



UL 5085-1

STANDARD FOR SAFETY

Low Voltage Transformers – Part 1: General Requirements

UL Standard for Safety for Low Voltage Transformers – Part 1: General Requirements, UL 5085-1

First Edition, Dated April 17, 2006

Summary of Topics

This revision of ANSI/UL 5085-1 dated June 2, 2022 is being issued to update the title page to reflect the most recent designation as a Reaffirmed American National Standard (ANS). No technical changes have been made.

As noted in the Commitment for Amendments statement located on the back side of the title page, UL and CSA are committed to updating this harmonized standard jointly. However, the revision pages dated June 2, 2022 will not be jointly issued by UL and CSA as these revision pages only address UL ANSI approval dates.

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The requirements are substantially in accordance with Proposal(s) on this subject dated March 25, 2022.

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ANSI/UL 5085-1-2013 (R2022)

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This ANSI/UL Standard for Safety consists of the First edition including revisions through June 2, 2022.

The most recent designation of ANSI/UL 5085-1 as a Reaffirmed American National Standard (ANS) occurred on May 24, 2022. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

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Preface

This is the harmonized CSA Group and UL standard for low voltage transformers. It is the first edition of CSA C22.2 No. 66.1 and the first edition of UL 5085-1. This harmonized standard has been jointly revised on December 6, 2013. For this purpose, CSA Group and UL are issuing revision pages dated December 6, 2013.

This harmonized standard was prepared by a Technical Harmonization Committee comprised of members from CSA Group, Underwriters Laboratories Inc. (UL), and representatives of the low voltage transformer manufacturing industry. The efforts and support of members of the Technical Harmonization Committee are gratefully acknowledged.

This Standard is considered suitable for use for conformity assessment within the stated scope of the Standard.

This standard was reviewed by the CSA Subcommittee on C22.2 No. 66, under the jurisdiction of the CSA Technical Committee on Industrial Products and the CSA Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the CSA Technical Committee.

Where reference is made to a specific number of samples to be tested, the specified number is to be considered a minimum quantity.

Note: Although the intended primary application of this standard is stated in its scope, it is important to note that it remains the responsibility of the users of the standard to judge its suitability for their particular purpose.

Level of harmonization

This standard uses the IEC format but is not based on, nor is it to be considered equivalent to, an IEC standard. This standard is published as an equivalent standard for CSA Group and UL.

An equivalent standard is a standard that is substantially the same in technical content, except as follows: Technical national differences are allowed for codes and governmental regulations as well as those recognized as being in accordance with NAFTA Article 905, for example, because of fundamental climatic, geographical, technological, or infrastructural factors, scientific justification, or the level of protection that the country considers appropriate. Presentation is word for word except for editorial changes.

Reasons for Differences from IEC

The Technical Harmonization Committee identified the following IEC Standard within the scope of this standard: IEC 61558-1 (1998-07), Safety of power transformers, power supply units, and similar - Part 1: General requirements.

The THC determined that the safe use of transformers and reactors is critically dependent on the electrical system in which they are intended to be installed. Significant investigation is required to assess safety and system compatibility issues that may lead to harmonization of traditional North American transformers and reactors with those presently addressed in the known IEC standards. The THC agreed such future investigation might be facilitated by completion of harmonization of North American standards for transformers and reactors.

Interpretations

The interpretation by the standards development organization of an identical or equivalent standard is based on the literal text to determine compliance with the standard in accordance with the procedure.

of the standards development organization. If more than one literal interpretation has been identified, a revision is to be proposed as soon as possible to each of the standards development organizations to more accurately reflect the intent.

Parts

The Standard for Low Voltage Transformers is divided into the following parts:

Part Number	Standard Title	Standard Number
1	General Requirements	CSA C22.2 No. 66.1/UL 5085-1
2	General Purpose Transformers	CSA C22.2 No. 66.2/UL 5085-2
3	Class 2 and Class 3 Transformers	CSA C22.2 No. 66.3/UL 5085-3
NOTES – 1. Part 1 covers the general requirements for transformer characteristics, marking, construction, and tests. Additional specific requirements are provided in the subsequent parts. 2. Part 2 and Part 3 supplement requirements and/or modify the corresponding clauses in Part 1 and should be applied together with Part 1. The numbered clauses in Part 2 and Part 3 correspond to the numbered clauses in Part 1.		

