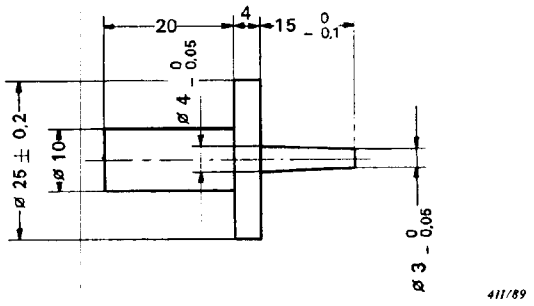
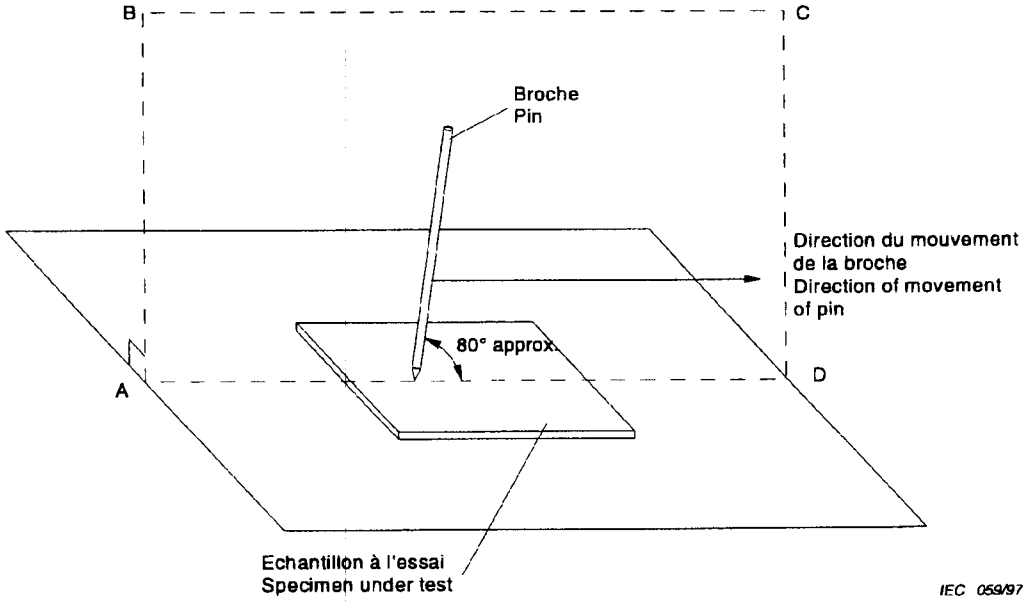


Dimensions en millimètres *Dimension in millimetres*

Figure 3 Broche d'essai (voir 9.2 et la CEI 1032 calibre d'essai 13)
Test pin (see 9.2 and IEC 1032 test probe 13)



NOTE – La broche est dans le plan ABCD perpendiculaire au spécimen en essai.
The pin is in the plane ABCD which is perpendicular to the specimen under test

Figure 4 Essai de résistance à l'abrasion pour les couches de revêtement isolant
Abrasion resistance test for insulating coated layers

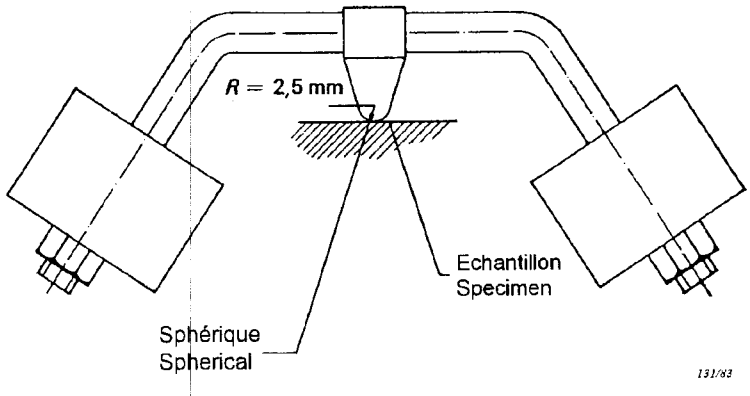


Figure 5 – Appareil pour l'essai à la bille (voir 27.1)
Ball-pressure apparatus (see 27.1)

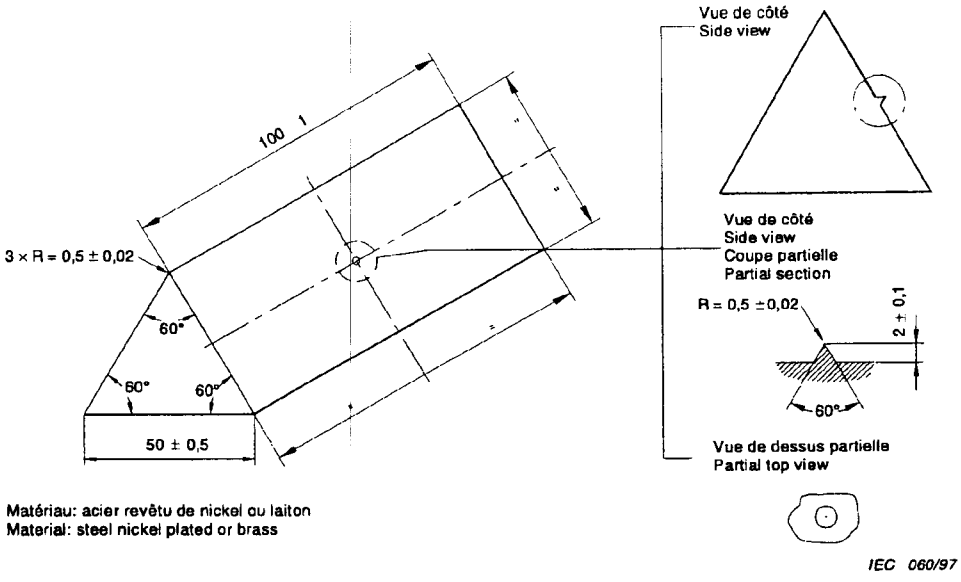


Figure 6a Mandrin
Mandrel

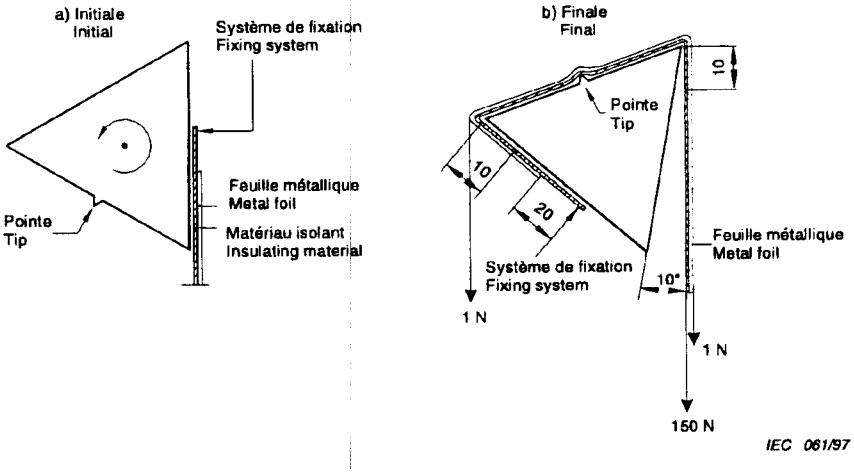


Figure 6b – Postion du mandrin
Position of mandril

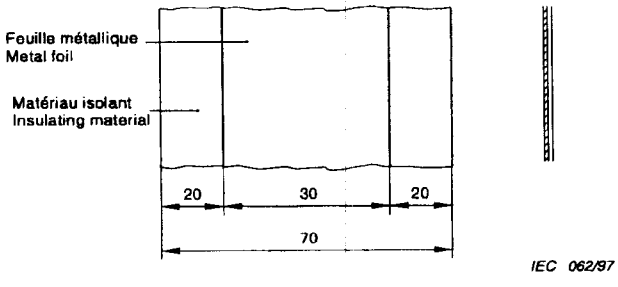


Figure 6c – Position de la feuille métallique sur le papier
Position of metal foil on paper

Figure 6 Disposition d'essai pour verifier la resistance mecanique des isolantes en couches minces (voir 26.3)
Test arrangement for checking mechanical withstanding of insulating materials in thin sheet layers (see 26.3)

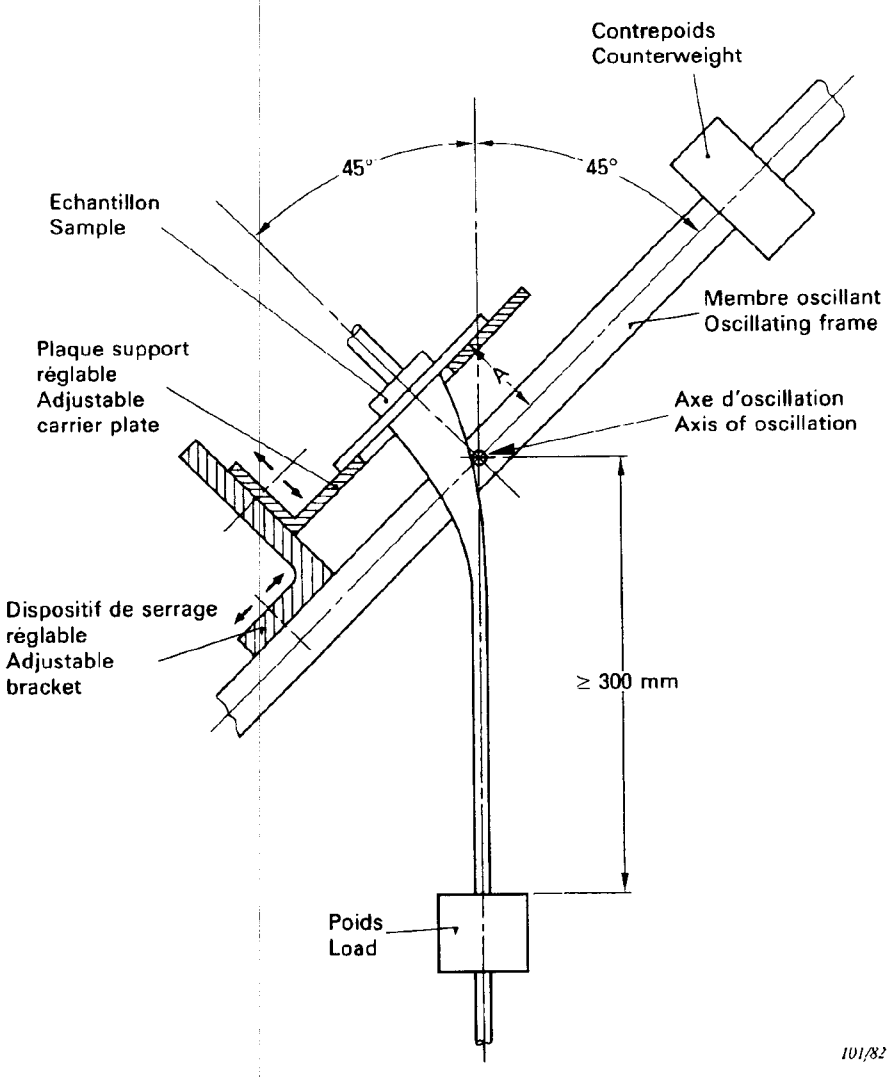


Figure 7 – Appareil d'essai de flexion (voir 22.9.4)
Flexing test apparatus (see 22.9.4)

Annex A
(normative)

Measurement of creepage distances and clearances

The width X of grooves specified in examples 1 to 10 apply to all examples as a function of the pollution degrees as follows:

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

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

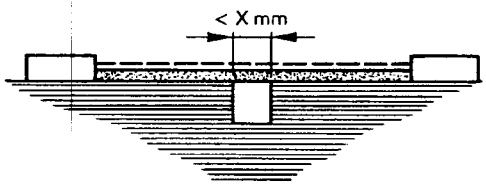
The methods of measuring **creepage distances** and clearances are indicated in the examples 1 to 10. These cases do not differentiate between gaps and grooves or between types of insulation.

The following assumptions are made

- *any recess is assumed to be bridged with an insulating link having a length equal to the specified width X and being placed in the most unfavourable position (see example 3);*
- *where the distance across a groove is equal to or larger than the specified width X, the **creepage distance** is measured along the contours of the groove (see example 2);*
- ***creepage distances** and **clearances**, measured between parts which can assume different positions in relation to each other, are measured when these parts are in their most unfavourable position.*

Exemple 1

Example 1



127/81

Condition: Ce chemin de **ligne de fuite** comprend une encoche à flancs parallèles ou convergents, de profondeur quelconque et de largeur inférieure à X mm.

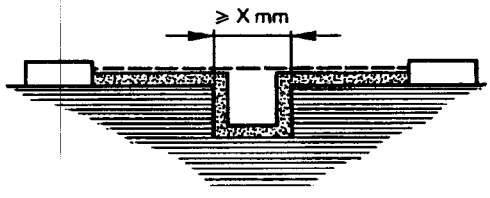
Règle: La **ligne de fuite** et la **distance d'isolement** sont mesurées en ligne droite au-dessus de l'encoche, comme indiqué ci-dessus.

Condition: Path under consideration includes a parallel or converging sided groove of any depth with a width of less than X mm.

Rule: **Creepage distance** and **clearance** are measured directly across the groove as shown above.

