BS EN 61558-2-23:2010

BSI Standards Publication

Safety of transformers, reactors, power supply units and combinations thereof

Part 2-23: Particular requirements and tests for transformers and power supply units for construction sites

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National foreword

This British Standard is the UK implementation of EN 61558-2-23:2010. It is identical to IEC 61558-2-23:2010. It supersedes BS EN 61558-2-23:2001 which will be withdrawn on 1 October 2013.

The UK participation in its preparation was entrusted to Technical Committee PEL/96, Small transformers.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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English version

Safety of transformers, reactors, power supply units and combinations thereof - Part 2-23: Particular requirements and tests for transformers and power supply units for construction sites

(IEC 61558-2-23:2010)

Sécurité des transformateurs, bobines d'inductance, blocs d'alimentation et des combinaisons de ces éléments - Partie 2-23: Règles particulières et essais pour les transformateurs et les blocs d'alimentation pour chantiers
(CEI 61558-2-23:2010)

Sicherheit von Transformatoren, Drosseln, Netzgeräten und entsprechenden Kombinationen - Teil 2-23: Besondere Anforderungen und Prüfungen für Transformatoren und Netzgeräte für Baustellen
(IEC 61558-2-23:2010)

This European Standard was approved by CENELEC on 2010-10-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Management Centre: Avenue Marnix 17, B - 1000 Brussels

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Foreword

The text of document 96/359/FDIS, future edition 2 of IEC 61558-2-23, prepared by IEC TC 96, Transformers, reactors, power supply units and similar products for low voltage up to 1 100 V, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61558-2-23 on 2010-10-01.

This European Standard supersedes EN 61558-2-23:2000.

The main changes consist of updating this Part 2-23 in accordance with EN 61558-1:2005.

This part is intended to be used in conjunction with the latest edition of EN 61558-1 and its amendments. It is based on EN 61558-1:2005.

This part supplements or modifies the corresponding clauses in EN 61558-1, so as to convert that publication into the standard: *Particular requirements and tests for transformers and power supply units for construction sites.*

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

Where a particular subclause of Part 1 is not mentioned in this part, that subclause applies as far as is reasonable. Where this part states "addition", "modification" or "replacement", the relevant text of Part 1 is to be adapted accordingly.

In this part, the following print types are used:

– requirements proper: in roman type;

– *test specifications: in italic type*;

– explanatory matter: in smaller roman type.

In the text of this part, the words in **bold** are defined in Clause 3.

Subclauses, notes, figures and tables additional to those in Part 1 are numbered starting from 101; supplementary annexes are entitled AA, BB, etc.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2011-07-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2013-10-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61558-2-23:2010 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60364-7-704:2005	NOTE	Harmonized as EN 60364-7-704:2007 (modified).
IEC 61558-2-16:2009	NOTE	Harmonized as EN 61558-2-16:2009 (not modified).

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

Annex ZA of Part 1 is applicable except as follows:

Addition:

Publication	Year	Title	EN/HD	Year
IEC 60068-2-27	-	Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock	EN 60068-2-27	-
IEC 60439-4	-	Low-voltage switchgear and controlgear assemblies - Part 4: Particular requirements for assemblies for construction sites (ACS)	EN 60439-4	-
IEC 61558-1	2005	Safety of power transformers, power supplies, reactors and similar products - Part 1: General requirements and tests	EN 61558-1 + corr. August	2005 2006

CONTENTS

SAFETY OF TRANSFORMERS, REACTORS, POWER SUPPLY UNITS AND COMBINATIONS THEREOF –

Part 2-23: Particular requirements and tests for transformers and power supply units for construction sites

1 Scope

Replacement:

This part of IEC 61558 deals with the safety of **transformers for construction sites** and **power supply units** incorporating **transformers for construction sites**. **Transformers** incorporating **electronic circuits** are also covered by this standard.

NOTE 1 Safety includes electrical, thermal and mechanical aspects.

Unless otherwise specified, from here onward, the term **transformer** covers **transformers for construction sites** and **power supply units** incorporating **transformers for construction sites.**

This part is applicable to **stationary** or **portable**, single-phase or polyphase, air-cooled (natural or forced) **independent** or **associated transformers, being isolating** or **safety isolating dry-type transformers** for the use on **construction sites.** The windings may be encapsulated or non-encapsulated.

The **rated supply voltage** does not exceed 1 000 V a.c., and the **rated supply frequency** and the **internal operating frequencies** do not exceed 500 Hz.

