

INTERNATIONAL STANDARD



GROUP ENERGY EFFICIENCY PUBLICATION

**Safety of transformers, reactors, power supply units and combinations thereof –
Part 2-10: Particular requirements and tests for separating transformers with
high insulation level and separating transformers with output voltages
exceeding 1 000 V**



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IEC 61558-2-10

Edition 2.0 2024-06
REDLINE VERSION

INTERNATIONAL STANDARD



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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.180

ISBN 978-2-8322-9131-3

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CONTENTS

FOREWORD	3
INTRODUCTION	2
1 Scope	7
2 Normative references	8
3 Terms and definitions	8
4 General requirements	9
5 General notes on tests	9
6 Ratings	9
7 Classification	10
8 Marking and other information	10
9 Protection against electric shock	13
10 Change of input voltage setting	14
11 Output voltage and output current under load	14
12 No-load output voltage	14
13 Short-circuit voltage	15
14 Heating	15
15 Short-circuit and overload protection	15
16 Mechanical strength	15
17 Protection against harmful ingress of dust, solid objects and moisture	15
18 Insulation resistance, dielectric strength and leakage current	15
19 Construction	16
20 Components	17
21 Internal wiring	17
22 Supply connection and other external flexible cables or cords	17
23 Terminals for external conductors	17
24 Provisions for protective earthing	17
25 Screws and connections	18
26 Creepage distances, clearances and distances through insulation	18
27 Resistance to heat, fire and tracking	19
28 Resistance to rusting	20
Annexes	21
Bibliography	22
Table 101 – Symbols indicating the kind of transformer	13
Table 101 102 – Output voltage difference	15
Table 102 103 – Table of dielectric strength test voltages for working voltages above 1 000 V	16
Table 104 – Minimum clearances in air up to 2 000 m above sea level	19
Table 104 105 – Creepage distances for material group III a, II and I (CTI > 175) for basic or supplementary insulation Minimum creepage distances for basic or supplementary insulation	20

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**SAFETY OF TRANSFORMERS, REACTORS,
POWER SUPPLY UNITS AND COMBINATIONS THEREOF –****Part 2-10: Particular requirements and tests for separating
transformers with high insulation level and separating
transformers with output voltages exceeding 1 000 V**

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.
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- 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.

This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 61558-2-10:2014. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 61558-2-10 has been prepared by IEC technical committee 96: Transformers, reactors, power supply units and combinations thereof. It is an International Standard.

This second edition cancels and replaces the first edition published in 2014. 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) overvoltage categories I, II, III and IV for clearances and dielectric strength tests are included;
- c) clearances for homogenous field conditions deleted.

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

Draft	Report on voting
96/589/FDIS	96/595/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 separating transformers with high insulation level and separating transformers with output voltages exceeding 1 000 V*.

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.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

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 2-10: Particular requirements and tests for separating transformers with high insulation level and separating transformers with output voltages exceeding 1 000 V

1 Scope

Replacement:

This part of IEC 61558 deals with the safety of **separating transformers with high insulation level** and **separating transformers with output voltages exceeding 1 000 V**. 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 **separating transformers** with **high insulation level** and **separating transformers** with **output voltages** exceeding 1 000 V AC or 1 500 V DC.

This document is applicable to **stationary** or **portable**, single-phase or polyphase, 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 units (SMPS) 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.~~

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.

Where applicable the **no-load output voltage** or the **rated output voltage**:

- does not exceed 1 000 V AC or 1 500 V DC for **separating transformers with high insulation level**;
- does exceed 1 000 V AC or 1 500 V DC and does not exceed 15 000 V AC or 15 000 V DC for **separating transformers with output voltage exceeding 1 000 V**.

This document does not apply to:

- **transformers** covered by IEC 60076-11;
- neon **transformers** covered by IEC 61050; and
- **power supplies** and converters for use with or in products according to IEC 61347-2-10.

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 used only in applications where **double or reinforced insulation** between circuits is not required by the installation rules or by the end product standard.

NOTE 2 3 Normally, the **transformers** are intended to be used with equipment to provide voltages different from the **supply voltage** for the functional requirements of the equipment. The protection against electric shock can be provided (or completed) by other features of the equipment, such as the **body**. Parts of **output circuits** can be connected to the **input circuits** or to **protective earthing**.