Exemple 2

Example 2



128/81

Condition: Ce chemin de **ligne de fuite** comprend une encoche à flancs parallèles de profondeur quelconque et de largeur égale ou supérieure à X mm.

Règle: La **distance d'isolement** est la distance en ligne droite. Le chemin de la **ligne de fuite** longe le profil de l'encoche.

Condition: Path under consideration includes a parallel sided groove of any depth and equal to or more than X mm wide.

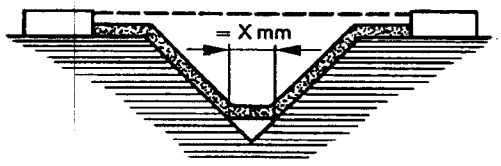
Rule: **Clearance** is the "line of sight" distance. Creepage path follows the contour of the groove.

– – – – – Distance d'isolement
Clearance

Ligne de fuite
Creepage distance

Exemple 3

Example 3



Condition: Ce chemin de **ligne de fuite** comprend une encoche en V dont l'angle d'ouverture est inférieur à 80° et dont la largeur est supérieure à X mm.

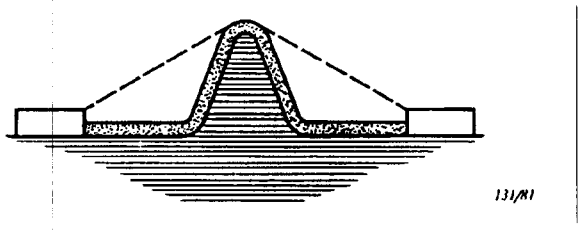
Règle: La **distance d'isolement** est la distance en ligne droite. Le chemin de la **ligne de fuite** longe le profil de l'encoche mais «court-circuite» le bas de l'encoche par un tronçon de X mm.

Condition: Path under consideration includes a V-shaped groove with an internal angle of less than 80° and a width greater than X mm.

Rule: **Clearance** is the "line of sight" distance. Creepage path follows the contour of the groove but "short-circuits" the bottom of the groove by a length of X mm.

Exemple 4

Example 4



Condition: Ce chemin de ligne de fuite comprend une nervure.

Règle: La **distance d'isolement** est le chemin dans l'air le plus court par dessus le sommet de la nervure. Le chemin de la **ligne de fuite** longe le profil de la nervure.

Condition: Path under consideration includes a rib.

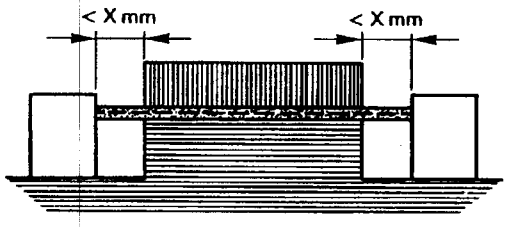
Rule: **Clearance** is the shortest direct air path over the top of the rib. Creepage path follows the contour of the rib.

Distance d'isolement
Clearance

Ligne de fuite
Creepage distance

Exemple 5

Example 5



Condition: Ce chemin de **ligne de fuite** comprend deux parties non collées avec des encoches de largeur inférieure à X mm de chaque côté.

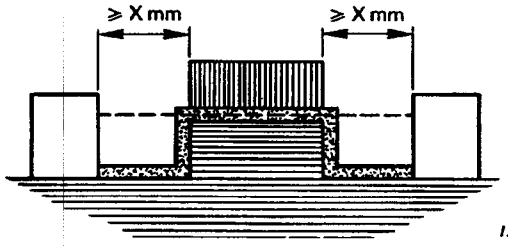
Règle: Le chemin de la **ligne de fuite** et de la **distance d'isolement** est la distance en ligne droite indiquée ci-dessus.

Condition: Path under consideration includes an uncemented joint with grooves less than X mm wide on either side.

Rule: **Creepage distance** and **clearance** path is the "line of sight" distance shown.

Exemple 6

Example 6



Condition: Ce chemin de **ligne de fuite** comprend deux parties non collées avec des encoches de largeur égal ou supérieure à X mm de chaque côté.

Règle: La **distance d'isolement** est la distance en ligne droite. Le chemin de la **ligne de fuite** longe le profil de l'encoche.

Condition: Path under consideration includes an uncemented joint with grooves equal to or more than X mm wide on each side.

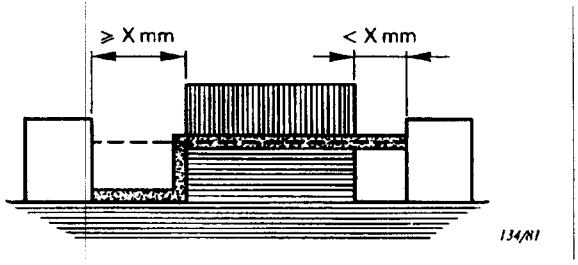
Rule: **Clearance** path is the "line of sight" distance. Creepage follows the contour of the groove.

– – – – – Distance d'isolement
Clearance

Ligne de fuite
Creepage distance

Exemple 7

Example 7



Condition: Ce chemin de **ligne de fuite** comprend deux parties non collées avec d'un côté, une encoche de largeur inférieure à X mm et, de l'autre côté, une encoche de largeur égale ou supérieure à X mm.

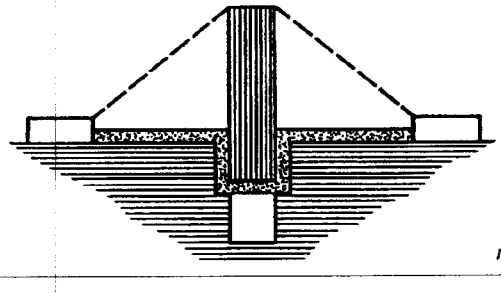
Règle: Le chemin de la distance d'isolement et de la **ligne de fuite** sont indiqués ci-dessus.

Condition: Path under consideration includes an uncemented joint with a groove on one side less than X mm wide and a groove on the other side equal to or more than X mm wide.

Rule: **Clearance** and creepage paths are as shown above.

Exemple 8

Example 8



Condition: La **ligne de fuite** à travers le joint est inférieure à la ligne de fuite par dessus la barrière.

Règle: La **distance d'isolement** est le chemin dans l'air le plus court par dessus le sommet de la barrière à travers l'encoche.

Condition: **Creepage distance** through the joint is less than **creepage distance** over the barrier.

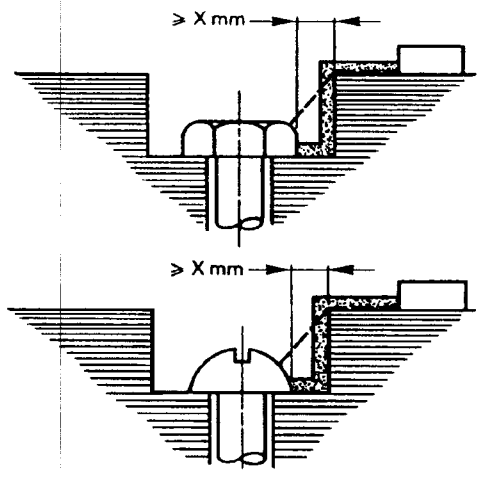
Rule: **Clearance** is the shortest direct air path over the top of the rib. **Creepage distance** follows the contour of the barrier through the groove.

– – – – – Distance d'isolement
Clearance

Ligne de fuite
Creepage distance

Exemple 9

Example 9

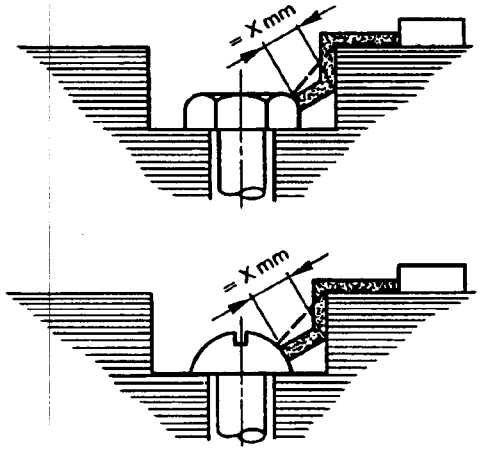


Distance entre tête de vis et paroi du logement trop faible pour être comptée.

Gap between head of screw and wall of recess too narrow to be taken into account.

Exemple 10

Example 10



Distance entre tête de vis et paroi du logement suffisante pour être comptée.

Gap between head of screw and wall of recess wide enough to be taken into account.

Distance d'isolement
Clearance

Ligne de fuite
Creepage distance

Annex B
(normative)

Testing a series of transformers

The prescriptions of this annex are intended to facilitate the testing of a series of transformers.

B.1 If a series of transformers is to be tested, the number of samples to be tested may be reduced.

Transformers can be considered as a series if:

a) they are of the same family, this meaning that they are covered by the same section of part 2;

b) they are of the same construction, implying that:

1) they have lamination or core from the same pattern range and made of the same material,

2) the same type of winding technology has been used (for example concentric or two chambers, same insulation system),

3) the same assembling technology has been used (for example open type, enclosed type, encapsulated type, impregnated, potted, etc.),

4) the same type of protection against overload has been used (for example fuses, **thermal cut-out**, etc.),

5) they are of the same frequency range;

c) they are designed for the same minimum and maximum ambient temperatures.

Variations in the following parameters are permitted, provided that the transformers comply in all other respects with the rules detailed above:

1) input voltage range;

2) output voltage range;

3) number of tapping and/or windings;

4) frequency in the declared frequency range;

5) **rated output.**

B.2 The number of samples needed in case of testing a series of transformers as defined above shall be:

a) for parameters 1) 2) and 3): two samples minimum and not more than four, chosen in order to be sure that they represent the most unfavourable situation in the family to be tested;

NOTE 1 – The samples should be chosen according to the following rules:

- one of the lowest **rated output** with the highest voltages and the lowest number of tappings;
- one of the highest **rated output** with the lowest voltages and the lowest number of tappings;
- one of the lowest **rated output** with the highest number of tappings with the highest voltage difference between adjacent windings;
- one of the medium **rated output** with medium voltages and medium number of tappings;
- one of the highest **rated output** with the lowest voltages and the highest number of windings.

When only two samples are chosen the first two alternative should be used.

b) for parameter 4): one sample of the lowest frequency and, in case of doubt, one sample of the highest frequency within the range;

NOTE 2 – If possible, the sample may be the second sample chosen for parameters 1), 2) and 3).

c) for parameter 5): two samples minimum, taken from the extremities of the range.

NOTE 3 – The samples should be chosen according to the following rules:

- one of the lowest **rated output** with the highest difference in percentage between the value of the current of the transformer and the value of the current of the relevant protective device, if any;
- one of the highest **rated output** with the highest difference in percentage between the value of the current of the transformer and the value of the current of the relevant protective device, if any;
- one sample representing the most unfavourable condition of the temperature of winding and core;
- one sample representing the most unfavourable condition of the temperature rise of the **enclosure**.

To be sure that in any case the most unfavourable situation is covered, the manufacturer shall declare the type in the series having the maximum losses in normal condition; this type shall be chosen as one of the samples to be tested.

The conditions above may be covered by a minimum of two samples.

The number of specimens for each sample shall be in accordance with 5.2, except for:

- the test of 14.3 where only two samples of three specimens in total are needed for the series, the samples being the two first of parameter 5;
- the test of 15.5 where only two samples of three specimens in total are needed for the series, the samples being the two first of parameter 5;
- the test of 16.4 where only three specimens in total are needed for the series, the heaviest type being chosen.

B.3 At least one specimen of each lamination or core size shall be provided for constructional clearances, mechanical strength, etc.

NOTE – The samples required in B.3 shall include the samples used in B.2.

