National Differences For

UL 60730-1

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

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These revisions are being issued to reflect the established effective date for UL 60730-1.

AS OF OCTOBER 19, 2018, THE THIRD EDITION OF UL 60730-1A, THE TWELFTH EDITION OF UL 873, AND THE THIRD EDITION OF UL 244A, WILL BE WITHDRAWN AND WILL BE REPLACED BY THIS STANDARD.

This document provides a single listing of the National Differences included in the UL adoption of the corresponding IEC standard.

Preface

This document provides a single listing of the technical National Differences included in the UL adoption of the corresponding IEC standard.

In its IEC-based standards, UL uses the notations indicated below to identify national difference type, and these types are additionally noted in this document. The standard may not use all types of these deviations.

D1 - These are deviations which are based on basic safety principles and requirements, elimination of which would compromise safety for U.S. consumers and users of products.

D2 - These are deviations based on safety practices. These are deviations for IEC requirements that may be acceptable, but adopting the IEC requirements would require considerable retesting or redesign on the manufacturer's part.

DC - These are deviations 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 deviations based on editorial comments or corrections.

DR - These are deviations based on the national regulatory requirements.

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.

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

National Differences

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.

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

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

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

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

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

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

2.1.5DV 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.

2.1.6DV 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.

2.1.21DV 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.

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

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

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

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

CLASS 0I is not applicable.

2.7.8DV D2 *Modification of 2.7.8:*

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

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.

3DV DR *Modification of 3 by adding the following after "the appropriate part 2":*

In addition, controls shall be constructed so as to be installable in accordance with the National Electrical Code, NFPA 70.

4.2.1DV D2 *Modification of 4.2.1:*

Replace "28" with "27 (plus annexes)".

5.1DV DR *Modification of 5.1 by adding the following text:*

The maximum RATED VOLTAGE is 600 V in the USA.

5.2DV DR *Modification of 5.2 by adding the following text:*

The maximum current is unlimited in the USA.

6.2.3DV DE *Modification of 6.2.3 by adding the following text to the end of the note:*

"(carry only), make only or break only."

6.2.5DV D2 *Modification of 6.2.5 by adding the following text:*

An INDEPENDENTLY mounted, in-line, or free standing control shall be rated in accordance with Annex DVB.

6.2.6DV D2 *Modification of 6.2.6 by adding the following text:*

An INDEPENDENTLY mounted, in-line, or free standing control shall be rated in accordance with Annex DVB.

6.4.3.13DV D1 *Addition: Add the following to 6.4.3.13:*

An action which is prevented from functioning automatically by a positive mechanical means (Type 1.AY or Type 2.AY)

6.5DV D2 *Modification of 6.5 by adding the following text:*

According to degrees of protection as indicated in the ENVIRONMENTAL protection enclosure requirements of UL 50 and UL 50E. Additional optional degrees of protection are permitted as shown in 6.5.1 and 6.5.2 or, for integrated or INCORPORATED CONTROLS, as otherwise declared.

6.13DV D2 *Replace 6.13 with the following:*

6.13DV.1 According to value of comparative tracking index (CTI) for the insulation material used

6.13DV.1.1 – material of material group IIIb with a CTI of 100 through 174 (CTI index 4);

6.13DV.1.2 – material of material group IIIa with a CTI of 175 through 249 (CTI index 3) or CTI of 250 through 399 (CTI index 2);

6.13DV.1.3 – material of material group II with a CTI of 400 through 599 (CTI index 1);

6.13DV.1.4 – material of material group I with a CTI of 600 or greater (CTI index 0).

7.2.9DV.1 D2 *Modification of 7.2.9 by adding the following:*

Alternating current (single phase)..... ∿ ″or a.c.″

7.2.9DV.2 D2 *Modification of 7.2.9 by adding the following:*

Direct current..... ⎓ ″or d.c.″

7.2.9DV.3 D2 *Modification of 7.2.9 by adding the following:*

Symbols for alternating current (single phase), alternating current (three phase), alternating current (three phase with neutral) and ambient temperature limits of SWITCH HEAD are not used in the USA.

7.2.9DV.4 D2 *Modification of 7.2.9 by adding the following:*

Letter type abbreviations (FLA for full load amperes, HP for horsepower) which clearly convey the assigned rating may be used.

7.2.9DV.5 D2 *Modification of 7.2.9 by adding the following:*

For independently-mounted, free standing and in-line controls, information regarding the connection of specific loads shall be on a wiring diagram or label attached to the control.

Table 1DV D2 *Modification of Table 1 with the following eleven national differences:*

DV.1 Insert row 4A, with the first column being “4A”, the second column being “Class 2 power source or circuit”, the third column being “DVC.2”, and the fourth column being “C”.

DV.2 Modify the third column of row 17 by adding, “DVC.1.21”.

DV.3 Modify row 89 by replacing "CISPR 11" with "FCC Part 15 and/or 18".

DV.4 Modify note (4) by replacing "α_1 = maximum rising rate (for TYPE 2 ACTIONS only)" with "α_2 = maximum rising rate (for TYPE 2 ACTIONS only)" and by replacing "β_1 = maximum falling rate (for TYPE 2 ACTIONS only)" with "β_2 = maximum falling rate (for TYPE 2 ACTIONS only)".

DV.5 Delete note (5).

DV.6 Replace note (6) with the following, "This note does not apply in the USA. Attachment or replacement of NON-DETACHABLE CORDS is not considered a USER function."

DV.7 Replace note (7) with the following, "Motor load and PILOT DUTY load ratings are established as indicated in annex DVB and DVC respectively, and marked accordingly."

DV.8 Add the following four paragraphs to note (8):

Control enclosures shall be marked in accordance with the environmental enclosure requirements of UL 50E.

A control enclosure which has been evaluated against the ingress of water only by the Rain Test shall be marked RAINTIGHT if so constructed that exposure to beating rain will not result in the entrance of water; RAINPROOF if so constructed, protected, or treated as to prevent beating rain from interfering with successful OPERATION of the control.

Control enclosures are not required to be marked to indicate the degree of protection against the entrance of solid objects.

The IP system of marking may be optionally placed on an enclosure.

DV.9 Add the following paragraph to note (9):

A switch having one or more push-in (SCREWLESS) TERMINALS shall be marked:

a) With instructions for connecting acceptably sized wire where readily visible during installation,

b) With instructions for disconnecting a wire from the terminal where readily visible during wiring and rewiring,

c) To specify use with ″solid wire only″ unless the terminal is intended for both solid and stranded wire, and

d) With instruction to strip the insulation from conductors a specific length, where readily visible during installation.

DV.10 Delete notes (10) – (21).

DV.11 Insert row 2A, with the first column being ″2A″, the second column being ″Date code of manufacturing″, the third column being ″DVC.2″, and the fourth column being ″C.″

7.4.1DV D2 *Addition: Add the following to 7.4.1:*

Tests to determine the legibility and durability of markings placed on labels are in the Standard for Marking and Labeling Systems, UL 969. Markings, other than those placed on labels, are tested in accordance with Annex A.

7.4.6ADV D2 *Addition: Add the following to 7.4.6:*

See Annex DVC.

8.1.1DV DR *Replacement of the third paragraph of 8.1.1 with the following text:*

If SELV- or PELV-circuits supplied at higher than 30 volts are accessible, the current between the accessible part(s) and earth / referenced pole of the supply source of the SELV/PELV circuits shall comply with H.8.1.10.1.

8.1.3DV D2 *Modification of 8.1.3 by adding the following text:*

Sealing compounds are acceptable if investigated according to the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

8.1.9.5DV D2 *Modification of 8.1.9.5 by adding the following text:*

The requirements of 8.1.9 to 8.1.9.5 inclusive are replaced by the requirements of Annex DVA.

8.3.2.4DV D2 *Addition: Add the following to 8.3.2.4:*

The voltage between the pins of the plug shall not exceed 30 V.

9.1.1DV.1 D2 *Addition:*

A splice shall not be employed in a wire used for bonding purposes.

9.1.1DV.2 D2 *Addition of 9.1.1DV.2.1 and 9.1.1DV.2.2:*

9.1.1DV.2.1 Individually covered or insulated grounding conductors shall have a continuous outer finish that is either green, or green with one or more yellow stripes and no other conductors visible to the INSTALLER in a field wiring compartment shall be so identified.

9.1.1DV.2.2 Additional requirements related to Grounding and Bonding of electrical installations and systems are specified in Article 250 of the National Electrical Code (NEC), NFPA 70.

9.1.2DV D2 *Addition: Add the following to 9.1.2:*

A grounding connection shall reliably penetrate a nonconductive coating, such as paint or vitreous enamel. Compliance is checked by the test of 9.3.1.

9.3.2DV D2 *Modification of 9.3.2 by adding the following text after the notes:*

Earthing terminals for the connection of NON-DETACHABLE CORDS using methods X and M shall comply with the requirements of 10.2.

