



INTERNATIONAL STANDARD



GROUP SAFETY PUBLICATION

**Safety of transformers, reactors, power supply units and combinations thereof –
Part 2-14: Particular requirements and tests for variable transformers and power
supply units incorporating variable transformers for general applications**

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**Safety of transformers, reactors, power supply units and combinations thereof –
Part 2-14: Particular requirements and tests for variable transformers and power
supply units incorporating variable transformers for general applications**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

**Part 2-14: Particular requirements and tests for variable
transformers and power supply units incorporating
variable transformers for general applications**

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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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 61558-2-14:2012. 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 61558-2-14 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 2012. 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) description of constructions moved to IEC 61558-1:2017;
- c) new symbols for **power supply units** with linearly regulated output voltages and required **current collector** position changes.

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

Draft	Report on voting
96/507/CDV	96/528/RVC

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/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.

NOTE When "Part 1" is mentioned in this standard, it refers to 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 variable transformers and power supply units incorporating variable transformers for general applications*.

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

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.

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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, but in certain cases including limitation of voltage and horizontal safety function for SELV in accordance with IEC 60364-4-41.

The group safety function (GSF) is necessary because of responsibility e.g. 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 needed 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 2-14: Particular requirements and tests for variable transformers and power supply units incorporating variable transformers for general applications

1 Scope

Replacement

This part of IEC 61558 deals with the safety of **variable transformers** for general applications and **power supply units** incorporating **variable transformers** for general applications. **Transformers** incorporating **electronic circuits** are also covered by this document.

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

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

~~This standard is applicable to transformers and power supply units (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 take precedence.

This document does not apply to **transformers** covered by IEC 60076-11.

This document is applicable to **stationary** or **portable**, single-phase or polyphase, air-cooled (natural or forced) **independent** or **associated variable dry-type transformers**:

- ~~variable auto-transformers and power supply units incorporating variable auto-transformers;~~
- ~~variable separating transformers and power supply units incorporating variable separating transformers;~~
- ~~variable isolating transformers and power supply units incorporating variable isolating transformers;~~
- ~~variable safety isolating transformers and power supply units incorporating variable safety isolating transformers.~~

The windings ~~may~~ can be encapsulated or non-encapsulated.

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

The **rated output** does not exceed:

- 40 kVA for single-phase **variable auto-transformers and power supply units incorporating single-phase variable auto-transformers;**
- 200 kVA for polyphase **variable auto-transformers and power supply units incorporating poly-phase variable auto-transformers;**

- 1 kVA for single-phase **variable separating transformers** ~~and power supply units incorporating single-phase variable separating transformers~~;
- 5 kVA for polyphase **variable separating transformers** ~~and power supply units incorporating poly-phase variable separating transformers~~;
- 25 kVA for single-phase **variable isolating transformers** ~~and power supply units incorporating single-phase variable isolating transformers~~;
- 40 kVA for polyphase **variable isolating transformers** ~~and power supply units incorporating poly-phase variable isolating transformers~~;
- 10 kVA for single-phase **variable safety isolating transformers** ~~and power supply units incorporating single-phase variable safety isolating transformers~~;
- 16 kVA for polyphase **variable safety isolating transformers** ~~and power supply units incorporating poly-phase variable safety isolating transformers~~.

This document is applicable to **variable 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.

For **variable auto-transformers** ~~and power supply units incorporating variable auto-transformers~~:

- the **no-load output voltage** or the **rated output voltage** does not exceed 1 000 V AC or 1 415 V ripple-free DC;
- for **independent variable auto-transformers** the **rated output voltage** does exceed 50 V AC or 120 V ripple-free DC but does not exceed 250 V AC.

NOTE 3 Normally, **variable auto-transformers** ~~and power supply units~~ are intended to be associated with equipment to provide voltages different from the supply voltage for the functional ~~reasons~~ requirements of the equipment. The protection against electric shock can be provided or completed by other features of the equipment, such as the **body**.

NOTE 4 **Variable auto-transformers** ~~and power supply units incorporating variable auto-transformers~~ intended to be used by technically skilled or trained personnel are considered as **associated variable transformers** and ~~associated power supply units may~~ can have a **rated output voltage** less than 50 V AC.

For **variable separating transformers** ~~and power supply units incorporating variable separating transformers~~:

- the **no-load output voltage** or the **rated output voltage** does not exceed 1 000 V AC or 1 415 V ripple-free DC;
- for **portable variable separating transformers** the **rated output voltage** does exceed 50 V AC or 120 V ripple-free DC;
- ~~covered by this part may~~ are only **be** used where **double** or **reinforced insulation** between circuits is not required by the installation rules or by the end product standard.

NOTE 4 5 Normally, **variable separating transformers** ~~and power supply units~~ are intended to be associated with equipment to provide voltages different from the supply voltage for the functional ~~reasons~~ 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 protective earthing.

NOTE 5 6 **Variable separating transformers** ~~and power supply units incorporating variable separating transformers~~ intended to be used by technically skilled or trained personnel are considered as **associated variable transformers** and ~~associated power supply units and~~ can have a **rated output voltage** less than 50 V AC or 120 V ripple-free DC.

For **variable isolating transformers** ~~and power supply units incorporating variable isolating transformers~~:

- the **no-load output voltage** or the **rated output voltage** does not exceed 500 V AC or 708 V ripple-free DC. The **no-load output voltage** and the **rated output voltage** ~~may~~ can be up to 1 000 V AC or 1 415 V ripple-free DC for special applications or in accordance with ~~national wiring~~ the installation rules;

- for **independent variable isolating transformers** the **rated output voltage** does not exceed 250 V AC;
- are used where **double** or **reinforced insulation** between circuits is required by the installation rules or by the end product standard.

For variable safety isolating transformers ~~and power supply units incorporating safety isolating transformers~~:

- the **no-load output voltage** or the **rated output voltage** does not exceed 50 V AC or 120 V ripple-free DC;
- are used where **double** or **reinforced insulation** between circuits is required by the installation rules or by the end product standard.

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 6~~ Attention is drawn to the following, if necessary:

- **additional requirements** 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 ~~are also considered~~;
- the different conditions for transportation, storage, and operation of the **transformers** ~~are 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~~.

Future technological development of **transformers** 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 TCs 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 TC is, wherever applicable, to make use of BSPs and/or GSPs in the preparation of its publications.

2 Normative references

This clause of Part 1 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 61558-1:2017, *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:~~

For the purposes of this document, the terms and definitions given in Part 1 apply except as follows:

ISO and IEC maintain terminology 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

variable transformer

transformer having unlimited numbers of transformation ratios and adjustable by means of a movable **current collector** positioned along a continuous path of locally exposed winding turns

3.1.102

variable auto-transformer

variable transformer in which input and output voltages are derived from a common winding

3.2 General terms

Addition

3.2.101

current collector

assembly of moving contact parts which serve to transmit current from a point on the contact path to the tapping point at the bushings or terminals

3.2.102

drive

mechanical assembly used for moving the **current collector**

3.2.103

fixed winding

winding or part of the winding with no means for varying the transformation ratio

3.2.104

variable winding

winding or part of the winding with a contact path used for varying the transformation ratio

3.5 Ratings

Modification

3.5.5 is not applicable.

