

INTERNATIONAL STANDARD

IEC 61558-1

Second edition
2005-09

GROUP SAFETY PUBLICATION

**Safety of power transformers, power supplies,
reactors and similar products –**

**Part 1:
General requirements and tests**

*This **English-language** version is derived from the original **bilingual** publication by leaving out all French-language pages. Missing page numbers correspond to the French-language pages.*



Reference number
IEC 61558-1:2005(E)

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**Part 1:
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International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE **XH**

For price, see current catalogue

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**SAFETY OF POWER TRANSFORMERS, POWER SUPPLIES,
REACTORS AND SIMILAR PRODUCTS –****Part 1: General requirements and tests**

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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International Standard IEC 61558-1 has been prepared by IEC technical committee 96: Small power transformers, reactors and power supply units and similar products

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

This second edition of IEC 61558-1 cancels and replaces the first edition (1997), amendment 1 (1998) and IS 01. This new edition represents a complete revision of the previous edition. The changes were necessitated by the introduction of new technology and implementation of requirements from equipment committees.

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

FDIS	Report on voting
96/224/FDIS	96/228/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 second edition of Part 1 is only to be used in conjunction with parts 2 based on this edition. The parts 2 contain clauses to supplement or modify the corresponding clauses of this Part 1 in order to provide the relevant requirements for each type of transformer.

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

NOTE Annex U contains the optional t_w system (marking, requirements and tests).

IEC 61558 consists of the following parts, under the general title *Safety of power transformers, power supplies, reactors and similar products*:¹⁾

- Part 1: General requirements and tests
- Part 2-1: Particular requirements for separating transformers for general use
- Part 2-2: Particular requirements for control transformers
- Part 2-3: Particular requirements for ignition transformers for gas and oil burners
- Part 2-4: Particular requirements for isolating transformers for general use
- Part 2-5: Particular requirements for shaver transformers and shaver supply units
- Part 2-6: Particular requirements for safety isolating transformers for general use
- Part 2-7: Particular requirements for transformers for toys
- Part 2-8: Particular requirements for bell and chime transformers
- Part 2-9: Particular requirements for transformers for class III handlamps for tungsten filament lamps
- Part 2-12: Particular requirements for constant voltage transformers
- Part 2-13: Particular requirements for auto-transformers for general use
- Part 2-14: Particular requirements for variable transformers (*in preparation*)
- Part 2-15: Particular requirements for isolating transformers for the supply of medical locations
- Part 2-16: Particular requirements for switch mode power supplies and transformers for switch mode power supplies (*in preparation*)

¹⁾ Some of the parts of this series published earlier appeared under the general title *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 2-17: Particular requirements for transformers for switch mode power supplies

Part 2-19: Particular requirements for perturbation attenuation transformers

Part 2-20: Particular requirements for small reactors

Part 2-23: Particular requirements for transformers for construction sites

Other parts are under consideration.

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.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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.

INTRODUCTION

This International Standard covers safety requirements for **transformers**. Where the term **transformer** is used, it covers **transformers**, **reactors** and **power supplies** where applicable.

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

This standard 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 may occur in practice.

A **transformer** complying with this standard will not necessarily be judged to comply with the safety principles of this standard 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 standard 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 standard.

The standard dealing with non-safety aspects of electromagnetic compatibility (EMC) of **transformers** is IEC 62041: *Power transformers, power supply units, reactors and similar products – EMC requirements*. However, that standard also includes tests which may subject the **transformer** to conditions involving the safety aspects.

The objective of Part 1 of IEC 61558 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 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. Part 1 of IEC 61558 also contains normative routine tests.

Each part 2 in conjunction with Part 1 contains all the necessary requirements for the **transformer** being covered and does not contain references to other parts 2. For **transformers** with a protection index IP00 and associated **transformers**, it is possible to have circuits corresponding to different parts 2 within the same construction (e.g. SELV output circuit according to Part 2-6 and 230 V output circuit according to Part 2-4). However, if the **transformer** is covered by different parts 2 of IEC 61558, to the extent reasonable, the relevant part 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 2 for a particular **transformer** or group of **transformers** does not exist, the nearest applicable part 2 may be used as a guide to the requirements and tests.

