EESTI STANDARD EVS-EN 61558-1:2005

Jõutrafode, elektrivarustusseadmete ja muude taoliste seadmete ohutus. Osa 1: Üldnõuded ja katsetused

Safety of power transformers, power supplies, reactors and similar products Part 1: General requirements and tests

EESTI STANDARDIKESKUS

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

Käesolev Eesti standard EVS-EN 61558-1:2005 sisaldab Euroopa standardi EN 61558-1:2005+AC:2006 ingliskeelset teksti. Käesolev dokument on jõustatud 19.12.2005 ja selle kohta on avaldatud teade Eesti standardiorganisatsiooni ametlikus väljaandes. Standard on kättesaadav Eesti standardiorganisatsioonist.	This Estonian standard EVS-EN 61558-1:2005 consists of the English text of the European standard EN 61558-1:2005+AC:2006. This document is endorsed on 19.12.2005 with the notification being published in the official publication of the Estonian national standardisation organisation. The standard is available from Estonian standardisation organisation.

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

ICS 29.180

Võtmesõnad: ability to withstand short circuit, earthing, isolation resistance, mechanical strength, overload protection, protective transformers, safety requirements, temperature rise, transformers

EUROPEAN STANDARD **EN 61558-1**

NORME EUROPÉENNE

EUROPÄISCHE NORM November 2005

ICS 29.180 Supersedes EN 61558-1:1997 + A1:1998 + A11:2003

English version

Safety of power transformers, power supplies, reactors and similar products Part 1: General requirements and tests

(IEC 61558-1:2005)

Sécurité des transformateurs, alimentations, bobines d'inductance et produits analogues
Partie 1: Exigences générales et essais
(CEI 61558-1:2005)

Sicherheit von Transformatoren, Netzgeräten, Drosseln und dergleichen
Teil 1: Allgemeine Anforderungen und Prüfungen
(IEC 61558-1:2005)

This European Standard was approved by CENELEC on 2005-10-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

CENELEC
European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. EN 61558-1:2005 E

Foreword

The text of document 96/224/FDIS, future edition 2 of IEC 61558-1, prepared by IEC TC 96, Small power transformers, reactors, power supply units and similar products, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61558-1 on 2005-10-01.

This European Standard supersedes EN 61558-1:1997 + corrigendum April 2003 + A1:1998 + A11:2003.

The changes with respect to EN 61558-1:1997 were necessitated by the introduction of new technology and implementation of requirements from equipment committees.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2006-07-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2008-10-01

This new 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).

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.

Annex ZA has been added by CENELEC.

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Endorsement notice

The text of the International Standard IEC 61558-1:2005 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60038	NOTE	Harmonized as HD 472 S1:1989 (modified).
IEC 60051	NOTE	Harmonized in EN 60051 series (not modified).
IEC 60584-1	NOTE	Harmonized as EN 60584-1:1995 (not modified).
IEC 60738-1	NOTE	Harmonized as EN 60738-1:1999 (not modified).
IEC 60998-1	NOTE	Harmonized as EN 60998-1:2004 (modified).
IEC 61000-3-2	NOTE	Harmonized as EN 61000-3-2:2000 (modified).
IEC 61000-3-3	NOTE	Harmonized as EN 61000-3-3:1995 (not modified).
IEC 62041	NOTE	Harmonized as EN 62041:2003 (not modified).
CISPR 14	NOTE	Harmonized in EN 55014 series (not modified).