Annex C
(normative)

Table C.1 – Creepage distances (cr), clearances (cl) and distances through insulation (dti)
Material group II (400 ≤CTI <600)

P1 = **pollution degree** 1 P2 = **pollution degree** 2 P3 = **pollution degree** 3

	Type of insulation	Measurement				Working voltages[2] V											
		Through winding enamel[1]		Other than through winding enamel		≥25 ≤50		100		150		300		600		1 000	
		P2	P3	P2	P3	cl	cr	cl	cr	cl	cr	cl	cr	cl	cr	cl	cr
1) Insulation between **input** and **output circuits** **(basic insulation)**	a) **Creepage distances** and **clearances** between **live parts** of **input circuits** and **live parts** of **output circuits**	X		X	X	0,2 0,8 0,2 0,8	0,85 1,7 0,85 1,7	0,5 0,8 0,2 0,8	1,0 2,0 1,0 2,0	1,5 1,5 0,5 0,8	1,5 2,2 1,1 2,2	3,0 3,0 1,5 1,5	3,0 4,2 2,1 4,2	5,5 5,5 3,0 3,0	5,5 8,6 4,3 8,6	8,0 8,0 5,5 5,5	8,0 14,0 7,1 14,0
			X														
	Reduced values, 26.2 (P1)					–	0,18	–	0,25	–	0,3	–	0,7	–	1,7	–	3,2
	b) Distances through insulation between **input** or **output circuits** and an earthed metal screen	X	X	X	X	dti		dti		dti		dti		dti		dti	
						No requirements of thickness											
	c) Distances through insulation between **input** and **output circuits**	X	X	X	X	No requirements of thickness											
2) Insulation between **input** and **output circuits** **(double** or **reinforced insulation)**	a) **Creepage distances** and **clearances** between **live parts** of **input circuits** and **live parts** of **output circuits**	X		X	X	0,5 0,8 0,2 0,8	1,0 2,0 1,0 2,0	1,5 1,5 0,5 0,8	1,5 2,8 1,4 2,8	3,0 3,0 1,5 1,5	3,0 4,2 2,0 4,2	5,5 5,5 3,0 3,0	5,5 8,6 4,3 8,6	8,0 8,0 5,5 5,5	8,6 17,2 8,6 17,2	14,0 14,0 8,0 8,0	14,0 28,0 14,0 28,0
			X														
	Reduced values, see 26.2 (P1)					–	0,25	–	0,4	–	0,7	–	1,7	–	4,0	–	7,5
	b) Distances through insulation between **input** or **output circuits** and an earthed metal screen, see 26.3	X	X	X	X	dti		dti		dti		dti		dti		dti	
						0,1 [0,05][7]		0,2 [0,07][7]		0,25 [0,08][7]		0,5 [0,16][7]		0,7 [0,19][7]		1,0 [0,25][7]	
	c) Distances through insulation between **input** and **output circuits**, see 26.3	X	X	X	X	0,2[4] [0,1][5] –[6]		0,3[4] [0,1][5] –[6]		0,5[4] [0,15][5] –[6]		1,0[4] [0,3][5] –[6]		1,5[4] [0,4][5] –[6]		2,0[4] [0,5][5] –[6]	

For notes, see page 187

Dimensions in millimetres

Table C.1 *(continued)*

	Type of insulation	Measurement				Working voltages[2] V											
		Through winding enamel[1]		Other than through winding enamel		≥25 ≤50		100		150		300		600		1 000	
		P2	P3	P2	P3	cl	cr	cl	cr	cl	cr	cl	cr	cl	cr	cl	cr
3) Insulation between adjacent **input circuits** or insulation between adjacent **output circuits**[3]	**Creepage distances** and **clearances**	X	X	X	X	0,2 0,8	0,85 1,7	0,2 0,8	1,0 2,0	0,2 0,8	1,1 2,2	0,5 0,8	2,1 4,2	1,5 1,5	4,3 8,6	3,0 3,0	7,1 14,0
	Reduced values see 26.2 (P1)					–	0,18	–	0,25	–	0,3	–	0,7	–	1,7	–	3,2
4) **Creepage distances** and **clearances** between terminals for the connection of external cables and cords excluding those between screw terminals for **input** and for **output circuits**	a) Up to and including 6 A	X	X	X	X	3,0		3,6		4,0		6,0		9,0		12,5	
	b) Over 6 A up to and including 16 A	X	X	X	X	5,0		6,0		7,0		10,0		13,0		16,0	
	c) Over 16 A	X	X	X	X	10,0		11,0		12,0		14,0		17,0		20,0	
5) **Basic** or **supplementary insulation**	Between: a) **live parts** of different polarity			X		0,2	0,9	0,5	1,0	1,5	1,5	3,0	3,0	5,5	5,5	8,0	8,0
	b) **live parts** and the **body** if intended to be connected to protective earth				X	0,8	1,7	0,8	2,0	1,5	2,2	3,0	4,2	5,5	8,6	8,0	14,0
	c) accessible metal parts and metal rod of the same diameter as the flexible cable or cord (or metal foil wrapped around the cord) inserted inside inlet bushing, anchorage and the like	X				0,2	0,9	0,2	1,0	0,5	1,1	1,5	2,1	3,0	4,3	5,5	7,1
			X			0,8	1,7	0,8	2,0	0,8	2,2	1,5	4,2	3,0	8,6	5,5	14,0
	d) **live parts** and an intermediate metal part e) an intermediate metal part and the **body**																
	Reduced values, see 26.2 (P1)					–	0,03	–	0,1	–	0,24	–	0,7	–	1,7	–	3,2

For notes, see page 187

Dimensions in millimetres

Table C.1 *(concluded)*

	Type of insulation	Measurement				Working voltages[2] V											
		Through winding enamel[1]		Other than through winding enamel		≥25 ≤50		100		150		300		600		1 000	
		P2	P3	P2	P3	cl	cr	cl	cr	cl	cr	cl	cr	cl	cr	cl	cr
6) **Reinforced** or **double insulation**	Between the **body** and **live parts**			X		0,5	1,0	1,5	1,5	3,0	3,0	5,5	5,5	8,0	8,6	14,0	14,0
		X			X	0,8	2,0	1,5	3,0	3,0	4,2	5,5	8,6	8,0	17,2	14,0	28,0
			X			0,2	1,0	0,5	1,5	1,5	2,1	3,0	4,3	5,5	8,6	8,0	14,0
						0,8	2,0	0,8	3,0	1,5	4,2	3,0	8,6	5,5	17,2	8,0	28,0
	Between **body** and **live parts** of the **output circuit** if protected by additional provisions against transient voltages	X		X		0,2	1,0	0,2	1,5	0,5	2,1	1,5	4,3	3,0	8,6	5,5	14,0
			X		X	0,8	2,0	0,8	3,0	0,8	4,2	1,5	8,6	3,0	17,2	5,5	28,0
	Reduced values, see 26.2 (P1)					–	0,25	–	0,4	–	0,7	–	1,7	–	4,0	–	7,5
7) Distance through insulation (excluding insulation between **input** and **output circuit**)	a) **Basic**[8]	X	X	X	X	No requirement of thickness											
	b) **Supplementary**[8]					dti		dti		dti		dti		dti		dti	
		X	X	X	X	0,1[4] [0,05][5] –[6]		0,15[4] [0,05][5] –[6]		0,25[4] [0,08][5] –[6]		0,5[4] [0,15][5] –[6]		0,75[4] [0,20][5] –[6]		1,0[4] [0,25][5] –[6]	
	c) **Reinforced**	X	X	X	X	0,2[4] [0,1][5] –[6]		0,3[4] [0,1][5] –[6]		0,5[4] [0,15][5] –[6]		1,0[4] [0,3][5] –[6]		1,5[4] [0,4][5] –[6]		2,0[4] [0,5][5] –[6]	

Dimensions in millimetres

NOTES

1) Measurement through winding wire enamel if the winding wire complies at least with grade 1 of IEC 60317.
2) Values of **creepage distances** and **clearances** and distances through insulation may be found for intermediate values of **working voltages** by interpolation between the values in the table. No values are required for **working voltages** below 25 V as the voltage test of table 8 is considered sufficient.
3) These values do not apply:
   – inside each winding or between groups of windings intended to be permanently connected together, provided that the termination of windings to be connected together are at the same potential,
   – where the **working voltage** does not exceed 300 V and the winding wires comply at least with grade 1 of IEC 60317, even if the windings are intended to be connected in a series or parallel arrangement (e.g. input voltage 110/220 V).
4) For solid insulation.
5) In the case of insulation consisting of three layers.
6) In the case of insulation consisting of two separate layers (no glued layers are allowed in this case) and each layer passes the mandrel test of 26.3 at a voltage of 5,5 kV.
7) In the case of insulation consisting of two layers.
8) When **double insulation** is required between **input** and **output windings**, the total thickness through insulation shall be the same as shown in box 2 c) whether measured directly or via metal parts.
9) When the layers of insulation are made of turns of insulating tape, the winding of the tape should be such that at every place there is at least the required number of layers.
10) When a number is replaced by a dash in a column of the table it means that no value is required.

Annex D
(normative)

Table D.1 – Creepage distances (cr), clearances (cl) and distances through insulation (dti)
Material group I (CTI ≥600)

P1 = **pollution degree** 1 P2 = **pollution degree** 2 P3 = **pollution degree** 3

	Type of insulation	Measurement				Working voltages[2] V											
		Through winding enamel[1]		Other than through winding enamel		≥25 ≤50		100		150		300		600		1 000	
		P2	P3	P2	P3	cl	cr	cl	cr	cl	cr	cl	cr	cl	cr	cl	cr
1) Insulation between **input** and **output circuits** **(basic insulation)**	a) **Creepage distances** and **clearances** between **live parts** of **input circuits** and live parts of **output circuits**	X		X	X	0,2 0,8 0,2 0,8	0,6 1,5 0,6 1,5	0,5 0,8 0,2 0,8	0,7 1,8 0,7 1,8	1,5 1,5 0,5 0,8	1,5 2,0 0,8 2,0	3,0 3,0 1,5 1,5	3,0 3,9 1,5 3,9	5,5 5,5 3,0 3,0	5,5 7,7 3,0 7,7	8,0 8,0 5,5 5	8,0 12,5 5,5 12,5
			X														
	Reduced values, 26.2 (P1)					–	0,18	–	0,25	–	0,3	–	0,7	–	1,7	–	3,2
	b) Distances through insulation between **input** or **output circuits** and an earthed metal screen	X	X	X	X	dti		dti		dti		dti		dti		dti	
						No requirements of thickness											
	c) Distances through insulation between **input** and **output circuits**	X	X	X	X	No requirements of thickness											
2) Insulation between **input** and **output circuits** **(double** or **reinforced insulation)**	a) **Creepage distances** and **clearances** between **live parts** of **input circuits** and **live parts** of **output circuits**	X		X	X	0,5 0,8 0,2 0,8	0,7 1,8 0,7 1,8	1,5 1,5 0,5 0,8	1,5 2,5 1,0 2,5	3,0 3,0 1,5 1,5	3,0 3,9 1,5 3,9	5,5 5,5 3,0 3,0	5,5 7,7 3,0 7,7	8,0 8,0 5,5 5,5	8,0 16,0 6,0 16,0	14,0 14,0 8,0 8,0	14,0 25,0 10,0 25,0
			X														
	Reduced values, see 26.2 (P1)					–	0,25	–	0,4	–	0,7	–	1,7	–	4,0	–	7,5
	b) Distances through insulation between **input** or **output circuits** and an earthed metal screen, see 26.3	X	X	X	X	dti		dti		dti		dti		dti		dti	
		0,1 [0,05][7]		0,2 [0,07][7]		0,25 [0,08][7]		0,5 [0,16][7]		0,7 [0,19][7]		1,0 [0,25][7]					
	c) Distances through insulation between **input** and **output circuits**, see 26.3	X	X	X	X	0,2[4] [0,1][5] –[6]		0,3[4] [0,1][5] –[6]		0,5[4] [0,15][5] –[6]		1,0[4] [0,3][5] –[6]		1,5[4] [0,4][5] –[6]		2,0[4] [0,5][5] –[6]	

For notes, see page 193

Dimensions in millimetres

Table D.1 *(continued)*

	Type of insulation	Measurement				Working voltages[2] V											
		Through winding enamel[1]		Other than through winding enamel		≥25 ≤50		100		150		300		600		1 000	
		P2	P3	P2	P3	cl	cr	cl	cr	cl	cr	cl	cr	cl	cr	cl	cr
3) Insulation between adjacent **input circuits** or insulation between adjacent **output circuits**[3]	**Creepage distances** and **clearances**	X	X	X	X	0,2 0,8	0,6 1,5	0,2 0,8	0,7 1,8	0,2 0,8	0,8 2,0	0,5 0,8	1,5 3,9	1,5 1,5	3,0 7,7	3,0 3,0	5,0 12,5
	Reduced values see 26.2 (P1)					–	0,18	–	0,25	–	0,3	–	0,7	–	1,7	–	3,2
4) **Creepage distances** and **clearances** between terminals for the connection of external cables and cords excluding those between screw terminals for **input** and for **output circuits**	a) Up to and including 6 A	X	X	X	X	3,0		3,6		4,0		6,0		9,0		12,5	
	b) Over 6 A up to and including 16 A	X	X	X	X	5,0		6,0		7,0		10,0		13,0		16,0	
	c) Over 16 A	X	X	X	X	10,0		11,0		12,0		14,0		17,0		20,0	
5) **Basic** or **supplementary insulation**	Between: a) **live parts** of different polarity			X		0,2	0,6	0,5	0,7	1,5	1,5	3,0	3,0	5,5	5,5	8,0	8,0
	b) **live parts** and the **body** if intended to be connected to protective earth	X			X	0,8	1,5	0,8	1,8	1,5	2,0	3,0	3,9	5,5	7,7	8,0	12,5
	c) accessible metal parts and metal rod of the same diameter as the flexible cable or cord (or metal foil wrapped around the cord) inserted inside inlet bushing, anchorage and the like		X			0,2 0,8	0,6 1,5	0,2 0,8	0,7 1,8	0,5 0,8	0,8 2,0	1,5 1,5	1,5 3,9	3,0 3,0	3,0 7,7	5,5 5,5	5,5 12,5
	d) **live parts** and an intermediate metal part e) an intermediate metal part and the **body**																
	Reduced values, see 26.2 (P1)					–	0,03	–	0,1	–	0,24	–	0,7	–	1,7	–	3,2

