IEC 61558-2-23

Edition 3.0 2024-06

INTERNATIONAL STANDARD

NORME INTERNATIONALE

GROUP ENERGY EFFICIENCY PUBLICATION
PUBLICATION GROUPÉE SUR L'EFFICACITÉ ÉNERGÉTIQUE

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 61558-2-23:2024-06(en-fr)

IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, …). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch
Discover our powerful search engine and read freely all the publications previews, graphical symbols and the glossary. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 500 terminological entries in English and French, with equivalent terms in 25 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC
La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC
Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC - webstore.iec.ch/advsearchform
La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, …). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished
Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc
Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch
Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications, symboles graphiques et le glossaire. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org
Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 500 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 25 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

IEC 61558-2-23

Edition 3.0 2024-06

INTERNATIONAL STANDARD

NORME INTERNATIONALE

GROUP ENERGY EFFICIENCY PUBLICATION
PUBLICATION GROUPÉE SUR L'EFFICACITÉ ÉNERGÉTIQUE

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**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 29.180

ISBN 978-2-8322-8866-5

CONTENTS

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

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at https://patents.iec.ch. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 61558-2-23 has been prepared by IEC technical committee 96: Transformers, reactors, power supply units and combinations thereof. It is an International Standard.

This third edition cancels and replaces the second edition published in 2010. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) adjustment of structure and references in accordance with IEC 61558-1:2017;
b) new symbol for power supply units with linearly regulated output voltage.

The text of this International Standard is based on the following documents:

Draft	Report on voting
96/590/FDIS	96/596/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

It has the status of a group safety publication in accordance with IEC Guide 104.

This International Standard is to be used in conjunction with IEC 61558-1:2017.

This document supplements or modifies the corresponding clauses in IEC 61558-1:2017, 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 in the IEC 61558 series published 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 this document states "*addition*", "*modification*" or "*replacement*", the relevant text of IEC 61558-1:2017 is to be adapted accordingly.

In this document, 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 document, the words in **bold** are defined in Clause 3.

Subclauses, notes, figures and tables additional to those in IEC 61558-1:2017 are numbered starting from 101; supplementary annexes are entitled AA, BB, etc.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

IEC/TC 96 has a group safety function in accordance with IEC Guide 104 for transformers other than those intended to supply distribution networks, in particular transformers and power supply units intended to allow the application of protective measures against electric shock as defined by TC 64, which is about electrical installations and protection against electric shock, but in certain cases including the limitation of voltage and horizontal safety function for **SELV**, in accordance with IEC 60364-4-41.

The group safety function (GSF) is used because of responsibility for **safety extra-low voltage** (**SELV**) in accordance with IEC 61140:2016, 5.2.6 and IEC 60364-4-41:2005, 414.3.1 or control circuits in accordance with IEC 60204-1:2016, 7.2.4.

The group safety function is used for each part of IEC 61558-2 because different standards of the IEC 61558 series can be combined in one construction but in certain cases with no limitation of **rated output** power.

For example an **auto-transformer** in accordance with IEC 61558-2-13 can be designed with a separate **SELV-circuit** in accordance with the particular requirements for IEC 61558-2-6 relating to the general requirements of IEC 61558-1.

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 document.

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 document 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 can be encapsulated or non-encapsulated.

For **power supply units** (linear) this document is applicable. For **switch mode power supply units**, IEC 61558-2-16 is applicable together with this document. Where two requirements are in conflict, the most severe takes precedence.

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

The **rated output** does not exceed:

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

This document 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 for construction sites have a **no-load output voltage** and a **rated output voltage** exceeding 50 V AC and not exceeding 250 V AC.

Safety isolating transformers for construction sites have a **no-load output voltage** and a **rated output voltage** not exceeding 50 V AC.

NOTE 3 This document 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**.

NOTE 4 **Transformers** covered by this document are used in applications where it is required by the installation rules or by the appliance specification for protection purposes.

When the **transformers** are incorporated into **low voltage switchgear and controlgear assemblies for construction sites** as specified in IEC 61439-4, the additional requirements of IEC 61439-4 apply to the assembly.

NOTE 5 For **transformers** filled with liquid dielectric or pulverised material, such as sand, additional requirements are under consideration.

Attention is drawn to the following if necessary:

- for **transformers** intended to be used in vehicles, on board ships, and aircraft, additional requirements (from other applicable standards, national rules, etc.);
- measures to protect the **enclosure** and the components inside the **enclosure** against external influences such as fungus, vermin, termites, solar-radiation, and icing;
- the different conditions for transportation, storage, and operation of the **transformers**;
- additional requirements in accordance with other appropriate standards and national rules can be applicable to **transformers** intended for use in special environments.

It is possible that the future technological development of **transformers** will require an increase in the upper limit of the frequencies. Until then this document may be used as a guidance document.

This group safety publication focusing on safety guidance is primarily intended to be used as a product safety standard for the products mentioned in the scope, but is also intended to be used by technical committees in the preparation of publications for products similar to those mentioned in the scope of this group safety publication, in accordance with the principles laid down in IEC Guide 104 and ISO/IEC Guide 51.

One of the responsibilities of a technical committee is, wherever applicable, to make use of basic safety publications and/or group safety publications in the preparation of its publications.