This standard used in combination with Part 2-16 for **Switch mode power supply units** (**SMPS**) is also applicable to **power supplies** with **internal operating frequencies** higher than 500 Hz. Where the two requirements are in conflict the most severe take precedence

The **rated output** does not exceed:

– 25 kVA for single-phase **transformers;**
– 40 kVA for poly-phase **transformers.**

This part is applicable to **transformers** without limitation of the **rated output** subject to an agreement between the purchaser and the manufacturer.

NOTE 2 **Transformers** intended to supply distribution networks are not included in the scope.

Isolating transformers and **power supply units** incorporating **isolating transformers for construction sites** have a **no-load output voltage** and a **rated output voltage** exceeding 50 V a.c. and not exceeding 250 V a.c.

Safety isolating transformers and **power supply units** incorporating **safety isolating transformers for construction sites** have a **no-load output voltage** and a **rated output voltage** not exceeding 50 V a.c.

NOTE 3 This standard is applicable to **transformers** for the supply of electricity in locations as specified in IEC 60364-7-704. The latter also specifies the protection by using an earthed midpoint or starpoint of the **output winding**.

Transformers and **power supply units** covered by this part are used in applications where it is required by the installation rules or by the appliance specification for protection purposes.

When the **transformers** or **power supply units** are incorporated into **low voltage switchgear and controlgear assemblies for construction sites** as specified in IEC 60439-4, the additional requirements of IEC 60439-4 will apply to the assembly.

NOTE 4 For **transformers** filled with liquid dielectric or pulverised material, such as sand, additional requirements are under consideration.

NOTE 5 Attention is drawn to the following:

- measures to protect the **enclosure** and the components inside the **enclosure** against external influences like fungus, vermin, termites, solar-radiation and icing should also be considered;
- the different conditions for transportation, storage, and operation of the **transformers** and **power supply units** should also be considered;
- additional requirements in accordance with other appropriate standards and national rules may be applicable to **transformers** and **power supply units** intended for use in special environments such as tropical environment.

NOTE 6 Future technological development of **transformers** may necessitate a need to increase the upper limit of the frequencies, until then this standard may be used as a guidance document.

2 Normative references

This clause of Part 1 is applicable except as follows:

Addition:

IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60439-4, *Low-voltage switchgear and controlgear assemblies – Part 4: Particular requirements for assemblies for construction sites (ACS)*

IEC 61558-1:2005, *Safety of power transformers, power supplies, reactors and similar products – Part 1: General requirements and tests*

3 Terms and definitions

This clause of Part 1 is applicable except as follows:

Addition:

3.101
low voltage switchgear and controlgear assembly for construction sites (ACS)
combination of one or several transforming or switching devices with associated control, measuring, signalling, protective and regulating equipment complete with all their internal electrical and mechanical connections and structural parts, designed and built for use on all construction sites, indoors or outdoors.

4 General requirements

This clause of Part 1 is applicable.

5 General notes on tests

This clause of Part 1 is applicable.

6 Ratings

This clause of part 1 is applicable except as follows:

Addition:

6.101 The **rated output voltage** shall not exceed:

- 250 V a.c. for **isolating transformers** with a non-earthed mid-point (single-phase) or a non-earthed star-point (three-phase) or delta connection (three-phase) and for **power supply units** incorporating such **transformers**;
- 110 V a.c. for **isolating transformers** with a mid-point (single-phase) earthed in the construction or a star-point (three-phase) earthed in the construction and for **power supply units** incorporating such **transformers**;
- 50 V a.c. for **safety isolating transformers** and for **power supply units** incorporating **safety isolating transformers**.

The **rated output voltage** shall exceed:

- 50 V a.c. for **isolating transformers** and for **power supply units** incorporating **isolating transformers**.

Preferred values for the **rated output voltage** are

- 110 V and 230 V for **portable**, single-phase **isolating transformers**;
- 72 V, 110 V and 230 V for other **isolating transformers**;
- 6 V, 12 V, 24 V, 42 V and 48 V for **safety isolating transformers**.

