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Edition 1.1
1998-07

Edition 1:1997 consolidated with amendment 1:1998

GROUP SAFETY PUBLICATION

**Safety of power transformers, power supply units
and similar –**

**Part 1:
General requirements and tests**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**SAFETY OF POWER TRANSFORMERS, POWER SUPPLY UNITS
AND SIMILAR –****Part 1: General requirements and tests**

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical reports or guides and they are accepted by the National Committees in that sense.
- 4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
- 5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
- 6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61558-1 has been prepared by IEC technical committee 96: Small power transformers, reactors and **power supply units** and special transformers, reactors and **power supply units**: Safety requirements.

It has the status of a group safety publication in accordance with IEC Guide 104: Guide for the drafting of safety standards, and the role of Committees with safety pilot functions and safety group functions (1984).

This consolidated version of IEC 61558-1 is based on the first edition (1997) [documents 96/47/FDIS and 96/70/RVD] and its amendment 1 (1998) [documents 96/106/FDIS and 96/109/RVD].

It bears the edition number 1.1.

A vertical line in the margin shows where the base publication has been modified by amendment 1.

This part 1 is to be used in conjunction with the appropriate part 2, which contains clauses to supplement or modify the corresponding clauses of part 1, in order to provide the relevant requirements for each type of product.

This part 1 replaces Chapter I of IEC 60742 and IEC 60989.

However, individual countries may wish to consider its application, so far as is reasonable, to transformers not mentioned in part 2, and to transformers designed on new principles.

If the functions of a transformer are covered by different parts 2 of IEC 61558, the relevant part 2 is applied to each function separately, so far as is reasonable. If applicable, the influence of the function on the other is taken into account.

Annexes A, B, C, D, E, F, G, H, J, and K form an integral part of this standard.

Annexes L, M, N, P, Q, R, S, T, U and V are for information only.

In this standard, 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 the standard, the words in **bold** are defined in clause 3.

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INTRODUCTION

In general, this International Standard covers safety requirements for transformers.

When elaborating this standard, the requirements of IEC 60364 were taken into account as far as possible, so that a transformer may be installed in accordance with these wiring rules. However, national wiring rules may differ.

This standard recognizes the internationally accepted level of protection against hazards such as electrical, mechanical and fire of transformers when operated as in normal use, taking into account the manufacturer's instructions. It also covers abnormal situations which can be expected in practice.

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

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

Standards dealing with non-safety aspects of transformers are:

- CISPR 11 and CISPR 14 concerning radio interference suppression;
- IEC 61000-3-2 and IEC 61000-3-3 concerning electromagnetic compatibility.

The object of part 1 of IEC 61558 is to provide a set of requirements and tests which are considered to be generally applicable to most types of transformers, and which can be called up as required by the relevant part 2 of IEC 61558. Part 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 2.

The part 2 series, in referring to any of the clauses of part 1, specify the extent to which that part 2 is applicable and the order in which the tests are to be performed; they also include additional requirements as necessary. Each part 2 is self-contained and therefore does not contain references to other part 2.

Where the requirements of any of the clauses of part 1 are referred to in a part 2 by the phrase "This clause of part 1 is applicable", this phrase is to be interpreted as meaning that all requirements of that clause of part 1 apply, except any which are clearly inapplicable to the particular type of transformer covered by that part 2.

Each part 2 of IEC 61558 (containing requirements for a particular type of transformer) is published separately for ease of revision, and additional parts 2 will be added as and when a need for them is recognized.

SAFETY OF POWER TRANSFORMERS, POWER SUPPLY UNITS AND SIMILAR –

Part 1: General requirements and tests

1 Scope

1.1 This International Standard deals with all aspects of safety (such as electrical, thermal and mechanical) of:

- a) **Stationary** or **portable**, single-phase or polyphase, air-cooled (natural or forced) **isolating** and **safety isolating transformers, associated** or otherwise, having a **rated supply voltage** not exceeding 1 000 V a.c. and **rated frequency** not exceeding 1 MHz, the **rated output** not exceeding the following values.

NOTE 1 – For higher frequencies, this standard may be used as a guidance document.

For **isolating transformers**:

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

For **safety isolating transformers**:

- 10 kVA for single-phase transformers;
- 16 kVA for polyphase transformers.

The **no-load** output voltage and **rated output voltage** do not exceed:

- for **isolating transformers** 500 V a.c. or 708 V ripple free d.c.

NOTE 2 – For **isolating transformers**, the no-load **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 special purposes.

- for **safety isolating transformers** 50 V a.c. r.m.s. and/or 120 V ripple free d.c. between conductors or between any conductor and earth.

NOTE 3 – **Isolating** and **safety isolating transformers** are used where **double** or **reinforced insulation** between circuits is required by the installation rules or by the appliance specification (for example toys, bells, portable **tools**, handlamps).

Rated values for each type of transformer are indicated in the relevant part 2.