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

The principle for preparation of the different parts 2 is as follows:

IEC 61558 principle

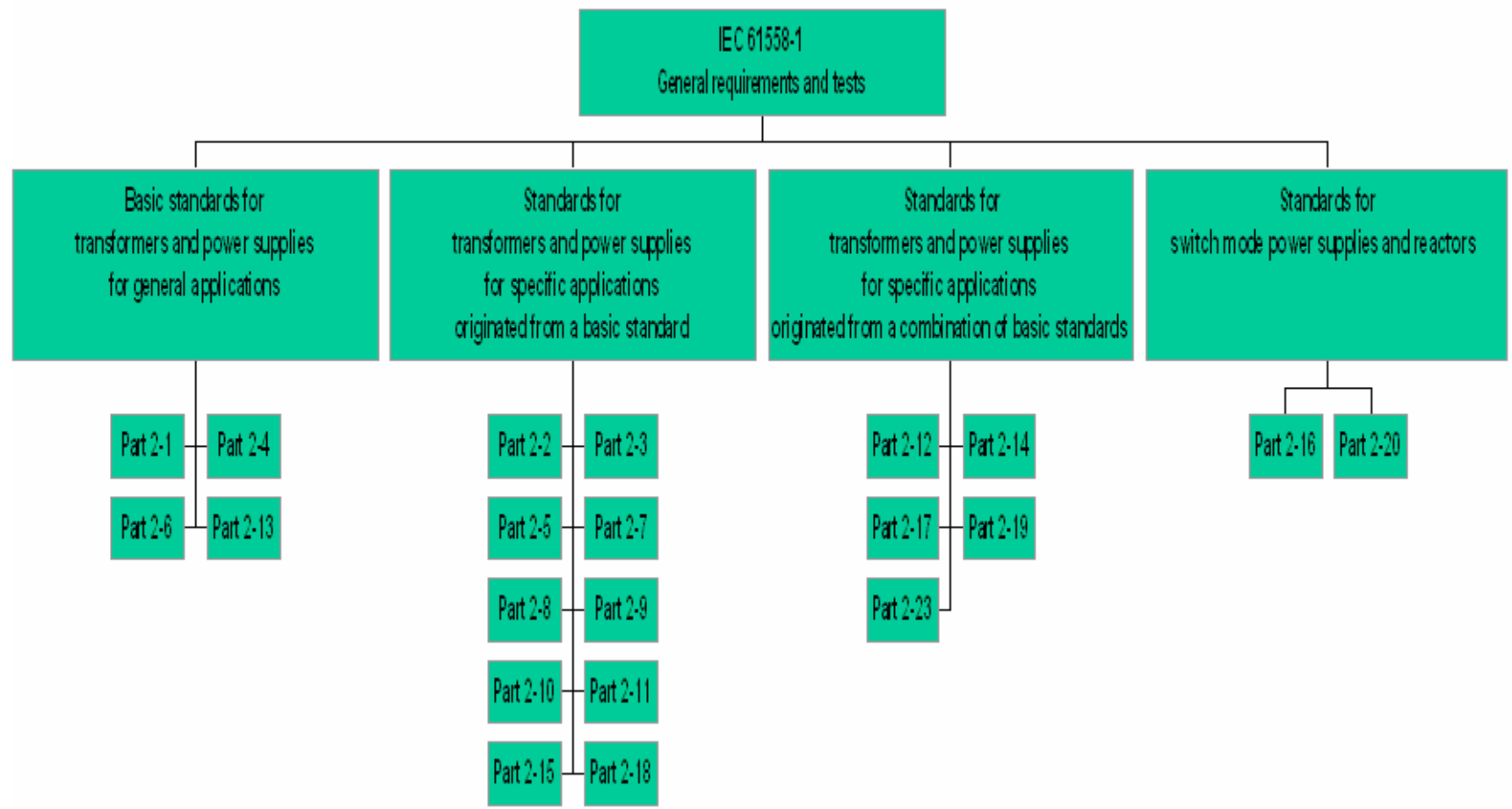


Figure 0 – IEC 61558 principle

IEC 1269/05

Relevant clauses of this standard (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.