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE Where an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60065 (mod)	2001	Audio, video and similar electronic apparatus - Safety requirements	EN 60065	2002
IEC 60068-2-2	1974	Basic environmental testing procedures Part 2: Tests - Tests B: Dry heat	EN 60068-2-2 [1)]	1993
IEC 60068-2-6	- [2)]	Part 2: Tests - Test Fc: Vibration (sinusoidal)	EN 60068-2-6	1995 [3)]
IEC 60068-2-32	- [2)]	Part 2: Tests - Test Ed: Free fall (Procedure 1)	EN 60068-2-32	1993 [3)]
IEC 60068-2-75	- [2)]	Part 2-75: Tests - Test Eh: Hammer tests	EN 60068-2-75	1997 [3)]
IEC 60076-1 (mod)	- [2)]	Power transformers Part 1: General	EN 60076-1 + A11 + A12	1997 [3)] 1997 2002
IEC/TR 60083	- [2)]	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	HD 566 S1 [4)]	1990
IEC 60112	2003	Method for the determination of the proof and the comparative tracking indices of solid insulating materials	EN 60112	2003
IEC 60127-3	- [2)]	Miniature fuses Part 3: Sub-miniature fuse-links	EN 60127-3 + corr. June	1996 [3)] 1996
IEC 60216	Series	Electrical insulating materials - Thermal endurance properties	EN 60216	Series

[1)] EN 60068-2-2:1993 includes supplement A:1976 to IEC 60068-2-2:1974.

[2)] Undated reference.

[3)] Valid edition at date of issue.

[4)] HD 566 S1 is superseded by EN 60085:2004, which is based on IEC 60085:2004.

Publication	Year	Title	EN/HD	Year
IEC 60227 [5)]	Series	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V	-	-
IEC 60245 [6)]	Series	Rubber insulated cables - Rated voltages up to and including 450/750 V	-	-
IEC 60269 (mod)	Series	Low-voltage fuses	EN/HD 60269	series
IEC 60269-2	- [2)]	Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application)	EN 60269-2	1995 [3)]
IEC 60269-2-1 (mod)	- [2)]	Part 2-1: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) Sections I to VI: Examples of types of standardized fuses	HD 60269-2-1	2005 [3)]
IEC 60269-3	- [2)]	Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household and similar applications)	EN 60269-3	1995 [3)]
IEC 60269-3-1 (mod)	- [2)]	Part 3-1: 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	HD 60269-3-1	2004 [3)]
IEC 60309	Series	Plugs, socket-outlets and couplers for industrial purposes	EN 60309	Series
IEC 60317	Series	Specifications for particular types of winding wires	EN 60317	Series
IEC 60320	Series	Appliance couplers for household and similar general purposes	EN 60320	Series
IEC 60320-2-3	- [2)]	Part 2-3: Appliance coupler with a degree of protection higher than IPX0	EN 60320-2-3	1998 [3)]
IEC 60384-14	- [2)]	Fixed capacitors for use in electronic equipment Part 14: Sectional specification - Fixed capacitors for electromagnetic interference suppression and connection to the supply mains	EN 60384-14	2005 [3)]
IEC 60417	data-base	Graphical symbols for use on equipment	-	-

[5)] The HD 21 series, which is related to, but not directly equivalent with the IEC 60227 series, applies instead.

[6)] The HD 22 series, which is related to, but not directly equivalent with the IEC 60245 series, applies instead.

Publication	Year	Title	EN/HD	Year
IEC 60449	1973	Voltage bands for electrical installations of buildings	HD 193 S2 [7)]	1982
IEC 60454	Series	Specifications for pressure-sensitive adhesive tapes for electrical purposes	EN 60454	Series
IEC 60529	1989	Degrees of protection provided by enclosures (IP Code)	EN 60529 + corr. May	1991 1993
IEC 60664-1	1992	Insulation coordination for equipment within low-voltage systems Part 1: Principles, requirements and tests	EN 60664-1 [8)]	2003
IEC 60664-3	2003	Part 3: Use of coating, potting or moulding for protection against pollution	EN 60664-3	2003
IEC 60691	2002	Thermal-links - Requirements and application guide	EN 60691	2003
IEC 60695-2-10	- [2)]	Fire hazard testing Part 2-10: Glowing/hot-wire based test methods - Glow-wire apparatus and common test procedure	EN 60695-2-10	2001 [3)]
IEC 60695-2-11	2000	Part 2-11: Glowing/hot-wire based test methods - Glow-wire flammability test method for end-products	EN 60695-2-11	2001
IEC 60695-10-2	- [2)]	Part 10-2: Abnormal heat - Ball pressure test	EN 60695-10-2	2003 [3)]
IEC 60730 (mod)	Series	Automatic electrical controls for household and similar use	EN 60730	Series
IEC 60730-1 (mod)	1999	Automatic electrical controls for household and similar use Part 1: General requirements	EN 60730-1 + A12 + A13 + A14	2000 2003 2004 2005
IEC 60851-3	1996	Winding wires - Test methods Part 3: Mechanical properties	EN 60851-3	1996
IEC 60851-5	1996	Part 5: Electrical properties	EN 60851-5	1996
IEC 60851-6	1996	Part 6: Thermal properties	EN 60851-6	1996
IEC 60884-1	2002	Plugs and socket-outlets for household and similar purposes Part 1: General requirements	-	-
IEC 60884-2-4	- [2)]	Part 2-4: Particular requirements for plugs and socket-outlets for SELV	-	-