- b) **Stationary** or **portable**, single-phase or polyphase, air-cooled (natural or forced) **separating transformers**, auto-transformers, variable transformers and small reactors, associated or not, having a **rated supply voltage** not exceeding 1 000 V a.c., a **rated frequency** not exceeding 1 MHz, a rated no-load or load output voltage not exceeding 15 kV a.c. or d.c., and for **independent transformers** not less than 50 V a.c. and/or 120 V ripple free d.c. and a **rated output** not exceeding the following values:

- 1 kVA for single-phase transformers;
- 2 kVAR for single-phase reactors;
- 5 kVA for polyphase transformers;
- 10 kVAR for polyphase reactors;

unless otherwise specified in the relevant part 2.

NOTE 1 – **Separating transformers** are used where **double** or **reinforced insulation** between circuits is not required by the installation rules or by the appliance specification.

NOTE 2 – The technological development of transformers might imply a need to increase the higher limit of the **rated frequency**.

NOTE 3 – Normally, the transformers are intended to be associated with equipment to provide voltages different from the supply voltage for the functional requirement of the equipment. The safety insulation may be provided (or completed) by other features of the equipment, such as the **body**. Parts of **output circuits** may be connected to the **input circuit** or to protective earth.

c) **Power supply units** incorporating a transformer of types a) or b).

NOTE 1 – This may include units for transforming, rectifying, converting, frequency inverting or their combinations intended for power supplying electrical equipment, except for switch-mode power supplies.

NOTE 2 – Examples of **power supply units** are transformers, battery eliminators and converters for building-in or self-contained. In the latter case they can even be provided with integrated pins, intended to be introduced into fixed socket-outlets.

NOTE 3 – Requirements for transformers for switch-mode power supplies are contained in IEC 61558-2-17.

1.2 This standard is applicable to **dry type transformers**. The windings may be encapsulated or non-encapsulated.

NOTE 1 – For transformers filled with liquid dielectric or pulverised material, such as sand, requirements are under consideration.

This standard is also applicable to transformers associated with specific items of equipment, to the extent decided upon by the relevant IEC technical committees.

Transformers incorporating electronic circuits are also covered by this standard.

This standard does not apply to external circuits and their components connected to terminals or socket-outlets of the transformer.

NOTE 2 – Examples are wiring, fuses and switches.

NOTE 3 – Attention is drawn to the fact that:

- for transformers intended to be used in vehicles or on board ships or aircraft, additional requirements may be necessary;
- for transformers intended to be used in tropical countries, special requirements may be necessary;
- in locations where special environmental conditions prevail, particular requirements may be necessary in accordance with IEC 60364-5-51.

2 Normative references

The following normative documents contain provision which, through reference in this text, constitute provisions of this part of IEC 61558. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreement based on this part of IEC 61558 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(421):1990, *International Electrotechnical Vocabulary (IEV) – Chapter 421: Power transformers and reactors*

IEC 60051, *Direct acting indicating analogue electrical measuring instruments and their accessories*

IEC 60065:1985, *Safety requirements for mains operated electronic and related apparatus for household and similar general use*

IEC 60068-2-2:1974, *Environmental testing – Part 2: Tests – Test B: Dry heat*

IEC 60068-2-6:1995, *Environmental testing – Part 2: Tests – Test Fc and guidance: Vibration (sinusoidal)*

IEC 60068-2-32:1975, *Environmental testing – Part 2: Tests – Test Ed: Free fall (procedure 1)*

IEC 60068-2-63:1991, *Environmental testing – Part 2: Tests – Test Eg: Impact, spring hammer*

IEC 60076-1:1993, *Power transformers – Part 1: General*

IEC 60083:1975, *Plugs and socket-outlets for domestic and similar general use – Standards*

IEC 60085:1984, *Thermal evaluation and classification of electrical insulation*

IEC 60112:1979, *Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions*

IEC 60127, *Miniature fuses*

IEC 60216, *Guide for the determination of thermal endurance properties of electrical insulating materials*

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

IEC 60245, *Rubber insulated cables of rated voltages up to and including 450/750 V*

IEC 60269-2:1986, *Low voltage fuses – Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application)*

IEC 60269-2-1:1987, *Low voltage fuses – Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) – Sections I to III*

IEC 60269-3:1987, *Low voltage fuses – Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household and similar applications)*

IEC 60269-3-1:1994, *Low voltage fuses – Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household and similar applications) – Sections I to IV*

IEC 60309, *Plugs, socket-outlets and couplers for industrial purposes*

IEC 60317, *Specifications for particular types of windings wires*

IEC 60320, *Appliance couplers for household and similar general purposes*

IEC 60364-4-41:1992, *Electrical installations of buildings – Part 4: Protection for safety – Chapter 41: Protection against electrical shock*

IEC 60364-5-51:1994, *Electrical installations of buildings – Part 5: Selection and erection of electrical equipment – Chapter 51: Common rules*

IEC 60384-14:1993, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*

IEC 60417:1973, *Graphical symbols for use on equipment. Index, survey and compilation of the single sheets*