Addition

3.5.101

rated output voltage range

output voltage range (for polyphase **transformer** and **power supply units**, the phase-to-phase voltage) at **rated supply voltage**, **rated supply frequency**, **rated output current**, and **rated power factor** assigned to the **transformer** or **power supply unit** by the manufacturer

4 General requirements

This clause of Part 1 is applicable except as follows:

Addition

If the **current collector** ~~may not~~ cannot stay permanently in the same position it ~~has to~~ shall be marked on the **variable transformer** with the symbol IEC 60417-6263:2014-03 (see 8.11) placed adjacent to the supply information (e.g. on the rating plate).

5 General notes on tests

This clause of Part 1 is applicable except as follows:

5.3*Addition*

The test of 16.101 shall be conducted before all other tests.

6 Ratings

This clause of Part 1 is applicable except as follows:

Addition

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

- 1 000 V AC or 1 415 V ripple-free DC for **variable auto-transformers** and **variable separating transformers**;
- 500 V AC or 708 V ripple-free DC for **variable isolating transformers**; the **rated output voltage** ~~may~~ can exceed these limits in order to be in accordance with the ~~national wiring installation~~ rules, however, it shall not exceed 1 000 V AC or 1 415 V ripple-free DC;
- 250 V AC for **portable variable auto-transformers**, **portable variable separating transformers** and **independent variable isolating transformers**;
- 50 V AC or 120 V ripple-free DC for **variable safety isolating transformers**.

This document is also applicable to **variable transformers** of a **rated output voltage** of more than 1 000 V AC or 1 415 V ripple-free DC. Such **transformers**, however, are classified as special **transformers** and are subject to agreement between purchaser and manufacturer. ~~Such special variable transformers have no limitation in terms of their rated output voltage.~~

The **rated output voltage** shall exceed:

- 50 V AC or 120 V ripple-free DC for ~~variable~~ **independent variable auto-transformers** and **independent variable separating transformers**.

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

- 40 kVA for single-phase **variable auto-transformers**;
- 200 kVA for polyphase **variable auto-transformers**;
- 1 kVA for single-phase **variable separating transformers**;
- 5 kVA for polyphase **variable separating transformers**;
- 25 kVA for single-phase **variable isolating transformers**;
- 40 kVA for polyphase **variable isolating transformers**;
- 10 kVA for single-phase **variable safety isolating transformers**;
- 16 kVA for polyphase **variable safety isolating 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 **internal operational 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

This clause of Part 1 is applicable.

8 Marking and other information

This clause of Part 1 is applicable except as follows:

8.1 b)

Replacement

rated output voltage range in volts or kilovolts;

For **transformers** incorporating a rectifier, the **rated output voltage range** after the rectifier shall be marked with the arithmetic mean value. If, however, the output voltage is given as an RMS value, this shall be stated.

NOTE An RMS value is distinguished from an arithmetic mean value by the use of RMS in the marking.

8.1 h)

~~*Replacement of the first sentence by the following:*~~

~~*Relevant graphical symbols shown in 8.11 indicating the kind of **transformers**;*~~

Replacement

Replace the content up to the first semi-colon by the following:

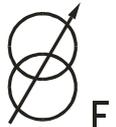
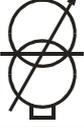
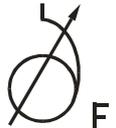
relevant graphical symbols shown in Table 101 that indicate the kind of **transformer**.

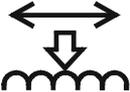
8.11

Addition

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

Table 101 – Symbols indicating the kind of transformer

Symbol or graphical symbol	Explanation or title	Identification IEC 60417
	Fail-safe variable separating variable transformer	6014-1 IEC 60417-6014:2008-02
	Non-short-circuit proof variable separating variable transformer	6014-2 IEC 60417-6014:2008-02
	Short-circuit proof variable separating variable transformer (inherently or non-inherently)	6014-3 IEC 60417-6014:2008-02
	Fail-safe variable isolating variable transformer	6015-1 IEC 60417-6015:2008-02
	Non-short-circuit proof variable isolating variable transformer	6015-2 IEC 60417-6015:2008-02
	Short-circuit proof variable isolating variable transformer (inherently or non-inherently)	6015-3 IEC 60417-6015:2008-02
	Fail-safe safety variable isolating variable transformer	6016-1 IEC 60417-6016:2008-02
	Non-short-circuit proof variable safety isolating variable transformer	6016-2 IEC 60417-6016:2008-02
	Short-circuit proof variable safety isolating variable transformer (inherently or non-inherently)	6016-3 IEC 60417-6016:2008-02
	Fail-safe variable auto-transformer	6018-1 IEC 60417-6018:2008-02
	Non-short-circuit proof variable auto-transformer	6018-2 IEC 60417-6018:2008-02

	Short-circuit proof variable auto-transformer (inherently or non-inherently)	6048-3 IEC 60417-6018:2008-02
	Power supply unit, linear	IEC 60417-6210:2013-10
	Current collector position change	IEC 60417-6263:2014-03

Addition

8.101 An instruction sheet showing the method of operation, use and maintenance shall be supplied with each **transformer** (e.g. in case of ~~variable associated~~ **variable auto-transformers** or **associated variable separating transformers**, intended to be used only by technically skilled or trained personnel).

If the **variable transformer** is not **short-circuit proof**, the information shall be given in the instruction sheet for use.

The overload protection and short-circuit protective devices in the primary circuit of a **variable transformer** cannot provide adequate overload protection in the secondary circuit. It is, therefore, always necessary to provide secondary circuit protection.

8.102 The **short-circuit voltage** at a certain position of the **current collector** shall be marked, when it is subject to an agreement between purchaser and manufacturer.

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 except as follows:

Addition

11.101 When the **transformer** is connected to the **rated supply voltage**, at the **rated supply frequency**, and loaded with the **rated output current**, at the **rated power factor**, the maximum output voltage shall not differ from the rated value by more than 10 % at the highest output voltage.

The output voltage is measured when the **transformer** is connected to the **rated supply voltage**, at the **rated supply frequency**, and loaded with the **rated output current**, at the **rated power factor** and with the **current collector** in a position which will produce the highest voltage drop in steady state condition. In case of a **variable auto-transformer**, the measurement is made with the **current collector** in the middle of the **input winding**.

The **current collector** should be placed in the most unfavourable position when tapings or elevated voltage are included in the construction.

12 No-load output voltage

This clause of Part 1 is applicable except as follows:

Addition

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:

- 1 000 V AC or 1 415 V ripple-free DC for **variable auto-transformers** and **variable separating transformers**;
- 500 V AC or 708 V ripple-free DC for **variable isolating transformers**. The **no-load output voltage** and the **rated output voltage** ~~may~~ can be up to 1 000 V AC or 1 415 V ripple-free DC for special applications;

NOTE The **no-load output voltage** and the **rated output voltage** can be up to 1 000 V AC or 1 415 V ripple-free DC in accordance with ~~national wiring~~ the installation rules.

- 50 V AC or 120 V ripple-free DC for **variable safety isolating transformers**.

For **independent variable transformers**, this **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 or 120 V ripple-free DC for ~~variable independent variable auto-transformers~~ and ~~variable independent variable separating transformers~~ ~~or 120 V ripple-free d.c.~~

Independent variable auto-transformers and **independent auto- and variable independent separating transformers** ~~and power supply units~~ intended to be used by technically skilled or trained personnel are considered as **associated variable transformers** and ~~associated power supply units and may~~ can have a **rated output voltage** less than 50 V AC.

