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INTERNATIONAL STANDARD

NORME INTERNATIONALE

GROUP SAFETY PUBLICATION

PUBLICATION GROUPÉE DE SÉCURITÉ

Safety of transformers, reactors, power supply units and combination thereof – Part 2-12: Particular requirements and tests for constant voltage transformers and power supply units for constant voltage

Sécurité des transformateurs, bobines d'inductance, blocs d'alimentation et des combinaisons de ces éléments – Partie 2-12: Exigences particulières et essais pour les transformateurs à tension constante et les blocs d'alimentation pour tension constante

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CONTENTS

FOREWORD 3
1 Scope 5
2 Normative references 7
3 Terms and definitions 7
4 General requirements 7
5 General notes on tests 7
6 Ratings 7
7 Classification 8
8 Marking and other information 8
9 Protection against electric shock 9
10 Change of input voltage setting 9
11 Output voltage and output current under load 9
12 No-load output voltage 10
13 Short-circuit voltage 11
14 Heating 11
15 Short-circuit and overload protection 11
16 Mechanical strength 12
17 Protection against harmful ingress of dust, solid objects and moisture 12
18 Insulation resistance, dielectric strength and leakage current 12
19 Construction 13
20 Components 17
21 Internal wiring 17
22 Supply connection and other external flexible cables or cords 17
23 Terminals for external conductors 17
24 Provision for protective earthing 17
25 Screws and connections 17
26 Creepage distances, clearances and distances through insulation 17
27 Resistance to heat, fire and tracking 18
28 Resistance to rusting 18
Annexes 19
Annex C (normative) 19
Annex D (normative) 19
Annex L (normative) 19
Annex R (normative) 19
Bibliography 20

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 2-12: Particular requirements and tests for constant voltage transformers and power supply units for constant voltage

FOREWORD

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International Standard IEC 61558-2-12 has been prepared by IEC technical committee 96: Transformers, reactors, power supply units, and combination thereof.

This second edition cancels and replaces the first edition published in 2001. It constitutes a technical revision. The main changes consist of updating this part in accordance with IEC 61558-1:2009.

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

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

FDIS	Report on voting
96/253/FDIS	96/266/RVD

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

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

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

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

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

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

Where a particular subclause of Part 1 is not mentioned in this part, that subclause applies as far as is reasonable. Where this part states "addition", "modification" or "replacement", the relevant text of Part 1 has to be adopted accordingly.

In this part, the following print types are used:

- requirements proper: in roman type;
- *test specifications: in italic type*;
- explanatory matter: in smaller roman type.

In the text of this part the words in **bold** are defined in Clause 3.

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

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

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

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

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

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

Part 2-12: Particular requirements and tests for constant voltage transformers and power supply units for constant voltage

1 Scope

Replacement:

This part of IEC 61558 deals with the safety of **constant voltage transformers** for general applications and **power supply units** for **constant voltage** for general applications. **Constant voltage transformers** incorporating **electronic circuits** are also covered by this standard.

NOTE 1 Safety includes electrical, thermal and mechanical aspects.

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

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

- **constant voltage auto-transformers;**
- **constant voltage separating transformers;**
- **constant voltage isolating transformers;**
- **constant voltage safety isolating transformers.**

The windings may be encapsulated or non-encapsulated.

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

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

The **rated supply voltage** does not exceed 1 000 V a.c., the **rated supply frequency** does not exceed 500 Hz, the **internal operating resonant frequency** does not exceed 30 kHz and the **internal operating frequency** does not exceed 100 MHz.

The **rated output** does not exceed:

- 40 kVA for single-phase **constant voltage auto-transformers**;
- 200 kVA for poly-phase **constant voltage auto-transformers**;
- 25 kVA for single-phase **constant voltage separating transformers** and **constant voltage isolating transformers**;
- 40 kVA for poly-phase **constant voltage separating transformers** and **constant voltage isolating transformers**;
- 10 kVA for single-phase **constant voltage safety isolating transformers**;

– 16 kVA for poly-phase **constant voltage safety isolating transformers**.

This part is applicable to **transformers** without limitation of the **rated output** subject to an agreement between the purchaser and the manufacturer.

NOTE 2 Transformers intended to supply distribution networks are not included in the scope.

Where applicable to constant voltage auto-transformers

- the **no-load output voltage** or the **rated output voltage** does not exceed 1 000 V a.c. or 1 415 V ripple-free d.c., and for **independent constant voltage auto-transformers,** the **no-load output voltage** and the **rated output voltage** exceed 50 V a.c. or 120 V ripple-free d.c.;
- **constant voltage auto-transformers** covered by this part are used only in applications where no **insulation** between circuits is required by the installation rules or by the end product standard.

