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INTERNATIONAL STANDARD

NORME INTERNATIONALE

GROUP SAFETY PUBLICATION
PUBLICATION GROUPÉE DE SÉCURITÉ

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

Sécurité des transformateurs, bobines d'inductance, blocs d'alimentation et des combinaisons de ces élements – Partie 2-23: Règles particulières et essais pour les transformateurs et les blocs d'alimentation pour chantiers

IEC 61558-2-23:2010

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

FOREWORD

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

International Standard IEC 61558-2-23 has been prepared by IEC Technical Committee 96: Transformers, reactors, power supply units, and combinations thereof.

This second edition cancels and replaces the first edition published in 2000. It constitutes a technical revision. The main changes consist of updating this Part 2-23 in accordance with IEC 61558-1:2005.

This part has the status of a group safety publication in accordance with IEC Guide 104: *The preparation of safety publications and the use of basic safety publications and group safety publications*.

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The text of this standard is based on the following documents:

FDIS	Report on voting
96/359/FDIS	96/368/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

This part is intended to be used in conjunction with the latest edition of IEC 61558-1 and its amendments. It is based on the second edition (2005) of that standard.

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

A list of all parts of the IEC 61558 series, under the general title: *Safety of transformers, reactors, power supply units and combinations thereof*, can be found on the IEC website.

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.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

NOTE The attention of National Committees is drawn to the fact that equipment manufacturers and testing organizations may need a transitional period following publication of a new, amended or revised IEC publication in which to make products in accordance with the new requirements and to equip themselves for conducting new or revised tests.

It is the recommendation of the committee that the content of this publication be adopted for implementation nationally not earlier than 12 months from the date of publication.

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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**.

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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.

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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.**

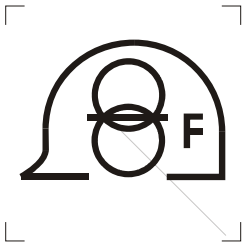
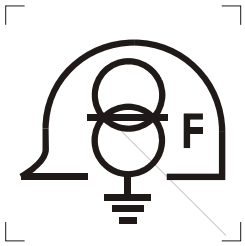
8 Marking and other information

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

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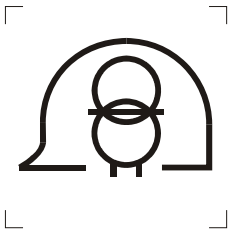
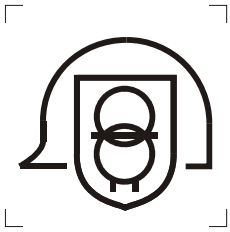
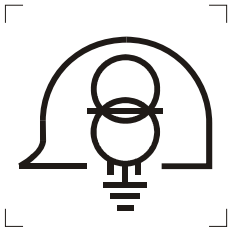
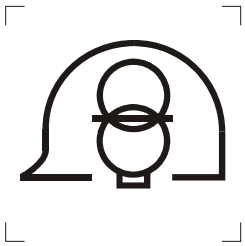
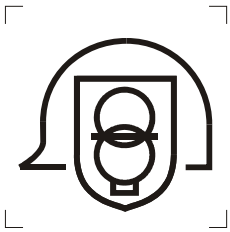
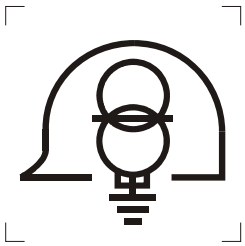
Symbol or graphical symbol	Explanation or title	Identification
	Isolating transformer for construction sites, non-short-circuit proof	IEC 60417-6010-4
	Isolating transformer for construction sites, non-short-circuit proof, safety	IEC 60417-6010-5
	Isolating transformer for construction sites, non-short-circuit 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: $\frac{U_{\text{no-load}} - U_{\text{load}}}{U_{\text{load}}} \times 100\ \%$

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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.

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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).

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