9.3.4DV D2 *Modification of 9.3.4 by adding the following text:*

A FLYING LEAD for connection to an external earthing conductor shall have a free length of 6 inch (152 mm) and shall have the free end insulated – for example, shall have the end folded back and taped to the lead – unless the lead is located so that it cannot contact LIVE PARTS in the event that the lead is not used in the field. It shall be not smaller than (1) the size specified in Table 9.3.4DV.1 (2) the conductor supplying the motor or component, whichever is smaller or (3) shall be tested to determine that it withstands overload and short-circuit conditions.

Table 9.3.4DV.1 D2 *Addition:*

Table 9.3.4DV.1

Rating or SETTING of automatic overcurrent device in circuit ahead of equipment, conduit, etc, Not exceeding amperes	Size of conductor [1]			
	Copper wire AWG	Aluminum wire AWG	Rigid conduit or Pipe, Inch	Electrical metallic tubing, Inches
20[2]	12	10	1/2	1/2
30	10	8	1/2	1/2
40	10	8	1/2	1/2
60	10	8	1/2	1/2
100	8	6	1/2	1/2
200	6	4	1/2	1

[1] Or equivalent cross-sectional area.

[2] For a cord-connected device, the grounding wire in the cord may be the same size as the current-carrying conductors.

9.3.6.1DV D2 *Addition: Add 9.3.6.1DV.1 and 9.3.6.1DV.2:*

9.3.6.1DV.1 An equipment-grounding terminal or lead grounding point shall be connected to the frame or enclosure by a positive means, such as by a bolted or screwed connection.

9.3.6.1DV.2 A grounding point shall be located so that it is unlikely that the grounding means will be removed during normal servicing.

10.1.1DV D2 *Addition of 10.1.1DV.1 and 10.1.1DV.2:*

10.1.1DV.1 Terminals for fixed wiring shall comply with the requirements contained in the Standard for Terminal Blocks, UL 1059. Methods X and M are not used in the USA. The attachment of a power supply cord may be made by the methods specified for external, internal, or INTEGRATED CONDUCTORS.

10.1.1DV.2 Flat quick connect terminals may be employed for limited energy, safety extra low voltage circuits. Such connections shall:

a) Have both engagement parts shipped with the control

b) Have engagement parts provided with a means to permit interlocking

c) Be accompanied by instructions for proper installation

10.1.4DV DR *Modification of 10.1.4 by adding the following text:*

With reference to Note 1, the nominal cross-sectional area of a conductor is related to the current being carried and shall be as stated in Article 310 and Article 400 of the National Electrical Code, NFPA 70.

10.1.4.2DV D2 *Deletion:*

Delete 10.1.4.2.

10.1.14DV.1 D2 *Addition of 10.1.14DV.1.1:*

10.1.14DV.1.1 A terminal plate tapped for a wire binding screw shall have two or more full threads which may be extruded to provide two full threads.

11.1DV D2 *Modification of 11.1 by adding the following text:*

Requirements for insulating materials and polymeric enclosures are contained in Annex D and/or the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

11.1.3.1DV D2 *Modification of 11.1.3.1 by adding the following text:*

Individually covered or insulated grounding conductors shall have a continuous outer finish that is either green, or green with one or more yellow stripes.

11.1.3.2DV D2 *Modification of 11.1.3.2 by adding the following text:*

All individually covered or insulated conductors other than grounding conductors shall not use a continuous outer finish that is either green, or green with one or more yellow stripes.

11.2.3.3DV D2 *Addition of 11.2.3.3DV.1 to 11.2.3.3DV.4:*

11.2.3.3DV.1 A No. 18 AWG or 16 AWG (0,82 or 1,3 mm^2) rubber-covered wire in other than a low-voltage circuit as described in 2.1.5 shall be at least Type RFH-1 with impregnated braid, for a potential of 300 V or less; and shall be at least Type RFH-2 with impregnated braid and shall be acceptable for the application for a potential of 301 – 600 V.

11.2.3.3DV.2 A No. 14 AWG (2,1 mm^2) or larger conductor shall be Type TW, RH, or RHW wire.

11.2.3.3DV.3 Other types of conductors that have been found to be acceptable may also be employed; Type TF wire may be used wherever Type RFH-1 or RFH-2 wire is acceptable.

11.2.3.3DV.4 Tubing shall not be subjected to sharp bends, tension, compression, or repeated flexing, and shall not contact sharp edges, projections, or corners. Tubing may be used in dry or damp locations but is not acceptable in wet locations.

11.2.4DV D2 *Modification of 11.2.4 by adding the following text:*

The tests for insulating properties of a cord's sheath are contained in UL 62.

11.3.5.1DV D2 *Modification of 11.3.5.1 by adding the following text after the note:*

A component, such as a resistor, capacitor, diode, and the like, shall not be connected across the contacts of a safety control or a protective device unless it can be validated through a failure assessment that a single component fault will not result in a loss of protective function.

11.4.16DV D2 *Addition:*

A Type 1.A.Y or 2.A.Y action (OFF POSITION) shall be so designed that it provides a FULL DISCONNECTION that is prevented from reclosing automatically when in the OFF POSITION by positive mechanical means.

11.5DV D2 *Addition of 11.5DV.1 to 11.5DV.4:*

11.5DV.1 In-line cord, free-standing and INDEPENDENTLY MOUNTED CONTROLS shall meet the applicable environmental enclosure requirements of UL 50 and of Annex DVA.

11.5DV.2 Accessible enclosures of the electrical parts of integrated and INCORPORATED CONTROLS shall be so designed that the controls meet the appropriate requirements.

11.5DV.3 A nonmetallic part such as a reset knob, lever, or button that protrudes through an opening in the enclosure that is not larger than 650 mm^2 (1 in^2) in area shall be made of a material classified as 5VA, 5VB, V-0, V-1, or V-2 in accordance with UL 94.

11.5DV.4 A nonmetallic part that protrudes through an opening in the enclosure that is larger than 650 mm^2 (1 in^2) in area shall be made of a material classified 5VA or 5VB and complies with the requirements for polymeric enclosures in this standard (see also Annex D).

11.6.3.2DV D2 *Addition: Add the following to 11.6.3.2:*

The special conduit box provided with the control shall comply with the appropriate requirements of the Standard for Enclosures for Electrical Equipment, UL 50.

11.6.3.4DV D2 *Addition: Add the following to 11.6.3.4:*

INDEPENDENTLY MOUNTED CONTROLS for surface mounting used with exposed wiring shall be provided with cable or conduit entries, knock-outs, or glands, which allow connection of the appropriate type of cable or conduit complying with the National Electrical Code (NEC), NFPA 70, and relevant UL standards.

11.7.2.1DV D2 *Modification: Replace 11.7.2.1 with 11.7.2.1DV.1:*

11.7.2.1DV.1 Strain relief used in controls other than integrated and incorporated, intended to be connected by means of a NON-DETACHABLE CORD, shall comply with the requirements of the Standard for Insulating Bushings, UL 635 and be suitable for the application with respect to the hole size and shape, maximum use temperature and wire size/type. To ensure that the hole size and shape is suitable for the bushing, the test noted in 11.7.2.11DV should be conducted.

11.7.2.11DV D2 *Modification to replace 11.7.2.11 with the following text:*

A strain-relief device shall withstand without damage to the cord or conductors and without displacement a direct pull of 35 pounds (156 N) applied to the cord for 1 minute. Supply connections within the equipment are to be disconnected from terminals or splices during the test.

11.7.2.12DV D2 *Addition: Add the following to 11.7.2.12:*

In the USA, the torque test is not applicable.

11.8.2DV DR *Modification of 11.8.2 by adding the following text:*

Cord conductors shall comply with the size requirements in the National Electrical Code, ANSI/NFPA 70.

11.9DV D2 *Addition of 11.9DV.1:*

11.9DV.1 INDEPENDENTLY MOUNTED

11.9DV.1.1 CONTROLS intended to be permanently connected to FIXED WIRING shall allow the connection of the supply wires after the control has been fixed to its support, and shall be provided with:

a) A set of terminals allowing the connection of cables for FIXED WIRING of the nominal cross-sectional areas specified in Clause 10;

b) A set of supply leads accommodated in a suitable compartment;

c) Cable entries, conduit entries, knockouts or glands which allow the connection of the appropriate types of cable or conduit.

d) Such a control may be provided with a plug and flexible cord if the following conditions are met:

1) The cord connection of the equipment facilitates frequent interchange,

2) Reduction of the TRANSMISSION of noise or vibration is accomplished, or

3) The fastening means or mechanical connections are intended to permit removal for maintenance and repair.

11.9.4DV D2 *Addition:*

A soft-rubber bushing shall not be less than 3/64 inch (1,2 mm) thick and shall be located so that it will not be exposed to oil, grease, oily vapor, or other substance having a deleterious effect on rubber.