IEC 60449:1973, *Voltage bands for electrical installations of buildings*

IEC 60454, *Specification for pressure-sensitive adhesive tapes for electrical purposes*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*

IEC 60536:1976, *Classification of electrical and electronic equipment with regard to protection against electric shock*

IEC 60536-2:1992, *Classification of electrical and electronic equipment with regard to protection against electric shock – Part 2: Guidelines to requirements for protection against electric shock*

IEC 60664-1:1992, *Insulation co-ordination for equipment within low voltage systems – Part 1: Principles, requirements and tests*

IEC 60664-3:1992, *Insulation co-ordination for equipment within low voltage systems – Part 3: Use of coating to achieve insulation co-ordination of printed board assemblies*

IEC 60691:1993, *Thermal-links – Requirements and application guide*

IEC 60695-2-1/0:1994, *Fire hazard testing – Part 2: Test methods – Section 1/sheet 0: Glow-wire test methods – General*

IEC 60695-2-1/1:1994, *Fire hazard testing – Part 2: Test methods – Section 1/sheet 1: Glow-wire end-product test and guidance*

IEC 60707:1981, *Method of test for the determination of the flammability of solid electrical insulating materials when exposed to an igniting source*

IEC 60730-1:1993, *Automatic electrical controls for household and similar use – Part 1: General requirements*

IEC 60738-1:1982, *Directly heated positive step-function temperature coefficient thermistors – Part 1: Generic specification*

IEC 60851, *Methods of test for windings wires*

IEC 60884-1:1994, *Plugs and socket-outlets for household and similar purposes – Part 1: General requirements*

IEC 60884-2-4:1993, *Plugs and socket-outlets for household and similar purposes – Part 2: Particular requirements for plugs and socket-outlets for SELV*

IEC 60898:1995, *Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations*

IEC 60906-1:1986, *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 60906-3:1994, *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 60947-7-1:1989, *Low-voltage switchgear and controlgear – Part 7: Ancillary equipment – Section 1: Terminal blocks for copper conductors*

IEC 60990:1990, *Methods of measurement of touch-current and protective conductor current*

IEC 60998-1:1990, *Connecting devices for low voltage circuits for household and similar purposes – Part 1: General requirements*

IEC 60998-2-1:1990, *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 60998-2-2:1991, *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*

<https://www.intertek.com/standards/iec/60999-1-1990>
IEC 60999-1:1990, *Connecting devices – Safety requirements for screw-type and screwless-type clamping units for electrical copper conductors – Part 1: General requirements and particular requirements for conductors from 0,5 mm² up to 35 mm² (included)*

IEC 61000-3-2:1995, *Electromagnetic compatibility (EMC) – Part 3: Limits – Section 2: Limitation of emission of harmonic currents in low-voltage power supply systems for equipment with rated current ≤ 16 A*

IEC 61000-3-3:1994, *Electromagnetic compatibility (EMC) – Part 3: Limits – Section 3: Limitation of voltage fluctuation and flicker in low-voltage power supply systems for equipment with rated current ≤ 16 A*

IEC 61032:1990, *Test probes to verify protection by enclosures*

IEC 61058-1:1990, *Switches for appliances – Part 1: General requirements*

IEC 61140:1992, *Protection against electric shock. Common aspects for installations and equipment*

ISO 3:1973, *Preferred numbers – Series of preferred numbers*

ISO 4046: 1978, *Paper, board, pulp and related terms – Vocabulary*

ISO 8820, *Road vehicles – Blade type fuse-links*

3 Definitions

Further definitions of transformers intended for particular use are indicated in the relevant parts 2.

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

When the terms voltage and current are used, they imply, for alternating voltages and currents, the r.m.s. values, unless otherwise specified; for direct voltages and currents, they imply the arithmetic mean value, unless otherwise specified.

For the purpose of this International Standard, the following definitions apply:

3.1 Transformers

3.1.1 (power) transformer: A 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. [IEV 421-01-01]

NOTE – Toroidal transformers are included in that definition.

3.1.2 isolating transformer: A transformer with **protective separation** between the **input** and **output windings**.

3.1.3 safety isolating transformer: An **isolating transformer** designed to supply **SELV** (safety extra-low voltage) or **PELV** (protective extra-low voltage) circuits.

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

3.1.5 flush-type transformer: A transformer designed to be mounted in a flush-type mounting box.

3.1.6 associated transformer: A transformer designed to supply specific appliances or equipment or part of them, and either incorporated in or not incorporated in, but specially designed to be used only with the specific appliance(s) or equipment.

3.1.7 incorporated transformer: An **associated transformer** which is designed to be built into a specific appliance or equipment, the **enclosure** of which provides protection against electric shock.

3.1.8 transformer for specific use: An **associated transformer** which, without being incorporated in an appliance or equipment, is fixed to or delivered with the appliance or equipment.

3.1.9 short-circuit proof transformer: A transformer in which the temperature does not exceed the specified limits when the transformer is overloaded or short-circuited, and which continues to meet all requirements of this standard after the removal of the overload or short-circuit.