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Edition 3.0 2023-06
EXTENDED VERSION

INTERNATIONAL STANDARD

colour inside

This extended version of IEC 61558-2-7:2023 includes the content of the references made to IEC 61558-1:2017

GROUP SAFETY PUBLICATION

Safety of transformers, reactors, power supply units and combinations thereof – Part 2-7: Particular requirements and tests for transformers and power supply units for toys





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CONTENTS

FOREWORD 9
INTRODUCTION TO IEC 61558-1:2017 12
INTRODUCTION 15
1 Scope 16
2 Normative references 17
3 Terms and definitions 20
3.1 Transformers 20
3.2 General terms 24
3.3 Operations and protections 25
3.4 Circuits and windings 27
3.5 Ratings 28
3.6 No-load values 30
3.7 Insulation 30
3.8 Touch current and protective earthing conductor current 34
4 General requirements 34
5 General notes on tests 34
6 Ratings 37
7 Classification 37
8 Marking and other information 38
9 Protection against electric shock 44
9.1 General 44
9.2 Protection against contact with hazardous-live-parts 45
9.2.1 Determination of hazardous-live-parts 45
9.2.2 Accessibility to hazardous-live-parts 45
9.2.3 Accessibility to non hazardous-live-part 48
9.3 Protection against hazardous electrical discharge 48
10 Change of input voltage setting 49
11 Output voltage and output current under load 49
12 No-load output voltage 50
13 Short-circuit voltage 51
14 Heating 51
14.1 General requirements 51
14.1.1 Temperature-rise test 51
14.1.2 Alternative temperature-rise test 53
14.1.3 Determination of steady-state conditions 56
14.2 Application of 14.1 or 14.3 according to the insulation system 58
14.3 Accelerated ageing test for undeclared class of insulation system 59
14.3.1 General 59
14.3.2 Heat run 59
14.3.3 Vibration 59
14.3.4 Moisture treatment 60
14.3.5 Measurements 60
15 Short circuit and overload protection 60
15.1 General requirements 60
15.1.1 Short circuit and overload test method 60

15.1.2 Alternative short circuit and overload test method 62
15.2 Inherently short-circuit proof transformers 62
15.3 Non-inherently short-circuit proof transformers 62
15.4 Non-short-circuit proof transformers 64
15.5 Fail-safe transformers 64
16 Mechanical strength 65
16.1 General 65
16.2 Stationary transformers 66
16.3 Portable transformers (except portable transformers with integral pins for introduction in socket-outlet in the fixed wiring) 66
16.4 Portable transformers provided with integral pins for introduction in socket-outlets of the fixed wiring 66
16.4.1 General requirements 66
16.4.2 Portable transformers provided with integral pins according to EN 50075 (IEC plug type C) for introduction in socket-outlets of the fixed wiring 67
16.5 Additional requirements for transformers to be used in vehicles and railway applications 68
16.5.1 Transformers to be used in vehicles and railway applications 68
16.5.2 Test requirements for the transportation of transformers 69
17 Protection against harmful ingress of dust, solid objects and moisture 71
17.1 Degrees of protection provided by enclosures (IP code) 71
17.1.1 General requirements 71
17.1.2 Tests on transformers with enclosure 72
17.2 Humidity treatment 74
18 Insulation resistance, dielectric strength and leakage current 75
18.1 General 75
18.2 Insulation resistance 75
18.3 Dielectric strength test 75
18.4 Insulation between and within windings 77
18.5 Touch current and protective earthing conductor current 77
18.5.1 General 77
18.5.2 Touch current 78
18.5.3 Protective earthing conductor current 79
19 Construction 80
19.1 General construction 80
19.2 Flammability of materials 80
19.3 Short-circuit characteristics of portable transformers 80
19.4 Class II transformer contact prevention of accessible conductive parts 80
19.5 Class II transformer insulation reassembling after service 81
19.6 Loosening of wires, screws or similar parts 81
19.7 Resistor or capacitor connection with accessible conductive parts 81
19.8 Bridging of separated conductive parts by resistors or capacitors 82
19.9 Insulating material separating input and output windings 82
19.10 Accidental contact protection against hazardous-live-parts provided by isolating coating 83
19.11 Insulating material of handles, operating levers, knobs and similar parts 84
19.12 Winding construction 84
19.13 Fixing of handles, operating levers and similar parts 88
19.14 Fixing of covers providing protection against electric shock 88