6.102 The **rated output** shall not exceed:

- 25 kVA for single-phase **isolating** and **safety isolating transformers** and **power supply units** incorporating such **transformers**;
- 40 kVA for polyphase **isolating** and **safety isolating transformers** and **power supply units** incorporating such **transformers**;

Preferred values for the **rated output** are

- 25 VA, 40 VA, 63 VA, 100 VA, 160 VA, 250 VA, 400 VA, 630 VA, 1 000 VA, 1 600 VA,
- 2 500 VA, 4 000 VA, 6 300 VA, 10 kVA, 16 kVA and 25 kVA for single-phase **transformers**;
- 630 VA, 1 000 VA, 1 600 VA, 2 500 VA, 4 000 VA, 6 300 VA, 10 kVA, 16 kVA, 25 kVA and 40 kVA for poly-phase **transformers**.

Intermittent duty cycle may be assigned only to **portable transformers** and **power supply units** having a **rated output** not exceeding 6,3 kVA.

6.103 The **rated supply frequency** shall not exceed 500 Hz.

6.104 The **rated supply voltage** shall not exceed 1 000 V a.c.

6.105 **Transformers** with **intermittent duty cycle** shall be intended for a **rated** operating time of 5 min "on" and a resting time of 15 min "off".

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6.106 The supply current is limited to a maximum of 125 A, and in the case of flexible cable or socket outlet, to 63 A.

Compliance with 6.101 to 6.106 is checked by inspection of the marking.

7 Classification

This clause of Part 1 is applicable except as follows:

7.5 *Replacement:*

According to their **duty type**:

- **continuous duty;**
- **intermittent duty cycle.**

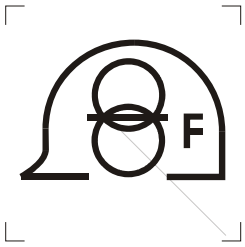
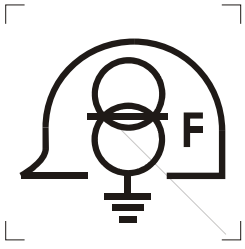
8 Marking and other information

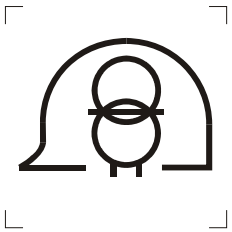
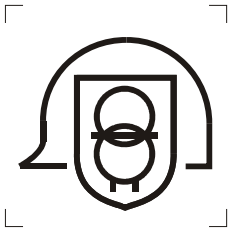
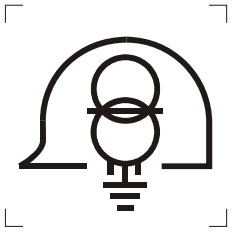
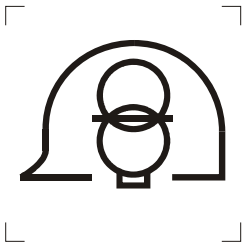
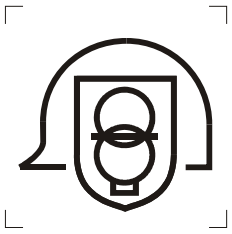
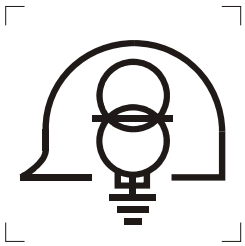
This clause of Part 1 is applicable except as follows:

8.1 h) *Replacement:*

The **transformers** shall be marked with one of the graphical symbols shown in 8.11;

8.11 *Addition:*

Symbol or graphical symbol	Explanation or title	Identification
	Isolating transformer for construction site, fail-safe	IEC 60417-6010-1
	Isolating transformer for construction site, fail- safe, safety	IEC 60417-6010-2
	Isolating transformer for construction site, fail-safe, mid-point or star-point earthed	IEC 60417-6010-3

Symbol or graphical symbol	Explanation or title	Identification
	Isolating transformer for construction sites, non-short-circuit proof	IEC 60417-6010-4
	Isolating transformer for construction sites, non-short-circuit proof, safety	IEC 60417-6010-5
	Isolating transformer for construction sites, non-short-circuit proof, mid-point or star-point earthed	IEC 60417-6010-6
	Isolating transformer for construction sites, short-circuit proof	IEC 60417-6010-7
	Isolating transformer for construction sites, short-circuit proof, safety	IEC 60417-6010-8
	Isolating transformer for construction sites, short-circuit proof, mid-point or star-point earthed	IEC 60417-6010-9

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9 Protection against electric shock

This clause of Part 1 is applicable.

10 Change of input voltage setting

This clause of Part 1 is applicable.

11 Output voltage and output current under load

This clause of Part 1 is applicable.