For notes, see page 193

Dimensions in millimetres

Table D.1 *(concluded)*

	Type of insulation	Measurement				Working voltages[2] V											
		Through winding enamel[1]		Other than through winding enamel		≥25 ≤50		100		150		300		600		1 000	
		P2	P3	P2	P3	cl	cr	cl	cr	cl	cr	cl	cr	cl	cr	cl	cr
6) **Reinforced** or **double insulation**	Between the **body** and **live parts**	X		X	X	0,5 0,8 0,2 0,8	0,7 1,8 0,7 1,8	1,5 1,5 0,5 0,8	1,5 2,5 1,0 2,5	3,0 3,0 1,5 1,5	3,0 3,9 1,5 3,9	5,5 5,5 3,0 3,0	5,5 7,7 3,0 7,7	8,0 8,0 5,5 5,5	8,0 16,0 6,0 16,0	14,0 14,0 8,0 8,0	14,0 25,0 10,0 25,0
	Between **body** and **live parts** of the **output circuit** if protected by additional provisions against transient voltages	X	X	X	X	0,2 0,8	0,7 1,8	0,2 0,8	1,0 2,5	0,5 0,5	1,5 3,9	1,5 1,5	3,0 7,7	3,0 3,0	6,0 16,0	5,5 5,5	10,0 25,0
	Reduced values, see 26.2 (P1)					–	0,25	–	0,4	–	0,7	–	1,7	–	4,0	–	7,5
7) Distance through insulation (excluding insulation between **input** and **output circuit**)	a) **Basic**[8]	X	X	X	X	No requirement of thickness											
	b) **Supplementary**[8]	X	X	X	X	dti 0,1[4] [0,05][5] –[6]		dti 0,15[4] [0,05][5] –[6]		dti 0,25[4] [0,08][5] –[6]		dti 0,5[4] [0,15][5] –[6]		dti 0,75[4] [0,20][5] –[6]		dti 1,0[4] [0,25][5] –[6]	
	c) **Reinforced**	X	X	X	X	0,2[4] [0,1][5] –[6]		0,3[4] [0,1][5] –[6]		0,5[4] [0,15][5] –[6]		1,0[4] [0,3][5] –[6]		1,5[4] [0,4][5] –[6]		2,0[4] [0,5][5] –[6]	

Dimensions in millimetres

NOTES

1) Measurement through winding wire enamel if the winding wire complies at least with grade 1 of IEC 60317.
2) Values of **creepage distances** and **clearances** and distances through insulation may be found for intermediate values of **working voltages** by interpolation between the values in the table. No values are required for **working voltages** below 25 V as the voltage test of table 8 is considered sufficient.
3) These values do not apply:
   – inside each winding or between groups of windings intended to be permanently connected together, provided that the termination of windings to be connected together are at the same potential,
   – where the **working voltage** does not exceed 300 V and the winding wires comply at least with grade 1 of IEC 60317, even if the windings are intended to be connected in a series or parallel arrangement (e.g. input voltage 110/220 V).
4) For solid insulation.
5) In the case of insulation consisting of three layers.
6) In the case of insulation consisting of two separate layers (no glued layers are allowed in this case) and each layer passes the mandrel test of 26.3 at a voltage of 5,5 kV.
7) In the case of insulation consisting of two layers.
8) When **double insulation** is required between **input** and **output windings**, the total thickness through insulation shall be the same as shown in box 2 c) whether measured directly or via metal parts.
9) When the layers of insulation are made of turns of insulating tape, the winding of the tape should be such that at every place there is at least the required number of layers.
10) When a number is replaced by a dash in a column of the table it means that no value is required.

Annex E
(normative)

Glow-wire test

The glow-wire test is carried out in accordance with IEC 60695-2-1/0.

For the purpose of this standard, the following applies with reference to the relevant clauses and subclauses of IEC 60695-2-1/1.

5 Severity

The temperature of the tip of the glow-wire shall be 650 °C.

7 Conditioning

Preconditioning is required.

9 Test procedure

Add to 9.1 the following paragraph:

If possible, the tip of the glow-wire is applied to flat surfaces and not to grooves, knock-outs, narrow recesses or sharp edges.

Annex F
(normative)

Requirements for switches complying with IEC 61058

F.1 Manually operated mechanical switches shall meet one of the following requirements, a) or b)

a) The switch, tested as a separate component, shall comply with the requirements and tests of IEC 61058-1, whereby the following applies:

- the number of operating cycles shall be 10 000 (see 7.1.4.4 of IEC 61058-1);
- the switch shall be suitable for use in the relevant **pollution degree** situation (see 7.1.6.2 of IEC 61058-1);
- the switch shall be of category D regarding the resistance to heat and fire (see 7.1.9.3 of IEC 61058-1).

The characteristics of the switch with regard to:

1) the rating of the switch (see clause 6 of IEC 61058-1);
2) the classification of the switch according to:
   - nature of supply (see 7.1.1 of IEC 61058-1),
   - type of load to be controlled by the switch (see 7.1.2 of IEC 61058-1),
   - ambient air temperature (see 7.1.3 of IEC 61058-1)

shall be appropriate for the function of the switch under normal operating conditions.

If the switch is a mains switch which controls mains socket-outlet(s), the rated current I and the rated peak surge current of the socket-outlet(s) as specified in clause F.2 shall be taken into account.

Compliance is checked according to test specifications of IEC 61058-1, by inspection and by measurements,

b) The switch, tested as part of the apparatus working under normal operating conditions, shall meet the requirements of F.2, F.3 and F.4.

F.2 The switch shall withstand without excessive wear or other harmful effects the electrical, thermal and mechanical stresses that occur in normal use, and shall have a mechanism complying with 13.3 of IEC 61058-1 for both d.c. switches and a.c. mains switches.

Compliance is checked according to 13.1 of IEC 61058-1 and by the following endurance test:

The switch is subjected to 10 000 cycles of operation with a sequence according to 17.1.2 of IEC 61058-1, except the increased voltage test at accelerated speed specified in 17.2.4 of IEC 61058-1, and under electrical and thermal conditions given by the normal operating conditions of the apparatus.

The test is carried out on three specimens, no failure is allowed.

F.3 If the switch is a mains switch which controls mains socket-outlet(s), the endurance test is carried out with an additional load connected to the socket-outlet(s), consisting of the circuit shown in figure 9 of IEC 61058-1, taking into account figure 10.

The rated current *I* of the additional load shall correspond to the marking of the socket-outlet(s) (see item e) of 5.2). The peak surge current of the additional load shall have a value as shown in table F.1.

Table F.1

Rated current of the socket-outlet(s) A	Peak surge current A
$I \leq 0,5$	20
$0,5 < I \leq 1,0$	50
$1,0 < I$	100

If the socket-outlet(s) is/are marked with the current which may be drawn, this/these value(s) is/are chosen for the rated current *I* of the socket-outlet(s).

If the socket-outlet(s) is/are marked with the power which may be drawn, the rated current I of the socket-outlet(s) is calculated from this/these value(s).

After the test, the switch shall show no damage in the sense of this standard. In particular, it shall show no deterioration of its **enclosure**, no reduction of **clearances** and **creepage distances** and no loosening of electrical connections with mechanical fixing.

Compliance is checked by inspection and by the tests specified in clauses F.4 and F.5, respectively, in the given order.

F.4 The switch shall be so constructed that it does not attain excessive temperatures in normal use. The materials used shall be such that the performance of the switch is not adversely affected by the operation in normal use in the conditions given by the apparatus. In particular, the material and design of the contacts and terminals shall be such that the operation and the performance of the switch are not adversely affected by its oxidation or other deterioration.

Compliance is checked in the "ON" position under normal operating conditions and according to 16.2.2 d), i) and m) of IEC 61058-1, taking into account the rated current I of mains socket-outlet(s), if any, including the peak surge current according to clause F.3.

F.5 The switch shall have adequate dielectric strength.

Compliance is checked by the following tests:

The switch shall withstand a dielectric strength test as specified in 18.3, without being previously subjected to the humidity treatment, the test voltage being decreased to 75 % of the corresponding test voltage specified in that subclause, but not less than 500 V r.m.s. (700 V peak).

- *The test voltage is applied in the "ON" position between **hazardous live parts** and accessible conductive parts, and, in addition, between the poles in case of a multipole switch.*
- *The test voltage is applied in the "OFF" position across each contact gap. During the test, resistors and capacitors in parallel to a contact gap may be disconnected.*

Annex G
(normative)

Tracking test

For the purpose of this standard, materials are separated into three groups by their comparative tracking index (CTI) values, as follows:

material group I	600 < (CTI)
material group II	400 < (CTI) <600
material group IIIa	175 < (CTI) <400

Separation of the material groups is determined by compliance with the comparative tracking index test made in accordance with IEC 60112.

The test is made on three separate specimens or on three pieces cut from the relevant component, care being taken that the electrodes are clean, correctly shaped and correctly positioned before each test is started. In case of doubt, the test is repeated, if necessary, on a new specimen.

For the purpose of this standard, the following applies with reference to the clauses and subclauses of IEC 60112.

3 Test specimen

The last sentence of the first paragraph does not apply.

5 Test apparatus

The note in 5.1 does not apply.

Note 4 in 5.3 does not apply.

The test solution A as described in 5.4 is used.

6 Procedure

For the CTI test of 6.2, notes 2 and 3 of clause 3 also apply.

Subclause 6.3 does not apply.

Annex H
(normative)

Electronic circuits

H.1 Scope

For circuits comprising at least one electronic component the standard applies with the following modifications.

H.3 Definitions

Additional definitions:

H.3.8 Electronic circuits and components

H.3.8.1 electronic component: Part in which conduction is achieved principally by electrons moving through a vacuum, gas or semiconductor.

NOTE – Neon indicators are not considered to be electronic components.

H.3.8.2 electronic circuit: Circuit incorporating at least one electronic component.

H.5 General notes on tests

Additions:

H.5.1 All clauses of part 1, as modified in this annex, and in the parts 2 for the specific transformers, apply to electronic circuits.

H.5.2 The accumulation of stress resulting from successive tests is to be avoided. It may be necessary to replace components or to use additional samples.

NOTE – The number of additional samples should be kept to a minimum by an evaluation of the relevant circuits.

H.15 Short circuit and overload protection

Additions:

H.15.6 Electronic circuits shall be so designed and applied that a fault condition will not render the transformer unsafe with regard to electric shock, fire hazard or dangerous malfunction.

Compliance is checked by evaluation of the fault conditions specified in H.15.8 for all circuits or parts of circuits, unless they comply with the conditions specified in H.15.7.

If the safety of the transformer under any of the fault conditions depends on the operation of a fuse-link, the test of H.15.9 is made.

During and after each test, the temperatures shall not exceed the values specified in table 3 of 15.1 and the transformer shall comply with the conditions specified in 15.1.

If a conductor of a printed circuit board becomes open-circuited, the transformer is considered to have withstood the particular test, provided that all six of the following conditions are met:

- the printed circuit board complies with the requirements of FV1 or better according to IEC 60707;
- the interrupted conductors have not peeled by more than 2 mm on each side;
- the interruption is in a low-power circuit as described in H.15.7, and in addition the voltage over the interruption shall not exceed 50 V;
- the transformer complies with the requirements of this subclause with the interrupted conductors bridged;
- no other conductor has been loosened over a length of more than 5 mm;
- any peeled or loosened conductor does not reduce the **creepage distances** and **clearances** between **hazardous live parts** and **accessible parts** below the values specified in clause 26.

NOTE 1 – Unless it is necessary to replace components after any of the tests, the dielectric strength test of 18.3 need only be carried out after the final test on the electronic circuit.

NOTE 2 – In general, examination of the transformer and its circuit diagram will reveal the fault conditions which have to be simulated, so that testing can be limited to those cases which may be expected to give the most unfavourable result.

H.15.7 Fault conditions a) to f) specified in H.15.8 are not applied to circuits or parts of circuits where both of the following conditions are met:

- the electronic circuit is a low-power circuit as described below;
- the protection against electric shock, fire hazard, mechanical hazards or dangerous malfunction in other parts of the transformer does not rely on the correct functioning of the electronic circuit.

A low-power circuit is determined as follows (an example is given in figure H.1):

The transformer is operated at rated voltage and a variable resistor, adjusted to its maximum resistance, is connected between the point to be investigated and the opposite pole of the supply source.

The resistance is then decreased until the power consumed by the resistor reaches a maximum. Any point nearest to the supply at which the maximum power delivered to this resistor does not exceed 15 W at the end of 5 s is called a low-power point. The part of the circuit which is further from the supply source than a low-power point is considered to be a low-power circuit.

NOTE 1 –The measurements are made from only one pole of the supply source, preferably the one that gives the fewest low power points.

When determining the low power points, it is recommended to start with points close to the supply source.

NOTE 2 – The power consumed by the variable resistor is measured by a wattmeter.

H.15.8 The following fault conditions are considered and, if necessary, applied one at a time. Consequential faults are taken into consideration.

a) Short circuit of **creepage distances** and **clearances** between **live parts** of different polarity, if these distances are less than those specified in clause 26.

b) Open circuit at the terminals of any component.

c) Short circuit of capacitors, unless they comply with IEC 60384-14.

d) Short circuit of any two terminals of an electronic component, other than integrated circuits. This fault condition is not applied between the two circuits of an optocoupler.

e) Open circuit or short circuit inside an integrated circuit. In that case, the possible hazardous situations of the transformer are assessed to ensure that safety does not rely on the correct functioning of such a component.

All possible output signals of the integrated circuit are considered in the result. If it can be shown that a particular output signal is unlikely to occur, then the relevant fault is not considered.

NOTE 1 – Microprocessors are tested as integrated circuits.

NOTE 2 – Semiconductor components such as thyristors and triacs are subjected to fault conditions b) and d).

f) In addition, each low-power circuit is short-circuited by connecting the low power point to the pole of the supply from which the measurements were taken.

For simulation of the fault conditions, the transformer is operated at any supply voltage between 0,94 times and 1,06 times the ***rated supply voltage****.*

Where any of the fault conditions are simulated, the test is continued until steady conditions are established.

In each case, the test is ended if interruption of the supply occurs within the transformer.