19.15 Strain on fixed socket-outlets caused by pin-transformers connection 88
19.16 Portable transformers for use in irregular or harsh conditions 88
19.17 Drain hole of transformers protected against ingress of water 88
19.18 Plug connected transformers protected against ingress of water 88
19.19 Flexible cable or flexible cord connection for class I portable transformers 88
19.20 SELV- and PELV-circuit separation of live parts 89
19.21 Protection against contact for FELV-circuit 89
19.22 Protective earthing regarding class II transformers 90
19.23 Protective earthing regarding class III transformers 90
20 Components 91
21 Internal wiring 97
22 Supply connection and other external flexible cables or cords 97
23 Terminals for external conductors 104
24 Provisions for protective earthing 106
25 Screws and connections 106
26 Creepage distances, clearances and distances through insulation 109
26.1 General 109
26.2 Creepage distances and clearances 109
26.2.1 General 109
26.2.2 Windings covered with adhesive tape 109
26.2.3 Uncemented insulationing parts 109
26.2.4 Cemented insulating parts 110
26.2.5 Enclosed parts (e.g. by impregnation or potting) 110
26.3 Distance through insulation 112
27 Resistance to heat, fire and tracking 122
27.1 General 122
27.2 Resistance to heat 122
27.2.1 General 122
27.2.2 External accessible parts 122
27.2.3 Internal parts 123
27.3 Resistance to abnormal heat under fault conditions 123
27.4 Resistance to fire 124
27.4.1 General 124
27.4.2 External accessible parts 125
27.4.3 Internal parts 125
27.5 Resistance to tracking 126
28 Resistance to rusting 126
Annex A (normative) Measurement of creepage distances and clearances 127
Annex B (normative) Testing a series of transformers 131
B.1 General 131
B.2 Requirements 131
B.3 Constructional inspection 132
Annex C (void) 133
Annex D (void) 134
Annex E (normative) Glow-wire test 135
E.1 General 135
E.2 Severity 135

E.3 Conditioning 135
E.4 Test procedure 135
Annex F (normative) Requirements for manually operated switches which are parts of transformers assembly 136
F.1 General 136
F.2 Switches tested as a separate component 136
F.3 Switches tested as part of the transformer 136
Annex G (normative) Tracking test 139
G.1 General 139
G.2 Test specimen 139
G.3 Test apparatus 139
G.4 Procedure 139
Annex H (normative) Electronic circuits 140
H.1 General 140
H.2 General notes on tests (addition to Clause 5) 140
H.3 Short circuit and overload protection (addition to Clause 15) 140
H.4 Creepage distances, clearances and distances through insulation (addition to Clause 26) 142
Annex I (informative) Dimensions for rectangular cross-section connectors of transformers, basic dimensions and coordination 144
Annex J (normative) Measuring network for touch-currents 147
Annex K (normative) Insulated winding wires 148
K.1 General 148
K.2 Type tests 148
K.2.1 General 148
K.2.2 Dielectric strength test 148
K.2.3 Flexibility and adherence 148
K.2.4 Heat shock 149
K.2.5 Retention of dielectric strength after bending 149
K.3 Testing during manufacturing 150
K.3.1 General 150
K.3.2 Routine test 150
K.3.3 Sampling test 150
Annex L (normative) Routine tests (production tests) 151
L.1 General 151
L.2 Protective earthing continuity test 151
L.3 Checking of no-load output voltage 151
L.4 Dielectric strength test 151
L.5 Checking of protective devices mounting 152
L.6 Visual inspection 152
L.7 Repetition test after routine dielectric strength test 152
Annex M (informative) Examples to be used as a guide for 19.1 153
M.1 General 153
M.2 Coil-former 153
M.2.1 Concentric type 153
M.2.2 Side-by-side type 154
M.3 Windings 154
M.3.1 Without screen 154