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 and Table 103.*

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

The ratio is determined by Formula (1):

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

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 **output voltages** are measured when the **current collector** is placed in the most unfavourable position.

Table 101 102 – Output voltages ~~difference~~ ratio for auto-transformers, separating transformers and 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

For transformer types of a **rated output** power of more than 630 VA, the given ratio of **no-load output voltage** to on-load **output voltage** can exceed 5%. Such **transformers**, however, are classified as special **transformers** and are subject to agreement between purchaser and manufacturer.

The **output voltage** is measured when the **current collector** stays in the maximum end position.

Table 102 103 – Output voltages ~~difference~~ ratio for isolating transformers

Type of transformer Rated output VA	Ratio between no-load output voltage and output voltage under load %
- 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

Compliance with the requirements of 12.101 and 12.102 ~~shall be~~ 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** with the **current collector** in the same position as that used in the measurement of 11.101.

The ~~difference~~ ratio shall not exceed the values shown in Table 102 and Table 103.

13 Short-circuit voltage

This clause of Part 1 is not applicable.

Replacement

If there is a **short-circuit voltage** marking corresponding to a certain position of the **current collector**, the measured **short-circuit voltage** shall not deviate from the marked **short-circuit voltage** by more than 20 %.

Compliance is checked by measuring the **short-circuit voltage** of the **transformer** at ambient temperature.

14 Heating

This clause of Part 1 is applicable except as follows:

14.1.1 — ~~Modification of the 10th paragraph as follows:~~

Replacement

Replace the 11th paragraph as follows:

Transformers are supplied at the **rated supply voltage** and loaded with an impedance producing the **rated output current**, at the **rated power factor** and with the **current collector** repositioned to produce maximum **output voltage** (maximum voltage drop) within the range. The value of the output current is measured when steady state is established. Then the **supply voltage** is increased by 10 % and the output current is adjusted to the same value measured before. The output current is not adjusted for **independent variable transformers**. After this **configuration**, no change is made in the circuit.

In addition, for **variable auto-transformers**, the test is repeated, except the **current collector** is placed in the middle position of the **input winding**.

Addition

14.101 The temperature of the winding at the **winding/current collector** contact point in its most unfavourable position is measured by the use of thermocouples or other suitable means and shall not exceed the values shown in Table 104.

Table ~~103~~ 104 – Maximum permitted temperatures of the winding

Insulation class of winding	A	E	B	F	H
Temperatures °C	105	120	130	155	180

15 Short-circuit and overload protection

This clause of Part 1 is applicable except as follows:

15.4 Non-short-circuit proof transformers

Replacement

Replace the first paragraph as follows:

Non-short-circuit proof transformers are tested as indicated in 15.3 of Part 1 with the **current collector** placed in the most unfavourable position.

16 Mechanical strength

This clause of Part 1 is applicable except as follows:

Addition

16.101 Test of the drive

The **transformer** is loaded with an impedance producing the **rated output current** when the **current collector** is set at the maximum output voltage setting within the range. The **current collector** is moved over the entire length of the winding for 50 000 cycles at a speed of 10 cm/s \pm 2 cm/s. In the case of a motor driven **current collector** the speed shall be the highest speed provided by the motor.

NOTE A cycle is a forward and backward movement.

After the test, the **variable transformer** (including all parts of the **drive**) shall still meet all the requirements specified in this document.

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

This clause of Part 1 is applicable.

18 Insulation resistance, dielectric strength and leakage current

This clause of Part 1 is applicable except as follows:

18.4 Insulation between and within windings

Addition

During the test of insulation between winding it is allowed to isolate the **current collector** from the windings.

19 Construction

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

~~*Replacement of 19.1:*~~

~~19.1 General~~

~~NOTE To reflect different **transformer** types, this subclause is separated into the following three parts.~~

~~19.1.1 Variable auto-transformers~~

~~19.1.2 Variable separating transformers~~

~~19.1.3 Variable isolating and safety isolating transformers~~

~~19.1.1 Variable auto-transformers~~

~~19.1.1.1 Plug connected **auto-transformers** where the **rated input voltage** is higher than the **rated output voltage**, shall not have any potential to earth at the output socket higher than the **rated output voltage**.~~

~~This requirement shall be fulfilled by using one of the following methods:~~

~~19.1.1.1.1 Polarised input and output plug and socket outlet system~~

~~In this case, an instruction shall be given for not using such a **transformer** with a non-polarised plug and socket outlet system.~~

~~19.1.1.1.2 Polarity detecting device (for non polarised input and output plug and socket outlet system)~~

~~A polarity detecting device shall only energize the **output circuit** when the potential to earth at the poles of the output socket does not exceed the **rated output voltage**. The contact separation of the breaking device shall be at least of 3 mm in each pole.~~

~~NOTE A magnetic relay is an example of polarity detecting device.~~

~~*Compliance is checked by the following test:*~~

~~*The **auto-transformer** is connected to the mains supply at 1,1 times the **rated input voltage** under the most unfavorable condition of **load** and **output voltage**. The test is repeated with the polarity of the input reversed. During the test, the measured potential to earth of each pole shall not exceed the maximum **output voltage** under load (1,1 times the **rated output voltage** taking into account the permissible deviations of Clause 11).*~~

~~*Compliance is checked by measurement.*~~

~~If the polarity detecting device uses a current flowing to the earth for the detection, this current shall not exceed 0,75 mA and shall only be flowing for the period of measurement until the polarity is reversed.~~

~~Compliance is checked by measurement.~~

~~All the tests are repeated under the fault conditions of H.2.3 of Part 1. In this case the potential to earth of each pole shall not exceed 1,1 times the maximum output voltage under load for more than 5 s.~~

~~Compliance is checked by measurement.~~

~~19.1.1.2 Protection against direct contact with electrical and moving mechanical parts (contact path and drive) shall be ensured.~~

~~Compliance is checked by inspection.~~

~~19.1.2 Variable separating transformers~~

~~19.1.2.1 The input and output circuits shall be electrically separated from each other, and the construction shall be such that there is no possibility of any connection between these circuits, either directly or indirectly, via other **conductive parts**, except by deliberate action.~~

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

~~19.1.2.2 The insulation between the 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**).~~

~~19.1.2.3 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 at least **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 **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 **working voltage**).~~

~~19.1.2.3.1 Parts of **output circuits** may be connected to protective earth.~~

~~19.1.2.3.2 There shall be no connections between the **output winding** and the **body**, unless — for **associated transformers** — allowed by the relevant end product standard.~~

~~Compliance is checked by inspection.~~

~~19.1.2.4 Protection against direct contact with the **live parts** (contact path and **drive**) shall be ensured.~~

~~Compliance is checked by inspection.~~

~~19.1.3 Variable isolating and safety isolating transformers~~

~~19.1.3.1 The input and output circuits shall be electrically separated from each other, and the construction shall be such that there is no possibility of any connection between these circuits, either directly or indirectly, via other conductive parts, except by deliberate action.~~

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

~~19.1.3.2 The insulation between input and output winding(s) shall consist of double or reinforced insulation (rated for the working voltage).~~