[7)] HD 193 S2 includes A1:1979 to IEC 60449:1973.

[8)] EN 60664-1:2003 includes A1:2000 + A2:2002 to IEC 60664-1:1992.

Publication	Year	Title	EN/HD	Year
IEC 60898 (mod)	Series	Electrical accessories - Circuit-breakers for overcurrent protection for household and similar installations	EN 60898	Series
IEC 60906-1	- [2)]	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	- [2)]	Part 3: SELV plugs and socket-outlets, 16 A 6V, 12 V, 24 V, 48 V, a.c. and d.c.	-	-
IEC 60947-7-1	- [2)]	Low-voltage switchgear and controlgear Part 7-1: Ancillary equipment - Terminal blocks for copper conductors	EN 60947-7-1	2002 [3)]
IEC 60990 [9)]	1990	Methods of measurement of touch-current and protective conductor current	-	-
IEC 60998-2-1 (mod)	- [2)]	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	EN 60998-2-1	2004 [3)]
IEC 60998-2-2 (mod)	- [2)]	Part 2-2: Particular requirements for connecting devices as separate entities with screwless-type clamping units	EN 60998-2-2	2004 [3)]
IEC 60999-1	- [2)]	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 mm² up to 35 m² (included)	EN 60999-1	2000 [3)]
IEC 61032	1997	Protection of persons and equipment by enclosures - Probes for verification	EN 61032	1998
IEC 61058-1 (mod)	2000	Switches for appliances Part 1: General requirements	EN 61058-1 [10)]	2002
IEC 61140	- [2)]	Protection against electric shock - Common aspects for installation and equipment	EN 61140	2002 [3)]
ISO 4046-4	2002	Paper, board, pulps and related terms - Vocabulary Part 4: Paper and board grades and converted products	-	-
ISO 8820	Series	Road vehicles – Fuse links	-	-

[9)] IEC 60990:1990 is superseded by IEC 60990:1999, which is harmonized as EN 60990:1999.

[10)] EN 61058-1:2002 includes A1:2001 to IEC 61058-1:2000.

IEC 61558-1

Edition 2.0 2005-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

GROUP SAFETY PUBLICATION
PUBLICATION GROUPÉE DE SÉCURITÉ

Safety of power transformers, power supplies, reactors and similar products – Part 1: General requirements and tests

Sécurité des transformateurs, alimentations, bobines d'inductance et produits analogues – Partie 1: Exigences générales et essais

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CONTENTS

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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9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. 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 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.

The contents of the corrigenda of March 2008, March 2010 and April 2011 have been included in this copy.