M.3.2 With screen 155
Annex N (informative) Examples for checking points of dielectric strength test voltages 156
Annex O (void) 158
Annex P (informative) Examples for measurement points of creepage distances and clearances 159
Annex Q (informative) Explanation of IP numbers for degrees of protection 162
Q.1 General 162
Q.2 Degrees of protection against access to hazardous parts and against solid foreign objects 162
Q.3 Degrees of protection against ingress of water 164
Annex R (normative) Explanations of the application of 6.1.2.2.1 of IEC 60664-1:2007 165
R.1 Impulse dielectric test 165
R.2 Example 165
Annex S (void) 167
Annex T (void) 168
Annex U (void) 169
Annex V (informative) Symbols to be used for thermal cut-outs 170
V.1 General 170
V.2 Non-self-resetting thermal cut-out (see 3.3.4) 170
V.3 Self-resetting thermal cut-out (see 3.3.3) 170
Annex W (normative) Coated printed circuit boards 171
W.1 Preamble 171
W.2 General 171
W.3 Cold 171
W.4 Rapid change of temperature 171
W.5 Additional tests 171
Bibliography 172
Index of defined terms 174

Figure 1 – IEC 61558 principle 13
Figure 2 – Mounting box for flush-type transformer 36
Figure 3 – Test pin (see IEC 61032, test probe 13) 46
Figure 4 – Standard test finger (see IEC 61032, test probe B) 47
Figure 101 – Small test finger 48
Figure 5 – Example of back-to-back method – Single phase 55
Figure 6 – Example of back-to-back method – Three phase 56
Figure 102 – Arrangement for impact test for transformers (see 16.101) 65
Figure 7 – Amplitude spectrum density for random testing 69
Figure 8 – Normalised spectrum of shock 70
Figure 9 – Test voltage sequence 77
Figure 10 – Test configuration: single-phase equipment on star TN or TT system 79
Figure 11 – Abrasion resistance test for insulating coated layers 83
Figure 12 – Flexing test apparatus 102
Figure 13 – Test arrangement for checking mechanical withstanding of insulating materials in thin sheet layers 114
Figure 14 – Ball-pressure apparatus 122

Figure A.1 – Example 1 127
Figure A.2 – Example 2 128
Figure A.3 – Example 3 128
Figure A.4 – Example 4 128
Figure A.5 – Example 5 129
Figure A.6 – Example 6 129
Figure A.7 – Example 7 130
Figure A.8 – Example 8 130
Figure H.1 – Example of an electronic circuit with low-power points 143
Figure J.1 – Measuring network for touch-current 147
Figure M.1 – Examples for concentric type constructions 153
Figure M.2 – Examples for side-by-side type constructions 154
Figure M.3 – Examples for winding constructions without screen 154
Figure M.4 – Examples for wrapped winding constructions 155
Figure M.5 – Examples for winding constructions with screen 155
Figure N.1 – Transformer of class I construction with metal enclosure 156
Figure N.2 – Transformer of class II construction with metal enclosure 157
Figure N.3 – Transformer of class II construction with enclosure of insulating material 157
Figure P.1 – Transformer of class I construction 159
Figure P.2 – Transformer of class I construction with earthed metal screen 160
Figure P.3 – Transformer of class II construction with metal enclosure 160
Figure P.4 – Transformer of class II construction with enclosure of insulating material 161
Figure V.1 – Restored by manual operation 170
Figure V.2 – Restored by disconnection of the supply 170
Figure V.3 – Thermal link (see 3.3.5) 170
Figure V.4 – Self-resetting thermal cut-out 170

Table 1 – Symbols used on equipment or in instructions 41
Table 101 – Symbols indicating the kind of transformer 43
Table 2 – Values of maximum temperatures in normal use 51
Table 2 – Values of maximum temperatures in normal use 57
Table 3 – Explanation of the maximum winding temperatures required in Table 2 58
Table 4 – Test temperature and testing time (in days) per cycle 59
Table 5 – Maximum values of temperatures under short-circuit or overload conditions 61
Table 5 – Maximum values of temperatures under short-circuit or overload conditions 62
Table 6 – Values of T and k for fuses 63
Table 7 – Pull force on pins 67
Table 8 – Conditions for vibration testing (random) 68
Table 9 – Amplitude spectrum density ASD values for accelerated life testing 68
Table 10 – Frequency values depending on the weight of the specimen 69
Table 11 – Excitation values for vibration testing 69
Table 12 – Solid-object-proof transformer test 72
Table 13 – Values of insulation resistance 75