If the transformer incorporates an electronic circuit which operates to ensure compliance with clause 15, the relevant test is repeated with a single fault simulated, as indicated in a) to e) above.

Fault condition e) is applied to encapsulated and similar components if the circuit cannot be assessed by other methods.

Positive temperature coefficient resistors (PTCs) and negative temperature coefficient resistors (NTCs) are not short-circuited if they are used within their manufacturer's declared specification.

H.15.9 If, for any of the fault conditions specified in H.15.8, the safety of the transformer depends on the operation of a fuse-link, the test is repeated but with the fuse-link replaced by an ammeter.

In case of doubt, the maximum resistance of the fuse-link has to be taken into account when determining the current.

For miniature fuse-links complying with IEC 60127-3 the following applies.

If the current measured does not exceed 2,1 times the rated current of the fuse-link, the circuit is not considered to be adequately protected, and the test is carried out with the fuse-link short-circuited.

If the current is at least 2,75 times the rated current of the fuse-link, the circuit is considered to be adequately protected.

If the current measured exceeds 2,1 times the rated current of the fuse-link, but does not exceed 2,75 times the rated current, the fuse-link is short-circuited and the test is carried out:

- *for quick acting fuse-links for the relevant period, or for 30 min, whichever is the shorter;*
- *for time lag fuse-links, for the relevant period, or for 2 min, whichever is the shorter.*

NOTE – The verification whether the fuse-link acts as a protective device is based on the fusing characteristics specified in IEC 60127-3, which also gives the information necessary to calculate the maximum resistance of the fuse-link.

For fuses other than those complying with IEC 60127-3, the test is carried out as specified in 15.3.2 to 15.3.5.

H.26 Creepage distances, clearances and distances through insulation

Additions:

H.26.1 For conductive patterns on printed circuit boards, except at their edges, the values in table 13, table C.1 and table D.1 between parts of different polarity may be reduced as long as the peak value of the voltage stress does not exceed:

- 150 V per mm, with a minimum distance of 0,2 mm, if protected against the deposition of dirt;
- 100 V per mm, with a minimum distance of 0,5 mm, if not protected against the deposition of dirt.

For peak voltages exceeding 50 V, the reduced **creepage distances** only apply if the proof tracking index (PTI) of the printed circuit board has a resistance to tracking corresponding to at least material group IIIa.

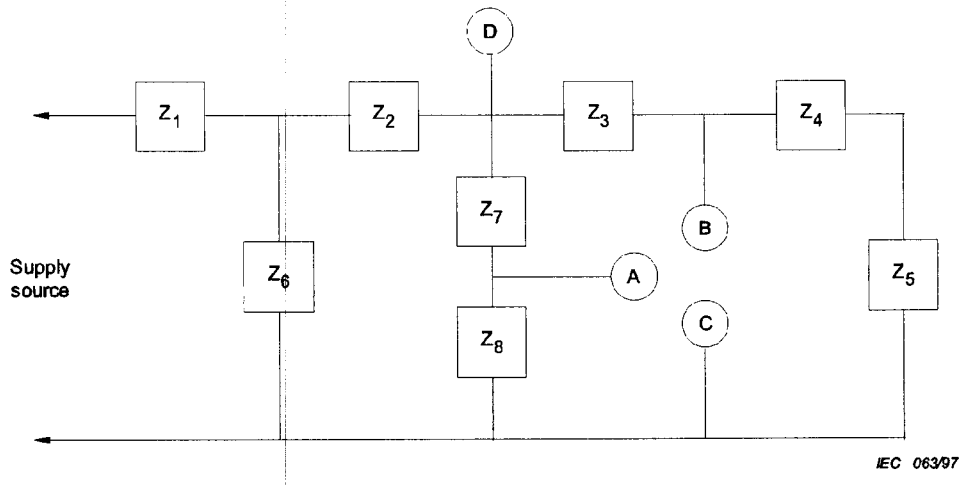
These distances may be reduced further provided that the transformer complies with the requirements of clause H.15 when the distances are short-circuited in turn.

NOTE – When the limits mentioned above lead to higher values than those of the table, the values of table 13, table C.1 and table D.1 apply.

For **live parts** of different polarity separated by **basic insulation** only, **creepage distances** and **clearances** smaller than those specified in the table are allowed, provided the requirements of clause H.15 are met if these **creepage distances** and **clearances** are short-circuited in turn.

Creepage distances and **clearances** within optocouplers are not measured if the individual insulation is adequately sealed, and if air is excluded between individual layers of the material.

H.26.2 For optocouplers, the conditioning procedure is carried out at a temperature of 50 K in excess of the maximum temperature measured on the surface of the optocoupler during the tests of clauses 14 or 15, the optocoupler being operated under the most onerous conditions which occur during these tests.



D is a point furthest from the supply source where the maximum power delivered to external load exceeds 15 W.

A and B are points closest to the supply source where the maximum power delivered to external load does not exceed 15 W. These are low-power points.

Points A and B are separately short-circuited to C.

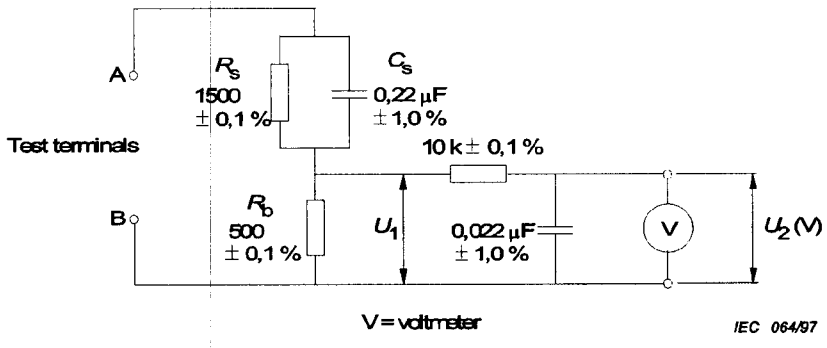
The fault conditions a) to e) specified in H.15.8 are applied individually to Z_1, Z_2, Z_3, Z_6, and Z_7.

Figure H.1 – Example of an electronic circuit with low-power points (see H.15.7)

Annex J
(normative)

Measuring network for touch-currents

(Taken from figure 4 of IEC 60990)



True r.m.s. reading		Input capacitance:	≤200 pF
Uncertainty:	≤2 %	Frequency range:	15 Hz to 1 MHz
Input resistance:	0,1 MΩ		

Figure J.1 – Measuring network for touch-current

Annex K
(normative)

Insulated winding wires for use as multiple layer insulation

This annex specifies winding wire insulated with polyimide film or equivalent insulation, that may be used to provide **basic**, **supplementary** or **reinforced insulation** in wound parts without additional interleaved insulation.

NOTE – Typical values of some properties of polyimide are given below for information. Adherence to these values is not part of this standard.

- Dielectric strength 180 kV/mm
- Dielectric constant 3,5
- Dissipation factor 0,003 at 1 kHz
- Insulation resistance 10^5 MΩ
- Surface resistivity 10^{16} Ω at 50 % relative humidity
- Folding endurance 10^4 cycles.

K.1 Wire construction

Winding wire shall be insulated with two or more layers. In case of spirally wrapped layers of tape, contra-rotation layers shall be used. Overlap of these layers shall be adequate to ensure continued overlap during manufacture of the wound part.

Such layers of tape shall be sealed to eliminate creepage paths between layers.

K.2 Conformance tests

The wire shall pass the following five type tests K.2.1 to K.2.5.

K.2.1 Dielectric strength

Test 13 of IEC 60851-5, applied for the same duration as in 18.3, with a test voltage not less than the appropriate voltage in table 8 of this standard, or 3 kV in case of two layers, 5,5 kV in case of three layers, whichever is the greater in each case.

K.2.2 Adherence and flexibility

Test 8 of 5.1.4 of IEC 60851-3, followed by the dielectric strength test K.2.1, carried out at rated ambient temperature.

K.2.3 Heat shock

Test 9 of 3.1 or 3.2 of IEC 60851-6, followed by the dielectric strength test K.2.1.

K.2.4 Retention of dielectric strength after bending

Test 13 of 4.6.1 c) of IEC 60851-5, followed by the dielectric strength test K.2.1.

K.2.5 Resistance to abrasion

Test 11 of IEC 60851-3 is applicable.

K.3 Routine test (production tests)

The wire shall be subjected by the wire manufacturer to 100 % dielectric strength testing in accordance with IEC 60851-5, with a test voltage not less than the appropriate voltage in table 8 of this standard, or 3 kV in the case of two layers, 5,5 kV in the case of three layers, whichever is the greater in each case.

Annex L
(informative)

Routine tests (production tests)

The tests specified in this annex are intended to reveal, as far as safety is concerned, unacceptable variations in material or manufacture. These tests are intended not to impair the properties and the reliability of the transformer, and should be made by the manufacturer on each transformer after production.

Further tests may have to be made to ensure that every transformer conforms with the specimens that withstood the tests of this standard, depending on the experience gained by the manufacturer.

The manufacturer may use a test procedure which is better suited to his production arrangements, and may make the tests at an appropriate stage during production, provided it can be shown that transformers which withstand the tests made by the manufacturer provide at least the same degree of safety as transformers which withstand the tests specified in this annex.

L.1 Earthing continuity test

For **class I transformers**, a current of at least 10 A, derived from a source with a no-load voltage not exceeding 12 V, is passed in turn between the earthing terminal and each of accessible metal parts which have to be earthed for safety reasons.

During this test, no interruption of the connections or substantial decrease of the current shall occur between the earthing terminal and the relevant accessible metal parts.

L.2 Checking of no-load output voltage

The **no-load output voltage** shall comply with clause 12.

L.3 Dielectric strength test

The test is made in accordance with table 8 of 18.3 at ambient temperature and without the moisture test of 17.2.

The specified test voltage is applied for 1 s.

The tests are made between:

a) **live parts** of the **input circuits** and accessible conductive parts of the transformer;

b) **input circuits** and **output circuits**.

No flashover or breakdown shall occur during the test.

Additional tests may be required for high insulation level transformers and **separating transformers** with **working voltage** above 1 000 V.

L.4 Checking of protective devices mounting

The operation of a protection device, if any, shall not be prevented by incorrect mounting of the device in the transformer.

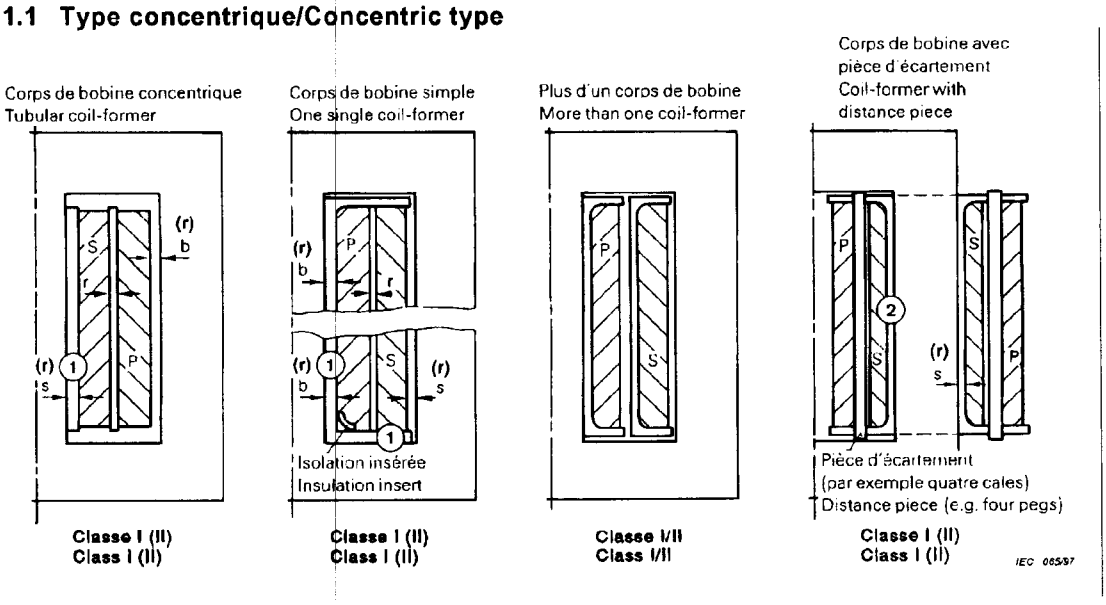
Compliance is checked by inspection.

