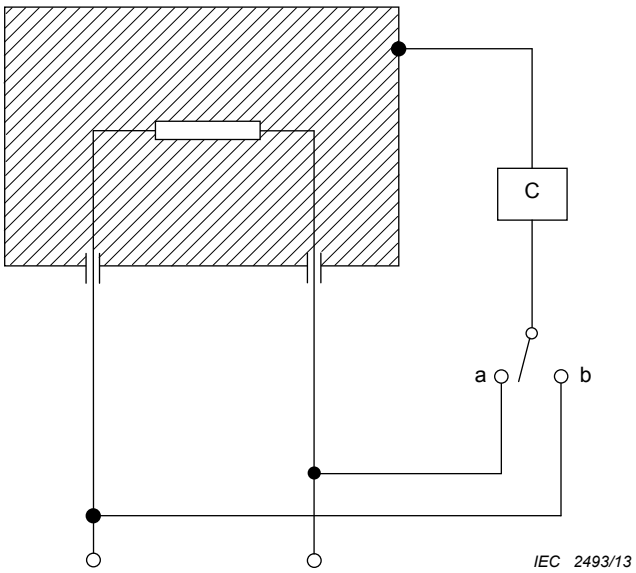
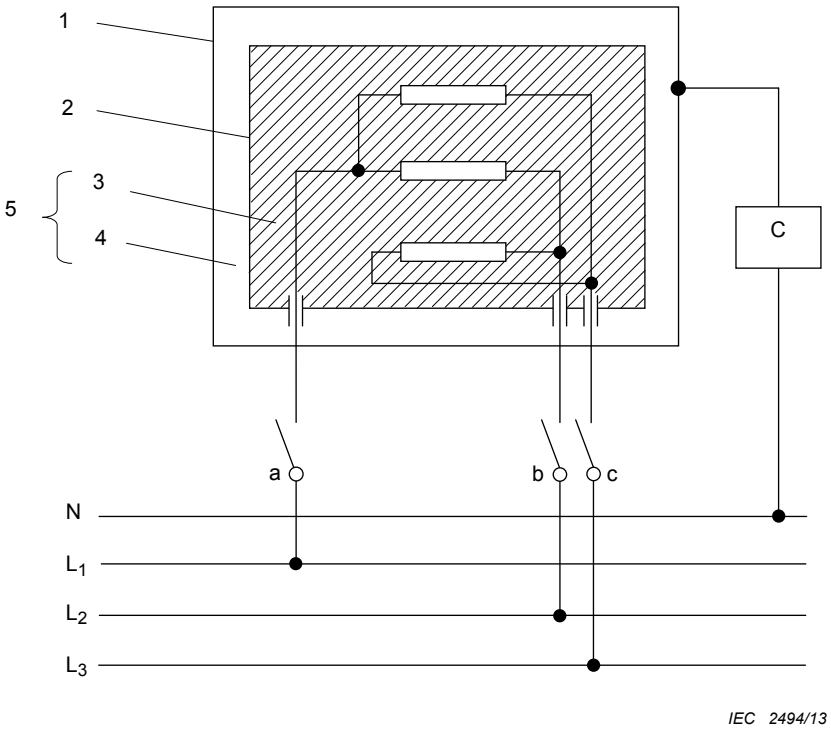


Key

C circuit of Figure E.1

Figure 26 – Diagram for leakage current measurement at operating temperature for single-phase connection of controls other than class II