12 No-load output voltage

This clause of Part 1 is applicable except as follows:

Addition:

12.101 The **no-load output voltage** shall not exceed:

- 250 V a.c. for **isolating transformers** with a non-earthed mid-point (single-phase) or a non-earthed star-point (three-phase) or delta connection (three-phase) and for **power supply units** incorporating such **transformers**;
- 116 V a.c. for **isolating transformers** with a mid-point (single-phase) earthed in the construction or a star-point (three-phase) earthed in the construction and for **power supply units** incorporating such **transformers**;
- 50 V a.c. for **safety isolating transformers** and for **power supply units** incorporating **safety isolating transformers.**

  For **independent transformers**, the **no-load output voltage** limitation applies even when **output windings**, not intended for interconnection, are connected in series.

The **no-load output voltage** shall exceed:

- 50 V a.c. for **isolating transformers** and **power supply units** incorporating **isolating transformers**.

12.102 The difference between the **no-load output voltage** and the **output voltage** under load shall not be excessive.

*Compliance with the requirements of 12.101 and 12.102 is checked by measuring the **no-load output voltage** at the **ambient temperature** when the **transformer** is connected to the **rated supply voltage** at the **rated supply frequency**.*

*The difference between the **no-load output voltage** measured in this clause and the **output voltage** under load measured during the test of Clause 11, expressed as a percentage of the latter voltage, shall not exceed the values shown in Table 101 or Table 102.*

NOTE The ratio is defined as follows: $\frac{U_{\text{no-load}} - U_{\text{load}}}{U_{\text{load}}} \times 100\ \%$

Table 101 – Ratio of output voltages for safety isolating transformers

Type of transformer Rated output VA	Ratio between no-load output voltage and output voltage under load %
Inherently short-circuit proof transformers:	
-up to and including 63	100
-over 63 up to and including 630	50
-over 630	20
Other transformers:	
-up to and including 10	100
-over 10 up to and including 25	50
-over 25 up to and including 63	20
-over 63 up to and including 250	15
-over 250 up to and including 630	10
-over 630	5

Table 102 – Ratio of output voltages for isolating transformers

Rated output VA	Ratio between no-load output voltage and output voltage under load %
All type of transformers:	
-up to and including 63	20
-over 63 up to and including 250	15
-over 250 up to and including 630	10
-over 630	5

For single phase **transformers** with earthed midpoint, the voltage between any pole of the **output circuit** and earth shall not exceed the $\left(\frac{\text{no - load output voltage}}{2}\right)$ ± 2,5 %.

For three phase **transformers** with earthed star-point, the voltage between any pole of the **output circuit** and earth shall not exceed the $\left(\frac{\text{no - load output voltage}}{\sqrt{3}}\right)$ ± 2,5 %.

13 Short-circuit voltage

This clause of Part 1 is applicable.

14 Heating

This clause of Part 1 is applicable.

15 Short-circuit and overload protection

This clause of Part 1 is applicable.

16 Mechanical strength

This clause of Part 1 is applicable except as follows:

16.1 *Replacement:*

Transformers and **power supply units for construction sites** shall have adequate mechanical strength, and be so constructed as to withstand such rough handling and transport as may be expected in normal use.

*Compliance is checked by the tests of 16.2 for **stationary transformers** and **power supply units** and by the tests of 16.2, 16.3 and 16.4 as appropriate, for **portable transformers** and **portable power supply units.***

*After the tests, the **transformers** or **power supply units** shall show no damage within the meaning of this standard. In particular, **hazardous live parts** shall not become accessible, when tested as described in 9.2. Insulating barriers shall not be damaged and handles, levers, knobs and the like shall not move on their shafts.*

NOTE 1 Damage to the finish, small dents which do not reduce **creepage distances** or **clearances** below the values specified in Clause 26, and small chips which do not adversely affect the protection against electric shock or moisture, are ignored.

NOTE 2 Cracks not visible with normal vision or corrected vision without magnification and surface cracks in fibre reinforced mouldings and the like are ignored.

In addition, with respect to the test of 16.4, bending of the pins during the test is considered acceptable.

16.2 *Replacement:*

16.2 Impact test and shock test

16.2.1 Impact test

NOTE This test simulates collisions between the **transformer** or **power supply unit** and mechanical handling equipment for construction site.