Table 14 – Table of dielectric strength test voltages 76
Table 15 – Limits for currents 79
Table 16 – Nominal cross-sectional areas of external flexible cables or cords 99
Table 17 – Pull and torque to be applied to external flexible cables or cords fixed to stationary and portable transformers 103
Table 18 – Torque to be applied to screws and connections 107
Table 19 – Torque test on glands 108
Table 20 – Clearances in mm 115
Table 21 – Creepage distances in mm 116
Table 22 – Distance through insulation in mm 117
Table 23 – Creepage distances and clearance between terminals for external connection 118
Table 24 – Values of FIW wires with minimum overall diameter and minimum test voltages according to the total enamel increase 120
Table A.1 – Width of groove values depending on the pollution degree 127
Table F.1 – Peak surge current of additional loads 137
Table I.1 – Dimensions of rectangular copper connectors 145
Table K.1 – Mandrel diameter 149
Table K.2 – Oven temperature 149
Table Q.1 – Degrees of protection against access to hazardous parts indicated by the first characteristic numeral 163
Table Q.2 – Degrees of protection against solid foreign objects indicated by the first characteristic numeral 163
Table Q.3 – Degrees of protection indicated by the second characteristic numeral 164
Table R.1 – Impulse test voltage according to 6.1.2.2.1 of IEC 60664-1:2007 165

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 2-7: Particular requirements and tests for transformers and power supply units for toys

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 extended version (EXV) of the official IEC Standard provides the user with the comprehensive content of the Standard.

IEC 61558-2-7:2023 EXV includes the content of IEC 61158-2-7:2023, and the references made to IEC 61558-1:2017.

The specific content of IEC 61558-2-7:2023 is displayed on a blue background.

IEC 61558-2-7 has been prepared by IEC technical committee 96: Transformers, reactors, power supply units and combinations thereof. It is an International Standard.

This third edition cancels and replaces the second edition published in 2007. This edition constitutes a technical revision.

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

a) adjustment of structure and references in accordance with IEC 61558-1:2017;

b) new symbol for power supply unit with linearly regulated output voltage.

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

Draft	Report on voting
96/579/FDIS	96/581/RVD

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

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

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

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

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

This document supplements or modifies the corresponding clauses in IEC 61558-1:2017, so as to convert that publication into the IEC standard: *Particular requirements and tests for transformers and power supply units for toys.*

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

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

Where this document states "*addition*", "*modification*" or "*replacement*", the relevant text of IEC 61558-1:2017 is to be adopted accordingly.

In this document, the following print types are used:

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

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

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.

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INTRODUCTION TO IEC 61558-1:2017

This document covers safety requirements for **transformers**. Where the term **transformer** is used, it covers **transformers**, **reactors** and **power supply units** where applicable.

During the development of this document, to the extent possible, the requirements of IEC 60364 (all parts) were taken into consideration, so that a **transformer** can be installed in accordance with the wiring rules contained in that document. However, national wiring rules can differ.

This document recognizes the internationally accepted levels of protection against the possible electrical, mechanical, and fire hazards caused by **transformers** operating under normal conditions in accordance with the manufacturer's instructions. It also covers abnormal conditions which can occur in practice.

A **transformer** complying with this document will not necessarily be judged to comply with the safety principles of this document if, when examined and tested, it is found to have other features that impair the level of safety covered by these requirements.

A **transformer** employing materials or having forms of construction differing from those detailed in this document may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be judged to comply with the safety principles of this document.

The document dealing with non-safety aspects of electromagnetic compatibility (EMC) of **transformers** is IEC 62041. However, that document also includes tests that can subject the **transformer** to conditions involving safety aspects.