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:

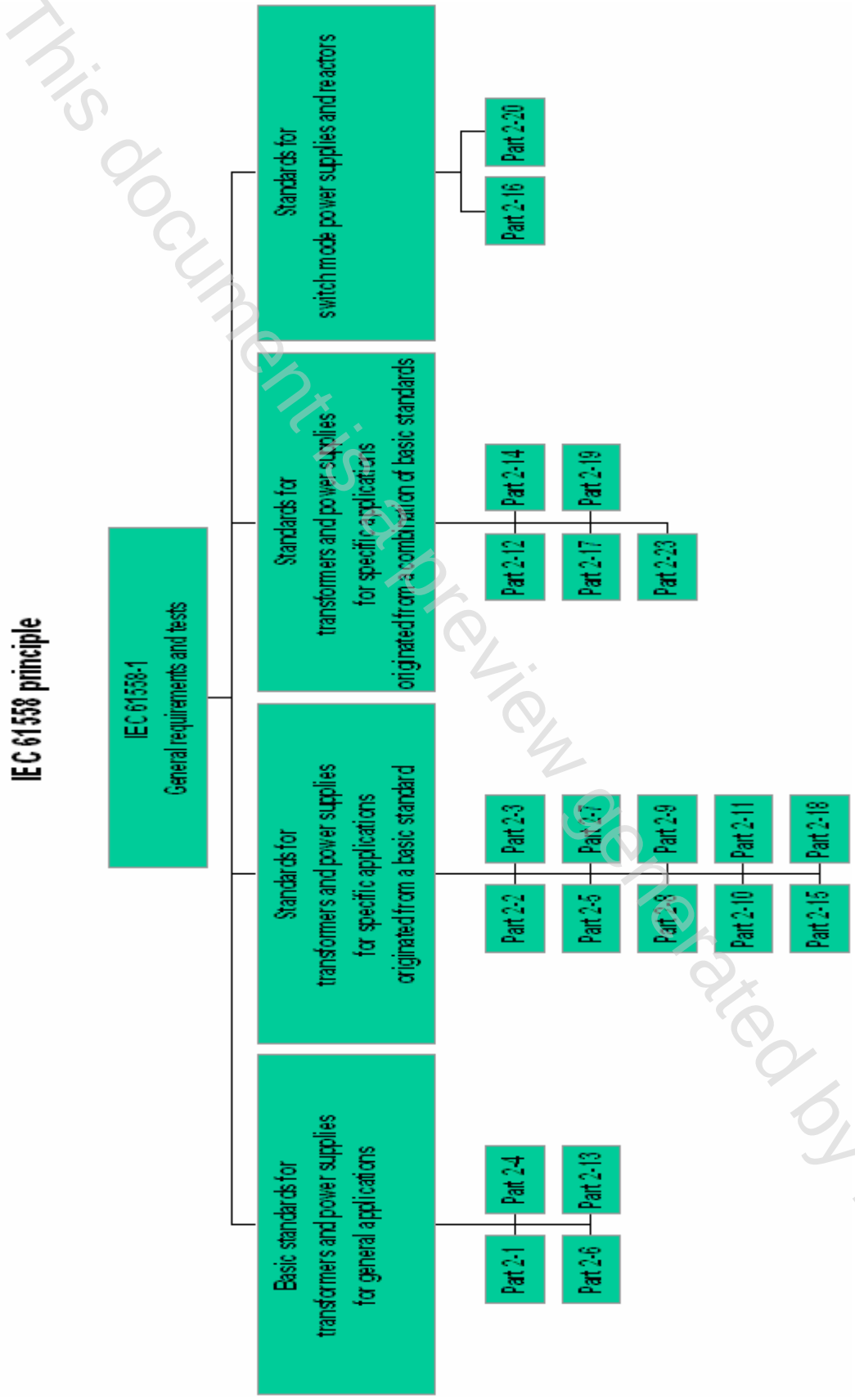

Figure 0 – IEC 61558 principle

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:2002[2)], *Graphical symbols for use on equipment*

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

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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 installations*[3])

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*

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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 mm^2 up to 35 mm^2 (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*

ISO 4046-4:2002, *Paper, board, pulp and related terms – Vocabulary*

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

3 Terms and definitions

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

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.

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

"Ripple-free" is conventionally an r.m.s. ripple voltage not more than 10 % of the d.c. component.

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

3.1 Transformers

3.1.1
(power) 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

[IEV 421-01-01]

NOTE The term frequency also implies that the waveform remains the same.

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