*The complete **transformer** or **power supply unit**, as applicable, shall be subjected to a series of impacts of 6 J applied to the **enclosure** as follows:*

*The equipment to be tested shall be fixed on a support of adequate rigidity to restrict movement of the **transformers** or **power supply units** to 0,1 mm under the effect of the prescribed impact. Three successive impacts shall be applied to the most unfavourable point of the **enclosure** by means of either:*

*a) a solid smooth steel sphere approximately 50 mm in diameter and with a mass of 500 g ± 25 g, falling freely from a rest position from a vertical height of 1,2 m onto the **enclosure** surface held in a horizontal plane. The hardness of the sphere shall be not less than 50 HR and not more than 58 HR (see Figure 101); or*

b) a similar steel sphere, which shall be suspended by a cord and swung as a pendulum in order to apply a horizontal impact, falling through a vertical distance of 1,2 m (see Figure 102).

*Sloping surfaces may be tested using the pendulum but if this is not convenient the surface will be aligned in the horizontal plane by turning the **transformers** or the **power supply units**, as applicable, on the support and the test a) is used. Before each test, an inspection of the sphere shall be made to ensure that it is free of burrs and defects.*

*The test shall be so arranged that the impacts are applied at positions where the weaknesses are most likely to be revealed. A minimum of 18 impacts shall be applied to the **transformers** or **power supply units**, as applicable.*

The test is not applicable to components such as socket-outlets, operating handles, illuminating lights, push buttons, actuators, etc., when these components are mounted in recesses with respect to the main surfaces, so that the distance between the most exposed parts of these components and the said surfaces is at least 10 mm.

*After the test, the **enclosure** shall continue to provide the degrees of protection specified in 19.16; any distortions or deformations of the **enclosure** and components shall neither be detrimental to the proper functioning of the **transformer**, nor decrease **creepage distances** and **clearances** to below the required values; actuators, handles, etc. shall still be operable.*

Superficial damage, removed paint, broken cooling ribs or similar parts, small indentations, cracks not visible with normal or corrected vision without further magnification, or surface cracks shall not constitute test failures.

16.2.2 Shock test

NOTE This test simulates the shocks received by **transformers** and **power supply units** carried loose on board vehicles on normal roads or on railway cars for long periods of time.

*The complete **transformers** or **power supply units**, as applicable, in working order shall be tested according to IEC 60068-2-27 with a severity of 500 m/s^2 peak acceleration and duration of 11 ms.*

*After the test, the **enclosure** shall continue to provide the degrees of protection specified in 19.16; any distortions or deformations of the **enclosure** and components shall neither be detrimental to the proper functioning of the **transformer**, nor decrease **creepage distances** and **clearances** to below the required values; actuators, handles, etc. shall still be operable.*

Superficial damage, removed paint, broken cooling ribs or similar parts, small indentations, cracks not visible with normal or corrected vision without further magnification, or surface cracks shall not constitute test failures.

17 Protection against harmful ingress of dust, solid objects and moisture

This clause of Part 1 is applicable.

18 Insulation resistance, dielectric strength and leakage current

This clause of Part 1 is applicable.

19 Construction

This clause of Part 1 is applicable except as follows:

Replace 19.1 of Part 1 by the following:

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19.1 The **input** and **output circuits** shall be electrically separated from each other, and the construction shall be such that there is no possibility of any connection between these circuits, either directly or indirectly, via other **conductive parts**, except by deliberate action.

Compliance is checked by inspection and measurements, taking Clauses 18 and 26 into consideration.

19.1.1 The insulation between **input** and **output winding(s)** shall consist of **double** or **reinforced insulation** (rated for the **working voltage**).

In addition, the following applies:

– for **class I transformers** not intended for connection to the mains supply by means of a plug, the insulation between the **input windings** and the **body** connected to earth shall consist of at least **basic insulation** rated for the **input voltage**. The insulation between the **output windings** and the **body** connected to earth, shall consist of at least **basic insulation** (rated for the **output voltage**);

– for **class I transformers** intended for connection to the mains supply by means of a plug, the insulation between the **input windings** and the **body** shall consist of at least **basic insulation**, and the insulation between the **output windings** and the **body** shall consist of at least **supplementary insulation** (both basic and **supplementary insulations** rated for the **working voltage**);

– for **class II transformers**, the insulation between the **input windings** and the **body** shall consist of **double** or **reinforced insulation** (rated for the **input voltage**). The insulation between the **output windings** and the **body** shall consist of **double** or **reinforced insulation** (rated for the **output voltage**).