Where applicable to **constant voltage separating transformers**

- the **no-load output voltage** or the **rated output voltage** does not exceed 1 000 V a.c. or 1 415 V ripple-free d.c., and for **independent constant voltage separating transformers,** the **no-load output voltage** and the **rated output voltage** exceed 50 V a.c. or 120 V ripple-free d.c.;
- **constant voltage separating transformers** covered by this part are used only in applications where **double** or **reinforced insulation** between circuits is not required by the installation rules or by the end product standard.

Where applicable to **constant voltage isolating transformers**

- the **no-load output voltage** or the **rated output voltage** does exceed 50 V a.c. or 120 V ripple-free d.c. and where applicable, does not exceed 500 V a.c. or 708 V ripple-free d.c. The **no-load output voltage** and the **rated output voltage** may be up to 1 000 V a.c. or 1 415 V ripple-free d.c. for special applications;
- **constant voltage isolating transformers** covered by this part are used only in applications where **double** or **reinforced insulation** between circuits is required by the installation rules or by the end product standard.

Where applicable to **constant voltage safety isolating transformers**

- the **no-load output voltage** or the **rated output voltage** does not exceed 50 V a.c. or 120 V ripple-free d.c.;
- **constant voltage safety isolating transformers** covered by this part are used only in applications where **double** or **reinforced insulation** between circuits is required by the installation rules or by the end product standard.

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

NOTE 3 Attention is drawn to the following:

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

NOTE 4 Future technological development of **transformers** may necessitate a need to increase the upper limit of the frequencies, until then this part may be used as a guidance document.

2 Normative references

This clause of Part 1 is applicable.

3 Terms and definitions

This clause of Part 1 is applicable except as follows:

Addition:

3.101
constant voltage transformer
transformer intended to limit the influence of the input voltage variations

NOTE This type of **transformer** may also limit the influence of transients.

3.102
regulation tolerance
deviation in per cent of the **rated output voltage** when the **constant voltage transformer** is supplied within the **rated supply voltage** variation

3.103
internal operating resonant frequency
frequency produced within a **constant voltage transformer**

4 General requirements

This clause of Part 1 is applicable.

5 General notes on tests

This clause of Part 1 is applicable.

6 Ratings

This clause of Part 1 is applicable except as follows:

Addition:

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

– 1 000 V a.c. or 1 415 V ripple-free d.c. for **constant voltage auto-transformers** and **constant voltage separating transformers**;
– 250 V a.c. for single-phase **portable constant voltage isolating transformers**;
– 400 V a.c. for polyphase **portable constant voltage isolating transformers**, and
– 500 V a.c. or 708 V ripple-free d.c. for **constant voltage isolating transformers**. For **constant voltage isolating transformers**, the **rated output voltage** may be up to 1 000 V a.c. or 1 415 V ripple-free d.c. to be in accordance with the national wiring rules or for a special purpose;
– 50 V a.c. or 120 V ripple-free d.c. for **constant voltage safety isolating transformers**.

The **rated output voltage** shall exceed:

– 50 V a.c. or 120 V ripple-free d.c. for **independent constant voltage auto-transformers, constant voltage separating transformers** and **constant voltage isolating transformers**.

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

– 40 kVA for single-phase **constant voltage auto-transformers**,
– 200 kVA for polyphase **constant voltage auto-transformers**,
– 25 kVA for single-phase **constant voltage separating** and **isolating transformers**,
– 40 kVA for polyphase **constant voltage separating** and **isolating transformers**,
– 10 kVA for single-phase **constant voltage safety isolating transformers**,
– 16 kVA for polyphase **constant voltage safety isolating transformers**,

except for **constant voltage transformers** subject to an agreement between the purchaser and the manufacturer.

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

6.104 The rated value of the output **regulation tolerance** shall be given at the **rated supply voltage** range, the **rated output,** and the power factor = 1.

6.105 For **constant voltage independent transformers,** the input voltage variation shall not be less than 10 %.

6.106 The **internal operating resonant frequency** shall not exceed 30 kHz.

6.107 The **internal operating frequency** shall not exceed 100 MHz.

Compliance with 6.101 to 6.107 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 a) *Replacement of the first sentence by the following:*

rated supply voltage(s) and the input voltage variation in %;

8.1 b) *Replacement of the first sentence by the following:*

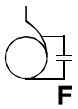
Replace the first sentence by the following:

rated output voltage(s) and the **regulation tolerance** of this voltage(s) in %;

8.1 h) *Replacement of the first sentence by the following:*

relevant graphical symbols shown in 8.11 indicating the kind of **transformer**;