As an option, the thermal characteristics of **transformers** can be specified by the rated maximum operating temperature of the winding (symbol t_w) which shall not be exceeded to ensure a minimum lifetime as specified in Annex U. In addition, for **transformers** subjected to abnormal conditions as specified in Clause 15, the specified temperature limit shall not be exceeded when the **transformer** is built into an appliance or used as an independent **transformer**.

SAFETY OF POWER TRANSFORMERS, POWER SUPPLIES, REACTORS AND SIMILAR PRODUCTS –

Part 1: General requirements and tests

1 Scope

This International Standard deals with safety aspects of power **transformers**, power supplies, reactors and similar products such as electrical, thermal and mechanical safety.

This standard covers the following types of **dry-type transformers**, **power supplies**, including **switch mode power supplies**, and **reactors**, the windings of which may be encapsulated or non-encapsulated :

NOTE 1 The distinction between **transformers**, **power supplies** and **switch mode power supplies** is as follows:

- for **transformers**, there is no change in frequency .However, **transformers** (e.g. constant voltage **transformers**) may have an internal resonance frequency not exceeding 30 kHz;
- for **power supplies**, the **internal operational frequency** and waveform are different from the **supply frequency** and waveform, and the **internal operational frequency** does not exceed 500 Hz (see definition 3.1.19);
- for **switch mode power supplies**, the **internal operational frequency** and waveform are different from the **supply frequency** and waveform and the **internal operational frequency** exceeds 500 Hz and does not exceed 100 MHz.

The relevant parts 2 may be found in the introduction of this standard.

a) Stationary or portable, single-phase or poly-phase, air-cooled (natural or forced), **isolating** and **safety isolating transformers**, **independent** or **associated**, not forming a part of distribution networks and with the following characteristics:

- **rated supply voltage** not exceeding 1 000 V a.c.;
- **rated supply frequency** not exceeding 500 Hz;

and complying with the following values, unless otherwise specified in the relevant part 2:

- for **isolating transformers**:
 - rated output for single phase **transformers**, not exceeding 25 kVA, and for poly-phase **transformers** not exceeding 40 kVA.
 - **no-load output voltage** and the **rated output voltage** exceeding 50 V a.c., and not exceeding 500 V a.c, or 1 000 V a.c. to be in accordance with the National Wiring Rules or for a special application.
- for **safety isolating transformers**:
 - **rated output** for single phase **transformers** not exceeding 10 kVA, and for poly-phase **transformers** not exceeding 16 kVA.
 - **no-load output voltage** and the **rated output voltage** not exceeding 50 V a.c. between conductors, or between any conductor and protective earth.

NOTE 1 **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).

b) **Stationary or portable**, single-phase or polyphase, air-cooled (natural or forced) **separating transformers, auto-transformers, variable transformers** and small **reactors, independent or associated**, not forming a part of distribution networks and with the following characteristics:

- **rated supply voltage** not exceeding 1 000 V a.c.;
- **rated supply frequency** not exceeding 500 Hz;

and complying with the following values, unless otherwise specified in the relevant part 2:

- no-load output voltage or a rated output voltage for both independent and associated **transformers** not exceeding 15 kV a.c., and for independent **transformers**, a rated output voltage not less than 50 V a.c.;
- **rated output** not exceeding the following values:
 - 1 kVA for single-phase **transformers**;
 - 2 kVAR for single-phase **reactors**;
 - 5 kVA for poly-phase **transformers**;
 - 10 kVAR for poly-phase **reactors**.

NOTE 2 **Separating transformers** are used where **double or reinforced insulation** between circuits is not required by the installation rules or by the appliance specification.

NOTE 3 Normally, the **transformers** of type b) are intended to be associated with the equipment to provide voltages different from the supply voltage for the functional requirements of the equipment. The protection against electric shock 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 the protective earth.

c) **Stationary or portable**, single-phase or polyphase, air-cooled (natural or forced), **independent or associated power supplies** and **switch mode power supplies** incorporating one or more **transformer(s)** of type a) or b), not forming a part of distribution networks and with the following characteristics:

- **rated supply voltage** not exceeding 1 000 V a.c.;
- **rated supply frequency** not exceeding 500 Hz;
- internal operational frequency for power supplies not exceeding 500 Hz and for switch mode power supplies not exceeding 100 MHz;

and with the following values, unless otherwise specified in the relevant part 2:

- for power supplies and switch mode power supplies incorporating **isolating transformers**:
 - **rated output** for single- phase or polyphase **power supplies** or **switch mode power supplies** not exceeding 1 kVA;
 - **no-load output voltage** and the **rated output voltage** exceeding 50 V a.c. or 120 V ripple- free d.c., and not exceeding 500 V a.c. or 708 V ripple- free d.c., or 1 000 V a.c. or 1 415 V ripple- free d.c. to be in accordance with national wiring rules or for a special application;
- for **power supplies** and **switch mode power supplies** incorporating **safety isolating transformers**:
 - **rated output** for single- phase or polyphase **power supplies** and **switch mode power supplies** not exceeding 1 kVA;
 - **no-load output voltage** and **rated output voltage** not exceeding 50 V a.c. or 120 V ripple- free d.c. between conductors, or between any conductor and protective earth.

NOTE 4 **Power supplies** and **switch mode power supplies** incorporating **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).

- for **power supplies** and **switch mode power supplies** incorporating **separating transformers**, **auto-transformers**, and **variable transformers**:
 - **rated output** for single-phase or polyphase **power supplies** and **switch mode power supplies** not exceeding 1 kVA;
 - **no-load output voltage** and **rated output voltage** for both, **independent** and **associated transformers** not exceeding 15 kV a.c., and for **independent transformers**, a **rated output voltage** not less than 50 V a.c.;

NOTE 5 **Power supplies** and **switch mode power supplies** incorporating **separating transformers** are used where **double** or **reinforced insulation** between circuits is not required by the installation rules or by the appliance specification.

- d) This standard is also applicable to t_w -marked **transformers** with a rated output not exceeding 1 000 VA and where the t_w -temperature does not exceed 140 °C (t_w 140). However, t_w -marking of **transformers** is optional.

This standard also applies to **transformers**, **power supplies**, **switch mode power supplies**, and **reactors** incorporating electronic circuits.

This standard does not apply to external circuits and their components intended to be connected to the input and output terminals or socket-outlets of the **transformers**, **power supplies** and **switch mode power supplies**, and **reactors**.

NOTE 6 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 like 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, such as tropical environment

NOTE 7 Future technological development of **transformers** may necessitate a need to increase the upper limit of the frequencies; until then this standard may be used as a guidance document.

2 Normative references

The following referenced documents are indispensable for the application 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 60065:2001, *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, *Environmental testing – Part 2: Tests – Test FC: Vibration (sinusoidal)*

IEC 60068-2-32, *Environmental testing – Part 2: Tests – Test Ed: Free fall*

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

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

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

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

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

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

IEC 60216 (all parts), *Electrical insulating materials – Properties of thermal endurance*

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

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

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

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

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

IEC 60269-3, *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, *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: examples of types of standardized fuses*

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

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

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, *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-DB:2002²⁾, *Graphical symbols for use on equipment*

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

²⁾ "DB" refers to the IEC on-line database.

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

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

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

IEC 60664-3:2003, *Insulation co-ordination for equipment within low voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution*

IEC 60691:2002, *Thermal-links – Requirements and application guide*

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

IEC 60695-2-11:2000, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods- Glow-wire flammability test method for end-products*

IEC 60695-10-2, *Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test*

IEC 60730 (all parts), *Automatic electrical controls for household and similar use*

IEC 60730-1:1999, *Automatic electrical controls for household and similar use – Part 1: General requirements*

IEC 60851-3:1996, *Winding wires – Test methods: Part 3: Mechanical properties*

IEC 60851-5:1996, *Winding wires – Test methods: Part 5: Electrical properties*

IEC 60851-6:1996, *Winding wires – Test methods: Part 5: Thermal properties*

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

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

IEC 60898 (all parts), *Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations³⁾*

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: Ancillary equipment – Section 1: Terminal blocks for copper conductors*

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

³⁾ IEC 60898-2 is published under the general title *Circuit-breakers for overcurrent protection for household and similar installations* (i.e. without the element of “Electrical accessories” in the title).

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 – 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 61032:1997, *Protection of persons and equipment by enclosures - Probes for verification*

IEC 61058-1:2000, *Switches for appliances – Part 1: General requirements*

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

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