The objective of of IEC 61558-1 is to provide a set of requirements and tests considered to be generally applicable to most types of **transformers**, and which can be called up as required by the relevant part of IEC 61558-2. IEC 61558-1 is thus not to be regarded as a specification by itself for any type of **transformer**, and its provisions apply only to particular types of **transformers** to the extent determined by the appropriate part of IEC 61558-2. IEC 61558-1 also contains normative routine tests.

Each part of IEC 61558-2 in conjunction with this document contains all the necessary requirements for the **transformer** being covered and does not contain references to other parts of IEC 61558-2. For **transformers** with a protection index IP00 and associated **transformers**, it is possible to have circuits corresponding to different parts of IEC 61558-2 within the same construction (e.g. SELV output circuit according to IEC 61558-2-6 and a 230 V output circuit according to IEC 61558-2-4). However, if the **transformer** is covered by different parts IEC 61558-2, to the extent reasonable, the relevant part of IEC 61558-2 is applied to each function/application separately. If applicable, the effect of one function on the other is taken into consideration.

If an appropriate part of IEC 61558-2 does not exist for a particular **transformer** or group of **transformer**s, the nearest applicable part may be used as a guide to the requirements and tests.

However, individual countries may wish to consider its application, to the extent reasonable, to transformers not mentioned in the IEC 61558-2 series, and to transformers designed on new principles.

Where the requirements of any of the clauses of a part of IEC 61558-2 refer to IEC 61558-1 by the phrase "This clause of Part 1 is applicable", this phrase means that all the requirements of that clause of IEC 61558-1 are applicable, except those requirements that are clearly not applicable to the particular type of **transformer** covered by that part of IEC 61558-2.

The principle for the preparation of the different parts of IEC 61558-2 is as shown in Figure 1.