8.11 *Addition:*

Symbol or graphical symbol	Explanation or title	Identification
	**Fail-safe constant voltage separating transformer**	IEC 60417-6011
	**Non-short-circuit-proof constant voltage separating transformer**	IEC 60417-6011
	**Short-circuit-proof constant voltage separating transformer**	IEC 60417-6011
	**Fail-safe constant voltage isolating transformer**	IEC 60417-6012
	**Non-short-circuit-proof constant voltage isolating transformer**	IEC 60417-6012
	**Short-circuit-proof constant voltage isolating transformer**	IEC 60417-6012
	**Fail-safe constant voltage safety isolating transformer**	IEC 60417-6013
	**Non-short-circuit-proof constant voltage safety isolating transformer**	IEC 60417-6013
	**Short-circuit-proof constant voltage safety isolating transformer**	IEC 60417-6013
	**Fail-safe constant voltage auto-transformer**	IEC 60417-6017
	**Non-short-circuit-proof constant voltage auto-transformer**	IEC 60417-6017
	**Short-circuit-proof constant voltage auto-transformer**	IEC 60417-6017

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:

11.1 *Replacement:*

11.1 When the **transformer** is connected to the **rated supply voltage** plus or minus the input voltage variation declared by the manufacturer, at the **rated supply frequency**, and loaded with an impedance resulting in the **rated output** at the **rated output voltage** and, for a.c., at the **rated power factor**, the output voltage shall not differ from the rated value by more than the **regulation tolerance**.

*Compliance is checked by measuring the output voltage when steady-state conditions are established. During the test, the **transformer** is connected to the **rated supply voltage**, plus or minus the highest input voltage variation, at the **rated supply frequency**, and loaded with an impedance resulting in the **rated output** at the **rated output voltage** and the **rated power factor**.*

*For **transformers** incorporating a rectifier, the output voltage shall be measured at the terminals of the d.c. circuit by means of a voltmeter giving the arithmetical mean value, unless the effective (r.m.s.) value is specifically stated (see 8.1).*

*For **transformers** with more than one **rated supply voltage**, the requirement is applicable for each of the **rated supply voltages**.*

*For **transformers** with multiple **output windings**, the loads are applied to every multiple section simultaneously, unless otherwise declared.*

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 a.c. or 1 415 V ripple-free d.c. for **constant voltage auto-transformers** and **constant voltage separating transformers**;

– 250 V a.c. for single-phase **portable constant voltage isolating transformers**;

– 400 V a.c. for polyphase **portable constant voltage isolating transformers**, and

– 500 V a.c. or 708 V ripple-free d.c. for other **constant voltage isolating transformers**.

  In this case, the **no-load output voltage** may be up to 1 000 V a.c. or 1 415 V ripple-free d.c. to be in accordance with the national wiring rules or for special purpose;

– 50 V a.c. or 120 V ripple-free d.c. for **constant voltage safety isolating transformers**.

The **no-load output voltage** shall exceed:

– 50 V a.c. or 120 V ripple-free d.c. for **constant voltage independent auto-**, **separating** and **isolating transformers**.

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

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

The difference between the **no-load output voltage** measured in this clause and the **output voltage** under load measured during the test of Clause 11, expressed as a percentage of the latter voltage, shall not exceed 10 %.

NOTE The ratio is defined as follows: $\frac{U_{\text{no-load}} - U_{\text{load}}}{U_{\text{load}}} \times 100\ \%$

where $U_{\text{no-load}}$ is the no-load output voltage and U_{load} is the output voltage under load.

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

13 Short-circuit voltage

This clause of Part 1 is applicable.

14 Heating

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

14.1 *Replacement of the 10th paragraph starting with "***Transformers** are supplied...*" by the following:*

The **constant voltage transformers** are connected to the **rated supply voltage** and loaded with an impedance resulting in the **rated output**, at the **rated output voltage** and, for a.c., at the **rated power factor**. The supply voltage is then increased to the value of the highest input voltage variation declared by the manufacturer. After this voltage increase, no change or adjustment is made in the circuit. The test is repeated under no-load condition with the highest or the lowest input voltage variation if this is a more unfavorable condition.

15 Short-circuit and overload protection

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

15.1 *Replacement of the 2nd paragraph starting with " Compliance is checked..." by the following:*

*Compliance is checked by inspection and by the following tests, which are carried out immediately after the test according to 14.1, at the same ambient temperature, and without changing the position of the **constant voltage transformer** at the maximum value of the **rated supply voltage** designed for the **constant voltage transformer**.*

15.2 *Replacement:*

***Inherently short-circuit-proof constant voltage transformers** shall be tested as follows:*

*Before starting the test, it is necessary to determine the highest output current of the **constant voltage transformer** at the maximum value of the supply voltage designed for the **constant voltage transformer**. The **constant voltage transformer** is then loaded with the maximum output current or the **output winding(s)** short-circuited, whichever results in the maximum temperature.*