PART 1: GENERAL REQUIREMENTS

1 Scope

1.1 These requirements cover the following types of transformers:

- a) Air-cooled transformers and reactors for general use;
- b) General purpose autotransformers;
- c) Ferroresonant transformers;
- d) Class 2 and Class 3 transformers (which are evaluated in accordance with Part 3);
- e) Cord-connected transformers (which are evaluated in accordance with Part 2);
- f) Transformers incorporating overcurrent or over-temperature protective devices, transient voltage surge protectors, or capacitors; and
- g) Permanently-connected transformers.

1.2 These transformers are intended to be used in accordance with the National Electrical Code, ANSI/NFPA 70, or CSA C22.1, the Canadian Electrical Code, Part I. The Canadian Electrical Code defines low voltage as any voltage from 31 to 750 V inclusive and high voltage as any voltage above 750 V. The National Electrical Code, ANSI/NFPA 70, defines low voltage as any voltage up to 600 V, nominal. Therefore, low voltage transformers intended for use in Canada may be rated above 600 V up to 750 V. Low voltage transformers intended for use in the United States are rated up to 600 V. Where information in clauses and tables in this standard reference voltage ranges, the limit of 600 V applies in the United States, while the limit of 750 V applies in Canada.

1.3 The standard does not cover the following transformers:

- a) Direct plug-in types;
- b) Neon;
- c) Liquid-immersed;
- d) Variable voltage (Variac);
- e) Low voltage landscape;
- f) Swimming pool and spa;
- g) Ignition;
- h) High intensity lighting;
- i) Toy;
- j) Fluorescent lamp types;
- k) Transformers for welders;
- l) Distribution;

- m) Transformers intended for use in the United States with a nominal primary rating of more than 600 V;
- n) Transformers incorporating rectifying or waveshaping circuitry;
- o) Transformers for use with radio- and television-type appliances;
- p) Transformers intended for use in the United States having overvoltage taps rated over 660 V;
- q) Autotransformers used in industrial control equipment, which are evaluated in accordance with the requirements of the Standard for Industrial Control Equipment, UL 508, or CSA C22.2 No. 14, Industrial Control Equipment; and
- r) Other special types of transformers covered in requirements for other electrical devices or appliances.

1.4 Part 1, as well as Part 2 and Part 3, establish the characteristics, construction, operating conditions, markings, and test conditions for each type of transformer.

1.5 The requirements in this standard may be modified by requirements in an end product standard if a transformer is intended for use only as a component in other equipment.

2 Definitions

2.1 The following definitions apply in this standard:

2.1.1 CLASS 2 TRANSFORMER – A transformer that has a 30 V rms maximum secondary potential under any condition of loading.

Note: The impedance within an inherently-limited transformer limits the current output to a particular maximum value. Maximum power is limited by winding impedance (inherently limited) or by overcurrent protection (not-inherently limited). It may or may not be provided with a thermostat or other temperature sensitive device to limit its maximum temperature. A not-inherently limited Class 2 transformer is provided with overcurrent protection to limit the maximum power output.

2.1.2 CLASS 3 TRANSFORMER – A transformer that has a secondary potential over 30 V rms and less than 100 V for inherently-limited transformers, or less than 150 V for not-inherently limited transformers.

Advisory Note: These transformers are intended for use only in the United States. See Annex D of Part 3.

2.1.3 COMPOUND-FILLED TRANSFORMER – A transformer in which the windings or windings and core are enclosed with an insulating fluid or thermal compound that becomes solid and retains its hardness at intended operating temperatures and storage temperatures.

2.1.4 DRY-TYPE TRANSFORMER – A transformer in which the core and coils are in a gaseous or dry compound insulating material.