2 Normative references

IEC 61558-1:2017, Clause 2 is applicable, except as follows:

Addition:

IEC 60068-2-27:2008, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60245-4:2011, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 4: Cords and flexible cables*

IEC 61558-1:2017, *Safety of transformers, reactors, power supply units and combinations thereof – Part 1: General requirements and tests*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61558-1 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.2 General terms

Addition:

3.2.101
low voltage switchgear and controlgear assembly for construction sites
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

IEC 61558-1:2017, Clause 4 is applicable.

5 General notes on tests

IEC 61558-1:2017, Clause 5 is applicable.

6 Ratings

IEC 61558-1:2017, Clause 6 is applicable except as follows:

Addition:

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

- 250 V AC for **isolating transformers** with a non-earthed mid-point (single-phase) or a non-earthed star-point (three-phase) or delta connection (three-phase);
- 115 V AC for **isolating transformers** with a mid-point (single-phase) earthed in the construction or a star-point (three-phase) earthed in the construction;
- 50 V AC for **safety isolating transformers**.

The **rated output voltage** shall exceed:

- 50 V AC for isolating transformers

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

- 115 V and 230 V for **portable**, single-phase **isolating transformers**;
- 72 V, 115 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**;
- 40 kVA for polyphase isolating and **safety isolating 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 polyphase **transformers**.

Intermittent duty cycle can be assigned only to **portable transformers** having a **rated output** not exceeding 6,3 kVA.

Transformers without limitation of the **rated output** shall be subject to agreement between the purchaser and the manufacturer.

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

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

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".

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

IEC 61558-1:2017, Clause 7 is applicable, except as follows:

Replacement:

7.5 **Transformers** are classified in accordance with their duty type:

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

8 Marking and other information

IEC 61558-1:2017, Clause 8 is applicable, except as follows:

8.1 h)

Replacement of the content up to the first semi-colon with the following:

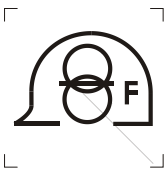
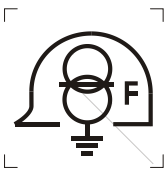
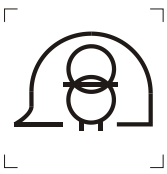
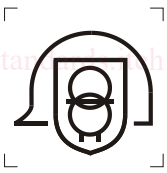
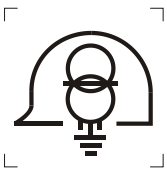
relevant graphical symbols shown in Table 101 that indicate the kind of **transformer**

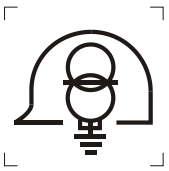
8.11

Addition:

The symbol for linear **power supply units** shall be used in conjunction with the symbol indicating the kind of **transformer**.

Table 101 – Symbols indicating the kind of transformer

Symbol or graphical symbol	Explanation or title	Identification
	**Isolating transformer for construction sites, fail-safe**	IEC 60417-6010-1:2007-02
	**Safety isolating transformer for construction sites, fail-safe**	IEC 60417-6010-2:2007-02
	**Isolating transformer for construction sites, fail-safe**, mid-point or star-point earthed	IEC 60417-6010-3:2007-02
	**Isolating transformer for construction sites**, non-short-circuit proof	IEC 60417-6010-4:2007-02
	**Safety isolating transformer for construction sites**, non-short-circuit proof	IEC 60417-6010-5:2007-02
	**Isolating transformer for construction sites**, non-short-circuit proof, mid-point or star-point earthed	IEC 60417-6010-6:2007-02
	**Isolating transformer for construction sites**, short-circuit proof (inherently or non-inherently)	IEC 60417-6010-7:2007-02
	**Safety isolating transformer for construction sites**, short-circuit proof (inherently or non-inherently)	IEC 60417-6010-8:2007-02

Symbol or graphical symbol	Explanation or title	Identification
	**Isolating transformer for construction sites**, short-circuit proof (inherently or non-inherently), mid-point or star-point earthed	IEC 60417-6010-9:2007-02
	**Power supply unit, linear** To identify the electronic device incorporating **transformer**(s) and electronic circuitry(ies), that converts electrical power into single or multiple power outputs, the output voltage is linearly regulated. The internal operating frequency does not exceed 500 Hz.	IEC 60417-6210:2013-10

9 Protection against electric shock

IEC 61558-1:2017, Clause 9 is applicable.

10 Change of input voltage setting

IEC 61558-1:2017, Clause 10 is applicable.

11 Output voltage and output current under load

IEC 61558-1:2017, Clause 11 is applicable.

12 No-load output voltage

IEC 61558-1:2017, Clause 12 is applicable except as follows:

Addition:

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

- 250 V AC for **isolating transformers** with a non-earthed mid-point (single-phase) or a non-earthed star-point (three-phase) or delta connection (three-phase);
- 115 V AC for **isolating transformers** with a mid-point (single-phase) earthed in the construction or a star-point (three-phase) earthed in the construction;
- 50 V AC for **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 AC for isolating **transformers**.

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

The ratio between the **no-load output voltage** measured in Clause 12 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 102 or Table 103.

The ratio is determined by Formula (1):

$$\frac{U_{\text{no-load}} - U_{\text{load}}}{U_{\text{load}}} \times 100(\%) \quad (1)$$

where

$U_{\text{no-load}}$ is the no-load output voltage, expressed in V;

U_{load} is the output voltage under load, expressed in V.

Table 102 – Output voltage ratio 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 103 – Output voltage ratio for isolating transformers

Type of transformer **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