11.9.5DV.1 DE *Modification of 11.9.5:*

Replace ″cable or cord″ to ″or EXTERNAL CONDUCTOR″.

11.9.5DV.2 D2 *Modification of 11.9.5 by adding the following text:*

A terminal box or compartment on equipment that is to be permanently connected electrically shall be located so that wire connections therein will be accessible for INSPECTION, without disturbing either line-voltage or safety-circuit wiring after the equipment is installed in the intended manner. However, wire connections to equipment intended to be mounted on an outlet box may be accessible upon removal of the equipment from the box. A device which is acceptable for use with a fitting for only one type of wiring system shall be supplied with such a fitting.

11.10.3DV D2 *Addition of the following text:*

Controls designed for fixed socket-outlets as shown in Figure 31DV shall have a weight of 0,79 kg or less and the design shall be suitable for the application. The maximum acceptable moment, center of gravity and dimensions of the control shall be within the limits given in Figure 31DV for plug-in TIME SWITCHES featuring two or three integral blades or pins.

11.11.1.2DV D2 *Modification of 11.11.1.2 by adding 11.11.1.2DV.1 after the notes:*

11.11.1.2DV.1 A polymeric COVER attached by screws shall comply with the requirements of 11.11.1 with the screws loosened one full turn.

11.11.1.3DV D2 *Addition: Add 11.11.1.3DV.1 – 11.11.1.3DV.4 to 11.11.1.3:*

11.11.1.3DV.1 An enclosure COVER shall be hinged if it gives access to fuses, thermal cutouts, or any other overload-protective device, the functioning of which requires renewal, or if it is necessary to open the COVER in connection with normal OPERATION of the device.

11.11.1.3DV.2 A COVER hinged to comply with 11.11.1.3DV.3 and 11.11.1.3DV.4, shall not depend solely upon screws or other similar means requiring the use of a TOOL to hold it closed, but shall be provided with a spring latch or catch.

11.11.1.3DV.3 A door or cover giving access to a fuse or thermal cutout in other than a low-voltage circuit shall:

a) Shut closely against a 1/4 inch rabbet or the equivalent,

b) Have turned flanges for the full length of four edges, or

c) Have angle strips fastened to it.

11.11.1.3DV.4 A strip used to provide a rabbet and an angle strip fastened to the edges of a door shall be secured at not less than two points, not more than 1-1/2 inch (38,1 mm) from each end of each strip and at points between these end fastenings not more than 6 inch (152,4 mm) apart.

11.11.1.4DV D2 *Addition: Add 11.11.1.4DV.1 – 11.11.1.4DV.3:*

11.11.1.4DV.1 Glass covering an observation opening shall be reliably secured in place so that it cannot be readily displaced in service and shall provide mechanical protection for the enclosed parts.

11.11.1.4DV.2 Glass for an opening not more than 4 inches (102 mm) in any dimension shall not be less than 1/16 inch (1.6 mm) thick, and glass for a larger opening, but not more than 144 inches^2 (929 cm^2) in area and having no dimension greater than 12 inches (305 mm), shall not be less than 1/8 inch (3.2 mm) thick. Glass that covers a larger area shall not be less than 1/8 inch thick and shall conform to one of the following:

a) The glass shall be of a nonshattering or tempered type that, when broken, shall conform to the performance specifications in the Safety Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings, ANSI Z97.1-1984, ; or

b) b) Shall withstand a 2-1/2 foot-pound (2.41 J) impact from a 2-inch (50.8-mm) diameter, 1.18 pound (535 g) steel sphere without cracking or breaking to the extent that a piece is released or dropped from its intended position.

11.11.1.4DV.3 A transparent material other than glass employed as a covering over an opening in an enclosure shall be investigated to determine if it has adequate mechanical strength and is otherwise acceptable for the purpose. Compliance is checked by the applicable requirements and tests of Annex D.

11.13.1DV D2 *Addition: Add the following:*

11.13.1DV.1 If an electronic circuit/component is relied upon to prevent a hazard under normal or abnormal operation of the product, that electronic circuit/component is considered to be providing a protective function. Such components/circuits shall comply with the relevant requirements for protective controls unless it can be shown through a fault assessment and tests of clause 27 that failure or malfunction of the protective circuit/component will not lead to a hazardous condition of the control i.e., loss of the protective function.

NOTE – Examples of such circuits could be zero cross circuits, power regulation circuits, overcurrent protection etc.

12.1.1DV D2 *Modification of 12.1.1 by adding the following text:*

Controls classified as having protection against ingress of water and dust shall meet the applicable environmental enclosure requirements of UL 50. Compliance with IEC 529 may be optionally provided, in which case, 12.1.1 to 12.1.6 apply.

12.1.6DV D2 *Modification of 12.1.6 by adding the following text after the note:*

Gaskets and seals that are relied upon to prevent ingress of water and dust shall comply with the requirements of Standard for Gaskets and Seals, UL 157.

12.1.6.3DV D2 *Addition of the following paragraphs:*

12.1.6.3DV.1 Gaskets and seals that are relied upon to prevent ingress of water and dust shall comply with the requirements of the Standard for Gaskets and Seals, UL 157.

12.1.6.3DV.2 The gasket and seals material shall have physical properties as specified in Table 12.1DV.1 before and after aging under the conditions specified in Table 12.1DV.2.

Table 12.1DV.1
Physical properties for gaskets

	Neoprene or rubber compound		Polyvinyl chloride materials	
	Before test	After test	Before test	After test
Recovery – Maximum set when 1-inch (25.4-mm) gage marks are stretched to 2-1/2 inches (63.5 mm) held for 2 minutes and measured 2 minutes after release	1/4 inch (6.4 mm)	–	Not specified	
Elongation – Minimum increase in distance between 1-inch gage marks at break	250 percent, 1 – 3-1/2 inches (25.4 – 88.9 mm)	65 percent of original	250 percent, 1 – 3-1/2 inches	75 percent of original
Tensile Strength – Minimum force at breaking point	850 psi (5.9 MPa)	75 percent of original	1200 psi (8.3 MPa)	90 percent of original

Table 12.1DV.2
Aging conditions

Measured temperature rise		Material	Test program
°C	°F		
35	63	Rubber or neoprene	Air oven aging for 70 hours at 100.0°C ± 2.0°C (212.0°C ± 3.6°F)
35	63	Thermoplastic	Aged in full-draft, air-circulating oven for 168 hours at 87.0 ± 1.0°C (188.6 ± 1.8°F)
50	90	Rubber or neoprene	Air oven aging for 168 hours at 100.0°C ± 2.0°C (212.0°F ± 3.6°F)
50	90	Thermoplastic	Aged in full-draft, air-circulating oven for 240 hours at 100.0 ± 1.0°C (212.0 ± 1.0°F)
55	99	Rubber, neoprene or thermoplastic	Aged in full-draft, air-circulating oven for 168 hours at 113.0 ± 1.0°C (235.4 ± 1.8°F)
65	117	Rubber or neoprene	Aged in full-draft, air-circulating oven for 240 hours at 121.0 ± 1.0°C (249.8 ± 1.8°F)

Table 12.1DV.2 Continued on Next Page

Table 12.1DV.2 Continued

Measured temperature rise		Material	Test program
°C	°F		
65	117	Thermoplastic	Aged in full-draft, air-circulating oven for 168 hours at 121.0 ± 1.0°C (249.8 ± 1.8°F) for 1440 hours at 97.0 ± 1.0°C (206.6 ± 1.8°F)
80	144	Rubber, neoprene or thermoplastic	Aged in full-draft, air-circulating oven for 168 hours at 136.0 ± 1.0°C (276.8 ± 1.8°F)

12.1.6.3DV.3 *Compliance is checked by* INSPECTION. The material shall show no signs of deformation, melt or deterioration to a degree that will affect its sealing properties.

12.1.6.3DV.4 If gaskets are secured by adhesives, samples of the gasket, adhesive and mounting surface shall be exposed for 72 hours to each of the following conditions, for a temperature rise not exceeding 35°C (63°F) obtained during the heating test:

a) 100°C (212°F),

b) Immersion in distilled water, and

c) Minus 10°C (14°F).

12.1.6.3DV.5 *Compliance is checked by measuring the force required to peel the gasket from its mounting surface after the above exposure. The force shall not be less than 75 percent of the value determined on the as-received samples.*

Table 12DV D2 *Add, "up to and including 600 V" to the end of note 1) after the word, "mains" and replace note 14) with "Void."*

13.2.1DV D2 *Addition of the following two paragraphs:*

13.2.1DV.1 Induced Potential Test – Each of three separate magnet-coil-winding samples, mentioned in 20.3.1DV, shall withstand without breakdown the induced potential test after constant temperatures have been reached as a result of OPERATION under the conditions specified in Clause 14. While still heated, the coil winding shall be subjected to an alternating potential of twice the RATED VOLTAGE at any suitable frequency – typically 120 hertz or higher – for 7 200 electrical cycles or for 60 seconds, whichever is less. The required test voltage is to be obtained by starting at one-quarter or less of the full value and increasing to the full value in not more than 15 seconds. After being held for the time specified, the voltage is to be reduced within 5 seconds to one-quarter or less of the maximum value, and the circuit is to be opened.