2.1.5 ENCAPSULATED COIL – A coil that is enclosed with an insulating fluid that becomes solid.

2.1.6 EXPOSED CORE TRANSFORMER – A transformer having an exposed magnetic core lamination.

2.1.7 INDUSTRIAL CONTROL TRANSFORMER – A transformer suitable for field installation and intended to operate within a 40°C (104°F) ambient temperature.

2.1.8 NONVENTILATED DRY-TYPE TRANSFORMER – A dry-type enclosed transformer which is constructed to provide no intentional circulation of external air through the transformer and is intended to operate at normal ambient room air pressure.

2.1.9 VENTILATED DRY-TYPE TRANSFORMER – A dry-type enclosed transformer constructed so that ambient air may circulate through the enclosure to cool the transformer core and windings.

2.1.10 WINDING – A continuous conductor made up of a number of turns magnetically coupled to a magnetic core, to which a voltage is either applied or induced.

Note: Two or more such conductors that are permanently factory connected to form intermediate voltage taps, current taps, or similar items are considered a single winding. The winding can consist of single or parallel-wound conductors.

3 General

3.1 Components

3.1.1 Except as indicated in Clause [3.1.2](#), a component of a product covered by this standard shall comply with the requirements for that component. See Annex [B](#) for a list of standards covering components generally used in the products covered by this standard. A component shall comply with the CSA or UL standards as appropriate for the country where the product is to be used.

3.1.2 A component is not required to comply with a specific requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or
- b) Is superseded by a requirement in this standard.

3.1.3 A component shall be used in accordance with its rating established for the intended conditions of use.

3.1.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

3.1.5 For transformers intended for use in Canada the following applies: General requirements applicable to this standard are given in CAN/CSA-C22.2 No. 0, General Requirements – Canadian Electrical Code, Part II.

3.2 Reference Publications

3.2.1 Products covered by this Standard shall comply with the reference installation codes and standards as appropriate for the country where the product is to be used. When the product is intended for use in more than one country, the product shall comply with the installation codes and standards for all countries where it is intended to be used.

For undated references to standards, such reference shall be considered to refer to the latest edition and all revisions to that edition up to the time when this standard was approved. For dated references to standards, such reference shall be considered to refer to the dated edition and all revisions published to that edition up to the time the standard was approved. See the following information for a list of reference publications.

ANCE Standards

NMX-J-235/2-ANCE

Enclosures for Electrical Equipment, Environmental Considerations

CSA Standards

C22.1-02

Canadian Electrical Code, Part 1 (19th Edition)

CAN/CSA-C22.2 No. 0-M91 (R2001)

General Requirements – Canadian Electrical Code, Part II

C22.2 No. 0.1-M1985 (R2013)

General Requirements for Double-Insulated Equipment

C22.2 No. 0.15-01

Adhesive Labels

CAN/CSA-C22.2 No. 0.17-00 (R2004)

Evaluation of Properties of Polymeric Materials

C22.2 No. 14-95 (R2001)

Industrial Control Equipment

CAN/CSA-C22.2 No. 18-98 (R2003)

Outlet Boxes, Conduit Boxes, Fittings, and Associated Hardware

CAN/CSA-C22.2 No. 65-03

Wire Connectors

CAN/CSA-C22.2 No. 94-M91 (R2001)

Special Purpose Enclosures

CAN/CSA C22.2 No. 94.2

Enclosures for Electrical Equipment, Environmental Considerations

C22.2 No. 153-M1981 (R2003)

Quick-Connect Terminals

C22.2 No. 209-M1985 (R2004)