~~In addition, the following applies:~~

- ~~— for class I transformers not intended for connection to the mains supply by means of a plug, the insulation between the input windings and the body connected to earth shall consist of at least basic insulation rated for the input voltage. The insulation between the output windings and the body connected to earth, shall consist of at least basic insulation (rated for the output voltage);~~
- ~~— for class I transformers intended for connection to the mains supply by means of a plug, the insulation between the input windings and the body shall consist of at least basic insulation, and the insulation between the output windings and the body shall consist of at least supplementary insulation (both basic and supplementary insulations rated for the working voltage);~~
- ~~— for class II transformers, the insulation between the input windings and the body shall consist of double or reinforced insulation (rated for the input voltage). The insulation between the output windings and the body shall consist of double or reinforced insulation (rated for the output voltage).~~

~~19.1.3.3 For transformers with intermediate conductive parts (e.g. the iron core) not connected to the body and located between the input and output windings the insulation between the input windings and any intermediate conductive parts shall consist of at least basic insulation, and the insulation between the output windings and any intermediate conductive parts shall consist of at least supplementary insulation (both basic and supplementary insulations rated for the working voltage).~~

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

~~NOTE 2— Basic insulation and supplementary insulation are interchangeable.~~

~~In addition, the following applies:~~

- ~~— for class I transformers, the insulation between the input and output windings via the intermediate conductive parts (even if they are connected to earth) shall consist of double or reinforced insulation (rated for the working voltage);~~
- ~~— for class II transformers, the insulation between the input windings and the body, and between the output windings and the body via the intermediate conductive parts shall consist of double or reinforced insulation (rated for the input and output voltage);~~
- ~~— for transformers different from independent (IP00), the insulation between the input and output windings via the intermediate conductive parts shall consist of double or reinforced insulation (rated for the working voltage).~~

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

- ~~— the intermediate conductive parts are normally the iron core made by laminated plates insulated each other by oxide. It is not assured that all foils are correctly connected to the earth;~~
- ~~— for transformer different from independent it is not assured that in the final applications the iron core will be connected to earth.~~

~~19.1.3.4 For class I transformers not intended for connection to the mains supply by means of a plug, the insulation between the input and output windings may consist of basic~~

~~insulation plus protective screening instead of double or reinforced insulation, provided the following conditions are complied with:~~

- ~~— the insulation between the **input winding** and the protective screen shall comply with the requirements for **basic insulation** (rated for the input voltage);~~
- ~~— the insulation between the protective screen and the **output winding** shall comply with the requirements for **basic insulation** (rated for the output voltage);~~
- ~~— the protective screen shall, unless otherwise specified, consist of a metal foil or of a wire wound screen extending at least the full width of the **input winding** and shall have no gaps or holes;~~
- ~~— where the protective screen does not cover the entire width of the **input winding**, additional adhesive tapes or equivalent insulation shall be used to ensure **double insulation** in that area;~~
- ~~— if the protective screen is made of a foil, the turns shall be insulated from each other. In case of only one turn, it shall have an isolated overlap of at least 3 mm;~~
- ~~— the wire of a wire wound screen and the lead out wire of the protective screen shall have a cross-sectional area at least corresponding to the rated current of the overload device to ensure that if a breakdown of insulation should occur, the overload protective device will open the circuit before the lead out wire is destroyed;~~
- ~~— the lead out wire shall be soldered to the protective screen or secured in an equally reliable manner.~~

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

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

~~**19.1.3.5** There shall be no connection between **output circuits** and the protective earth, unless this is allowed for **associated transformers** by the relevant equipment standard.~~

~~**19.1.3.6** 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.*~~

~~**19.1.3.7** 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 part**.*~~

~~**19.1.3.8** **Portable transformers** having a **rated output** not exceeding 630 VA shall be class II.~~

~~In case of **variable transformer** intended to be used by technically skilled or trained personal, it is allowed to have a class 1 transformer.~~

~~**19.1.3.9** For **transformers** for connection to the mains by means of a plug of any type (incorporated or not), the alternative with **basic insulation plus protective screening** is not allowed.~~

This clause of Part 1 is applicable and general requirements for the different **transformer** types are defined in the following subclauses of Part 1:

19.1.2 for **variable auto-transformers**

Addition

19.1.2.101 Protection against direct contact with electrical and moving mechanical parts (contact path and **drive**) shall be ensured.

Compliance is checked by inspection.

19.1.3 for **variable separating transformers**

Addition

19.1.3.101 Protection against direct contact with the live parts (contact path and **drive**) shall be ensured.

Compliance is checked by inspection.

19.1.4 for **variable isolating transformers** and **variable safety isolating transformers**

19.1.4.8

Addition

In case of a **variable transformer** intended to be used by technically skilled or trained personnel, it is allowed to have a class 1 **transformer**.

20 Components

This clause of Part 1 is applicable.

21 Internal wirings

This clause of Part 1 is applicable.

22 Supply connection and other external flexible cables or cords

This clause of Part 1 is applicable.

23 Terminals for external conductors

This clause of Part 1 is applicable.

24 Provisions for protective earthing

This clause of Part 1 is applicable.

25 Screws and connections

This clause of Part 1 is applicable.

26 Creepage distances, clearances and distances through insulation

This clause of Part 1 is applicable.

27 Resistance to heat, fire and tracking

This clause of Part 1 is applicable.

28 Resistance to rusting

This clause of Part 1 is applicable.

Annexes

The Annexes of Part 1 are applicable.

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Bibliography

The Bibliography of Part 1 is applicable, except as follows:

Addition

IEC 60076-11:2018, *Power transformers – Part 11: Dry-type transformers*

~~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 (all parts), *Safety of transformers, reactors, power supply units and combinations thereof*

IEC 60204-1:2016, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

IEC GUIDE 104:2019, *The preparation of safety publications and the use of basic safety publications and group safety publications*

ISO/IEC GUIDE 51:2014, *Safety aspects – Guidelines for their inclusion in standards*

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

GROUP SAFETY PUBLICATION
PUBLICATION GROUPEE DE SÉCURITÉ

**Safety of transformers, reactors, power supply units and combinations thereof –
Part 2-14: Particular requirements and tests for variable transformers and power
supply units incorporating variable transformers for general applications**

**Sécurité des transformateurs, bobines d'inductance, blocs d'alimentation et des
combinaisons de ces éléments –
Partie 2-14: Exigences particulières et essais pour les transformateurs variables
et les blocs d'alimentation incorporant des transformateurs variables pour
applications générales**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**SAFETY OF TRANSFORMERS, REACTORS, POWER
SUPPLY UNITS AND COMBINATIONS THEREOF –****Part 2-14: Particular requirements and tests for variable
transformers and power supply units incorporating
variable transformers for general applications**

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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IEC 61558-2-14 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 2012. 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) description of constructions moved to IEC 61558-1:2017;
- c) new symbols for **power supply units** with linearly regulated output voltages and required **current collector** position changes.

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

Draft	Report on voting
96/507/CDV	96/528/RVC

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/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.

NOTE When "Part 1" is mentioned in this standard, it refers to 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 variable transformers and power supply units incorporating variable transformers for general applications*.

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

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, but in certain cases including limitation of voltage and horizontal safety function for SELV in accordance with IEC 60364-4-41.