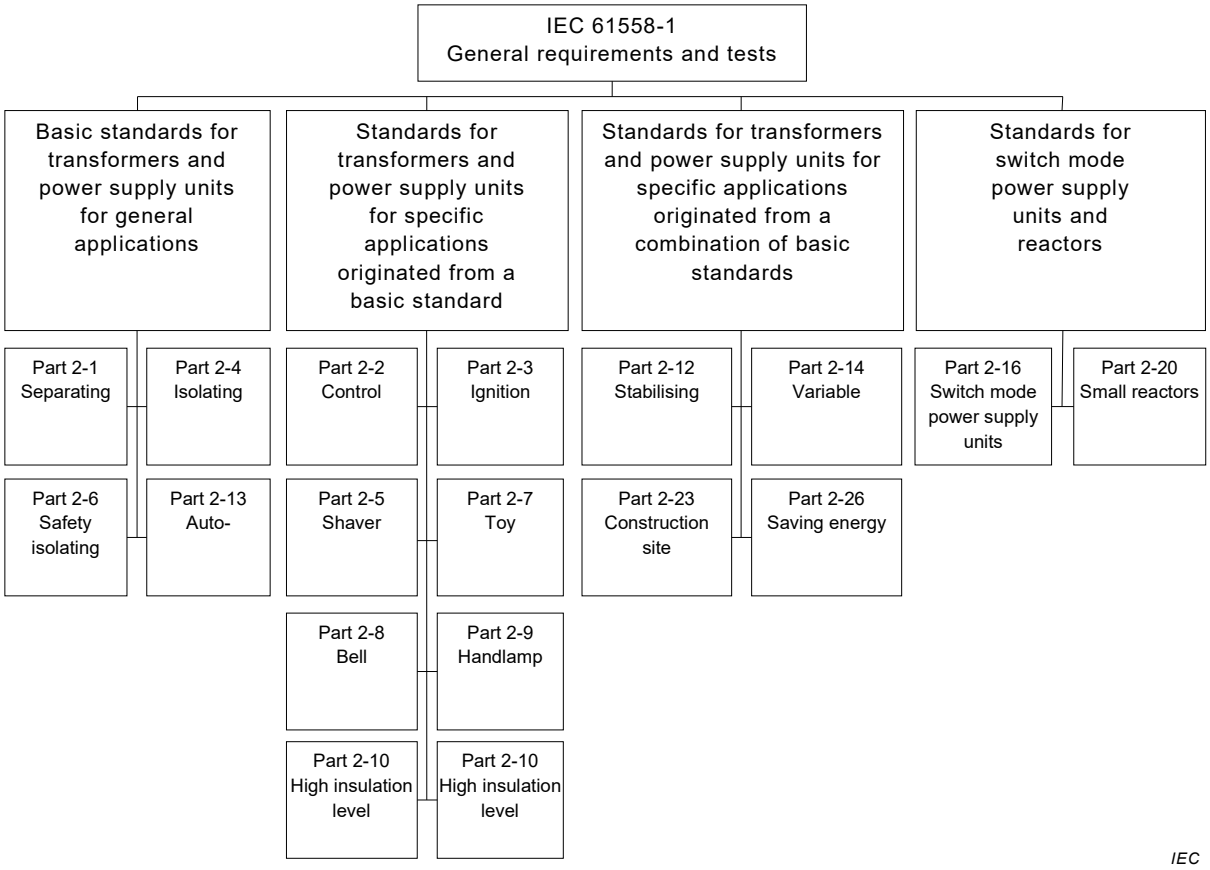


Figure 1 – IEC 61558 principle

Relevant clauses of this document (e.g. clauses dealing with thermal endurance test for windings) apply also to **transformers** forming an integral part of an appliance and which cannot be tested separately.

The IEC 61558 series consists of the following parts, under the general title *Safety of transformers, reactors, power supply units and combination thereof:*[1]

Part 1: General requirements and tests

Part 2-1: Particular requirements and tests for separating transformers for general applications

Part 2-2: Particular requirements and tests for control transformers

Part 2-3: Particular requirements and tests for ignition transformers for gas and oil burners

Part 2-4: Particular requirements and tests for isolating transformers

Part 2-5: Particular requirements and tests for shaver transformers and shaver supply units

Part 2-6: Particular requirements and tests for safety isolating transformers

Part 2-7: Particular requirements and tests for transformers for toys

Part 2-8: Particular requirements and tests for transformers for bells and chimes

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

[1] Some of the parts of this series published earlier appeared under the general title *Safety of power transformers, power supplies, reactors and similar products or Safety of power transformers, power supply units and similar or Safety of power transformers, power supply units and similar devices*. Future editions of these parts will be issued under the new general title indicated above.

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

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

Part 2-13: Particular requirements and tests for auto transformers

Part 2-14: Particular requirements and tests for variable transformers

Part 2-15: Particular requirements and tests for isolating transformers for the supply of medical locations

Part 2-16: Particular requirements and tests for switch mode power supply units and transformers for switch mode power supply units

Part 2-20: Particular requirements and tests for small reactors

Part 2-23: Particular requirements and tests for transformers and power supply units for construction sites

Part 2-26: Particular requirements and tests for transformers and power supply units all for saving energy and other purposes

Other parts are under consideration.

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 the limitation of voltage and horizontal safety function for SELV, in accordance with IEC 60364-4-41.

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

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

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

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

Part 1: General requirements and tests

1 Scope

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

NOTE 1 Safety includes electrical, thermal and mechanical aspects.

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

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

This document is applicable to **independent transformers** and **transformers for specific use**.

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

The **rated supply voltage** does not exceed 250 V AC. The **rated supply frequency** and the **internal operating frequencies** do not exceed 500 Hz.

The **rated output** does not exceed 200 VA and a **rated output current** does not exceed 10 A.

The **no-load output voltage** does not exceed 33 V AC or 46 V ripple-free DC, and the **rated output voltage** does not exceed 24 V AC or 33 V ripple-free DC.

In general, this document does not take into consideration children playing with the **transformers**.

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

Attention is drawn to the following if necessary:

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

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 technical committees in the preparation of publications for products similar to those mentioned in the scope of this group safety publication, in accordance with the principles laid down in IEC Guide 104 and ISO/IEC Guide 51.