Thermal Cut-Offs

CAN/CSA-C22.2 No. 60065:03

Audio, Video and Similar Electronic Apparatus – Safety Requirements

CAN/CSA-C22.2 No. 60950-1-03

Information Technology Equipment – Safety – Part 1: General Requirements

UL Standards

UL 50

Enclosures for Electrical Equipment

UL 50E

Enclosures for Electrical Equipment, Environmental Considerations

UL 310

Electrical Quick-Connect Terminals

UL 486A-486B

Wire Connectors

UL 486E

Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors

UL 508

Industrial Control Equipment

UL 514C

Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers

UL 746B

Polymeric Materials – Long Term Property Evaluations

UL 746C

Polymeric Materials – Use in Electrical Equipment Evaluations

UL 969

Marking and Labeling Systems

UL 1446

Systems of Insulating Materials – General

UL 2097

Reference Standard for Double Insulation Systems for Use in Electronic Equipment

UL 2353

Single- and Multi-Layer Insulated Winding Wire

UL 60691

Thermal-Links – Requirements and Application Guide

ANSI/NFPA¹ Standards

ANSI/NFPA 70,

National Electrical Code

ASTM² Standards

A 90/A 90M

Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings

A 653/A 653M

Standard Specification for Steel Sheet, Zinc-Coated, (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process,



Documents

Document Sharing Hub

D 396

Standard Specification for Fuel Oils

E230/E230M

Standard Specification and Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples

ANSI/IEEE³ Standards

IEEE C57.12.91

Standard Test Code for Dry-Type Distribution and Power Transformers.

¹ American National Standards Institute/National Fire Protection Association.

² American Society for Testing and Materials.

³ American National Standards Institute/Institute of Electrical and Electronics Engineers, Inc.

3.3 Units of Measurement

3.3.1 The values given in SI (metric) units shall be normative, except for AWG/kcmil conductor sizes. Any other values given shall be for information purposes only.

4 Construction

4.1 The requirements in Part 1 are general in nature and apply to all transformers where applicable. Part 1 covers the general requirements for transformer characteristics, marking, construction and tests. Additional requirements for various transformer types are detailed in Part 2 and Part 3. Part 2 and Part 3 supplement or modify the corresponding clauses in Part 1 and should be read together with Part 1. The numbering of clauses in Part 2 and Part 3 corresponds to the numbered clauses in Part 1.

5 Mechanical Assembly

5.1 A transformer shall be formed and assembled so that it is able to resist the abuses to which it is likely to be subjected. A risk of fire, electric shock, or injury to persons shall not result from a reduction of spacings, loosening or displacement of parts, or other serious defect.

5.2 An adhesive used in the assembly of the enclosure shall be investigated as specified in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, or CAN/CSA-C22.2 No. 0, General Requirements – Canadian Electrical Code, Part II, as applicable.

Note: Methods utilizing fusion techniques, such as solvent cementing, ultrasonic welding, electromagnetic induction, and thermal welding, need not be investigated.

5.3 An unenclosed core and coil transformer shall be provided with mounting brackets, a mounting plate, or other suitable means for mounting.

6 Enclosures

6.1 General

6.1.1 Transformers shall have enclosures of noncombustible, moisture-absorption resistant material that encases all live parts. In addition to the overall enclosure, the requirements in Clauses [6.1.2](#) – [6.1.14](#) and [Table 5](#) apply to those portions of an enclosure surrounding a terminal or wiring compartment.

Note 1: Component type transformers intended for installation in other equipment (e.g., open coil, open core types) do not require an enclosure.

Note 2: Industrial control transformers rated 5 kVA or less are not required to be equipped with an enclosure.

6.1.2 The thickness of a sheet metal enclosure shall comply with the following:

- a) [Table 2](#), [Table 3](#), and [Table 4](#) or
- b) The requirements for the Compression test in Clause [24.2](#) for an enclosure with reinforcement similar to a supporting frame.

6.1.3 With regard to Clause [6.1.2](#), a supporting frame is an angled structure or channel, or folded rigid piece of sheet metal, that:

- a) Is attached to the enclosure surface;
- b) Has essentially the same outside dimensions as the enclosure surface; and
- c) Has sufficient torsional rigidity to resist the bending moments that may be transmitted by the enclosure surface when the surface is deflected.

6.1.4 With regard to Clause [6.1.2](#), the following are considered construction types without a supporting frame:

- a) A single sheet with single formed flanges (formed edges);
- b) A single sheet that is corrugated or ribbed;
- c) An enclosure surface loosely attached to a frame, for example, with spring clips; and
- d) An enclosure surface having an unsupported edge.

