope of this standard.

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.

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IEC 60038, *IEC standard voltages*

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

[1] There exists a consolidated edition 7.2:2011 including IEC 60065:2001 and its Amendments 1:2005 and 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]

[2] Withdrawn

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

[3] There exists a consolidated edition 4.1:2009 including IEC 60112:2003 and its 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*

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

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[4] There exists a consolidated edition 2.1:2001 including IEC 60529:1989 and its 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 60664-3:2016, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution*

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*

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 mm^2 up to 35 mm^2 (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*

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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*

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*

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*

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

IEC 62326 (all parts), *Printed boards*

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

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

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: Emission*[5]; Amendment 1:2008

[5] There exists a consolidated edition 5.1:2009 including CISPR 14-1:2005 and its 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*

1.2DV D2 ***Addition of the following to 1.2:***

The following UL Standards are referenced in this Standard:

UL 50
Enclosures for Electrical Equipment, Non-Environmental Considerations

UL 50E
Enclosures for Electrical Equipment, Environmental Considerations

UL 62
Flexible Cords and Cables

UL 94
Plastic Materials for Parts in Devices and Appliances, Tests for Flammability of

UL 157
Gaskets and Seals

UL 248-14
Low-Voltage Fuses – Part 14: Supplemental Fuses

UL 310
Terminals, Electrically Quick-Connect

UL 508
Industrial Control Equipment

UL 514A
Metallic Outlet Boxes

UL 514B
Fittings, Conduit, Tubing and Cable

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UL 514C
Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers

UL 635
Insulating Bushings

UL 746C
Polymeric Materials – Use in Electrical Equipment Evaluations

UL 796
Printed-Wiring Boards

UL 969
Marking and Labeling Systems

UL 1059
Terminal Blocks

UL 1434
Thermistor-type Devices

UL 4200A
Products Incorporating Button or Coin Cell Batteries of Lithium Technologies

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

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

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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 conductors and 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 declared 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).

2.1.5DV D1 ***Modification of Note 2 to entry 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

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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

2.1.6DV DR *Addition of the following note to 2.1.6:*

A Class 2 transformer which is considered a safety isolating transformer is defined as a step-down transformer of the low-voltage secondary type 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

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

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(CONDUCTIVE) SHIELD (US)
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
(ELECTRICALLY) PROTECTIVE SHIELD (US)
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
(ELECTRICALLY) PROTECTIVE SHIELDING (US)
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

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– 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

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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

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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

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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

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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

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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
MAXIMUM TEMPERATURE
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.

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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

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

"that is mechanically secured (see 11.4.101DV)."

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).

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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.

2.5.3DV D2 *Modification of Note 1 to entry:*

A fuse in the plug is regarded to be part of the CONTROL if the cord is non-detachable using attachment methods Y or Z.

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

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

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

Note 2 to entry: 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

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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.

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

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– 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

2.7.8DV D2 *Modification of 2.7.8:*

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

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.

2.7.10DV DE *Relocation of Note 2 to entry:*

Relocate Note 2 to entry under 2.7.9.

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)

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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]

2.7.15DV 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.

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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.]

2.7.15.1DV D2 *Addition:*

PROTECTIVE BONDING CONDUCTOR
a conductor in the equipment, or a combination of conductive parts in the equipment, connecting a main protective earthing terminal to a part of the equipment that is required to be earthed

2.7.15.2DV D2 *Addition:*

PROTECTIVE EARTHING CONDUCTOR
a conductor connecting the main protective earthing terminal or lead in the equipment to the building earth, or in the power SUPPLY CORD, connecting a main protective earthing terminal in the equipment to an earth point in the building installation

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

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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

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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 Figure 14 and Figure 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

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Note 1 to entry: 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

Note 1 to entry: 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 electric connection with the EQUIPOTENTIAL BONDING SYSTEM

[SOURCE: IEC 60050-195:1998, 195-02-32]

2.9.16
PROTECTIVE BONDING TERMINAL
terminal intended for PROTECTIVE EQUIPOTENTIAL BONDING purposes

Note 1 to entry: 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, for example, protection against electric shock

[SOURCE: IEC 60050-195:1998, 195-02-09]

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

Note 1 to entry: 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

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