IEC 61558-2-9

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REDLINE VERSION

INTERNATIONAL STANDARD

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GROUP ENERGY EFFICIENCY PUBLICATION

Safety of transformers, reactors, power supply units and combinations thereof – Part 2-9: Particular requirements and tests for transformers and power supply units for class III handlamps ~~for tungsten filament lamps~~

IEC 61558-2-9:2024-06 RLV(en)

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

Part 2-9: Particular requirements and tests for transformers and power supply units for class III handlamps ~~for tungsten filament lamps~~

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 61558-2-9:2010. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

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IEC 61558-2-9 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) addition of a new symbol for power supply unit with linearly regulated output voltage;

c) document is not only valid for transformers for tungsten filament handlamps.

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

Draft	Report on voting
96/593/FDIS	96/597/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 document 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 document 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 class III handlamps.*

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 adopted 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.

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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.

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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 example 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.

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

Part 2-9: Particular requirements and tests for transformers and power supply units for class III handlamps ~~for tungsten filament lamps~~

1 Scope

Replacement:

This part of IEC 61558 deals with the safety of **transformers for class III handlamps** ~~for tungsten filament lamps~~ and **power supply units incorporating transformers for class III handlamps** ~~for tungsten filament lamps~~. **Transformers** incorporating **electronic circuits** are also covered by this document.

NOTE 1 Safety includes electrical, thermal and mechanical ~~and chemical~~ aspects.

Unless otherwise specified, from here onward, the term **transformer** covers **transformers for class III handlamps** ~~for tungsten filament lamps~~ and **power supply units incorporating transformers for class III handlamps** ~~for tungsten filament lamps~~.

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.

This document is applicable to **stationary** or **portable**, single-phase, air-cooled (natural or forced) **independent** or **associated dry-type transformers.** The windings ~~may~~ can be encapsulated or non-encapsulated.

~~This standard is applicable to **transformers** and **power supply** (linear) with **internal operational frequencies** not exceeding 500 Hz.~~

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

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

Transformers ~~for **class III handlamps for tungsten filament lamps**~~ have the following additional characteristics:

– **the no-load output voltage** and the **rated output voltage** do not exceed 50 V AC or 120 V ripple-free DC;
– there is only a small difference between the **no-load output voltage** and the **rated output voltage**.

The **rated output** does not exceed 10 kVA.

This document is not applicable to external circuits and their components intended to be connected to the input terminals and output terminals of the **transformers**.

NOTE 2 **Transformers** covered by this document are only used in applications where **double** or **reinforced insulation** between circuits is required by the installation rules or by the end product standard.

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~~NOTE 2~~ 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.) ~~may be necessary~~;
– measures to protect the **enclosure** and the components inside the enclosure against external influences such as fungus, vermin, termites, solar-radiation, and icing ~~should also be considered~~;
– the different conditions for transportation, storage, and operation of the **transformers** ~~should also be considered~~;
– additional requirements in accordance with other appropriate standards and national rules ~~may~~ can be applicable to **transformers** intended for use in special environments.

~~NOTE 3~~ Future technological development of **transformers** ~~may~~ can necessitate a need to increase the upper limit of the frequencies. Until then this document ~~may~~ can 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 60245-4:2011, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 4: Cords and flexible cables*

IEC 61558-1:~~2005~~2017, ~~*Safety of power transformers, power supplies, reactors and similar products*~~ *Safety of transformers, reactors, power supply units and combinations thereof – Part 1: General requirements and tests*

IEC 61558-2-16:2021, *Safety of transformers, reactors, power supply units and combinations thereof – Part 2-16: Particular requirements and tests for switch mode power supply units and transformers for switch mode power supply units for general applications*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61558-1:2017 apply, except as follows:

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

3.1 Transformers

Addition:

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3.1.101
transformer for class III handlamps ~~**for tungsten filament lamps**~~
associated **safety isolating transformer** intended to supply one or more class III handlamps ~~for tungsten filament lamps~~

3.1.102
power supply unit incorporating transformer for class III handlamps ~~**for tungsten filament lamps**~~
power supply unit where an associated **safety isolating transformer** is used intended to supply one or more **class III handlamps** ~~**for tungsten filament lamps**~~

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 50 V AC or 120 V ripple-free DC.

For **independent transformers**, this **output voltage** limitation applies even when **output windings**, not intended for interconnection, are connected in series.

6.102 The **rated output** shall not exceed 10 kVA.

6.103 The **rated supply frequency** and the **internal** ~~**operational**~~ **operating frequencies** shall not exceed 500 Hz.

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

Compliance with the requirements of 6.101 to 6.104 is checked by inspection of the marking.

7 Classification

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

7.2

Replacement:

7.2 According to short-circuit ~~protection~~ characteristic or protection against abnormal ~~conditions~~ use:

– **inherently short-circuit proof transformers**;
– **non-inherently short-circuit proof transformers.**

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7.3

Replacement:

7.3 According to their degree of protection ~~provided~~ ensured by the **enclosure** ~~for~~

– **portable transformers** shall ~~be code~~ have a degree of protection of at least IP24 ~~or higher~~.

7.5

Replacement:

7.5 According to their **duty-~~time~~type**:

– **continuous operation.**

7.8

Replacement:

7.8 According to their transient overvoltage condition:

– **overvoltage category II.**

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 by 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**.