Annexe M/Annex M
(informative)

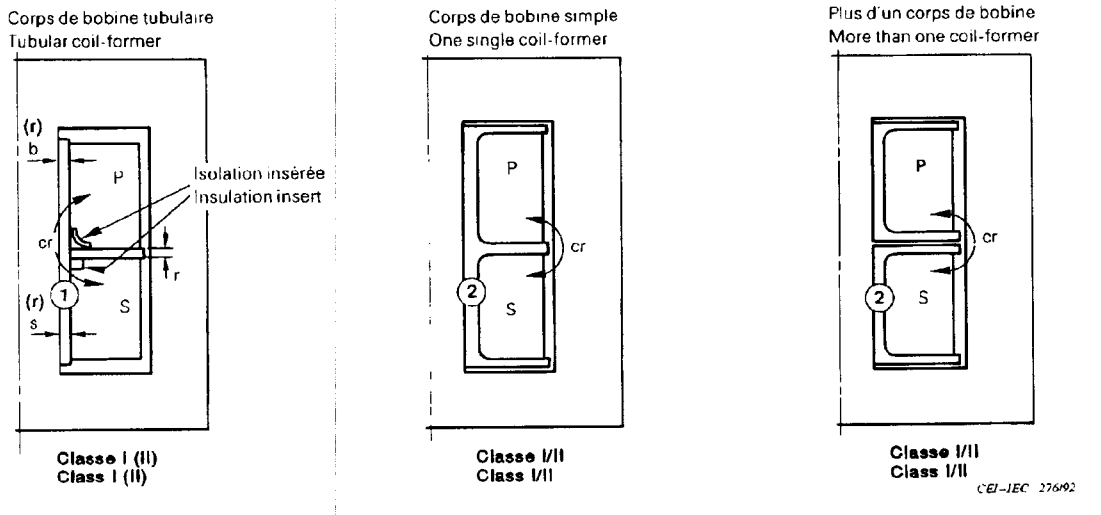
Exemples destinés à être utilisés comme guide pour 19.1
Examples to be used as a guide for 19.1

M.1 Corps de bobine/Coil-former

M.1.1 Type concentrique/Concentric type



M.1.2 Type cloisonné/Side-by-side type



1 Corps cylindrique d'épaisseur spécifiée pour l'**isolation supplémentaire** ou au moins trois couches de ruban (voir article 26)

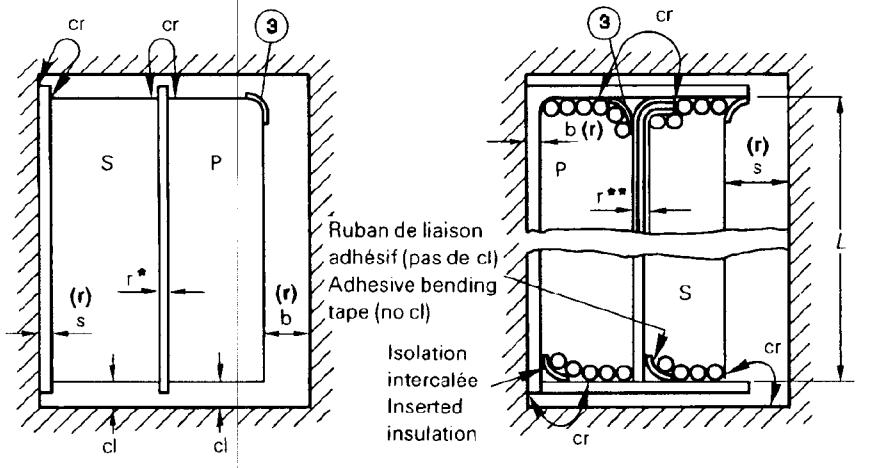
2 Fait partie de l'épaisseur spécifiée pour l'**isolation supplémentaire** de l'article 26

1 A tube of a specified thickness for **supplementary insulation** or at least three layers of tape (see clause 26)

2 Formed part of thickness as specified for **supplementary insulation** in clause 26

M.2 Enroulements/Windings

M.2.1 Sans écran/Without screen



Classe I (II)
Class I (II)

Classe I (II)
Class I (II)

IEC 066/97

r*: Elément d'épaisseur spécifiée ou au moins trois couches de ruban

r*: One piece of specified thickness or at least three layers of tape

r**: Un élément d'épaisseur spécifiée plus un ruban adhésif ou insertion d'isolant ou au moins trois couches de ruban plus par exemple un ruban adhésif ou au moins quatre couches de ruban cranté

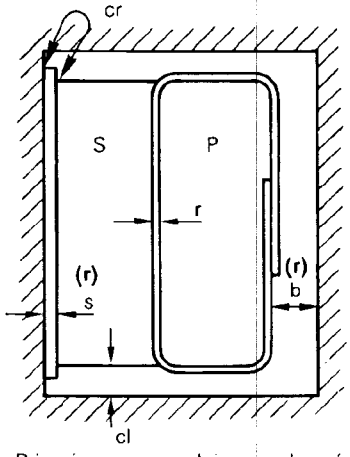
r**: one piece of specified thickness plus an adhesive tape or an insulation insert or at least three layers of tape plus, for example, an adhesive tape or at least four layers of serrated tape

3 Dernier tour de l'enroulement maintenu en position

Par exemple ruban de liaison adhésif ou élément de liaison

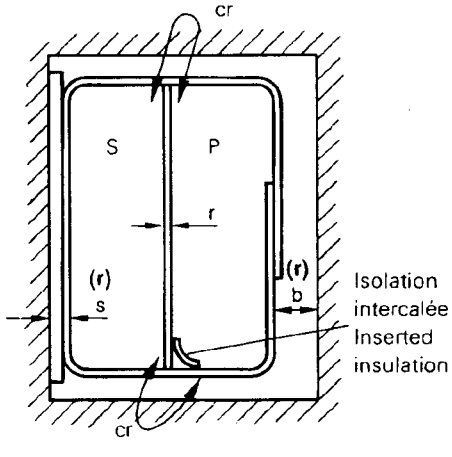
3 Last turn of winding prevented from being displaced

For example adhesive bonding tape or a bonding agent



Primaire *ou* secondaire enveloppé de matière isolante
Input *or* output wrapped with insulating material

Classe I (II)
Class I (II)

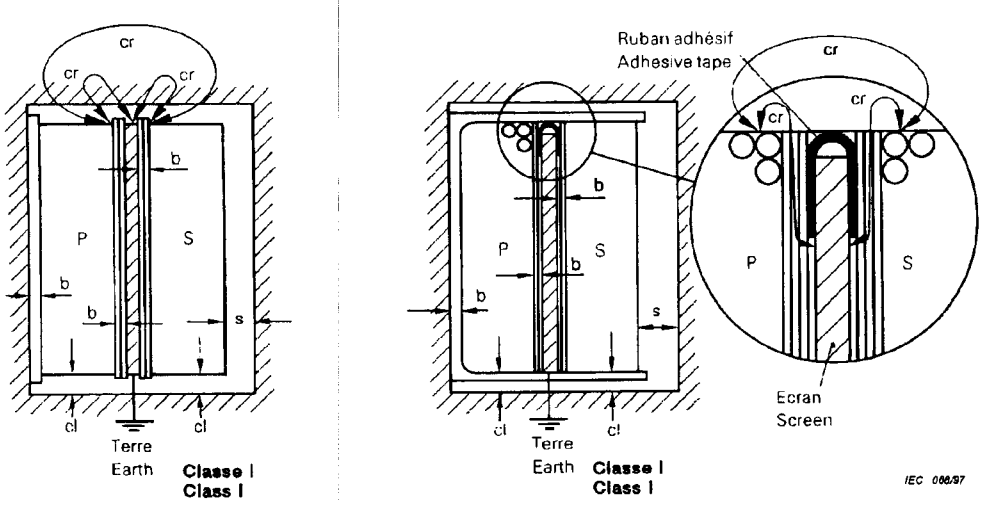


Primaire *et* secondaire enveloppés de matière isolante (pas de cr)
Input *and* output wrapped with insulating material (no cr)

Classe I (II)
Class I (II)

IEC 067/97

M.2.2 Avec écran
With screen



Pour construction de classe I

cr = **ligne de fuite**
cl = **distances d'isolement**
b = **isolation fondamentale**
s = **isolation supplémentaire**
r = **isolation renforcée ou isolation double**
P = primaire ou premier enroulement
S = secondaire ou second enroulement

Pour construction de classe II

les abréviations sont données entre parenthèse

For class I construction

cr = **creepage distance**
cl = **clearance**
b = **basic insulation**
s = **supplementary insulation**
r = **reinforced insulation or double insulation**
P = input or first winding
S = output or second winding

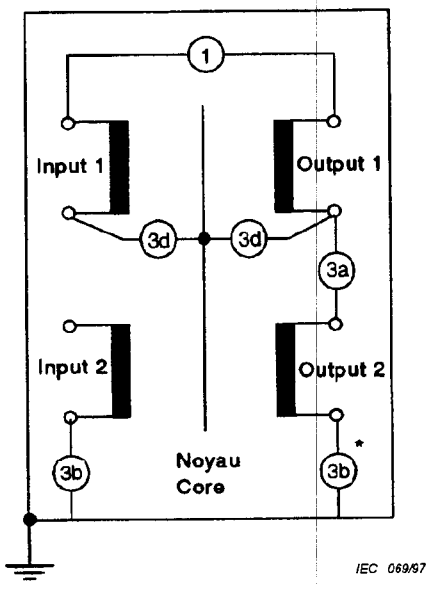
For class II construction

the abbreviations are given in brackets

Annexe N/Annex N
(informative)

Exemples de points d'application de tensions d'essai
Examples of points of application of test voltages

NOTE – Les chiffres entourés d'un cercle se réfèrent à certains points du tableau 8. D'autres modes de construction ou des dispositions différentes peuvent être utilisés



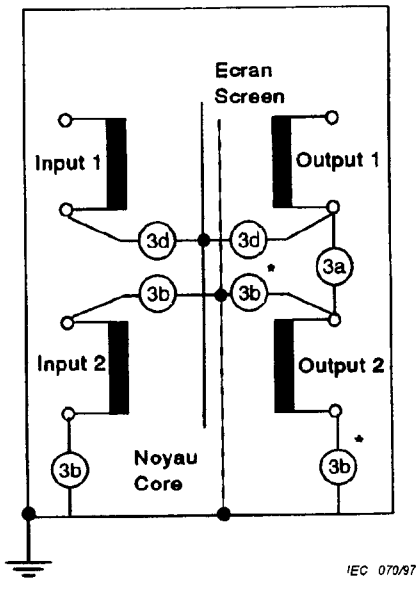
Exemple 1

Transformateur de classe I

Example 1

Transformer of class I construction

NOTE – Numbers in circles refer to certain items in table 8. Other methods of construction or layout may be used.

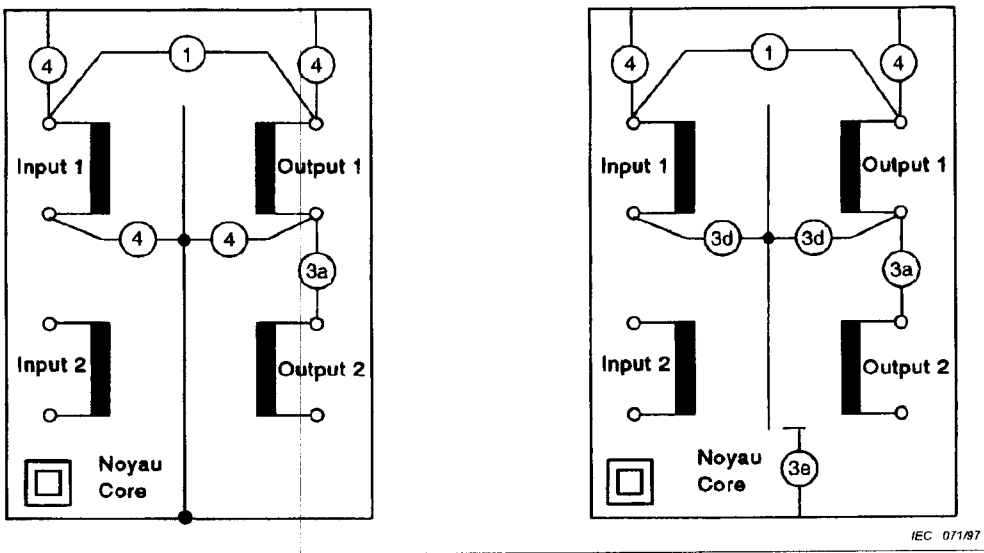


Exemple 2

Transformateur de classe I avec écran métallique mis à la terre

Example 2

Transformer of class I construction with earthed metal screen



Exemple 3

Example 3

a) Noyau relié à la masse

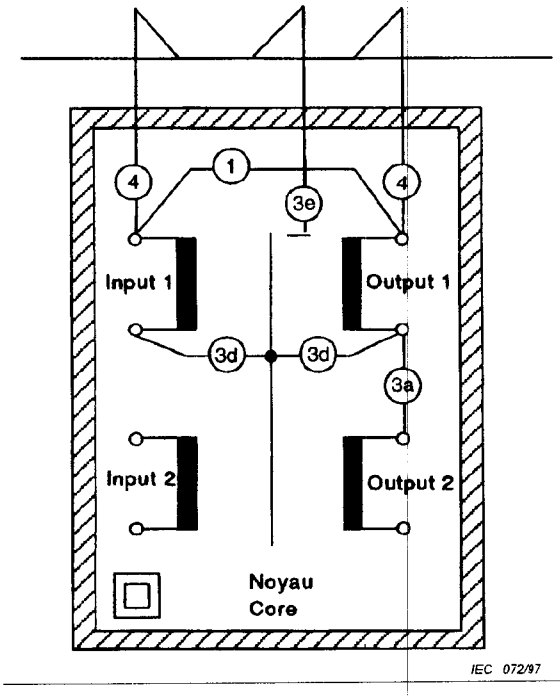
Core connected to the **body**

b) Noyau non relié à la **masse**

Core not connected to the **body**

Transformateur de classe II avec enveloppe métallique

Transformer of class II construction with metal **enclosure**



Feuille métallique
Metal foil

Exemple 4

Transformateur de classe II avec enveloppe isolante

Example 4

Transformer of class II construction with **enclosure** of insulating material

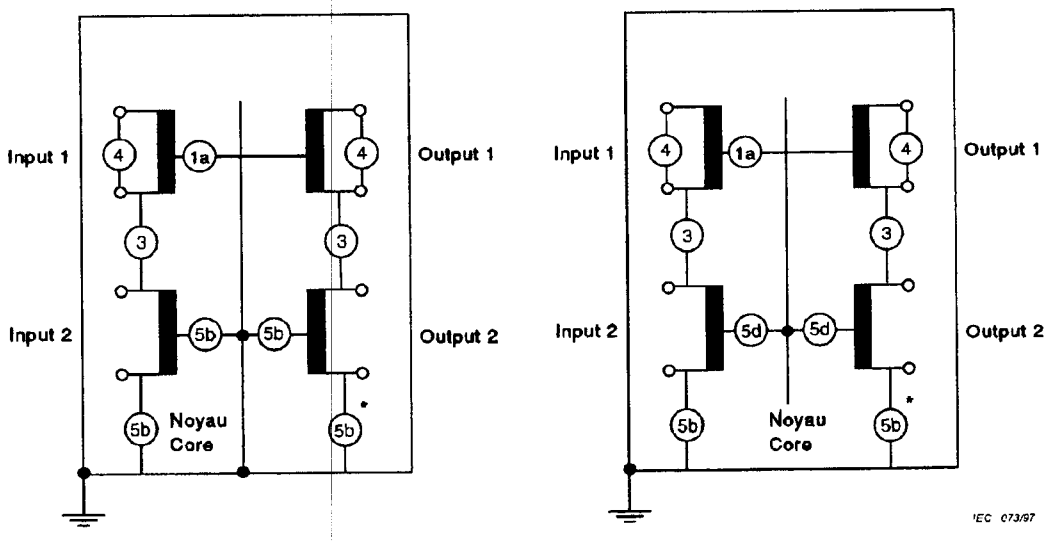
Annexe P/Annex P
(informative)