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

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60065:2014, *Audio, video and similar electronic apparatus – Safety requirements*

IEC 60068-2-6, *Environmental testing – Part 2-6: Tests – Test FC: Vibration (sinusoidal)*

IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-31, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*

IEC 60068-2-75, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*

IEC 60076-1, *Power transformers – Part 1: General*

IEC 60076-11:2004, *Power transformers – Part 11: Dry-type transformers*

IEC TR 60083, *Plugs and socket-outlets for domestic and similar general use standardized in member countries of IEC*

IEC 60085:2007, *Electrical insulation – Thermal evaluation and designation*

IEC 60112:2003, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60127 (all parts), *Miniature fuses*

IEC 60127-3, *Miniature fuses – Part 3: Sub-miniature fuse-links*

IEC 60216 (all parts), *Electrical insulating materials – Thermal endurance properties*

IEC 60227 (all parts), *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V*

IEC 60227-1:2007, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 1: General requirements*

IEC 60227-5:2011, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 5: Flexible cables (cords)*

IEC 60245 (all parts), *Rubber insulated cables – Rated voltages up to and including 450/750 V*

IEC 60245-1:2003, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 1: General requirements*

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

IEC 60269 (all parts), *Low voltage fuses*

IEC 60269-2:2013, *Low voltage fuses – Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) – Examples of standardized systems of fuses A to K*

IEC 60269-3:2010, *Low voltage fuses – Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household or similar applications) – Examples of standardized systems of fuses A to F*

IEC 60309 (all parts), *Plugs, socket-outlets and couplers for industrial purposes*

IEC 60317 (all parts), *Specifications for particular types of windings wires*

IEC 60317-0-7:2012, *Specifications for particular types of winding wires – Part 0-7: General requirements – Fully insulated (FIW) zero-defect enamelled round copper wire with nominal conductor diameter of 0,040 mm to 1,600 mm*

IEC 60317-56, *Specifications for particular types of winding wires – Part 56: Solderable fully insulated (FIW) zero-defect polyurethane enamelled round copper wire with nominal conductor diameter 0,040 mm to 1,600 mm, class 180*

IEC 60320 (all parts), *Appliance couplers for household and similar general purposes*

IEC 60320-2-3, *Appliance couplers for household and similar general purposes – Part 2-3: Appliance couplers with a degree of protection higher than IPX0*

IEC 60384-14:2013, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*

IEC 60417*, Grapahical symbols for use on equipment*
(available at http://www.graphical-symbols.info/equipment)

IEC 60454 (all parts), *Pressure-sensitive adhesive tapes for electrical purposes*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*
IEC 60529:1989/AMD1:1999
IEC 60529:1989/AMD2:2013

IEC 60664-1:2007, *Insulation coordination for equipment within low voltage systems – Part 1: Principles, requirements and tests*

IEC 60664-3:2016, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution*

IEC 60691:2015, *Thermal-links – Requirements and application guide*

IEC 60695-2-10:2013, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60695-2-11:2014, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products*

IEC 60721-3-2, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 2: Transportation*

IEC 60730 (all parts), *Automatic electrical controls*

IEC 60730-1:2013, *Automatic electrical controls – Part 1: General requirements*

IEC 60851-3:2009, *Winding wires – Test methods: Part 3: Mechanical properties*

IEC 60851-5:2008, *Winding wires – Test methods: Part 5: Electrical properties*

IEC 60851-6:2012, *Winding wires – Test methods: Part 6: Thermal properties*

IEC 60884-1:2002, *Plugs and socket-outlets for household and similar purposes – Part 1: General requirements*
IEC 60884-1:2002/AMD1:2006
IEC 60884-1:2002/AMD2:2013

IEC 60884-2-4, *Plugs and socket-outlets for household and similar purposes – Part 2-4: Particular requirements for plugs and socket-outlets for SELV*

IEC 60898 (all parts), *Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations*

IEC 60906-1, *IEC system of plugs and socket-outlets for household and similar purposes – Part 1: Plugs and socket-outlets 16 A 250 V a.c.*

IEC 60906-3, *IEC system of plugs and socket-outlets for household and similar purposes – Part 3: SELV plugs and socket-outlets, 16 A 6 V, 12 V, 24 V, 48 V, a.c. and d.c.*

IEC 60947-7-1, *Low-voltage switchgear and controlgear – Part 7-1: Ancillary equipment – Terminal blocks for copper conductors*

IEC 60990:2016, *Methods of measurement of touch current and protective conductor current*