This document is applicable to **transformers** associated with specific equipment, to the extent decided upon by the relevant IEC technical committees.

NOTE 3 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.) ~~can 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 ~~can also be considered~~;
- the different conditions for transportation, storage, and operation of the **transformers** ~~can also be considered~~;
- additional requirements in accordance with other appropriate standards and national rules can be applicable to **transformers** intended for use in special environments, ~~such as tropical environment~~.

NOTE 4 It is possible that future technological development of **transformers** ~~can necessitate a need to~~ will require an increase in the upper limit of the frequencies. Until then this document 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 61558-1:2005, Safety of power transformers, power supplies, reactors and similar products
— Part 1: General requirements and tests
Amendment 1:2009~~

~~IEC 61558-2-16, 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~~

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

3 Terms and definitions

~~This clause of Part 1 is applicable except as follows:~~

~~The third paragraph is not applicable.~~

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>

3.1 Transformers

Addition:

3.1.101

separating transformer with high insulation level

separating transformer where the **output voltage** does not exceed 1 000 V AC or 1 500 V DC and does exceed 50 V AC or DC for **independent transformers**, the **output winding(s)** is (are) isolated from both, **input winding(s)** and **body** for a **working voltage** exceeding 1 000 V AC or 1 500 V DC but not exceeding 15 000 V AC or 15 000 V DC

~~Note 1 to entry: The output winding(s) are isolated from both, input winding(s) and body for a working voltage exceeding 1 000 V, a.c or 1 500 V d.c but not exceeding 15 000 V a.c or 15 000 V d.c.~~

3.1.102

separating transformer with output voltages exceeding 1 000 V

separating transformer where the **output circuits** of which are designed to give voltages exceeding 1 000 V AC or 1 500 V DC and not exceeding 15 000 V AC or 15 000 V DC

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

~~This clause of Part 1 is not applicable.~~

~~Replacement:~~

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

Addition:

6.101 The **rated output voltage** is limited as follows.

For **separating transformers with high insulation level**:

- the **no-load output voltage** or the **rated output voltage** shall not exceed 1 000 V AC or 1 500 V DC;
- for **independent transformers** the **rated output voltage** shall exceed 50 V AC or 50 V DC and this **output voltage** applies even when **output windings**, not intended for interconnection, are connected in series.

For **separating transformers with no load output voltages exceeding 1 000 V**:

- the **rated output voltage** shall exceed 1 000 V AC or 1 500 V DC and shall not exceed 15 000 V AC or 15 000 V DC;
- for **independent transformers** these **output voltage** limitations apply even when **output windings**, not intended for interconnection, are connected in series.

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

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

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

6.103 The **rated supply frequency** and the **internal 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.

8 Marking and other information

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

8.1 h)

~~*Replacement:*~~

~~Replace the first sentence by the following: relevant graphical symbols shown in 8.11 indicating the kind of transformer;~~

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

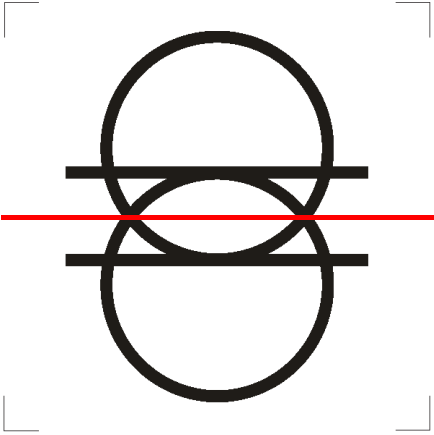
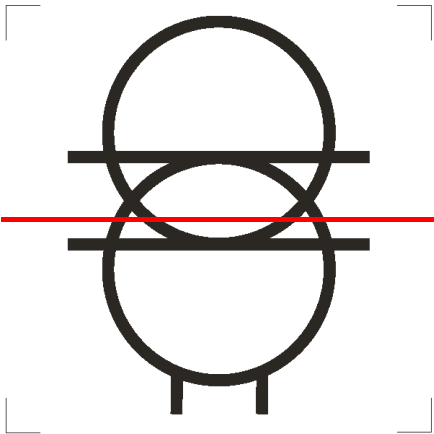
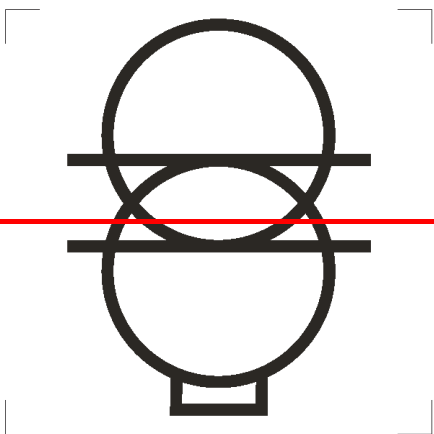
relevant graphical symbols shown in Table 101 that indicate the kind of **transformer**