The group safety function (GSF) is necessary because of responsibility e.g. 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 needed 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 2-14: Particular requirements and tests for variable transformers and power supply units incorporating variable transformers for general applications

1 Scope

Replacement

This part of IEC 61558 deals with the safety of **variable transformers** for general applications and **power supply units** incorporating **variable transformers** for general applications. **Transformers** incorporating **electronic circuits** are also covered by this document.

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

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

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 take precedence.

This document does not apply to **transformers** covered by IEC 60076-11.

This document is applicable to **stationary** or **portable**, single-phase or polyphase, air-cooled (natural or forced) **independent** or **associated variable dry-type transformers**:

- **variable auto-transformers**;
- **variable separating transformers**;
- **variable isolating transformers**;
- **variable safety isolating transformers**.

The windings can be encapsulated or non-encapsulated.

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

The **rated output** does not exceed:

- 40 kVA for single-phase **variable auto-transformers**;
- 200 kVA for polyphase **variable auto-transformers**;
- 1 kVA for single-phase **variable separating transformers**;
- 5 kVA for polyphase **variable separating transformers**;
- 25 kVA for single-phase **variable isolating transformers**;
- 40 kVA for polyphase **variable isolating transformers**;
- 10 kVA for single-phase **variable safety isolating transformers**;
- 16 kVA for polyphase **variable safety isolating transformers**.

This document is applicable to **variable 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.

For variable auto-transformers:

- the **no-load output voltage** or the **rated output voltage** does not exceed 1 000 V AC or 1 415 V ripple-free DC;
- for **independent variable auto-transformers** the **rated output voltage** does exceed 50 V AC or 120 V ripple-free DC but does not exceed 250 V AC.

NOTE 3 Normally, **variable auto-transformers** are intended to be associated 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**.

NOTE 4 **Variable auto-transformers** intended to be used by technically skilled or trained personnel are considered as **associated variable transformers** and can have a **rated output voltage** less than 50 V AC.

For variable separating transformers:

- the **no-load output voltage** or the **rated output voltage** does not exceed 1 000 V AC or 1 415 V ripple-free DC;
- for **portable variable separating transformers** the **rated output voltage** does exceed 50 V AC or 120 V ripple-free DC;
- are only used where **double** or **reinforced insulation** between circuits is not required by the installation rules or by the end product standard.

NOTE 5 Normally, **variable separating transformers** are intended to be associated 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 protective earthing.

NOTE 6 **Variable separating transformers** intended to be used by technically skilled or trained personnel are considered as **associated variable transformers** and can have a **rated output voltage** less than 50 V AC or 120 V ripple-free DC.

For variable isolating transformers:

- the **no-load output voltage** or the **rated output voltage** does not exceed 500 V AC or 708 V ripple-free DC. The **no-load output voltage** and the **rated output voltage** can be up to 1 000 V AC or 1 415 V ripple-free DC for special applications or in accordance with the installation rules;
- for **independent variable isolating transformers** the **rated output voltage** does not exceed 250 V AC;
- are used where **double** or **reinforced insulation** between circuits is required by the installation rules or by the end product standard.

For variable safety isolating transformers:

- the **no-load output voltage** or the **rated output voltage** does not exceed 50 V AC or 120 V ripple-free DC;
- are used where **double** or **reinforced insulation** between circuits is required by the installation rules or by the end product standard.

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**.

Attention is drawn to the following, if necessary:

- additional requirements for **transformers** intended to be used in vehicles, on board ships, and aircraft, (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.

Future technological development of **transformers** can necessitate a need to increase 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 TCs 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 TC is, wherever applicable, to make use of BSPs and/or GSPs in the preparation of its publications.

2 Normative references

This clause of Part 1 is applicable except as follows:

Addition

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 Part 1 apply except as follows:

ISO and IEC maintain terminology 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

variable transformer

transformer having unlimited numbers of transformation ratios and adjustable by means of a movable **current collector** positioned along a continuous path of locally exposed winding turns

3.1.102

variable auto-transformer

variable transformer in which input and output voltages are derived from a common winding

3.2 General terms

Addition

3.2.101

current collector

assembly of moving contact parts which serve to transmit current from a point on the contact path to the tapping point at the bushings or terminals

3.2.102

drive

mechanical assembly used for moving the **current collector**

3.2.103

fixed winding

winding or part of the winding with no means for varying the transformation ratio

3.2.104

variable winding

winding or part of the winding with a contact path used for varying the transformation ratio

3.5 Ratings

Modification

3.5.5 is not applicable.

Addition

3.5.101

rated output voltage range

output voltage range (for polyphase **transformer** and **power supply units**, the phase-to-phase voltage) at **rated supply voltage**, **rated supply frequency**, **rated output current**, and **rated power factor** assigned to the **transformer** or **power supply unit** by the manufacturer

4 General requirements

This clause of Part 1 is applicable except as follows:

Addition

If the **current collector** cannot stay permanently in the same position it shall be marked on the **variable transformer** with the symbol IEC 60417-6263:2014-03 (see 8.11) placed adjacent to the supply information (e.g. on the rating plate).

5 General notes on tests

This clause of Part 1 is applicable except as follows:

5.3

Addition

The test of 16.101 shall be conducted before all other tests.

6 Ratings

This clause of Part 1 is applicable except as follows:

Addition

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

- 1 000 V AC or 1 415 V ripple-free DC for **variable auto-transformers** and **variable separating transformers**;
- 500 V AC or 708 V ripple-free DC for **variable isolating transformers**; the **rated output voltage** can exceed these limits in order to be in accordance with the installation rules, however, it shall not exceed 1 000 V AC or 1 415 V ripple-free DC;
- 250 V AC for **portable variable auto-transformers**, **portable variable separating transformers** and **independent variable isolating transformers**;
- 50 V AC or 120 V ripple-free DC for **variable safety isolating transformers**.

This document is also applicable to **variable transformers** of a **rated output voltage** of more than 1 000 V AC or 1 415 V ripple-free DC. Such **transformers**, however, are classified as special **transformers** and are subject to agreement between purchaser and manufacturer.

The **rated output voltage** shall exceed:

- 50 V AC or 120 V ripple-free DC for **independent variable auto-transformers** and **independent variable separating transformers**.

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

- 40 kVA for single-phase **variable auto-transformers**;
- 200 kVA for polyphase **variable auto-transformers**;
- 1 kVA for single-phase **variable separating transformers**;
- 5 kVA for polyphase **variable separating transformers**;
- 25 kVA for single-phase **variable isolating transformers**;
- 40 kVA for polyphase **variable isolating transformers**;
- 10 kVA for single-phase **variable safety isolating transformers**;
- 16 kVA for polyphase **variable safety isolating 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 **internal operational 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

This clause of Part 1 is applicable.

8 Marking and other information

This clause of Part 1 is applicable except as follows:

8.1 b)

Replacement

rated output voltage range in volts or kilovolts;

For **transformers** incorporating a rectifier, the **rated output voltage range** after the rectifier shall be marked with the arithmetic mean value. If, however, the output voltage is given as an RMS value, this shall be stated.

NOTE An RMS value is distinguished from an arithmetic mean value by the use of RMS in the marking.

8.1 h)

Replacement

Replace the content up to the first semi-colon by the following:

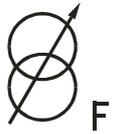
relevant graphical symbols shown in Table 101 that indicate the kind of **transformer**.