13.2.1DV.2 Induced Potential Option, Repeated – While heated, following OPERATION at 110% of RATED VOLTAGE as specified in 27.3, each of three samples shall withstand without breakdown a repeated induced potential test at 65% of the potential applied in accordance with 13.2.1DV.1.

13.2.3DV *Modification of 13.2.3 by adding the following text:*

Instead of the alternate potential a DC potential may be used rated 1,5 times the AC voltage required in Table 12DV.

14.4DV D2 *Modification of 14.4 by adding the following text after the note:*

The USA note is applicable to voltage sensitive controls. For current sensitive controls, the test is conducted at rated current.

Table 13DV D2 *Replacement:*

Table 13DV

Parts	Maximum temperature permitted °C
Pins of appliance inlets and plug-in devices [1] :	
– for very hot conditions	155
– for hot conditions	120
– for cold conditions	65
Windings [8) 9) 10) 13)], insulating materials and core laminations in contact therewith, if insulation system is:	
– of class A	100 [90]
– of class E	115 [105]
– of class B	120 [110]
– of class F	140 [135]
– of class H	165 [150]
Terminals and TERMINATIONS for EXTERNAL CONDUCTORS [1) 7) 14) C)]	75
Other terminals and TERMINATIONS [1) 2)]	85
Rubber or polyvinyl chloride insulation of conductors [1)]:	
– if flexing occurs or is likely to occur	60
– if no flexing occurs or is unlikely to occur	75
– with temperature marking or temperature rating	value marked
Cord sheath used as SUPPLEMENTARY INSULATION [12)]	60
Rubber other than synthetic when used for gaskets or other parts, the deterioration of which could impair compliance with this standard [12) A)] :	
– when used as SUPPLEMENTARY INSULATION or as REINFORCED INSULATION	65
– in other cases	75
Materials used as insulation other than for wires [3) 5) 12)]:	
– impregnated or varnished textile, paper or press board	95
– laminates bonded with:	
melamine formaldehyde, phenol-formaldehyde or phenol-furfural resins	110 [200]
urea-formaldehyde resins	90 [175]
– mouldings of [3)]	
phenol-formaldehyde, with cellulose fillers	110 [200]
phenol-formaldehyde, with mineral fillers	125 [225]
melamine-formaldehyde	100 [175]
urea-formaldehyde	90 [175]
polyester with glass fibre reinforcement	135
pure mica and tightly sintered ceramic material when such products are used as supplementary or REINFORCED INSULATION	425
other thermosetting materials and all thermo-plastic material [4)]	–
All ACCESSIBLE SURFACES except those of ACTUATING MEMBERS, handles, knobs, grips and the like	
– of metal	60
– of nonmetallic surface	85
ACCESSIBLE SURFACES of handles, knobs, grips and the like used for carrying and transporting the control [B)]:	
– of metal	55

Table 13DV Continued on Next Page

Table 13DV Continued

Parts	Maximum temperature permitted °C
– of porcelain or vitreous material	65
– of moulded material, rubber or wood	75
ACCESSIBLE SURFACE of ACTUATING MEMBERS, or of other handles, grips or the like which are held for short periods only:	
– of metal	60
– of porcelain or vitreous material	70
– of moulded material, rubber or wood B)	85
Wood in general	90
Supporting painted plywood surface	85
Current-carrying parts made of copper or brass 1) 6) 15)	230
Current-carrying parts made of steel 1) 12)	400
Other current-carrying parts 1) 6)	–
Points on or within a terminal box or compartment on which conductors to be connected to the control may rest C)	60
Solid contacts, busses, and connecting bars D)	90
Fuses G)	90
Power switching semi-conductors H)	–
Sealing compounds E)	–
Capacitors F)	–

1) For these parts, the test of this clause is repeated after clause 17.

2) The temperature measured shall not exceed 85 °C unless a higher value has been declared by the manufacturer.

3) The values in square brackets apply to those parts of a material used for ACTUATING MEMBERS, handles, knobs, grips and the like and which are in contact with hot metal, but are not accessible.

4) The maximum permissible temperatures shall not exceed those which can be shown to be acceptable in service for these materials. The temperatures shall be recorded for the purposes of clause 21.

5) Where a metal part is in contact with a part made of insulating material it is assumed that the temperature of the insulating material at the point of contact is the same as the temperature of the metal part.

6) The maximum permissible temperature shall not exceed those which have been shown to be acceptable in service for these materials.

7) For controls submitted in or on equipment, only the temperatures of terminals for fixed conductors are verified, as such equipment are not usually delivered with EXTERNAL CONDUCTORS. For equipment with other than terminals for fixed conductors, the temperature of the insulation of the EXTERNAL CONDUCTOR is determined instead of the temperature of the terminals.

In the USA, the maximum temperature permitted is 75 °C. Higher temperatures are permitted if the control is marked with the required temperature rating for the EXTERNAL CONDUCTORS.

8) The classification is in accordance with Systems of Insulating Materials – General, UL 1446.

Examples of class A material are: impregnated cotton, silk, artificial silk and paper; enamels based on oleo-or polyamide resins.

Examples of class B material are: glass fibre, melamine and phenol formaldehyde resins.

Examples of class E material are:

– moldings with cellulose fillers, cotton fabric laminates and paper laminates, bonded with melamine-formaldehyde, phenol-furfural resins;

– cross-linked polyester resins, cellulose triacetate films, polyethylene terephthalate films;

– varnished polyethylene terephthalate textile bonded with oil modified alkyd resin varnish;

– enamels based on polyvinylformal, polyurethane or epoxy resins.

More extensive accelerated temperature tests and, in addition, compatibility testing is required for insulation systems of class B and higher temperature classes.

For totally enclosed motors using class A, E and B material, the temperatures may be increased by 5 °C.

A totally enclosed motor is a motor so constructed that the circulation of the air between the inside and the outside of the case is prevented but not necessarily sufficiently enclosed to be called airtight.

Table 13DV Continued on Next Page

Table 13DV Continued

Parts	Maximum temperature permitted °C

[9] To allow for the fact that the temperature of windings of universal motors, relays, solenoids, etc., is usually below the average at the points accessible to thermo-couples, the figures without square brackets apply when the resistance method is used and those with square brackets apply when thermocouples are used. For the windings of vibrator coils and a.c. motors, the figures without square brackets apply in both cases.

[10] The value of the temperature rise of a copper winding is calculated from the formula:

$$\Delta t = [(R_2 - R_1)/ R_1] (234{,}5 + t_1) - (t_2 - t_1)$$

where:

Δt is the temperature rise;

R_1 is the resistance at the beginning of the test;

R_2 is the resistance at the end of the test;

t_1 is the working ambient temperature at the beginning of the test, to be set at τ_{MAX};

t_2 is the working ambient temperature at the end of the test;

At the beginning of the test, the windings are to be at τ_{MAX}.

It is recommended that the resistance of windings at the end of the test be determined by taking resistance measurements as soon as possible after switching off, and then at short intervals so that a curve of resistance against time can be plotted for ascertaining the resistance at the instant of switching off.

The maximum temperature attained for the purposes of this clause is derived by adding the temperature rise to τ_{MAX}.

[11] Void.

[12] The temperature values given, which are related to heat resistant properties of the material, may be exceeded where particular materials have been investigated and recognized as having special heat resistant properties.

[13] For small windings (that provide operational insulation only) with a cross section, the minor dimension of which is no greater than 5 mm, the maximum temperature permitted when measured by the resistance method is:

Class	° C
A	105
E	120
B	130
F	155
H	180

[14] For incorporated and integrated controls, no temperature limit is applicable, but attention is drawn to the fact that most equipment standards limit the temperature of terminals of fixed appliances to 85 °C, which is the maximum allowable temperature for ordinary PVC cable insulation. The maximum temperature recorded should not exceed the value declared in Table 1 (7.2 of the previous edition), item 21.

When a control is incorporated/integrated into an appliance, the terminals for external conductors will, as part of the appliance, be subject to the specified tests of the appliance standard and assessed for compliance with the temperature limits of that standard.

[15] Higher temperatures are acceptable for specific copper alloys if substantiated by test data from the alloy manufacturer to a recognized metallurgical standard. See also note 6.

[A] See sub-clause 12.1.6.

[B] Void.

[C] The temperature observed on the terminals and at points within a terminal box of a control for use with other than a residential appliance that is rated for continuous use above 25°C (77°F) may exceed the values specified but may not attain a temperature higher than 90°C (194°F). See DVC.3.1 and DVC.3.2.