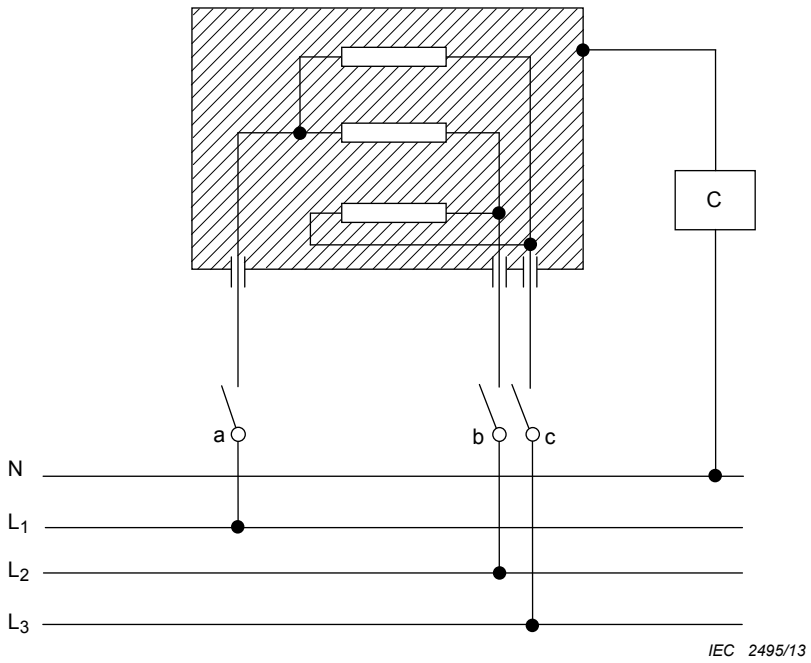
Key

C circuit of Figure E.1
1 **accessible part**
2 inaccessible metal part
3 **basic insulation**
4 **supplementary insulation**
5 **double insulation**

Connections and supplies

L_1, L_2, L_3, N supply voltage with neutral

Figure 27 – Diagram for leakage current measurement at operating temperature for three-phase connection of class II controls



Key

C circuit of Figure E.1

Connections and supplies

L_1, L_2, L_3, N supply voltage with neutral

Figure 28 – Diagram for leakage current measurement at operating temperature for three-phase connection of controls other than class II

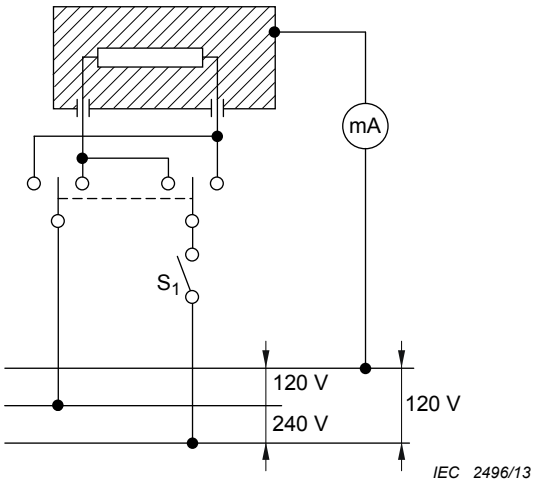


Figure 29 – Diagram for leakage current measurement at operating temperature for single-phase connection of controls other than class II

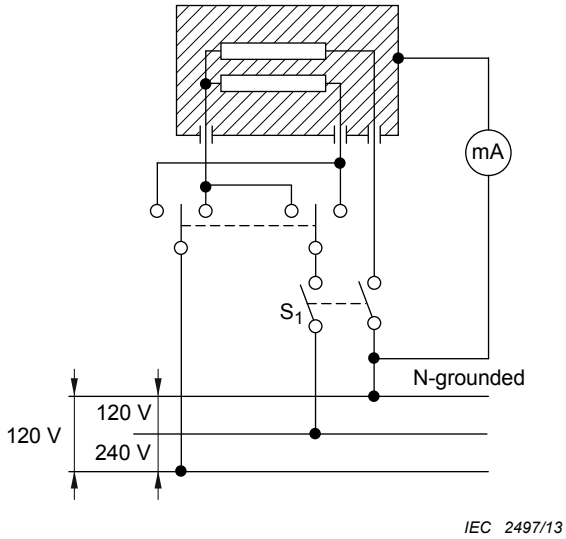


Figure 30 – Diagram for leakage current measurement at operating temperature for two-phase connection of controls to three-wire, ground neutral supply other than class II

Annex A
(normative)

Indelibility of markings

A.1 Markings on **controls** shall be adequately indelible for safety and are therefore classified according to the requirements for indelibility:

A.1.1 Markings which are not mandatory within the requirements of this standard.

A.1.2 Markings which are mandatory within the requirements of this standard but which are not accessible to the final **user** when the **control** is mounted or installed in the equipment.