The voltage of the **insulation level**, expressed in kV is not a part of the symbol.

8.11

Addition:

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

Symbol or graphical symbol	Explanation or title	Identification
	<p>Separating transformer, high insulation level, general</p> <p>To identify the separating transformer with high insulation level, where the letter "F" may be used adjacent to the symbol to indicate a fail-safe function.</p> <p>The voltage of the insulation level, expressed in kV, may be added adjacent to the symbol.</p>	IEC 60417-6063
	<p>Separating transformer, high insulation level, non-short-circuit-proof</p> <p>To identify the non-short-circuit-proof separating transformer with high insulation level.</p> <p>The voltage of the insulation level, expressed in kV, may be added adjacent to the symbol.</p>	IEC 60417-6064
	<p>Separating transformer, high insulation level, short-circuit-proof</p> <p>To identify the short-circuit-proof (inherently or non-inherently) separating transformer with high insulation level.</p> <p>The voltage of the insulation level, expressed in kV, may be added adjacent to the symbol.</p>	IEC 60417-6065

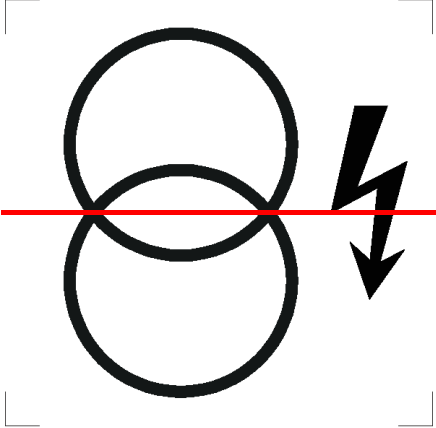
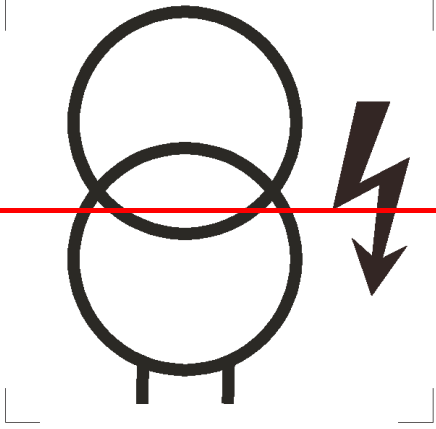
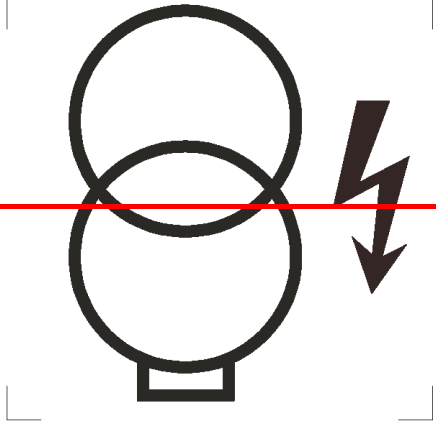
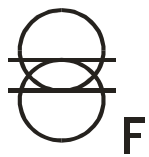
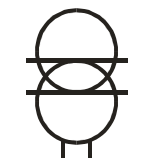
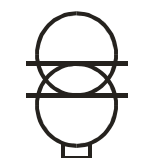
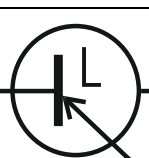
Symbol or graphical symbol	Explanation or title	Identification
	<p>Separating transformer, output voltages exceeding 1 kV, general</p> <p>To identify the separating transformer with output voltages exceeding 1 000 V and not exceeding 15 000 V, where the letter "F" may be used adjacent to the symbol to indicate a fail-safe function.</p>	IEC 60417-6066
	<p>Separating transformer, output voltages exceeding 1 kV, non-short-circuit-proof</p> <p>To identify the non-short-circuit-proof separating transformer with output voltages exceeding 1 000 V and not exceeding 15 000 V.</p>	IEC 60417-6067
	<p>Separating transformer, output voltages exceeding 1 kV, short-circuit-proof</p> <p>To identify the short-circuit-proof (inherently or non-inherently) separating transformer with output voltages exceeding 1 000 V and not exceeding 15 000 V.</p>	IEC 60417-6068