19.1.2 For **transformers** with **intermediate conductive parts** (e.g. the iron core) not connected to the **body** and located between the **input** and **output windings,** the insulation between the **input windings** and any **intermediate conductive part** shall consist of at least **basic insulation**, and the insulation between the **output windings** and any **intermediate conductive part** shall consist of at least **supplementary insulation** (both **basic** and **supplementary insulations** rated for the **working voltage**).

NOTE 1 An **intermediate conductive part** not separated from the input or **output windings** or the **body** by at least **basic insulation** is considered to be connected to the relevant part(s).

NOTE 2 **Basic insulation** and **supplementary insulation** are interchangeable.

In addition, the following applies:

– for **class I transformers**, the insulation between the **input** and **output windings** via the **intermediate conductive parts** (even if they are connected to earth) shall consist of **double** or **reinforced insulation** (rated for the **working voltage**);

– for **class II transformers**, the insulation between the **input windings** and the **body**, and between the **output windings** and the **body** via the **intermediate conductive parts** shall consist of **double** or **reinforced insulation** (rated for the **input** and **output voltage**);

– for **transformers** different from independent (IP00), the insulation between the **input** and **output windings** via the **intermediate conductive parts** shall consist of **double** or **reinforced insulation** (rated for the **working voltage**).

NOTE 3 In this clause the possibility to consider the intermediate metal part connected to earth and consequently to require **basic insulation** in both circuit (primary and secondary) is not allowed for the following reason:

– the intermediate metal part is normally the iron core made by laminated strips insulated from other by oxide coatings. It is not assured that all laminations are correctly connected to earth.

– for **transformer** different from independent, it is not assured that in the final applications the iron core will be connected to earth.

19.1.3 For **class I transformers** not intended for connection to the mains supply by means of a plug, the insulation between the **input** and **output windings** may consist of **basic insulation** plus **protective screening** instead of **double** or **reinforced insulation**, provided the following conditions are complied with:

– the insulation between the **input winding** and the **protective screen** shall comply with the requirements for **basic insulation** (rated for the **input voltage**);

– the insulation between the **protective screen** and the **output winding** shall comply with the requirements for **basic insulation** (rated for the **output voltage**);

– the **protective screen** shall, unless otherwise specified, consist of a metal foil or of a wire wound screen extending at least the full width of the **input winding** and shall have no gaps or holes;

– where the **protective screen** does not cover the entire width of the **input winding**, additional adhesive tapes or equivalent insulation shall be used to ensure **double insulation** in that area;

– if the **protective screen** is made of a foil, the turns shall be insulated from each other. In case of only one turn, it shall have an isolated overlap of at least 3 mm;

– the wire of a wire wound screen and the lead out wire of the **protective screen** shall have a cross-sectional area at least corresponding to the **rated current** of the overload device to ensure that if a breakdown of insulation should occur, the overload protective device will open the circuit before the lead-out wire is destroyed;

– the lead-out wire shall be soldered to the **protective screen** or secured in an equally reliable manner.

NOTE For the purpose of this subclause, the term "windings" does not include **internal circuits**

Examples of construction of windings are given in Annex M of Part 1.

19.16 *Addition:*

Transformers and **power supply units for construction sites** shall conform to the protection code of not less than IP 44 for **fixed transformers** and **power supply units,** and not less than IP 54 for **portable transformers** and **portable power supply units**, except socket-outlet(s) shall have a protection code not less than IP 44.

Addition:

19.101 There shall be no connections between the **output circuit** and the protective earth, unless this is allowed by the relevant equipment standard for **associated transformers** and **power supply units**.

19.102 There shall be no connections between the **output circuit** and the **body**, unless this is allowed by the relevant equipment standard for **associated transformers**.

Compliance is checked by inspection.

19.103 The input and output terminals for the connection of external wiring shall be so located that the distance measured between the points of introduction of the conductors into these terminals is not less than 25 mm. If a barrier is used to obtain this distance, the measurement shall be made over and around the barrier and it shall be of insulating material and be permanently fixed to the **transformer**.

*Compliance is checked by inspection and by measurement disregarding **intermediate conductive parts**.*

19.104 Portable transformers having a **rated output** not exceeding 630 VA shall be class II.

19.105 to **19.110** Void

19.111 Output circuits shall provide protection against electric shock by one of the following means:

– the socket-outlets are supplied by **SELV;**

– the socket-outlets are supplied by an **output circuit** not exceeding 110 V a.c. with the mid-point or star-point earthed to provide a line to earth voltage not exceeding 55 V a.c. single phase or 63,5 V a.c. three phase;

– the socket-outlets are supplied by **output circuits** not connected to earth and exceeding 50 V a.c.; each **output circuit** shall supply only one socket outlet.