Exemples de points de mesure des lignes de fuite et des distances d'isolement

Examples of points of measurement of creepage distances and clearances

NOTE – Les chiffres entourés d'un cercle se réfèrent à certains points des tableaux 13, C.1 et D.1. D'autres modes de construction ou des dispositions différentes peuvent être utilisés.

NOTE – Numbers in circles refer to certain items in table 13, table C.1 and table D.1. Other methods of construction or layout may be used.



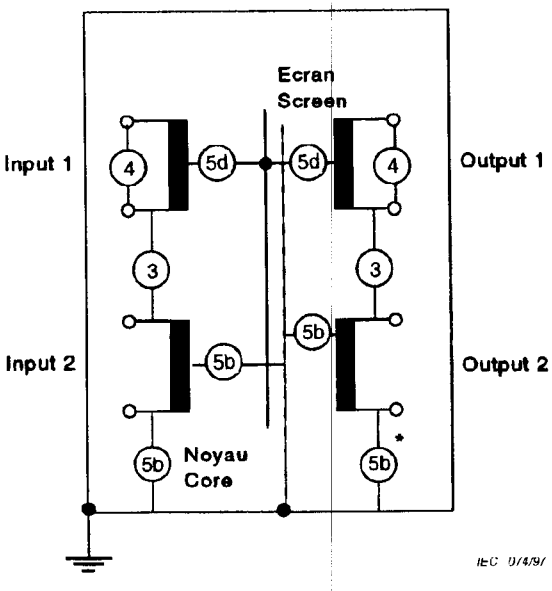
Exemple 1

Example 1

a) Noyau relié à la **masse**
Core connected to the **body**

b) Noyau non relié à la **masse**
Core not connected to the **body**

Transformateur de classe I
Transformer of class I construction

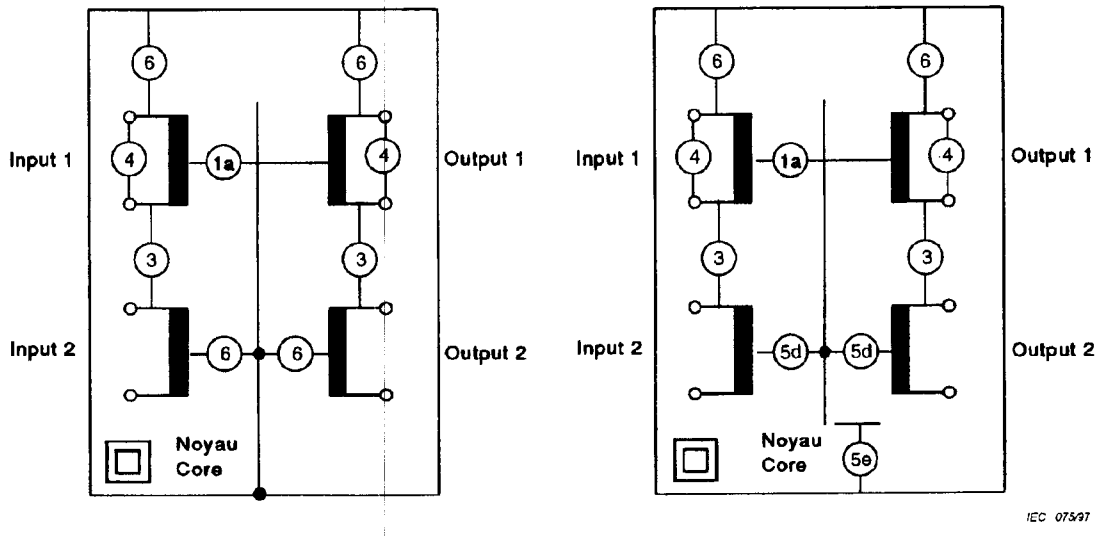


Exemple 2

Transformateur de classe I avec écran métallique mis à la terre

Example 2

Transformer of class I construction with earthed metal screen



Exemple 3

Example 3

a) Noyau relié à la masse

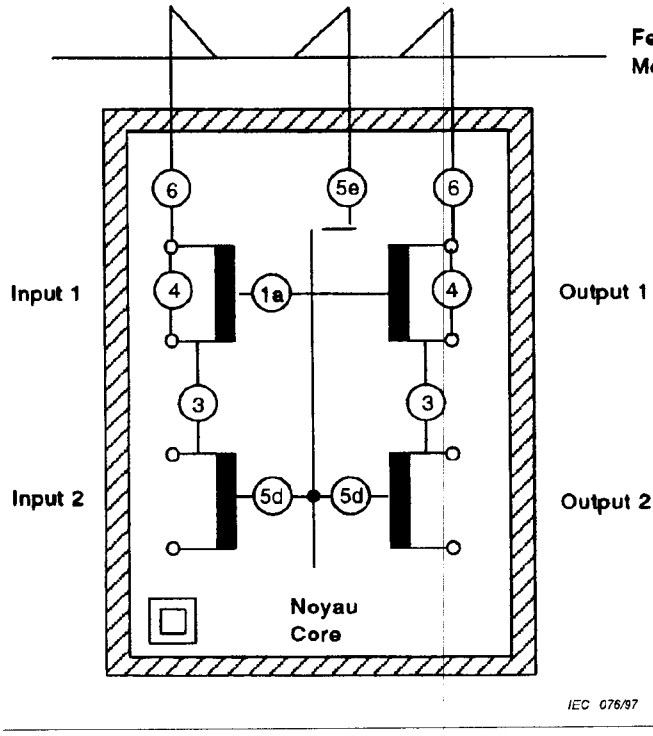
Core connected to the **body**

b) Noyau non relié à la **masse**

Core not connected to the **body**

Transformateur de classe II avec enveloppe métallique

Transformer of class II construction with metal **enclosure**



Exemple 4

Transformateur de classe II avec **enveloppe isolante**

Example 4

Transformer of class II construction with **enclosure** of insulating material

Annex Q
(informative)

Explanation of IP numbers for degrees of protection

For full details see IEC 60529 from which the following is an extract.

Q.1 The type of protection covered by this system of classification is as follows:

a) protection of persons against contacts with, or approach to, **live parts** and against contact with moving parts (other than smooth rotating shafts and the like) inside the **enclosure**;

b) protection of the equipment against ingress of solid foreign objects.

Q.2 Protection of the equipment inside the **enclosure** against harmful ingress of water.

The designation indicating the degrees of protection consists of the characteristics letters IP followed by two numerals (the "characteristic numerals") indicating conformity with the conditions stated in tables Q.1 and Q.2 respectively. The first numeral indicates the degree of protection described under item a) above and the second numeral the degree of protection described under item b) above.

Table Q.1 – Degrees of protection indicated by the first characteristic numeral

First characteristic numeral	Degree of protection	
	Short description	Brief details of objects which will be "excluded" from the enclosure
0	Non-protected	No special protection
1	Protected against solid objects greater than 50 mm	A large surface of the body, such as a hand (but no protection against deliberate access). Solid objects exceeding 50 mm in diameter
2	Protected against solid objects greater than 12,5 mm	Fingers or similar objects not exceeding 80 mm in length. Solid objects exceeding 12,5 mm in diameter
3	Protected against solid objects greater than 2,5 mm	**Tools**, wires, etc., of diameter or thickness greater than 2,5 mm. Solid objects exceeding 2,5 mm in diameter
4	Protected against solid objects greater than 1,0 mm	Wires or strips of thickness greater than 1,0 mm. Solid objects exceeding 1,0 mm in diameter
5	Dust-protected	Ingress of dust is not totally prevented but dust does not enter in sufficient quantity to interfere with satisfactory operation of the equipment
6	Dust-tight	No ingress of dust

Table Q.2 – Degrees of protection indicated by the second characteristic numeral

Second characteristic numeral	Degree of protection	
	Short description	**Details of the type of protection provided by the** enclosure
0	Non-protected	No special protection
1	Protected against dripping water	Dripping water (vertically falling drops) shall have no harmful effect
2	Protected against dripping water when **enclosure** tilted up to 15°	Vertically dripping water shall have no harmful effect when the **enclosure** is tilted at any angle up to 15° from its normal position
3	Protected against spraying water	Water falling as a spray at an angle up to 60° from the vertical shall have no harmful effect
4	Protected against splashing water	Water splashed against the **enclosure** from any direction shall have no harmful effect
5	Protected against water jets	Water projected by a nozzle against the **enclosure** from any direction shall have no harmful effect
6	Protected against powerful waterjet	Water projected in powerful jets shall not enter the **enclosure** in harmful quantities
7	Protected against the effects of temporary immersion in water	Ingress of water in a harmful quantity shall not be possible when the **enclosure** is temporarily immersed in water under defined conditions of pressure and time
8	Protected against the effects of continuous immersion in water	The equipment is suitable for continuous immersion in water under conditions which shall be specified by the manufacturer NOTE – Normally, this will mean that the equipment is hermetically sealed. However, with certain types of equipment it can mean that water can enter but only in such a manner that it produces no harmful effects.

Annex R
(informative)

Explanations of the application of 4.1.1.2.1 of IEC 60664-1

Under consideration.

Annex S
(informative)

Bibliography

IEC 60038:1983, *IEC standard voltages*

[C] NOTE - Harmonized as HD 472 S1:1989 (modified). [C]

IEC 60555:1982, *Disturbances in supply systems caused by household appliances and similar electrical equipment – Part 1: Definitions*

[C] NOTE - Harmonized as EN 60555-1:1987 (not modified). [C]

IEC 60584-1:1992, *Thermocouples – Part 1: Reference tables*

CISPR 11:1990, *Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment*

[C] NOTE – Harmonized as EN 55011:1991 (modified). [C]

CISPR 14:1993, *Limits and methods of measurement of electromagnetic disturbance characteristics of electrical motor-operated and thermal appliances for household and similar purposes, electric tools and electric apparatus*

[C] NOTE – Harmonized as EN 55014-1:1993 (not modified). [C]

Annex T
(informative)

Index of definitions

Annex U
(informative)

List of parts 2 (forthcoming publications)

IEC 61558-2-1, *Particular requirements for **separating transformers** for general use*

IEC 61558-2-2, *Particular requirements for control transformers*

IEC 61558-2-3, *Particular requirements for ignition transformers for gas and oil burners*

IEC 61558-2-4, *Particular requirements for **isolating transformers** for general use*

IEC 61558-2-5, *Particular requirements for shaver transformers and shaver supply units*

IEC 61558-2-6, *Particular requirements for **safety isolating transformers** for general use*

IEC 61558-2-7, *Particular requirements for transformers for toys*

IEC 61558-2-8, *Particular requirements for bells and chimes transformers*

IEC 61558-2-9, *Particular requirements for transformers for class III handlamps Incorporating tungsten filament lamps*

IEC 61558-2-10, *Particular requirements for high insulation level transformers with **working voltage** above 1 000 V*

IEC 61558-2-11, *Particular requirements for stray field transformers*

IEC 61558-2-12, *Particular requirements for stabilising transformers*

IEC 61558-2-13, *Particular requirements for auto transformers*

IEC 61558-2-14, *Particular requirements for variable transformers*

IEC 61558-2-15, *Particular requirements for **isolating transformers** for the supply of medical rooms*

IEC 61558-2-16, *Particular requirements for **power supply units** and similar*

IEC 61558-2-17, *Particular requirements for transformers for switch-mode power supplies*

IEC 61558-2-18, *Particular requirements for transformers for medical appliances*

IEC 61558-2-19, *Particular requirements for mains borne perturbation attenuator transformers with earthed mid-point*

IEC 61558-2-20, *Particular requirements for small reactors*

IEC 61558-2-21, *Particular requirements for transformers with special dielectric (liquid, SF_6)*

IEC 61558-2-22, *Particular requirements for transformers with rated maximum temperature for luminaires*

IEC 61558-2-23, *Particular requirements for transformers for construction sites*

A1 Annex V
(informative)

Symbols to be used for thermal cut-outs

V.1 Introduction

The purpose of this annex is to give information to the equipment manufacturer and the end user on the way to proceed for resetting the transformer after operation of the thermal cut-out.