These markings have to be sufficiently resistant to removal to withstand the manual handling in the **control manufacturer's** factory after final inspection, being packed and transported to the **equipment manufacturer's** factory, and handled during installation. Additionally, the marking shall remain legible in the presence of any vapour or other contaminant likely to be present.

A.1.3 Markings which are mandatory within the requirements of this standard and which are accessible to the final **user** of the equipment after the **control** is mounted or installed as for **normal use**.

These markings, in addition to being resistant to the handling, etc., described in A.1.2, have also to withstand the rubbing and handling expected during the use of the equipment. Markings on knobs, etc., shall survive the continual handling and rubbing as a result of manual **actuation**. Other markings should be resistant to cleaning, polishing and the like.

A.1.4 *Compliance with the requirements for indelibility of markings classified according to A.1.2 and A.1.3 is checked by the tests of Clause A.2 or A.3 using the apparatus shown in Figure 8.*

The principal part consists of a disc of hard white buffing felt, 65 mm in diameter and 7,5 mm thick. This is locked against rotation and is arranged to move across the surface to be tested with a stroke of 20 mm and to exert a measurable force on this surface. The standard test shall be 12 strokes (i.e., rotations of the eccentric) and shall take approximately 15 s.

During the tests, the appropriate part of the buffing disc is covered with one layer of white absorbent lint with the nap surface external.

The solvents used are:

– *neutral liquid detergent blended from alkyl benzene sulphonate and non-ionic detergents or 2 % of a solvent in deionized (distilled) water where the solvent consists of:*
  - *70 % (with volume) Natriumdodecylbenzylsulfonat, (Isomere), formula: C18H29NaO3S, CAS-No. 25155-30-0, and*
  - *30 % (with volume) Glycerin (other names: Glycerol, 1,2,3-Propantriol, Propantriol,E 422), formula: C3H8O3, CAS-No. 56-81-5;*
– *n-hexane (aliphatic solvent hexane with a content of aromatics of maximum 0,1 volume %, initial boiling point of approximately 69 °C and specific gravity of approximately 0,66 g/cm^3, CAS-No. 110-54-3), and*
– *deionized (distilled) water.*

A.2 *Compliance with the requirements for indelibility of markings classified according to A.1.2 is checked by the following tests:*

A.2.1 *The markings under consideration shall withstand drops of detergent standing on the marked surface for a period of 4 h. At the end of this period, the detergent "scab(s)" shall be removed by a very fine spray of warm water (40 ± 5) °C or by lightly wiping with a damp cloth.*

A.2.2 *The sample shall then be allowed to dry completely in an ambient room temperature of (25 ± 5) °C.*

A.2.3 *The sample shall then be rubbed in the apparatus of Figure 8, using dry lint and a weight of 250 g measured as indicated.*

A.2.4 *The sample shall then be rubbed using water-soaked lint and a weight of 250 g.*

A.2.5 *If the shape or position of marking is such that it cannot be bleached or rubbed with this apparatus (for example, by recessing the marked surface) then the tests of A.2.3 and A.2.4 are not applied.*

A.2.6 *At the conclusion of these tests, the marking shall still be legible.*

A.3 *Compliance with the requirements for indelibility of markings classified according to A.1.3 is checked by the following tests:*

A.3.1 *The marking under consideration shall be rubbed in the apparatus of Figure 8 using a dry lint and a weight of 750 g.*

A.3.2 *The marking shall then be rubbed in the apparatus using a water-soaked lint and a weight of 750 g.*

A.3.3 *The marking under consideration shall then withstand drops of detergent standing on the marked surface for a period of 4 h. At the end of this period, the detergent "scab(s)" shall be removed by a very fine spray of warm water (40 ± 5) °C or by lightly wiping with a damp cloth.*

A.3.4 *After being allowed to dry it shall be rubbed in the apparatus using a detergent soaked lint and a weight of 750 g.*

A.3.5 *After surplus detergent has been shaken off it shall be rubbed in the apparatus, using a petroleum spirit soaked lint and a weight of 750 g.*