NOTE The above methods of protection do not require an additional protection by means of an RCD (according to 704.410.3 of IEC 60364-7-704).

19.112 For **transformers** with mid-point or star-point at **output windings** intended to be connected to earth, the connection to earth shall be made in the field. These **transformers** shall not have the **output winding** tapped at any other point.

20 Components

This clause of Part 1 is applicable.

21 Internal wiring

This clause of Part 1 is applicable.

22 Supply connection and other external flexible cable or cords

This clause of Part 1 is applicable except as follows:

Replacement:

22.5 Transformers and **power supply units for use on construction sites** shall be provided with at least heavy polychloroprene cords according to code designation 66 of IEC 60245.

23 Terminals for external conductors

This clause of Part 1 is applicable.

24 Provisions for protective earthing

This clause of Part 1 is applicable.

25 Screws and connections

This clause of Part 1 is applicable.

26 Creepage distances, clearances and distances through insulation

This clause of Part 1 is applicable.

27 Resistance to heat, fire and tracking

This clause of Part 1 is applicable.

28 Resistance to rusting

This clause of Part 1 is applicable.

Figures

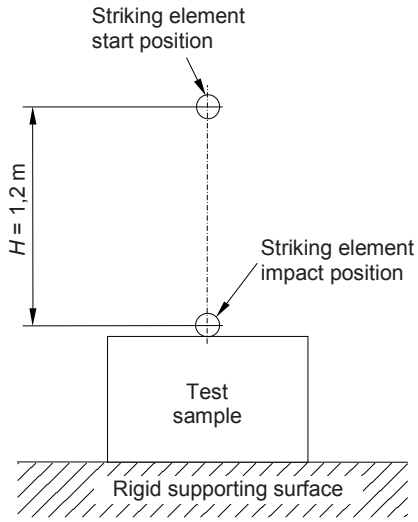

Figure 101 – Impact test for horizontal surface

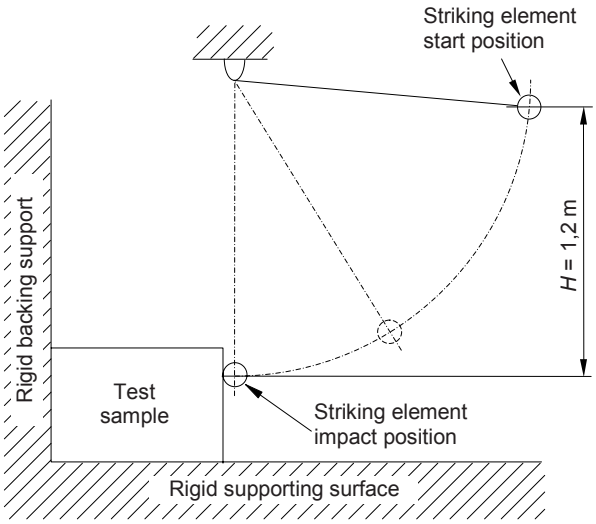

Figure 102 – Impact test for vertical surface

Annexes

The annexes of Part 1 are applicable except as follows:

Annex L

Routine tests (production tests)

This annex of Part 1 is applicable except as follows:

L.1 Protective earthing continuity test

Addition:

The earth contact tubes of socket outlets of the **output circuit(s**) are considered accessible metal part and included in the test as they are connected to the **body**.

L.2 Checking of no-load output voltage

Addition:

Transformers with the mid-point or star-point of the **output circuits** earthed shall not exceed 116 V a.c. The voltage from the **output winding** to earth shall not exceed the $\left(\frac{\text{output voltage}}{2}\right)$ single-phase or the $\left(\frac{\text{output voltage}}{\sqrt{3}}\right)$ three-phase.

Bibliography

The Bibliography of Part 1 is applicable except as follows:

Addition:

IEC 60364-7-704:2005, *Low-voltage electrical installations – Part 7-704:Requirements for special installations or locations – Construction and demolition site installations*

IEC 61558-2-16:2009, *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V – Part 2-16: Particular requirements and tests for switch mode power supply units and transformers for switch mode power supply units*

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