[D] If contacts of any metal and their supporting blades, busses, and connecting bars attain a temperature greater than 90°C (194°F) where a high ambient temperature or other external temperature prevails, or where affected by a bi-metal heater or other heat source in the assembly, the control shall perform acceptably when subjected to overload and endurance tests conducted at the high temperatures involved.

[E] The maximum acceptable temperature, corrected to a 25°C (77°F) assumed ambient temperature, of a sealing compound is 15°C (27°F) less than the melting-point temperature of the compound.

Table 13DV Continued on Next Page

Table 13DV Continued

Parts	Maximum temperature permitted °C
F) For a capacitor, the maximum allowable temperature is the marked temperature limit of the capacitor. G) A fuse that has been investigated and found acceptable for use at a higher temperature may be used at that temperature. H) For power switching semi-conductors, the maximum temperature rise on the case is the maximum case temperature for the applied power dissipation recommended by the semi-conductor manufacturer minus an assumed ambient of 40°C (104°F).	

Table 15DV D2 *Replacement:*

In the fifth row and fourth column of Table 15, replace "10 VA/V_T" with "10 VA/V_T or as declared".

Table 15DV DE *Replace the sentence under the heading of Table 15 to:*

(this table applies in Canada, USA, and all countries which use an overload test)

Table 16DV D2 *Replacement:*

In the fifth row and fourth column of Table 16, replace "10 VA/V_T" with "10 VA/V_T or as declared".

Table 16DV DE *Replace the heading of Table 16 to:*

Table 16 (17.2.3 of the previous edition) – Electrical conditions for the automatic and manual action tests of 17.8, 17.9, 17.11, 17.12 and 17.13

(This table applies in Canada, USA, and all countries which use an overload test)

17.3.2DV D2 *Modification of 17.3.2 by adding the following text:*

100% of the tests in 17.3.1 and 17.3.2 will be run at room ambient temperature or T_{MAX}, whichever is greater and at $T_{s\ max}$ for controls classified under 6.12.2.

17.6.2DV D2 *Delete the text, "In Canada and the USA the ageing test does not apply."*

17.11.4DV D2 *Modification of 17.11.4 by adding the following text:*

The number of cycles is 50.

18.1.6.3DV D2 *Modification of 18.1.6.3 by adding the following text:*

A fitting for flexible metal conduit shall secure the conduit so that the connection withstands without pulling apart a steady pull, as specified in Table 18.1.6.3DV.1, for 5 minutes.

Table 18.1.6.3DV.1 D2 *Addition:*

Table 18.1.6.3DV.1 – Pull Forces

Trade size of fitting	Metric designator	Force	
		N	(lbf)
1/2	16	333	(75)
3/4	21	444	(100)
1	27	556	(125)
1-1/4 to 4	35 to 103	667	(150)

18.2.1DV D2 ***Modification of 18.2.1 by adding the following text:***

The impact resistance of controls constructed of polymeric materials is determined during the tests of Annex D, Clauses D.2.11 and D.2.17. The impact resistance of controls constructed of metallic materials is determined as indicated in 18.4.

Table 17DV D2 ***Modification of note 4 of Table 17 by adding the following:***

At points at which a wiring system is to be connected, uncoated steel shall not be less than 0,032 in (0,81 mm) thick, zinc-coated steel shall not be less than 0,034 in (0,86 mm).

Table 18DV D2 ***Modification of note 4 of Table 18 by adding the following:***

At points at which a wiring system is to be connected, nonferrous metal shall not be less than 0.045 inch (1.14 mm) thick.

18.4.1DV D2 ***Modification of 18.4.1 by adding 18.4.1DV.1 and 18.4.1DV.2:***

18.4.1DV.1 A cast metal enclosure shall be not less than 0,035 inch (0,89 mm) thick if the enclosure will not be used as a splice box and if the voltage rating of the complete device is such that the voltage between any two conductors is 250 V or less and is limited to d.c. or single-phase a.c.

18.4.1DV.2 A cast metal enclosure shall be not less than 0,028 inch (0,71 mm) thick if the enclosure houses only low-voltage circuits.

18.4.2DV D2 ***Addition of 18.4.2DV.1 and 18.4.2DV.2:***

18.4.2DV.1 A sheet-steel transformer enclosure shall have a thickness of not less than 0,026 inch (0,66 mm) if uncoated and less than 0,029 inch (0,74 mm) if galvanized.

18.4.2DV.2 Sheet steel having a thickness of not less than 0,020 inch (0,51 mm) if uncoated and not less than 0,023 inch (0,58 mm) if galvanized may be used for a drawn end bell having maximum dimensions of 2-1/4 inches (57,2 mm) on the flat portion and 1-1/2 inches (38,1 mm) at the base of the drawn portion.

18.9.4DV D2 ***Addition of 18.9.4DV.1 to 18.9.4DV.7:***

18.9.4DV.1 For a control that is operated by a push, pull, slide, toggle, or lever adjustment, a force is to be applied to the free end of the adjustment in line with the intended movement in each direction of OPERATION for one minute. The force is to be 20 pounds (89 N) for a commercial control and 10 pounds (45 N) for a household product control. A separate sample is to be used for each test.

18.9.4DV.2 A control adjustment operated as described in paragraph 18.9.4DV.1 and intended for use with an extended operator, handle, or lever is to be tested with in in-line force applied to the free end of an extension representing the intended end-use application.

18.9.4DV.3 For a control that is operated by a rotary adjustment intended for use with a knob having a grip diameter or grip length of 1 inch (25,4 mm) or less, a torque is to be applied to the shaft in each direction of intended OPERATION. The torque is to be 9 pound-inches (1,0 N•m) for a commercial control and 7 pound-inches (0,8 N·m) for a household product control. A separate sample is to be used for each test.

18.9.4DV.4 A control that is operated by a rotary adjustment intended for use with a knob having a grip diameter or grip length of more than one inch (25,4 mm) is to be subjected to a torque that is proportionally greater than that specified in paragraph 18.9.4DV.2, based on the larger grip diameter or grip length of the knob used; the value for the torque to be used is to be determined by the formula:

$$T = (D_1/D)K$$

in which:

T is the test torque in pound inches (N•m)

D_1 is the grip diameter or grip length, as applicable in inches (m)

D is the 1 inch (0,025 m)

K is the 9 pounds-inches (1,0 N•m) for a commercial control, or 7 pound-inches (0,8 N•m) for a household control.

18.9.4DV.5 If a lever arm is intended to be attached to a rotary-control shaft, the assembly is to be tested as described in paragraph 18.9.4DV.2 with the force applied to the free end of the lever.

18.9.4DV.6 If an adjustment means is not provided with a control, the manufacturer is to assign a maximum dimension for the knob, lever, toggle, or the like, to be used with the control, and this dimension is to be used for determining the torque value.

18.9.4DV.7 Compliance is checked as in 18.1.5. In addition, for Type 2 controls the test of Clause 15 is conducted before and after this test and the measured OPERATING VALUE shall be within the declared DRIFT.

19.1.10DV D2 *Modification of 19.1.10 by adding the following text:*

The tests of 19.1.11 to 19.1.15 are not applicable to metal screws in engagement with a thread of metallic material.

20DV D2 *Modification: Replace the last sentence with the following:*

In the US, CREEPAGE DISTANCES and CLEARANCES between terminals for the connection of internal/external conductors shall comply with the Standard for Terminal Blocks, UL 1059.

20.3.1DV D2 *Addition: Add the following paragraph to 20.3.1:*

Insulation required in place of spacings between a magnet-coil winding and other uninsulated live parts or grounded metal parts may be thinner than 0.7 mm provided that it complies with the Induced potential test of 13.2.1DV.1 – 13.2.1DV.2.

20.3.2.2DV D2 *Modification by replacing the last paragraph of 20.3.2.2 with the following text:*

Optocouplers shall comply with the requirements for the Standard for Optical Isolators, UL 1577.

21.1DV D2 *Modification by replacing the last sentence of 21.1 with the following:*

In the USA, compliance is checked in accordance with the requirements of the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

24.1DV D2 *Modification of 24.1 by adding the following text after the first paragraph:*

Transformers shall comply with the relevant requirements of the Standard for Low Voltage Transformers – Part 1: General Requirements, UL 5085-1, and the Standard for Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers, UL 5085-3.

24.1.1DV D2 *Modification of 24.1.1 by adding the following text after the first paragraph:*

In addition, the transformer shall also comply with the requirements of the Standard for Low Voltage Transformers – Part 1: General Requirements, UL 5085-1, and the Standard for Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers, UL 5085-3.

24.2.1DV D2 *Modification of 24.2.1 by adding 24.2.1DV.1, 24.2.1DV.2, and 24.2.1DV.3:*

24.2.1DV.1 A component of a product covered by this standard shall comply with the requirements for that component, and shall be used in accordance with its recognized rating and other limitations of use. A list of standards covering various components are referenced in 1.5DV. A component need not comply with a specific requirement that:

a) Involves a feature or characteristic not needed in the application of the component in the product covered by this standard, or

b) Is superseded by a requirement in this standard.