When the symbols are used, they are intended for information. In the future, when they are known and recognized, the intention is to make them mandatory.

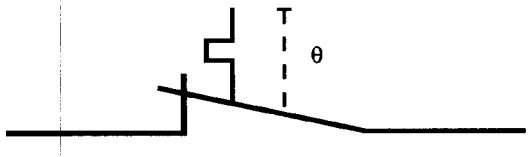
V.2 The symbols, when used, are placed on the transformer. They apply to both independent and associated transformers.

The following drawings are to be used.

NOTE – θ is the symbol used to show that the device is operated by temperature.

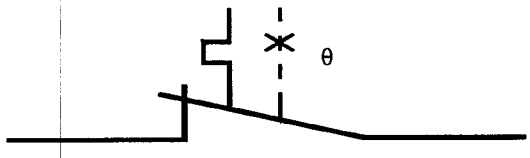
V.2.1 Non-self-resetting thermal cut-out (see 3.3.4)

V.2.1.1 Restored by manual operation



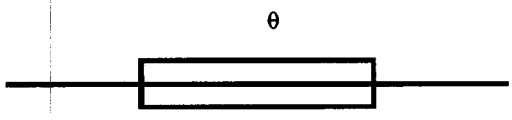
IEC 489/98

V.2.1.2 Restored by disconnection of the supply



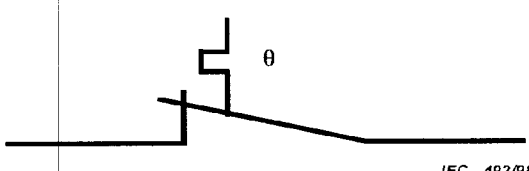
IEC 490/98

V.2.1.3 Thermal link (see 3.3.5)



IEC 491/98

V.2.2 Self-resetting thermal cut-out (see 3.3.3)



IEC 492/98

A1

Annex ZA (normative)

Special national conditions

Special national condition: National characteristic or practice that cannot be changed even over a long period, e.g. climatic conditions, electrical earthing conditions. If it affects harmonization, it forms part of the European Standard or Harmonization Document.

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

Clause	Special national condition
8.7	**Denmark**

Supply cords of class I transformers which are supplied without a plug, shall be provided with a visible tag containing the following text:

Vigtigt!
Lederen med grøn / gul isolation
må kun tilsluttes en klemme mærket
⏚ eller ⏚

(Important! The conductor having green/yellow insulation shall only be connected to a terminal marked ⏚ or ⏚ .)

If it is essential for the safety of the transformer, the tag shall be provided either with a wiring diagram showing the connection of the other conductors or with the following text:

For tilslutning af de øvrige ledere,
se medfølgende installationsvejledning.

(For the connection of the other conductors, see the enclosed instructions for installation.)

France (Décret n° 66.660 du 8 septembre 1966 en application de la loi n° 60.1375 du 21 décembre 1960)

The general French regulations prescribe that transformers having a rated supply voltage of 127 V require also the value 220 V.

22.8 **Denmark** (Danish Heavy Current Regulation, section 107-2-D1)

Replace the second paragraph by the following:

Supply cords of single-phase transformers having a rated current not exceeding 10 A shall be provided with a plug according to the following:

- Stationary class 1 transformers having a protection index IP 20
  Section 107-2-D1
  Standard Sheet DK 2-1a
  or
  IEC 83, Standard Sheet C 2b, C 3b or C 4

- Stationary class 1 transformers having a protection index higher than IP 20 and portable class I transformers with a rated input exceeding 630 V
  Section 107-2-D1,
  Standard Sheet DK 2-1a

- Class II transformers
  IEC 83,
  Standard Sheet C5 or C8

If multi-phase transformers and single-phase transformers having a rated current exceeding 10 A are provided with a supply cord and a plug, the plug shall comply with the following table:

Class	Plug**	
	Section 107-2-D1 Standard sheet	EN 60309-2 Standard sheet
I	DK 6-1a	2-II, 2-IV
II	DK 6-1a*	2-II, 2-IV*

* Earthing contact not connected.
** These plugs are also allowed for transformers having a rated current equal to or less than 10 A.

Sweden

Power supply flexible cables and cords of single-phase transformers having an input current at rated output not exceeding 16 A, shall be provided with a plug complying with CEE Publication 7, Standard sheets to be applied as follows:

Class I transformers Standard sheet IV, VI or VII;
Class II transformers Standard sheet XVI or XVIII.

Annex ZB (normative)

Normative references to international publications with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE: When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 50(421)	1990	International electrotechnical vocabulary Chapter 421: Power transformers and reactors	-	-
IEC 60051	series	Direct acting indicating analogue electrical-measuring instruments and their accessories	EN 60051	series
IEC 60065 (mod)	1985	Safety requirements for mains operated electronic and related apparatus for household and similar general use	EN 60065[1] + corr. November	1993 1993
IEC 60068-2-2	1974	Basic environmental testing procedures Part 2: Tests - Test B: Dry heat	EN 60068-2-2[2]	1993
IEC 60068-2-6	1982	Test Fc and guidance: Vibration (Sinusoidal)	HD 323.2.6 S2[3]	1988
IEC 60068-2-32	1975	Test Ed: Free fall	EN 60068-2-32[4]	1993
IEC 60068-2-63	1991	Part 2: Test methods - Test Eg: Impact, spring hammer	EN 60068-2-63	1994
IEC 60076-1 (mod)	1993	Power transformers Part 1: General	EN 60076-1	1997
IEC 60083	1975	Plugs and socket-outlets for domestic and similar general use - Standards	-	-
IEC 60085	1984	Thermal evaluation and classification of electrical insulation	HD 566 S1	1990

1) EN 60065 includes A1:1987 + A2:1989 + A3:1992 to IEC 60065.

2) EN 60068-2-2 includes supplement A:1976 to IEC 60068-2-2.

3) HD 323.2.6 S2 is superseded by EN 60068-2-6:1995, which is based on IEC 60068-2-6:1995.

4) EN 60068-2-32 includes A2:1990 to IEC 60068-2-32:1975.

Publication	Year	Title	EN/HD	Year
IEC 60112	1979	Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions	HD 214 S2	1980
IEC 60127	series	Miniature fuses	EN 60127	series
IEC 60216	series	Guide for the determination of thermal endurance properties of electrical insulating materials	HD 611 EN 60216	series series
IEC 60227 (mod)	series	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V	HD 21	series
IEC 60245 (mod)	series	Rubber insulated cables - Rated voltages up to and including 450/750 V	HD 22	series
IEC 60269-2	1986	Low-voltage fuses Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application)	EN 60269-2	1995
IEC 60269-2-1 (mod)	1987	Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) Sections I to III	HD 630.2.1 S1[5]	1996
IEC 60269-3	1987	Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household and similar applications)	EN 60269-3	1995
IEC 60269-3-1 (mod)	1994	Part 3-1: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household and similar applications) -- Sections I to IV	HD 630.3.1 S2[6]	1997
IEC 60309 (mod)	series	Plugs, socket-outlets and couplers for industrial purposes	EN 60309	series
IEC 60317	series	Specifications for particular types of winding wires	EN 60317	series
IEC 60320 (mod)	series	Appliance couplers for household and similar general purposes	EN 60320	series
IEC 60364-4-41 (mod)	1992	Electrical installations of buildings Part 4: Protection for safety Chapter 41: Protection against electric shock	HD 384.4.41 S2	1996

5) HD 630.2.1 S1 is superseded by HD 630.2.1 S2:1997, which is based on IEC 60269-2-1:1996, mod.
6) HD 630.3.1 S2 includes A1:1995 to IEC 60269-3-1.

Publication	Year	Title	EN/HD	Year
IEC 60364-5-51 (mod)	1994	Part 5: Selection and erection of electrical equipment -- Chapter 51: Common rules	HD 384.5.51 S2	1996
IEC 60384-14	1993	Fixed capacitors for use in electronic equipment - Part 14: Sectional specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains	-	-
IEC 60417	1973	Graphical symbols for use on equipment Index, survey and compilation of the single sheets	HD 243 S12[7]	1995
IEC 60449	1973	Voltage bands for electrical installations of buildings	HD 193 S2[8]	1982
IEC 60454	series	Pressure-sensitive adhesive tapes for electrical purposes	EN 60454	series
IEC 60529	1989	Degrees of protection provided by enclosures (IP Code)	EN 60529 + corr. May	1991 1993
IEC 60536	1976	Classification of electrical and electronic equipment with regard to protection against electric shock	HD 366 S1	1977
IEC 60536-2	1992	Part 2: Guidelines to requirements for protection against electric shock	-	-
IEC 60664-1 (mod)	1992	Insulation coordination for equipment within low-voltage systems Part 1: Principles, requirements and tests	HD 625.1 S1 + corr. November	1996 1996
IEC 60664-3	1992	Part 3: Use of coatings to achieve insulation coordination of printed board assemblies	HD 625.3 S1	1997
IEC 60691	1993	Thermal-links - Requirements and application guide	EN 60691[9]	1995
IEC 60695-2-1/0	1994	Fire hazard testing Part 2: Test methods Section 1/sheet 0: Glow-wire test methods General	EN 60695-2-1/0	1996
IEC 60695-2-1/1	1994	Section 1/sheet 1: Glow-wire end-product test and guidance	EN 60695-2-1/1[10]	1996

7) HD 243 S12 includes supplements A:1974 to M:1994 to IEC 60417.

8) HD 193 S2 includes A1:1979 to IEC 60449.

9) EN 60691 includes A1:1995 to IEC 60691.

10) EN 60695-2-1/1 includes corrigendum May 1995.

Publication	Year	Title	EN/HD	Year
IEC 60707	1981	Methods of test for the determination of the flammability of solid electrical insulating materials when exposed to an igniting source	HD 441 S1	1983
IEC 60730-1 (mod)	1993	Automatic electrical controls for household and similar use Part 1: General requirements	EN 60730-1 + corr. April + A11 + A12	1995 1997 1996 1996
IEC 60738-1	1982	Directly heated positive step-function temperature coefficient thermistors Part 1: Generic specification	-	-
IEC 60851	series	Methods of test for winding wires	HD 490 EN 60851	series series
IEC 60884-1	1994	Plugs and socket-outlets for household and similar purposes Part 1: General requirements	-	-
IEC 60884-2-4	1993	Part 2: Particular requirements for plugs and socket-outlets for SELV	-	-
IEC 60898	1995[11]	Electrical accessories - Circuit-breakers for overcurrent protection for household and similar installations	-	-
IEC 60906-1	1986	IEC System of plugs and socket-outlets for household and similar purposes Part 1: Plugs and socket-outlets 16 A 250 V a.c.	-	-
IEC 60906-3	1994	Part 3: SELV plugs and socket-outlets, 16 A 6 V, 12 V, 24 V, 48 V, a.c. and d.c.	-	-
IEC 60947-7-1	1989	Low-voltage switchgear and controlgear Part 7: Ancillary equipment Section 1: Terminal blocks for copper conductors	EN 60947-7-1 + corr. June + A11	1991 1997 1997
IEC 60990	1990	Methods of measurement of touch-current and protective conductor current	-	-
IEC 60998-1 (mod)	1990	Connecting devices for low-voltage circuits for household and similar purposes Part 1: General requirements	EN 60998-1	1993

11) IEC 60898:1987 + corrigendum May 1988 + A2:1990 + A3:1990 + corrigendum August 1990, modified are harmonized as EN 60898:1991. This European Standard applies with its corrigendum October 1991 and its amendments A1:1991 (IEC 60898:1987/A1:1989) and A11:1994 up to A16:1996.

Publication	Year	Title	EN/HD	Year
IEC 60998-2-1 (mod)	1990	Part 2-1: Particular requirements for connecting devices as separate entities with screw-type clamping units	EN 60998-2-1	1993
IEC 60998-2-2	1991	Part 2-2: Particular requirements for connecting devices as separate entities with screwless-type clamping units	EN 60998-2-2	1993
IEC 60999-1 (mod)	1990	Connecting devices - Safety requirements for screw-type and screwless-type clamping units for electrical copper conductors Part 1: General requirements and particular requirements for conductors from 0,5 mm² up to 35 mm² (included)	EN 60999-1 + corr. March	1993 1997
IEC 61000-3-2	1995	Electromagnetic compatibility (EMC) Part 3: Limits -- Section 2: Limits for harmonic current emissions (equipment input current up to and including 16 A per phase)	EN 61000-3-2 + corr. July + A13	1995 1997 1997
IEC 61000-3-3	1994	Section 3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current up to and including 16 A	EN 61000-3-3 + corr. July	1995 1997
IEC 61032	1990	Test probes to verify protection by enclosures	HD 601 S1	1991
IEC 61058-1	1990	Switches for appliances Part 1: General requirements	EN 61058-1	1992
IEC 61140	1992	Protection against electric shock - Common aspects for installation and equipment	-	-
ISO 3	1973	Preferred numbers - Series of preferred numbers	-	-
ISO 4046	1978	Paper, board, pulp and related terms Vocabulary	-	-
ISO 8820	series	Road vehicles - Blade-type electric fuse-links	-	-

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