IEC 60998-2-1, *Connecting devices for low-voltage circuits for household and similar purposes – Part 2-1: Particular requirements for connecting devices as separate entities with screw-type clamping units*

IEC 60998-2-2, *Connecting devices for low-voltage circuits for household and similar purposes – Part 2-2: Particular requirements for connecting devices as separate entities with screwless-type clamping units*

IEC 60999-1, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm^2 up to 35 mm^2 (included)*

IEC 61032, *Protection of persons and equipment by enclosures – Probes for verification*

IEC 61058-1:2016, *Switches for appliances – Part 1: General requirements*

IEC 61058-1-1:2016, *Switches for appliances – Part 1-1: Requirements for mechanical switches*

IEC 61140:2016, *Protection against electric shock – Common aspects for installation and equipment*

IEC 61373, *Railway applications – Rolling stock equipment – Shock and vibration tests*

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

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

ISO 8820 (all parts), *Road vehicles – Fuse-links*

EN 50075:1990*, Specification for flat non-wirable two-pole plugs 2.5 A 250 V, with cord, for the connection of class II-equipment for household and similar purposes*

DIN 43671:1975*, Copper bus bars; design for continuous current*

DIN 43670:1975*, Aluminium bus bars; design for continuous current*

DIN 43670-2:1985*, Aluminium bus bars copper cladding; design for continuous current*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

NOTE Further definitions of **transformers** intended for particular use are indicated in the relevant parts of IEC 61558-2.

When the term **transformer** is used it covers **transformer**, **reactor** and **power supply unit** where applicable.

Unless otherwise specified, the terms “voltage” and “current” imply the RMS values of alternating voltage and current, and for direct voltage and current, they imply the corresponding arithmetic mean values.

"Ripple-free" is conventionally an RMS ripple voltage not more than 10 % of the DC component.

An index of often used terms and definitions is provided at the end of this document.

3.1 Transformers

3.1.1
transformer
static piece of apparatus with two or more windings which, by electromagnetic induction, transforms a system of alternating voltage and current into another system of voltage and current usually of different values and at the same frequency for the purpose of transmitting electrical power

Note 1 to entry: The term frequency also implies that the waveform remains the same.

[SOURCE: IEC 60050-421:1990, 421-01-01, modified – “power” deleted and “NOTE” added]

3.1.2
isolating transformer
transformer with **protective separation** between the **input winding(s)** and **output winding(s)**

3.1.3
safety isolating transformer
isolating transformer designed to deliver **SELV** (safety extra-low voltage) or **PELV** (protective extra-low voltage)

3.1.4
separating transformer
transformer with **input winding**(s) separated from the **output winding**(s) by at least **basic insulation**

3.1.5
auto-transformer
transformer in which **input** and **output windings** have a common part

Note 1 to entry: **Auto-transformers** may have supplementary windings or tappings for adjustment purposes.

Note 2 to entry: Transformers with windings separated at least by functional insulation and electrically connected, will be treated as **auto-transformers**.

3.1.6
associated transformer
transformer designed to supply a specific appliance or equipment, or a part of them, and being either an **incorporated transformer** or a **transformer for specific use**

3.1.6.1
incorporated transformer
associated transformer designed to be built into a specific appliance or equipment, or into a part of them, and the **enclosure** of which provides protection against electric shock

3.1.6.2
transformer for specific use
associated transformer fixed to or delivered with the appliance or equipment, without being incorporated in this appliance or equipment and having its own **enclosure** which provides protection against electric shock

3.1.7
independent transformer
transformer designed to supply unspecified appliances and intended to be used without any additional **enclosure** which provides protection against electric shock

Note 1 to entry: Such a **transformer** can be either a portable **transformer** or a stationary **transformer**.

3.1.8
void

3.1.9
short-circuit proof transformer
transformer not exceeding the specified temperature limits when overloaded or short-circuited, and which continues to meet all the requirements of this document after removal of the overload or short-circuit and is not required to operate continuously under short-circuit or overload condition

Note 1 to entry: “Continues to meet all the requirements of this document” does not imply that all types of short-circuit proof **transformers** continue to operate.