24.2.1DV.2 Switch mode power supplies used in electronic controls shall comply with the tests of 24.2.1DV.3 and all of the applicable requirements of this standard.

24.2.1DV.3 Overload tests

24.2.1DV.3.1 Each output winding, or section of a tapped winding, is overloaded in turn, one at a time, while the other windings are kept loaded or unloaded, whichever load conditions of normal use is the least favorable.

24.2.1DV.3.2 Overloading is carried out by connecting a variable resistor (or an electronic load) across the winding or DC link. The resistor is adjusted as quickly as possible and readjusted, if necessary, after 1 minute to maintain the applicable overload. No further readjustments are then permitted.

24.2.1DV.3.3 For this test, any protective devices such as a fuse, manual reset circuit protector, thermal protector, etc were allowed to remain in the circuit.

24.2.1DV.3.4 If overcurrent protection is provided by a current-breaking device, the overload test current is the maximum current which the overcurrent protection device is just capable of passing for 1 hr. If this value cannot be derived from the specification, it is to be established by test.

24.2.1DV.3.5 If no overcurrent protection is provided, the maximum overload is the maximum power output obtainable from the power supply.

24.2.1DV.3.6 In case of voltage foldback, the overload is slowly increased to the point which causes the output voltage to collapse. The overload is then established at the point where the output voltage recovered and held for the duration of the test.

24.2.1DV.3.7 The duration of the test is to be for 1 hour or until ultimate results are reached.

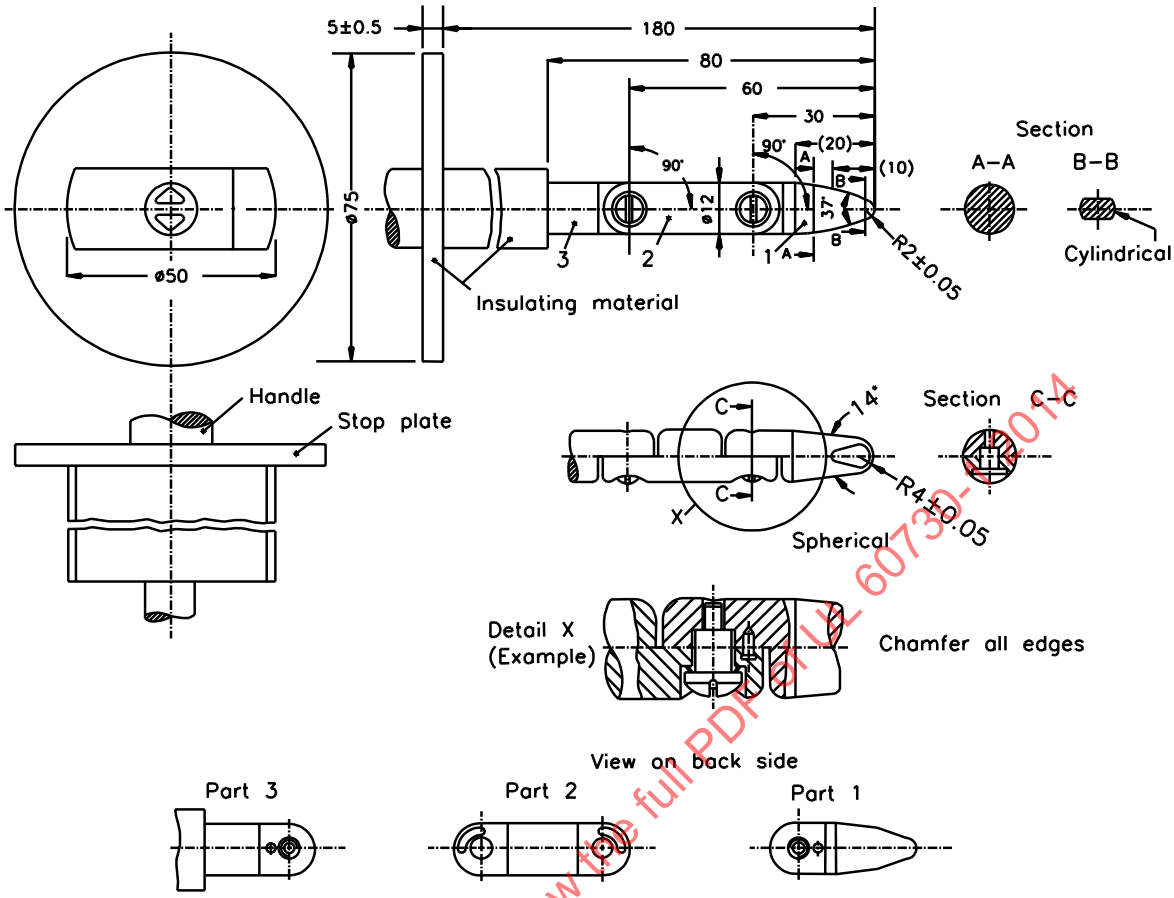
24.2.1DV.3.8 The maximum PEAK open-circuit voltage of each winding (directly at the winding of the transformer) and the maximum load current are measured and recorded such that the maximum output power may be determined.

24.2.1DV.3.9 For SELV applications, where the PEAK open circuit voltage measured directly at the secondary of the transformer exceeds the limits specified in 2.1.5, the measurement of the maximum output voltage of each winding may be made after certain protective impedances. In this case, the limits shall be in accordance with H.8.1.10.1. These measurements shall be made during NORMAL OPERATION and under ABNORMAL OPERATION (single component failure).

24.2.1DV.3.10 Following each test (while still in a heated condition), the transformer is to be subjected to the electric strength test of 13.2.

24.2.1DV.3.11 Compliance shall be in accordance with items a), b), d), e) and f) of H.27.1.1.3.

Figure 2DV D2 *Replacement of Figure 2:*



Dimensions in millimetres

Tolerances on dimensions without specific tolerance:

on angles: $^{0}_{-10}$°

on linear dimensions:

up to 25 mm: $^{0}_{-0,05}$ mm

over 25 mm: ±0,2 mm

Material of finger: heat–treated steel, etc.

Both joints of this finger may be bent through an angle of $(90\ ^{+10}_{0})$° but in one and the same direction only.

Using the pin and groove solution is only one of the possible approaches in order to limit the bending angle to 90°. For this reason dimensions and tolerances of these details are not given in the drawing. The actual design must ensure a $(90\ ^{+10}_{0})$° bending angle.

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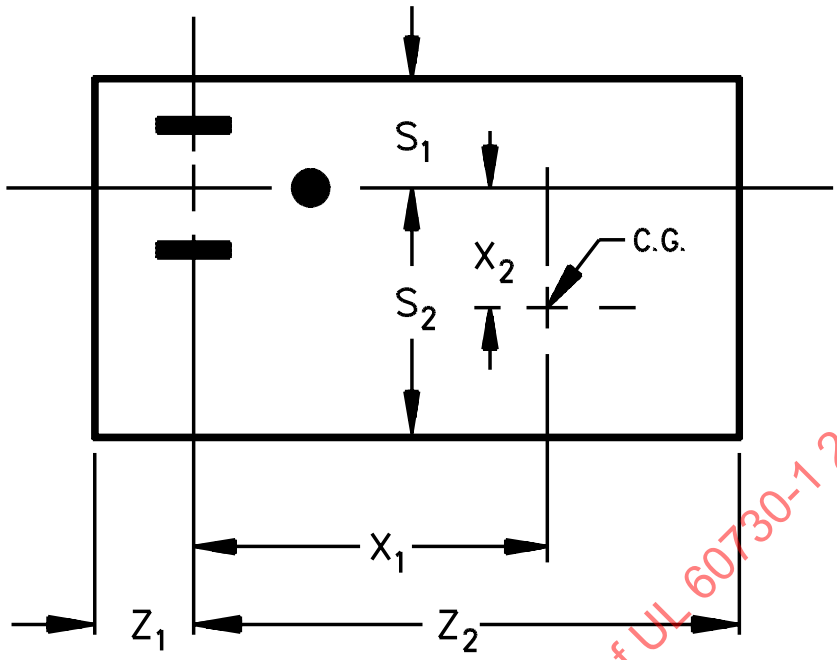
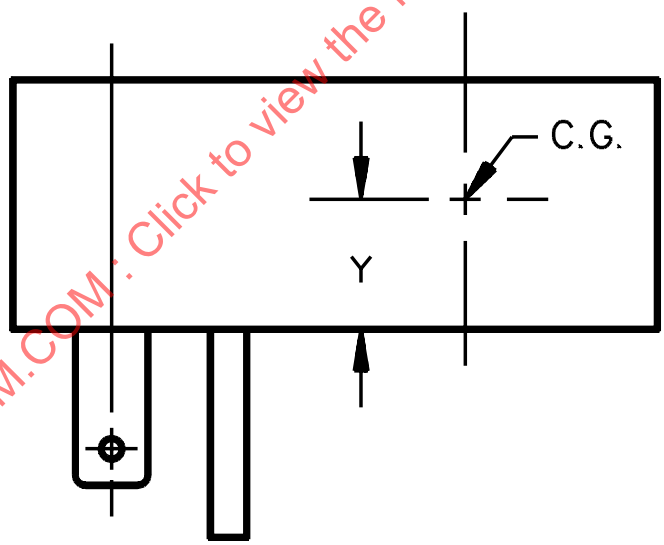
Figure 31DV D2 ***Addition of the following figure:***



FRONT VIEW



SIDE VIEW

C.G. = Center of Gravity

CP100A

H.17.14DV D2 *Addition of the following dashed item:*

– Electronic controls with type 2 action shall comply with the requirements of H.26.15.