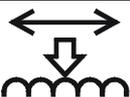
8.11

Addition

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

Table 101 – Symbols indicating the kind of transformer

Symbol or graphical symbol	Explanation or title	Identification IEC 60417
	Fail-safe variable separating transformer	IEC 60417-6014:2008-02
	Non-short-circuit proof variable separating transformer	IEC 60417-6014:2008-02
	Short-circuit proof variable separating transformer (inherently or non-inherently)	IEC 60417-6014:2008-02
	Fail-safe variable isolating transformer	IEC 60417-6015:2008-02
	Non-short-circuit proof variable isolating transformer	IEC 60417-6015:2008-02
	Short-circuit proof variable isolating transformer (inherently or non-inherently)	IEC 60417-6015:2008-02
	Fail-safe safety variable isolating transformer	IEC 60417-6016:2008-02
	Non-short-circuit proof variable safety isolating transformer	IEC 60417-6016:2008-02
	Short-circuit proof variable safety isolating transformer (inherently or non-inherently)	IEC 60417-6016:2008-02
	Fail-safe variable auto-transformer	IEC 60417-6018:2008-02
	Non-short-circuit proof variable auto-transformer	IEC 60417-6018:2008-02

	Short-circuit proof variable auto-transformer (inherently or non-inherently)	IEC 60417-6018:2008-02
	Power supply unit, linear	IEC 60417-6210:2013-10
	Current collector position change	IEC 60417-6263:2014-03

Addition

8.101 An instruction sheet showing the method of operation, use and maintenance shall be supplied with each **transformer** (e.g. in case of **associated variable auto-transformers** or **associated variable separating transformers**, intended to be used only by technically skilled or trained personnel).

If the **variable transformer** is not **short-circuit proof**, the information shall be given in the instruction sheet for use.

The overload protection and short-circuit protective devices in the primary circuit of a **variable transformer** cannot provide adequate overload protection in the secondary circuit. It is, therefore, always necessary to provide secondary circuit protection.

8.102 The **short-circuit voltage** at a certain position of the **current collector** shall be marked, when it is subject to an agreement between purchaser and manufacturer.

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 except as follows:

Addition

11.101 When the **transformer** is connected to the **rated supply voltage**, at the **rated supply frequency**, and loaded with the **rated output current**, at the **rated power factor**, the maximum output voltage shall not differ from the rated value by more than 10 % at the highest output voltage.

The output voltage is measured when the **transformer** is connected to the **rated supply voltage**, at the **rated supply frequency**, and loaded with the **rated output current**, at the **rated power factor** and with the **current collector** in a position which will produce the highest voltage drop in steady state condition. In case of a **variable auto-transformer**, the measurement is made with the **current collector** in the middle of the **input winding**.

The **current collector** should be placed in the most unfavourable position when tapings or elevated voltage are included in the construction.

12 No-load output voltage

This clause of Part 1 is applicable except as follows:

Addition

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:

- 1 000 V AC or 1 415 V ripple-free DC for **variable auto-transformers** and **variable separating transformers**;
- 500 V AC or 708 V ripple-free DC for **variable isolating transformers**. The **no-load output voltage** and the **rated output voltage** can be up to 1 000 V AC or 1 415 V ripple-free DC for special applications;

NOTE The **no-load output voltage** and the **rated output voltage** can be up to 1 000 V AC or 1 415 V ripple-free DC in accordance with the installation rules.

- 50 V AC or 120 V ripple-free DC for **variable safety isolating transformers**.

For **independent variable transformers**, this **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 or 120 V ripple-free DC for **independent variable auto-transformers** and **independent variable separating transformers**.

Independent variable auto-transformers and **independent variable separating transformers** intended to be used by technically skilled or trained personnel are considered as **associated variable transformers** and can have a **rated output voltage** less than 50 V AC.

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 and 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.

*The **output voltages** are measured when the **current collector** is placed in the most unfavourable position.*

Table 102 – Output voltage ratio for auto-transformers, separating transformers and 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

For **transformer** types of a **rated output** power of more than 630 VA, the given ratio of **no-load output voltage** to on-load **output voltage** can exceed 5%. Such **transformers**, however, are classified as special **transformers** and are subject to agreement between purchaser and manufacturer.

The **output voltage** is measured when the **current collector** stays in the maximum end position.

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 %
- 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

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** with the **current collector** in the same position as that used in the measurement of 11.101.

The ratio shall not exceed the values shown in Table 102 and Table 103.

13 Short-circuit voltage

This clause of Part 1 is not applicable.

Replacement

If there is a **short-circuit voltage** marking corresponding to a certain position of the **current collector**, the measured **short-circuit voltage** shall not deviate from the marked **short-circuit voltage** by more than 20 %.

Compliance is checked by measuring the **short-circuit voltage** of the **transformer** at ambient temperature.

14 Heating

This clause of Part 1 is applicable except as follows:

14.1.1

Replacement

Replace the 11th paragraph as follows:

Transformers are supplied at the **rated supply voltage** and loaded with an impedance producing the **rated output current**, at the **rated power factor** and with the **current collector** repositioned to produce maximum **output voltage** (maximum voltage drop) within the range. The value of the output current is measured when steady state is established. Then the **supply voltage** is increased by 10 % and the output current is adjusted to the same value measured before. The output current is not adjusted for **independent variable transformers**. After this configuration, no change is made in the circuit.

In addition, for **variable auto-transformers**, the test is repeated, except the **current collector** is placed in the middle position of the **input winding**.

Addition

14.101 The temperature of the winding at the **current collector** contact point in its most unfavourable position is measured by the use of thermocouples or other suitable means and shall not exceed the values shown in Table 104.

Table 104 – Maximum permitted temperatures of the winding

Insulation class of winding	A	E	B	F	H
Temperatures °C	105	120	130	155	180

15 Short-circuit and overload protection

This clause of Part 1 is applicable except as follows:

15.4 Non-short-circuit proof transformers

Replacement

Replace the first paragraph as follows:

Non-short-circuit proof transformers are tested as indicated in 15.3 of Part 1 with the **current collector** placed in the most unfavourable position.

16 Mechanical strength

This clause of Part 1 is applicable except as follows:

Addition

16.101 Test of the drive

The **transformer** is loaded with an impedance producing the **rated output current** when the **current collector** is set at the maximum output voltage setting within the range. The **current collector** is moved over the entire length of the winding for 50 000 cycles at a speed of 10 cm/s \pm 2 cm/s. In the case of a motor driven **current collector** the speed shall be the highest speed provided by the motor.

NOTE A cycle is a forward and backward movement.

After the test, the **variable transformer** (including all parts of the **drive**) shall still meet all the requirements specified in this document.

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

This clause of Part 1 is applicable.

18 Insulation resistance, dielectric strength and leakage current

This clause of Part 1 is applicable except as follows:

18.4 Insulation between and within windings

Addition

During the test of insulation between winding it is allowed to isolate the **current collector** from the windings.

19 Construction

This clause of Part 1 is applicable and general requirements for the different **transformer** types are defined in the following subclauses of Part 1:

19.1.2 for **variable auto-transformers**

Addition

19.1.2.101 Protection against direct contact with electrical and moving mechanical parts (contact path and **drive**) shall be ensured.

Compliance is checked by inspection.