A.3.6 *For the tests of A.3.1 to A.3.5 the thickness of the buffing disc may be progressively reduced from 7,5 mm in order that the marking may be reached and rubbed. However, the minimum thickness of the buffing disc shall be not less than 2,5 mm. If the thickness of the buffing disc is reduced the weight of 750 g shall be reduced in linear proportion.*

A.3.7 *At the conclusion of these tests, the marking shall still be legible.*

Annex B
(normative)

Measurement of creepage distances and clearances in air

*When determining and measuring **creepage distances** and **clearances**, the following assumptions are made, where D is equal to the **clearance** in air prescribed for the distance under consideration (see Figures B.1 to B.11 for examples of methods of measurement of **creepage distance** and **clearances**):*

- *a groove may have parallel, converging or diverging side walls;*
- *if a groove has diverging side walls, it is regarded as an air gap if its minimum width exceeds $D/12$, its depth exceeds D/2 and its width at the bottom of the groove is at least equal to $D/3$ (see Figure B.8) but in no case smaller than the minimum value X as permitted in the tabulation below;*
- *any corner having an angle less than 80 ° is assumed to be bridged by an insulating link having a width equal to $D/3$ or 1 mm, whichever is less, which is placed in the most unfavourable position (see Figure B.3);*
- *if the distance across the top of a groove is a least equal to $D/3$, or 1 mm, whichever is less, the **creepage distance** path follows the contour of the groove unless otherwise specified immediately above (see Figure B.2);*
- *for **creepage distances** and **clearances** in air between parts moving relatively one to another, these parts are considered to be in their most unfavourable position to each other;*
- ***creepage distances** determined according to these rules are not less than the corresponding (measured) **clearances** in air;*
- *any air gap having a width less than $D/3$ or 1 mm, whichever is less, is ignored in calculating the total **clearance** in air;*
- *for inserted or set-up barriers, the **creepage distances** are measured through the joint unless the parts are so cemented or heat-sealed together that ingress of humidity or dirt into the joint is not liable to occur.*

In the examples shown in Figures B.1 to B.10, the following identification is used:

▪▪▪▪▪▪▪▪▪▪▪ is a **creepage distance**;

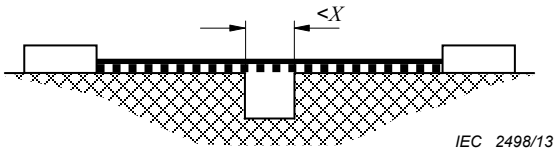
▬▬▬▬▬▬▬▬ is a **clearance** in air.

See Table B.1 for the value of X.

Table B.1 – Value of X

Pollution degree	***Width X of grooves: minimum values*** *mm*
1	*0,25*
2	*1,0*
3	*1,5*
4	*2,5*

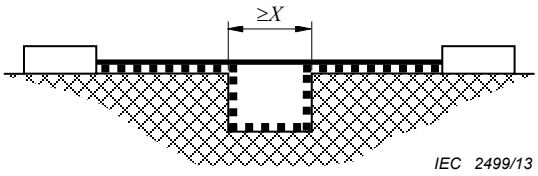
*If the associated **clearance** is less than 3 mm, the minimum groove width may be reduced to one-third of this **clearance**.*



The path under consideration includes a groove of any depth, having a width less than X.

Rule: The **clearance** path is the "line of sight" path.

Figure B.1 – Narrow groove

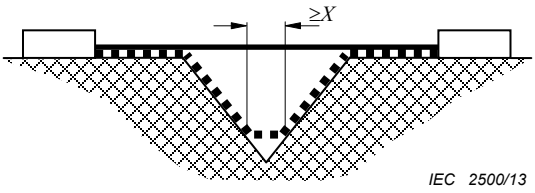


The path under consideration includes a groove of any depth, having a width equal to or more than X.

Rule: The **clearance** path is the "line of sight" path.

The **creepage distance** path follows the contour of the groove.