H.23DV D2 *Delete the second sentence in H.23.1 and add the following paragraph:*

H.23.1DV In the US, free-standing, independently-mounted and in-line cord electronic controls shall comply with FCC, Part 15, sub part C if mandated by local authorities having jurisdiction.

Table H.11DV D2 *Replacement of Table H.11 with Table H.11DV:*

Table H.11DV – Applicable test levels

Control type	Type action	Applicable clause H.26 tests	Applicable test levels or levels
Operating control -	Type 1 -	26.8, 26.9	2
Operating control -	Type 2 -	26.4 to 26.14	2
Protective control -	Type 2 -	26.4 to 26.14	3[1)]
Protective controls declared in Table 1 (7.2 of the previous edition), item 90 intended for use in accordance with IEC 60335-1	Type 2	26.4 to 26.14, 26.16	Applicable test levels according to 19.11.4 of IEC 60335-1
1) For the test of H.26.13, test levels 2 and 3 apply.			

H.26.8.3DV D2 *Modification of H.26.8.3 by adding the following sentence and table:*

The tests are carried out by subjecting the system to six pulses of each polarity, positive and negative (+,–), distributed at various angles of the supply waveform over the relevant operating modes as indicated in table H.14DV.1.

Table H.14DV.1

Number of impulses	Impulse, polarity	Angle of supply wave, degrees
2	Positive	45
2	Positive	90
2	Positive	270
2	Negative	90
2	Negative	225
2	Negative	270

H.26.10.5DV D2 ***Modification of H.26.10.5 by replacing it with the following:***

H.26.10.5DV.1 The tests are carried out by subjecting the system to sixty pulses of each polarity, positive and negative (+,−), distributed at various angles of the supply waveform over the relevant operating modes as indicated in table H.26.10.5DV.1.

Table H.26.10.5DV.1

Number of impulses	Impulse, polarity	Angle of supply wave, degrees
20	Positive	45
20	Positive	90
20	Positive	270
20	Negative	90
20	Negative	225
20	Negative	270

H.26.10.5DV.2 The short-circuit current shall be 500 amperes.

Table H.26.14.2DV D2 ***Modification of Table H.26.14.2 as follows:***

Replace “severity” in column 1 of table H.20 with “Test”.

H.26.15.1DV DE ***Modification of H.26.15.1 by replacing “H.26.12” with “H.26.14”.***

H.26.16DV D2 ***Addition of the following after H.26.16:***

Compliance shall be in accordance with H.26.15.

Table H.21DV D2 ***Replacement of Table H.21 with Table H.21DV:***

Table H.21DV – Electrical/electronic component fault modes table

Component type	Short[14]	Open[1]	Remarks
Fixed resistors			
Thin-film[13]		X	Includes SMD type
Thick-film[13]		X	Includes SMD type
Wire-wound[13] (single layer) enamelled or suitably coated		X	
All other types	X	X	
Variable resistors			
(for example, potentiometer/trimmer)			
Wire-wound (single layer)		X	
All other types	X[2]	X	
Capacitors			
X and Y types according to IEC 60384-14, UL 1414, and UL 1283		X	
All other types	X	X	
Inductors			
Wire-wound		X	
All other types	X	X	
Diodes			
All types	X	X	
Semiconductor type devices like transistors			
All types (for example, bipolar; LF; RF; microwave; FET; thyristor; Diac; Triac; Uni junction)	X[2]	X	3)
Hybrid circuit	4)	4)	
Integrated circuits			
All types not covered by H.11.12	X[5]	X	For IC outputs, note 3) applies
Optocouplers			
According to UL 1577	X[6]	X	
Relays			
Coils		X	
Contacts	X[7]	X	
Reed-relays	X	X	Contacts only
Transformers			
According to UL 5085-1, UL 5085-2, UL 5085-3		X	
All other types	X[2]	X	
Crystals	X	X	8)
Switches	X	X	9)
Connections (jumper wire)		X	10)
Cable and wiring		X	
Printed circuit board conductors			
According to UL 796	X[12]	C[11]	

[1] Only opening of one pin at any one time.

[2] Short-circuit each pin in turn with every other pin; only two pins at a time.

[3] For discrete or integrated thyristor type devices such as Triacs and SCRs, fault conditions shall include short circuit of any terminals with the third terminal open-circuited. The effect of any full wave type of component, such as a Triac going into a half-wave condition, either controlled or uncontrolled (thyristor or diode, respectively) shall be considered.

[4] Failure modes for individual components of the hybrid circuit are applicable as described for the individual components in this table.

Table H.21DV – Electrical/electronic component fault modes table Continued on Next Page

Table H.21DV – Electrical/electronic component fault modes table Continued

Component type	Short[14)]	Open[1)]	Remarks
[5)] The short circuit of any two adjacent terminals and the short circuiting of a) each terminal to the IC-supply, when applicable at the IC; b) each terminal to the IC-ground, when applicable at the IC. The number of tests implied for integrated circuits may normally make it impracticable to apply all the relevant fault conditions or to assess the likely hazards from an appraisal of the circuit diagram of the integrated circuit. It is therefore permissible first to analyse in detail all the possible mechanical, thermal and electrical faults which may develop either in the control itself or its output, due to the malfunction of the electronic devices or other circuit components, separately or in any combination. Except for types evaluated by H.11.12, a fault-tree analysis shall be conducted to include the results of multiple steady-state conditions to outputs and programmed bi-directional terminals for the purpose of identifying additional fault conditions for consideration. The failure mode ″short circuit″ is excluded between isolated sections for such ICs that have isolated sections. The isolation between the sections shall comply with the requirements of 13.2 for operational insulation. [6)] When optocouplers comply with 1577 with an isolation voltage of 5 000 V, the shorting between the input and output pins is not considered. [7)] The short-circuit mode is excluded for relays successfully tested to Clause 17. The successful test can be substituted by the use of a relay certified for the application. [8)] For crystal-based clocks, harmonic and sub-harmonic frequency variations affecting the timings should be considered. [9)] If switches are applied for the selection of safety times, purge times, programmes and/or other safety-related settings, these devices should function so that in the event of their opening, the safest possible condition arises (for example, in a burner control system, the shortest safety time or the longest purge time). The short-circuit failure mode is excluded for switches successfully tested to Clause 17. The successful test can be substituted by the use of a switch certified for the application. [10)] The requirements are the same as note 11), except they are applied to jumper wires intended for clipping when selecting a setting. [11)] If a short circuit at the output terminals of a component causes the opening of a printed circuit board conductor (fusible trace), that conductor shall be subject to an open-circuit fault analysis. [12)] The short-circuit failure mode is excluded if the requirements of Clause 20 are fulfilled. [13)] These components may be used for protective impedance, if the impedance of components complies with H.20.1.9.3 and withstands the impulse voltage test of 20.1.12 for at least overvoltage category III. [14)] The conditions which have led to the design of the clearances and creepages according to Clause 20 on the assembly for which exclusion from the fault mode “short” is claimed shall be maintained over the lifetime of the control. These conditions shall be declared or documented as follows. Control pollution situation (Table 1 (7.2 of the previous edition), requirement 49) Pollution situation in the micro-environment of the creepage or clearance, if cleaner than that of the control, and how this is designed (documentation) (Table 1 (7.2 of the previous edition), requirement 79) Rated impulse voltage of the control (Table 1 (7.2 of the previous edition), requirement 75). Rated impulse voltage for the creepage or clearance, if different from that of the control, and how this is ensured. (documentation) (Table 1 (7.2 of the previous edition), requirement 80) The values designed for tolerances of distances for which the exclusion from fault mode ″short″ is claimed. (declaration and documentation) (Table 1 (7.2 of the previous edition), requirement 81)			

J.1.1.1DV D2 ***Addition of J.1.1.1DV.1:***

J.1.1.1DV.1

Thermistors shall comply with the requirements of the Standard for Thermistor-type Devices, UL 1434.

T.3.1DV DE *Modification of T.3.1 as follows:*

Replace 8.1.1 of clause T.3.1 to H.8.1.10.1

U.1DV D2 *Addition of U.1DV.1:*

U.1DV.1 In the USA, relays used in controls are evaluated to the requirements of the Standard for Industrial Control Equipment, UL 508. Such components shall be judged for their suitability in the control application with respect to electrical, thermal, mechanical and environmental parameters.