19.1.3 for **variable separating transformers**

Addition

19.1.3.101 Protection against direct contact with the live parts (contact path and **drive**) shall be ensured.

Compliance is checked by inspection.

19.1.4 for **variable isolating transformers** and **variable safety isolating transformers**

19.1.4.8

Addition

In case of a **variable transformer** intended to be used by technically skilled or trained personnel, it is allowed to have a class 1 **transformer**.

20 Components

This clause of Part 1 is applicable.

21 Internal wiring

This clause of Part 1 is applicable.

22 Supply connection and other external flexible cables or cords

This clause of Part 1 is applicable.

23 Terminals for external conductors

This clause of Part 1 is applicable.

24 Provisions for protective earthing

This clause of Part 1 is applicable.

25 Screws and connections

This clause of Part 1 is applicable.

26 Creepage distances, clearances and distances through insulation

This clause of Part 1 is applicable.

27 Resistance to heat, fire and tracking

This clause of Part 1 is applicable.

28 Resistance to rusting

This clause of Part 1 is applicable.

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Annexes

The Annexes of Part 1 are applicable.

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Bibliography

The Bibliography of Part 1 is applicable, except as follows:

Addition

IEC 60076-11:2018, *Power transformers – Part 11: Dry-type transformers*

IEC 61558 (all parts), *Safety of transformers, reactors, power supply units and combinations thereof*

IEC 60204-1:2016, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

IEC GUIDE 104:2019, *The preparation of safety publications and the use of basic safety publications and group safety publications*

ISO/IEC GUIDE 51:2014, *Safety aspects – Guidelines for their inclusion in standards*

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

SÉCURITÉ DES TRANSFORMATEURS, BOBINES D'INDUCTANCE, BLOCS D'ALIMENTATION ET DES COMBINAISONS DE CES ÉLÉMENTS –**Partie 2-14: Exigences particulières et essais pour les transformateurs variables et les blocs d'alimentation incorporant des transformateurs variables pour applications générales**

AVANT-PROPOS

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L'IEC 61558-2-14 a été établie par le comité d'études 96 de l'IEC: Transformateurs, bobines d'inductance, blocs d'alimentation et combinaisons de ces éléments. Il s'agit d'une Norme internationale.

Cette deuxième édition annule et remplace la première édition parue en 2012. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) ajustement de la structure et des références conformément à l'IEC 61558-1:2017;
- b) description des constructions déplacées vers l'IEC 61558-1:2017;

- c) nouveaux symboles pour les **blocs d'alimentation** avec des tensions secondaires régulées linéairement et modifications de position du **collecteur de courant** exigées.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
96/507/CDV	96/528/RVC

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/publications/.

Il a le statut de publication groupée de sécurité conformément au Guide IEC 104.

Cette norme internationale doit être utilisée conjointement avec l'IEC 61558-1:2017.

NOTE Toute référence à la "Partie 1" dans cette norme renvoie à l'IEC 61558-1:2017.

Le présent document complète ou modifie les articles correspondants de l'IEC 61558-1:2017, de façon à transformer cette publication en norme IEC: *Exigences particulières et essais pour les transformateurs variables et les blocs d'alimentation incorporant des transformateurs variables pour applications générales*.

Une liste de toutes les parties de la série IEC 61558, publiées sous le titre général *Sécurité des transformateurs, bobines d'inductance, blocs d'alimentation et des combinaisons de ces éléments*, se trouve sur le site web de l'IEC.

Les futures normes de cette série porteront dorénavant le nouveau titre général cité ci-dessus. Le titre des normes existant déjà dans cette série sera mis à jour lors d'une prochaine édition.

Lorsque le présent document indique "*addition*", "*modification*" ou "*remplacement*", le texte correspondant de l'IEC 61558-1:2017 doit être adapté en conséquence.

Dans le présent document, les caractères d'imprimerie suivants sont utilisés:

- exigences proprement dites: caractères romains;
- *modalités d'essais*: caractères italiques;
- commentaires: petits caractères romains.

Dans le texte du présent document, les mots en **gras** sont définis à l'Article 3.

Les paragraphes, notes, figures et tableaux qui s'ajoutent à ceux de l'IEC 61558-1:2017 sont numérotés à partir de 101; les annexes supplémentaires sont désignées AA, BB, etc.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous webstore.iec.ch dans les données relatives au document recherché. À cette date, le document sera

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

INTRODUCTION

Le comité d'études 96 de l'IEC dispose d'une fonction groupée de sécurité conformément au Guide IEC 104 pour les transformateurs autres que ceux destinés à alimenter des réseaux de distribution, en particulier les transformateurs et les **blocs d'alimentation** destinés à permettre l'application de mesures de protection contre les chocs électriques telles que définies par le comité d'études 64, mais dans certains cas incluant la limitation de la tension et la fonction de sécurité horizontale pour les TBTS conformément à l'IEC 60364-4-41.

La fonction groupée de sécurité (FGS) est nécessaire en raison de la responsabilité, par exemple, pour la très basse tension de sécurité (TBTS) conformément à l'IEC 61140:2016, 5.2.6 et à l'IEC 60364-4-41:2005, 414.3.1 ou pour les circuits de commande conformément à l'IEC 60204-1:2016, 7.2.4.

La fonction groupée de sécurité est nécessaire pour chaque partie de l'IEC 61558-2 car différentes normes de la série IEC 61558 peuvent être combinées dans une construction mais dans certains cas sans limitation de la **puissance secondaire assignée**.

Par exemple, un **autotransformateur** conforme à l'IEC 61558-2-13 peut être conçu avec un circuit TBTS séparé conformément aux exigences particulières de l'IEC 61558-2-6 concernant les exigences générales de l'IEC 61558-1.

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SÉCURITÉ DES TRANSFORMATEURS, BOBINES D'INDUCTANCE, BLOCS D'ALIMENTATION ET DES COMBINAISONS DE CES ÉLÉMENTS –

Partie 2-14: Exigences particulières et essais pour les transformateurs variables et les blocs d'alimentation incorporant des transformateurs variables pour applications générales

1 Domaine d'application

Remplacement

La présente partie de l'IEC 61558 traite de la sécurité des **transformateurs variables** pour applications générales et des **blocs d'alimentation** incorporant des **transformateurs variables** pour applications générales. Les **transformateurs** incorporant des **circuits électroniques** sont également couverts par le présent document.

NOTE 1 La sécurité comprend des aspects électriques, thermiques, mécaniques et chimiques.

Sauf spécification contraire, dans la suite du document, le terme "**transformateur**" couvre les **transformateurs variables** pour applications générales et les **blocs d'alimentation** incorporant des **transformateurs variables** pour applications générales.

Pour les **blocs d'alimentation** (linéaires), le présent document s'applique. **Pour les blocs d'alimentation à découpage**, l'IEC 61558-2-16 s'applique avec le présent document. Lorsque deux exigences sont en contradiction, c'est la plus sévère qui prévaut.

Le présent document ne s'applique pas aux **transformateurs** couverts par l'IEC 60076-11.

Le présent document couvre les **transformateurs secs variables, indépendants ou associés, fixes ou mobiles**, monophasés ou polyphasés, à refroidissement par air (circulation naturelle ou forcée).

- **autotransformateurs variables;**
- **transformateurs variables à enroulements séparés;**
- **transformateurs variables de séparation de circuits;**
- **transformateurs variables de sécurité.**

Les enroulements peuvent être enrobés ou non enrobés.