Figure B.2 – Wide groove



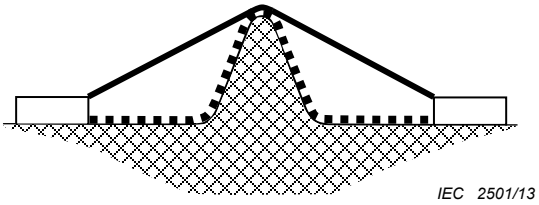
The path under consideration includes a V-shaped groove having a width greater or equal to X.

Rule: The **clearance** path is the "line of sight" path.

The **creepage distance** path follows the contour of the groove except that it bridges the groove where its width is equal to X.

Figure B.3 – V-shaped groove

Clearance **Creepage distance**

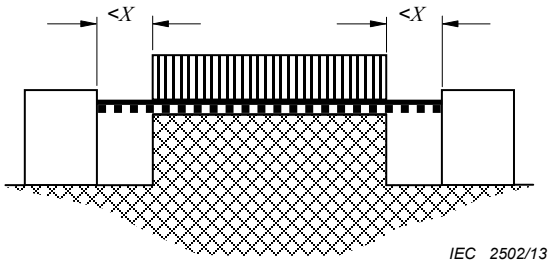


The path under consideration includes a rib.

Rule: The **clearance** path is the shortest air path over the top of the rib.

The **creepage distance** path follows the contour of the rib.

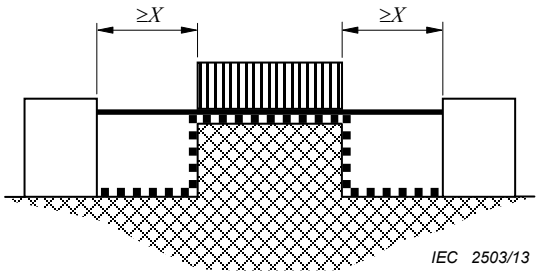
Figure B.4 – Rib



The path under consideration includes an uncemented joint and grooves having a width less than X on either side.

Rule: The **creepage distance** path and the **clearance** path is the "line of sight" path as shown.

Figure B.5 – Uncemented joint with narrow groove



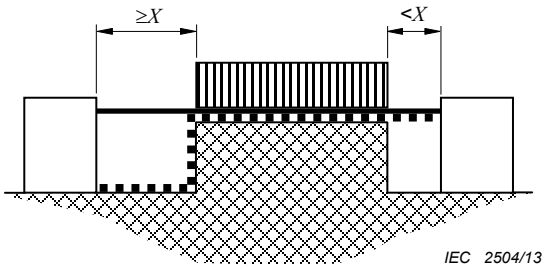
The path under consideration includes an uncemented joint and grooves having a width equal to or more than X.

Rule: The **clearance** path is the "line of sight" path as shown.

The **creepage distance** path follows the contour of the grooves.

Figure B.6 – Uncemented joint with wide groove

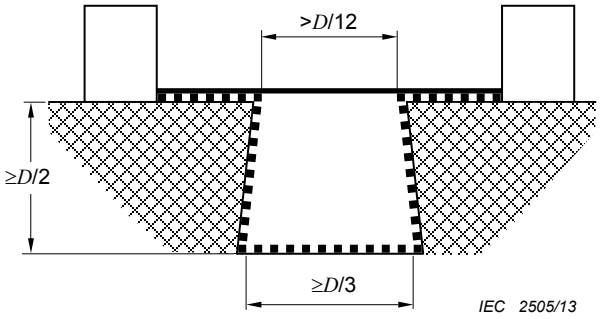
Clearance **Creepage distance**



The path under consideration includes an uncemented joint, a groove on one side having a width less than X, and a groove on the other having a width equal to or more than X.

Rule: The **clearance** path and the **creepage distance** path are as shown.

Figure B.7 – Uncemented joint with narrow and wide grooves



The path under consideration includes a groove having diverging side walls, a depth equal to or greater than $D/2$ and a width exceeding $D/12$ at the narrowest part and equal to or greater than $D/3$ at the bottom.

Rule: The **clearance** path is equal to the "line of sight" path.

The **creepage distance** path follows the contour of the groove.

The rule for Figure B.3 applies as well to the internal corners if they are less than 80°.

Figure B.8 – Diverging side walls

Clearance **Creepage distance**