Table 101 – Symbols indicating the kind of transformer

Symbol or graphical symbol	Explanation or title	Identification
	Fail-safe separating transformers with high insulation level The voltage of the insulation level, expressed in kV, shall be marked adjacent to the symbol.	IEC 60417-6063:2011-05
	Non-short-circuit proof separating transformer with high insulation level The voltage of the insulation level, expressed in kV, shall be marked adjacent to the symbol.	IEC 60417-6064:2011-05
	Short-circuit-proof separating transformer with high insulation level (inherently or non-inherently) The voltage of the insulation level, expressed in kV, shall be marked adjacent to the symbol.	IEC 60417-6065:2011-05
	Fail-safe separating transformers with output voltages exceeding 1 000 V	IEC 60417-6066:2011-06
	Non-short-circuit-proof separating transformer with output voltages exceeding 1 000 V	IEC 60417-6067:2011-06
	Short-circuit-proof separating transformer with output voltages exceeding 1 000 V (inherently or non-inherently)	IEC 60417-6068:2011-06
	Power supply unit, linear	IEC 60417-6210:2013-10

Addition:

8.101 Separating transformers with high insulation level shall be marked with the voltage of the **insulation level**, expressed in kV on the right side of the symbol.

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:

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

12.101 For separating transformers with high insulation level:

- the **no load output voltage** shall not exceed 1 000 V AC or 1 500 V DC. For **independent transformers** the **no-load output voltage** shall exceed 50 V AC or 50 V DC. This limitation applies even when independent **output windings**, not intended for interconnection, are connected in series.

12.102 For separating transformers with output voltages exceeding 1 000 V:

- the **no-load output voltage** shall exceed 1 000 V AC or 1 500 V DC and shall not exceed 15 000 V AC or DC. For **independent transformers** this limitation applies even when independent **output windings**, not intended for interconnection, are connected in series.

12.103 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.

~~The difference is expressed as a percentage of the latter voltage calculated according to the following~~ 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. ~~The difference shall not exceed the values shown in Table 101.~~

Table ~~101~~ 102 – Output voltage difference

Type of transformer Rated output VA	Difference 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 630	20
– over 630	15

*Compliance with the requirements of 12.101, 12.102 and 12.103 shall be checked by measuring the **no-load output voltage** at **ambient temperature** when the **transformer** is connected to the **rated supply voltage** at the **rated supply frequency**.*

13 Short-circuit voltage

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

14 Heating

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

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 except as follows:

18.3 Dielectric strength test

Replacement:

Immediately after the test of 18.2 the **insulation** is subjected for 1 min to a dielectric strength voltage of substantially sinusoidal wave form at 50 Hz or 60 Hz. The value of the dielectric strength test voltage and the points of application are given in ~~Table 102~~ Table 103.

Resistors, capacitors and other components are disconnected before carrying out the test.

For **working voltages** up to and including 1 000 V the dielectric strength voltage shall not be less than the values shown in Table 14 of IEC 61558-1:2017.