La **tension primaire assignée** ne dépasse pas 1 000 V en courant alternatif, et la **fréquence d'alimentation assignée** ainsi que les **fréquences de fonctionnement internes** ne dépassent pas 500 Hz.

La **puissance assignée** ne dépasse pas:

- 40 kVA pour les **autotransformateurs variables** monophasés;
- 200 kVA pour les **autotransformateurs variables** polyphasés;
- 1 kVA pour les **transformateurs variables à enroulements séparés** monophasés;
- 5 kVA pour les **transformateurs variables à enroulements séparés** polyphasés;
- 25 kVA pour les **transformateurs variables de séparation de circuits** monophasés;
- 40 kVA pour les **transformateurs variables de séparation de circuits** polyphasés;
- 10 kVA pour les **transformateurs variables de sécurité** monophasés;
- 16 kVA pour les **transformateurs variables de sécurité** polyphasés.

Le présent document s'applique aux **transformateurs variables** ne comportant pas de limitation de la **puissance assignée** faisant l'objet d'un accord entre l'acheteur et le constructeur.

NOTE 2 Les **transformateurs** destinés à alimenter des réseaux de distribution ne sont pas inclus dans le domaine d'application.

Pour les **autotransformateurs variables**:

- La **tension secondaire à vide** ou la **tension secondaire assignée** ne dépasse pas 1 000 V en courant alternatif ou 1 415 V en courant continu lissé;
- pour les **autotransformateurs variables indépendants**, la **tension secondaire assignée** dépasse 50 V en courant alternatif ou 120 V en courant continu lissé mais sans excéder 250 V en courant alternatif.

NOTE 3 Normalement, les **autotransformateurs variables** sont destinés à être associés à un équipement pour lui fournir des tensions différentes de la tension d'alimentation pour répondre à des exigences fonctionnelles. La protection contre les chocs électriques peut être obtenue ou complétée par d'autres particularités de l'équipement, telles que la **masse**.

NOTE 4 Les **autotransformateurs variables** destinés à être utilisés par un personnel techniquement qualifié ou averti sont considérés comme des **transformateurs variables associés** et peuvent avoir une **tension secondaire assignée** inférieure à 50 V en courant alternatif.

Pour les **transformateurs variables à enroulements séparés**:

- la **tension secondaire à vide** ou la **tension secondaire assignée** ne dépasse pas 1 000 V en courant alternatif ou 1 415 V en courant continu lissé;
- pour les **transformateurs variables mobiles à enroulements séparés**, la **tension secondaire assignée** dépasse 50 V en courant alternatif ou 120 V en courant continu lissé;
- ils sont utilisés uniquement lorsqu'une **double isolation** ou une **isolation renforcée** entre les circuits n'est pas exigée par les règles d'installation ou par la norme du produit final.

NOTE 5 Normalement, les **transformateurs variables à enroulements séparés** sont destinés à être associés à un équipement pour lui fournir des tensions différentes de la tension d'alimentation pour répondre à des exigences fonctionnelles. La protection contre les chocs électriques peut être obtenue ou complétée par d'autres particularités de l'équipement, telles que la **masse**. Certaines parties des **circuits secondaires** peuvent être raccordées à la mise à la terre de protection.

NOTE 6 Les **transformateurs variables à enroulements séparés** destinés à être utilisés par un personnel techniquement qualifié ou averti sont considérés comme des **transformateurs variables associés** et peuvent avoir une **tension secondaire assignée** inférieure à 50 V en courant alternatif ou 120 V en courant continu lissé.

Pour les **transformateurs variables de séparation de circuits**:

- la **tension secondaire à vide** ou la **tension secondaire assignée** ne dépasse pas 500 V en courant alternatif ou 708 V en courant continu lissé. La **tension secondaire à vide** et la **tension secondaire assignée** peuvent atteindre 1 000 V en courant alternatif ou 1 415 V en courant continu lissé pour des applications particulières ou conformément aux règles d'installation;
- pour les **transformateurs variables de séparation de circuits indépendants**, la **tension secondaire assignée** ne dépasse pas 250 V en courant alternatif;
- ils sont utilisés lorsqu'une **double isolation** ou une **isolation renforcée** entre les circuits est exigée par les règles d'installation ou par la norme du produit final.

Pour les **transformateurs variables de sécurité**:

- la **tension secondaire à vide** ou la **tension secondaire assignée** ne dépasse pas 50 V en courant alternatif ou 120 V en courant continu lissé;
- ils sont utilisés lorsqu'une **double isolation** ou une **isolation renforcée** entre les circuits est exigée par les règles d'installation ou par la norme du produit final.

Le présent document ne s'applique pas aux circuits externes et à leurs composants destinés à être connectés aux bornes d'entrée et de sortie des **transformateurs**.

L'attention est attirée sur les points suivants, le cas échéant:

- des exigences complémentaires pour les **transformateurs** destinés à être utilisés dans des véhicules ou à bord de navires ou d'aéronefs (provenant d'autres normes en vigueur, règlements nationaux, etc.);
- des mesures pour protéger les **enveloppes** et les composants qu'elles contiennent contre les influences du milieu extérieur comme la moisissure, la vermine, les termites, le rayonnement solaire, le givre;
- les différentes conditions de transport, de stockage et de fonctionnement des **transformateurs**;
- des exigences supplémentaires conformes à d'autres normes appropriées et règles nationales peuvent être applicables aux **transformateurs** destinés à être utilisés dans des environnements particuliers.

Il est possible que des évolutions technologiques futures des **transformateurs** nécessitent d'augmenter la limite supérieure de la fréquence. En attendant, le présent document peut être utilisé pour fournir des recommandations.

La présente publication groupée de sécurité portant sur les recommandations relatives à la sécurité est avant tout destinée à être utilisée en tant que norme en matière de sécurité des produits qui sont cités dans le domaine d'application, mais elle est également destinée à être utilisée par les comités d'études dans le cadre de l'élaboration de publications pour des produits similaires à ceux cités dans le domaine d'application de la présente publication groupée de sécurité, conformément aux principes établis dans le Guide IEC 104 et le Guide ISO/IEC 51.

L'une des responsabilités d'un comité d'études consiste, le cas échéant, à utiliser les publications fondamentales de sécurité et/ou les publications groupées de sécurité dans le cadre de l'élaboration de ses publications.

2 Références normatives

L'Article de la Partie 1 s'applique, à l'exception de ce qui suit:

Addition

IEC 61558-1:2017, *Sécurité des transformateurs, bobines d'inductance, blocs d'alimentation et des combinaisons de ces éléments – Partie 1: Exigences générales et essais*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions de la Partie 1 s'appliquent, à l'exception de ce qui suit:

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse <http://www.electropedia.org/>
- ISO Online browsing platform: disponible à l'adresse <http://www.iso.org/obp>

3.1 Transformateurs

Addition

3.1.101

transformateur variable

transformateur possédant un nombre illimité de rapports de transformation en charge, réglable au moyen d'un **collecteur de courant** mobile placé le long d'un chemin continu de spires d'enroulement exposées localement

3.1.102

autotransformateur variable

transformateur variable dans lequel les tensions primaire et secondaire sont dérivées à partir d'un enroulement commun

3.2 Termes généraux