6.1.5 The thickness of sheet steel enclosure shall be determined by taking the numerical average of five micrometer readings equally spaced across the full width of the sheet as rolled.

6.1.6 The thickness of an enclosure constructed of nonferrous sheet metal shall provide strength and rigidity equal to that of a sheet steel enclosure described in Clause [6.1.2](#).

6.1.7 A cast iron enclosure shall not be less than 6.4 mm (0.25 in) thick at tapped holes for conduit. The minimum thickness may be less than that specified when the cast iron complies with the Compression test in Clause [24.2](#). However, the thickness shall not be less than 3.2 mm (0.125 in), excluding any coating.

6.1.8 When threads for the connection of conduit are tapped only part of the way through a hole in the enclosure, there shall not be less than 5 full threads in the metal. There shall be a smooth, well-rounded inlet hole to provide a passage similar to that provided by a standard conduit bushing.

6.1.9 A transformer intended to be supported by rigid metal conduit shall have conduit hubs with not less than 5 full threads or a similar supporting means that is strong so that the parts would comply with the requirements specified in the Pullout, Bending, and Twisting Tests in Clause [20](#).

6.1.10 A knockout for the connection of conduit to a transformer wiring compartment shall be constructed in accordance with [Table 1](#).

6.1.11 Space shall be provided within a terminal or wiring compartment for a standard conduit bushing to be mounted on rigid metal conduit connected to the compartment.

6.1.12 Wires within an enclosure, compartment, or raceway shall be located or guarded to reduce the risk of contact with any sharp edge, burr, fin, or moving part that may cause damage to the conductor insulation.

6.1.13 Wiring space or other compartments provided for field wiring shall be free of any sharp edge, burr, fin, moving part, or sharp point of a sheet metal screw that would damage the conductor insulation or cause a cut-type injury.

6.1.14 An edge, projection, or corner of an enclosure, opening, frame, guard, knob, or handle of a device shall be smooth and rounded and shall not cause a cut-type injury when contacted during intended use or maintenance.

6.2 Nonmetallic enclosures

6.2.1 Polymeric Enclosures shall be rated minimum

- a) 5VA when provided with a surface area larger than 25,800 mm² (40 in²) or
- b) 5VB when provided with all surface areas less than 25,800 mm²

and shall be evaluated in accordance with the requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, or CAN/CSA-C22.2 No. 0.17, Evaluation of Properties of Polymeric Materials.

6.2.2 *Deleted*

6.2.3 Polymeric enclosures shall be subjected to the Polymeric enclosure impact test described in Clause [24.4](#).

6.3 Enclosures – specific environmental conditions

6.3.1 An enclosure intended for a specific environmental condition shall comply with the requirements in the Standard for Enclosures for Electrical Equipment, UL 50, or CAN/CSA-C22.2 No. 94, Special Purpose Enclosures or the Standard for Enclosures for Electrical Equipment, Environmental Considerations, CAN/CSA C22.2 No. 94.2/NMX-J-235/2/UL 50E.

6.3.2 An enclosure of a transformer complying with the requirements for a Type 3R, when used with a field-added rain hood, may be shipped without the hood. However, a specialty transformer and the hood shall be marked as described in Clauses 17.3.2 – 17.3.4 of Part 2.

6.3.3 The mounting or securing means provided for the hood shall be external to the enclosure.

Note: Internal means may be provided if it is constructed to reduce the risk of water entering the enclosure.

6.4 Mounting

6.4.1 A transformer shall be provided with a secure mounting means. It shall be constructed so that there will be a spacing through air of not less than 6.4 mm (0.25 in) between the supporting surface and the enclosure when the device is mounted on a plane surface.

Note: A 6.4 mm spacing is not required between the supporting surface and the enclosure when the transformer is intended to be mounted on an outlet box cover or intended for mounting in a knockout of an outlet box or cabinet.