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Table 101 – Symbols indicating the kind of transformer

Symbol or graphical symbol	Explanation or title	Identification
	Short-circuit proof transformer for class III ~~tungsten filament~~ handlamps (inherently or **non-inherently)**	IEC 60417-5953:2002-10
	Power supply unit, linear	IEC 60417-6210:2013-10

Addition:

8.101

~~**8.101**~~ For **transformers** intended for connection to the supply by means of a cable or cord and a plug, an instruction sheet or the equivalent shall be delivered with the **transformer**, drawing the attention of the user to the fact that the **output circuit(s)** shall be protected in accordance with national wiring rules.

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, except as follows:

11.1

Replacement of the first paragraph by the following:

11.1 When the **transformer** is connected to the **rated supply voltage** at the **rated supply frequency** and loaded with an impedance resulting in the **rated output** at the **rated output voltage**, and for AC current, at the **rated power factor**, the **output voltage** under load shall not differ from the **rated output voltage** by more than 5 %. For **transformers** with rectifiers, the output voltage under load shall not differ from the **rated output voltage** by more than 10 %.

12 No-load output voltage

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

Addition

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~~The **no-load output voltage** is measured when the **transformer** is connected to the **rated supply voltage** at the **rated supply frequency** at ambient temperature.~~

12.101 The **no-load output voltage** shall not exceed 50 V AC or 120 V ripple free DC.

For **independent transformers**, this **output voltage** limitation applies even when **output windings**, not intended for interconnection, are connected in series.

12.102 The difference between the **no-load output voltage** and the **output voltage** under load ~~(as measured in 11.1)~~ 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.*

~~The difference is expressed as a percentage of the latter voltage calculated according to the following formula:~~

The ratio is determined by Formula (1):

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

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 ~~101~~ 102 – ~~Ratio of output voltages for transformers for class III tungsten filament handlamps~~ Output voltage ratio

Rated output VA	Ratio between no-load output voltage and output voltage under load %
– up to and including 63	7,5
– over 63 up to and including 630	5,0
– over 630	2,5

*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 shall not exceed the values shown in Table 101.*~~

13 Short-circuit voltage

IEC 61558-1:2017, Clause 13 is applicable.

14 Heating

IEC 61558-1:2017, Clause 14 is applicable.

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15 Short-circuit and overload protection

IEC 61558-1:2017, Clause 15 is applicable.

16 Mechanical strength

IEC 61558-1:2017, Clause 16 is applicable.

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

IEC 61558-1:2017, Clause 17 is applicable.

18 Insulation resistance, dielectric strength and leakage current

IEC 61558-1:2017, Clause 18 is applicable.

19 Construction

IEC 61558-1:2017, Clause 19 is applicable, except as follows:

19.1 General construction

Replacement:

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~~, through other ~~metal~~ **conductive parts**, except by deliberate action.

Compliance is checked by inspection and measurements, taking Clause 18 and Clause 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 earthing shall consist of at least **basic insulation** rated for the **input voltage**. The insulation between the **output windings** and the **body** connected to earthing, 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 following requirements are applicable.

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19.1.2.1 For **class I** and **class II transformers**, 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**);

– 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 **transformer** other than **independent** (e.g. 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**);

19.1.2.2 As an alternative to 19.1.2.1 for **class I transformer** not intended to be connected by means of a plug and for **transformer** different from independent (e.g. IP00), if the construction assure that all laminated plates of the iron core are connected to earthing (e.g by soldering / welding) and if the in data sheet or instruction sheet clearly state that the safety of the **transformer** depends on the earthing connection and that is not possible to use in **class II equipment**, than the following apply:

– the insulation between the **input windings** and the **intermediate conductive part** connected to earth, and between the **output windings** and the **intermediate conductive part** connected to earthing, shall consist of at least **basic insulation** (rated for the **input** and **output voltage**);

19.1.2.3 In addition to 19.1.2.1 and 19.1.2.2 the insulation between the **intermediate conductive parts** and the **input windings**, and between the **intermediate conductive parts** and the **output windings** shall consist of at least **basic insulation** (rated for the **input** and **output voltage**). 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).

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~~ can 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 **output winding** and the **protective screen** 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 protective 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 IEC 61558-1:2017.

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19.16 Portable transformers for use in irregular or harsh conditions

Replacement:

Portable transformers shall have a degree of protection ~~code~~ of at least IP24.

Addition:

19.101 There shall be no connection between **output circuits** and the protective earthing, unless this is allowed for **associated transformers** by the relevant equipment standard.

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

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 which shall be of insulating material and 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**.

20 Components

IEC 61558-1:2017, Clause 20 is applicable.

21 Internal wiring

IEC 61558-1:2017, Clause 21 is applicable.

22 Supply connection and other external flexible cables or cords

IEC 61558-1:2017, Clause 22 is applicable, except as follows:

22.5

Addition:

Power supply cords of **transformers** with a degree of protection ~~code~~ of other than IPX0 shall ~~not~~ be ~~lighter than~~ at least ordinary polychloroprene sheathed cords ~~(code designation 60245 IEC 57)~~ according to IEC 60245-4:2011 – type 60245 IEC 57).

23 Terminals for external conductors

IEC 61558-1:2017, Clause 23 is applicable.

Documents
Document Sharing Hub
Full document details: IEC 61558-2-9 2024 RLV