DVA D2 *Addition of a new annex DVA as follows:*

DVA.1 Ventilating openings

DVA.1.1 A ventilating opening shall not be provided in an enclosure that houses a fuse or any portion of a circuit breaker other than the operating handle, unless the construction affords containment of electrical fault disturbances equivalent to that provided by an enclosure complying with the requirements in the 2nd through 4th paragraphs of the deviation to 11.11.1.2.

DVA.1.2 The following requirements apply to ventilating openings other than those provided in the enclosure of a room THERMOSTAT:

DVA.1.3 A ventilating opening shall not be provided in a compartment or part of an enclosure that contains field-wiring splices in a line-voltage circuit.

DVA.1.4 A ventilating opening shall not be located in a bottom surface or in a mounting surface of an enclosure.

DVA.1.5 The shortest distance between a ventilating opening and the bottom of an enclosure or a wall-mounting surface shall be at least one-quarter of the enclosure height or depth, respectively, or 1 inch (25,4 mm), whichever is less.

DVA.1.6 There shall be no emission of flame or molten material, or manifestation of risk of fire, during normal or abnormal tests on the control such as transformer burnout and burnout of a relay with blocked armature.

DVA.1.7 Unless the construction of a device provided with forced ventilation is such that there is no direct path between LIVE PARTS and the outlet opening, burnout tests in addition to those mentioned in Sub-clause DVA.1.6 shall be conducted to determine that there is no emission of flame or molten material through that opening.

DVA.1.8 Air from a ventilating opening, either forced or otherwise, shall not be directed:

a) Into a duct or into a concealed space in a building;

b) Against the mounting surface, and;

c) So that a disturbance would be propagated to other equipment.

DVA.2 Accessibility of LIVE PARTS

DVA.2.1 Electrical parts of a device, other than a supply cord or low-voltage terminals, shall be located or enclosed to reduce the risk of unintentional contact with an uninsulated LIVE PART. Additionally, electrical parts shall be located or enclosed so that protection against unintentional contact or shorting of LIVE PARTS that could result in a malfunction of the controlled equipment is provided. For the purpose of these requirements, film-coated wire is considered to be an uninsulated LIVE PART.

DVA.2.2 An opening in an enclosure of a control is acceptable if an accessibility probe as illustrated in figure DVA.3.2.2, when inserted into the opening, cannot be made to touch any part that involves the risk of electric shock to the END-USER or service personnel. However, in no case shall the opening be large enough to permit the entrance of a 1 inch (25,4 mm) diameter rod.

DVA.2.3 The accessibility probe shall be articulated into any configuration and shall be rotated or angled to any position before, during, or after insertion into the opening, and the penetration shall be to any depth allowed by the opening size, including minimal depth combined with maximum articulation.

DVA.2.4 If any part of the enclosure must be opened or removed for USER SERVICING with or without the use of TOOLS, or can be opened or removed without the use of TOOLS, the accessibility probe is to be applied without the part in place.

DVA.3 Other openings

DVA.3.1 The smaller dimension (width) of an opening in an enclosure around a dial, adjusting knob, lever, handle, pointer, or the like shall not be more than 1/8 inch (3,2 mm) for any SETTING or position of the dial, knob, and the like.

DVA.3.2 Except for ventilating openings or as specified in Sub-clauses DVA.3.1, an enclosure may have:

a) No more than four unused openings intended for mounting various components inside the enclosure. The largest dimension of each such opening shall be more than 3/16 inch (4,8 mm).

b) No more than four openings 1/8 inch (3,2 mm) or less in diameter for the escape of air or drainage of paint during the painting process, located as close to the corners of the enclosure as possible, preferably at the rear of the enclosure.

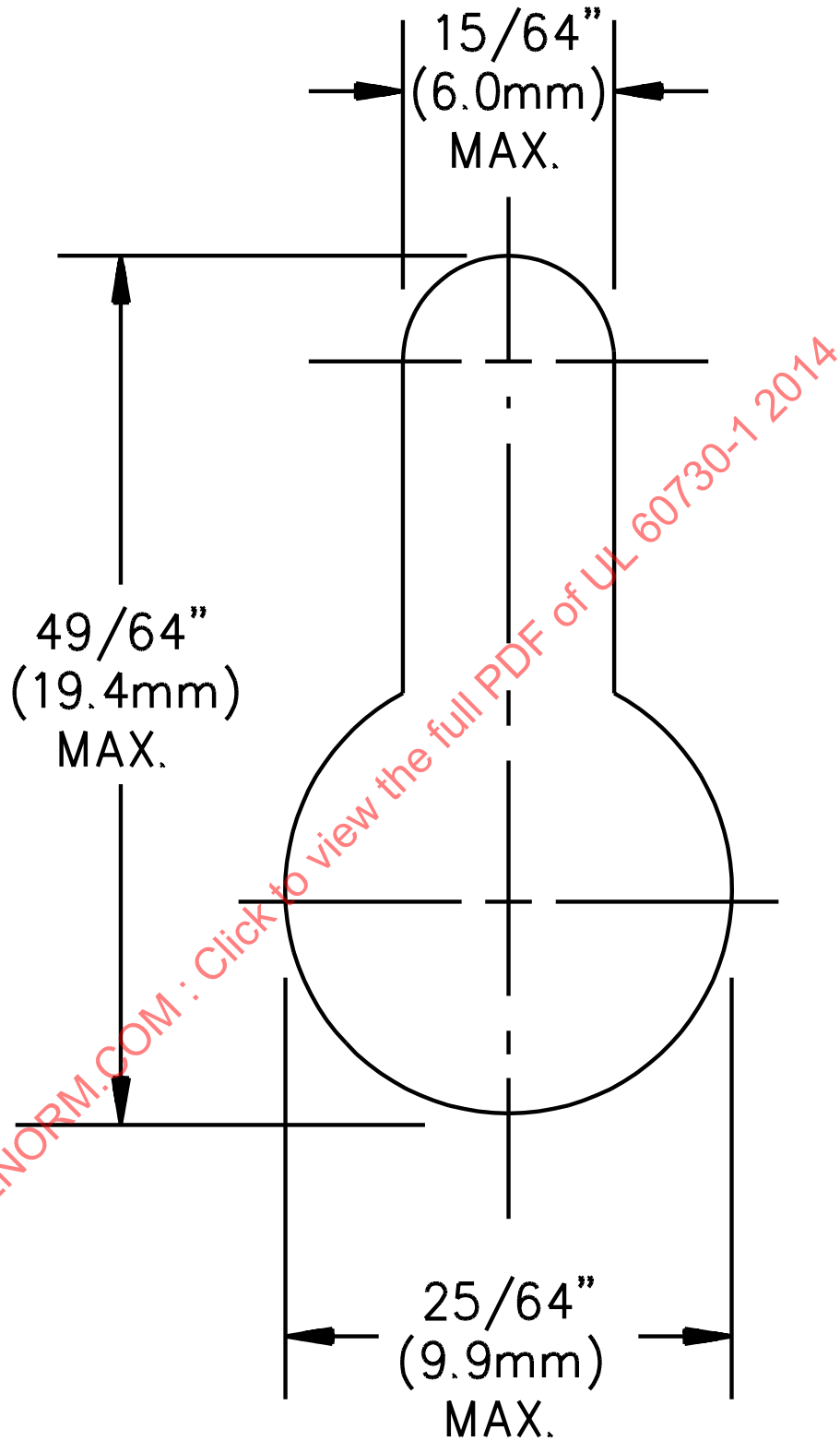
c) A drainage opening in an outdoor enclosure. The dimensions of such an opening shall not exceed 1/4 by 1/4 inch (6,4 mm by 6,4 mm).

d) Not more than four openings for mounting an enclosure having a maximum dimension of 18 inches (457 mm), six openings for an enclosure with a maximum dimension of more than 18 inches, but less than 48 inches (1,2 m); eight openings for an enclosure with a maximum dimensions of 48 inches or more. Four of the openings for mounting an enclosure with a maximum dimension of 12 inches (305 mm) may be keyhole slots having the configuration illustrated in figure DVA.3.2.1. The dimensions shown in figure DVA.3.2.1 may vary if the area

is equivalent. Four of the openings for mounting a larger enclosure may be keyhole slots, the dimensions of which are not specified, and which shall be judged with regard to the enclosure dimensions and configuration.

e) An opening for passage of a capillary tube, air pipe, bellows, or other necessary mechanism. The unclosed portion of such an opening shall not be larger than 1/16 inch (1,6 mm).

Figure DVA.3.2.1 D2 *Addition:*



EC600

Figure DVA.3.2.2 D2 *Addition:*

Figure DVA.3.2.2 – Accessibility probe
(Dimensions in millimeters)