Table 103 – Table of dielectric strength test voltages for working voltages above 1 000 V

Application of dielectric strength test voltage	Working voltage over 1 000 V, up to and including 15 000 V
Additional value for the corresponding transients of the different overvoltage categories	$U_{OVC I} = 500 \text{ V}$ $U_{OVC II} = 750 \text{ V}$ $U_{OVC III} = 1 000 \text{ V}$ $U_{OVC IV} = 1 250 \text{ V}$
1) Between live parts of input circuits and live parts of output circuits basic insulation	2 × working voltage +1 000 V + U_{OVC}
2) Over basic insulation or supplementary insulation between: <ul style="list-style-type: none"> a) live parts of different polarity. Test is not applicable within the same winding b) live parts and the body, if intended to be connected to the protective earthing c) accessible conductive parts and a metal rod of the same diameter as the flexible cable or cord (or metallic foil wrapped round the cord) inserted inside inlet bushing, cord guards and anchorage, and the like d) live parts and an intermediate conductive part e) conductive parts and the body f) each input circuit and all other input circuits connected together 	2 × working voltage +1 000 V + U_{OVC}
Dielectric strength test voltages for double or reinforced insulation (e.g. for a class II transformer insulation) shall be twice the values for basic insulation .	

19 Construction

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

19.1 General construction

Replacement:

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

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

Addition:

19.1.101 The **insulation** between **input** and **output winding(s)** shall consist of at least **basic insulation** (rated for the **working voltage**).

In addition, the following applies:

- for **class I transformers**, the **insulation** between the **input windings** and the **body**, and between the **output windings** and the **body**, shall consist of **basic insulation** (both **basic insulations** 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**, shall consist of **double** or **reinforced insulation** (both **double** or **reinforced insulations** rated for the **working voltage**).

19.1.102 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 **intermediate conductive parts** and the **input windings**, and between the **intermediate conductive parts** and the **output windings** shall consist of **basic insulation** (rated for the **working voltage**).

NOTE 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).

In addition, the following applies:

- for **class I transformers**, the **insulation** between the **input** and **output windings** via the **intermediate conductive parts** shall consist of at least **basic 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**).

Addition:

19.101 Parts of **output circuits** ~~may~~ can be connected to **protective earthing**.

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

Compliance is checked by inspection.

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.

23 Terminals for external conductors

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

24 Provisions for protective earthing

IEC 61558-1:2017, Clause 24 is applicable.

25 Screws and connections

IEC 61558-1:2017, Clause 25 is applicable.

26 Creepage distances, clearances and distances through insulation

IEC 61558-1:2017, Clause 26 is applicable except as follows:

Replacement:

26.1 General

Replacement of the first and second paragraph ~~by~~ together with the note with the following:

~~For working voltages up to and including 1 000 V the creepage distances, clearances and distances through insulation shall not be less than the values shown in Table 13 for insulating materials of group III a (see IEC 60664-1).~~

~~For working voltages over 1 000 V, up to and including 15 000 V the creepage distances, clearances and distances through insulation shall not be less than the values shown in Table 103 for insulating materials of at least group III a (see IEC 60664-1)~~

~~Compliance is checked by measurements under the provisions of 26.2 and 26.3~~

~~NOTE 1~~

~~— For working voltages up to and including 1 000 V: For materials of groups I and II, see Tables C.1 and D.1.~~

~~— For working voltages exceeding 1 000 V and up to and including 15 000 V: For material groups II and I see Table 103.~~

~~NOTE 2 Table 13, Table C.1 and Table D.1 and Table 102 are applicable only for frequencies up to and including 30 kHz.~~

~~Replacement of NOTE 7 by the following:~~

~~NOTE 7 Table 13, Table C.1 and Table D.1 take into consideration over voltage category II for basic insulation and over voltage category III for double or reinforced insulation.~~

For **working voltages** up to and including 1 000 V the **clearances, creepage distances** and distances through **insulation** shall not be less than the values shown in Table 20, Table 21 and Table 22 of IEC 61558-1:2017.

For **working voltages** above 1 000 V, up to and including 15 000 V the **clearances** and **creepage distances** shall not be less than the values shown in Table 104 and Table 105.

Compliance is checked by measurements in accordance with the provisions of 26.2 and 26.3.

NOTE 1 Table 20, Table 21 and Table 22 of IEC 61558-1:2017, and Table 104 and Table 105 of this document are applicable only for frequencies up to and including 30 kHz.

26.2 Creepage distances and clearances

Addition: