



UL 1411

STANDARD FOR SAFETY

Transformers and Motor Transformers for Use in
Audio-, Radio-, and Television-Type Appliances

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UL Standard for Safety for Transformers and Motor Transformers for Use in Audio-, Radio-, and Television-Type Appliances, UL 1411

Seventh Edition, Dated January 15, 2016

Summary of Topics

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Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at <http://csds.ul.com>.

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INTRODUCTION

1 Scope

1.1 These requirements apply to transformers, autotransformers, and motor-transformers intended to be used in audio-, radio-, and television-type appliances in which the primary winding is connected across the supply circuit.

1.2 The requirements in Sections 6 – 17, 25 – 28, 30, and 31 also apply to transformers intended for use in high-frequency, switching-type power supplies in which the transformer provides isolation from the supply circuit.

1.3 These requirements do not apply to transformers that are intended to transform only audio, video, and other signal waveforms. Those transformers are covered by the Standard for Isolating Signal and Feedback Transformers for Use in Electronic Equipment, UL 1876.

1.4 These requirements apply to a transformer or motor transformer that includes a separate current-limiting impedance such as a positive temperature coefficient (PTC) device complying with the requirements for thermistor-type devices, or a resistor complying with the Standard for Fusing Resistors and Temperature-Limited Resistors for Radio- and Television-Type Appliances, UL 1412.

2 Components

2.1 Except as indicated in 2.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

2.2 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- b) Is superseded by a requirement in this standard.

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

2.4 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 Units of Measurement

3.1 When a value for measurement is followed by a valued in other units in parentheses, the first stated valued is the requirement.

4 Undated References

4.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

5 Glossary

5.1 For the purpose of this standard the following definitions apply.

5.2 **ENCAPSULATION COMPOUND** – A material, generally of the polymeric type, that is at least 1/32 inch (0.8 mm) thick (when solidified) and that covers the transformer windings.

5.3 **HOUSING** – A partial or complete enclosure, generally of polymeric material or metal, that is around the outside of all or part of the transformer (such as end bells) but is not in contact with current-carrying parts.

5.4 **IMPREGNATION COMPOUND** – A coating material less than 1/32 inch (0.8 mm) thick, generally of the polymeric type and commonly in the form of varnish, that is absorbed by insulating materials such as electrical grade paper.

5.5 **LAYER-WOUND TRANSFORMER** – A transformer in which all of the turns in each layer of each winding are in a single plane. Turns in each layer are wound tightly next to each other with no gaps between them and the turns do not cross over other turns in that layer or the adjacent layers.

5.6 **POTTING COMPOUND** – A material intended to fill all the air spaces inside the housing of a transformer.

5.7 **TRANSFORMER** – A collective term used to designate a transformer, a motor transformer, or an autotransformer.

5.8 **WINDING** – A coil of wire including the start, finish, and crossover leads up to the point where insulated leads or terminals are connected.

CONSTRUCTION

6 Enclosure

6.1 A material used as all or part of the enclosure (end bells) of a transformer shall be classified V-0 or less flammable in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

Exception: This requirement does not apply to a bushing through which a lead passes.

6.2 A complete, individual enclosure (end bells) is not required when:

- a) Live parts are not accessible; or
- b) The transformer is used in an appliance having an enclosure that renders the live parts inaccessible.

An individual enclosure may be required in the end product if the transformer has not been tested as described in Abnormal Operation Tests, Section 29.

6.3 A potting compound employed in a transformer shall be classified HB or less flammable in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94. A potting compound classified HB or less flammable using 1/16-inch (1.6-mm) thick flat-stock samples may be used in lesser thicknesses in the transformer when determined acceptable.

6.4 An encapsulation compound that covers the exterior surface of a transformer shall be classified HB or less flammable in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94. An encapsulation compound classified HB or less flammable using 1/16-inch (1.6-mm) thick flat-stock samples may be used in lesser thicknesses in the transformer when determined acceptable.

7 Leads

7.1 Insulation

7.1.1 The insulation on lead wires shall be rated for the voltage involved and the highest temperature reached under any condition of actual use, and shall be rated "VW-1."

7.2 Cords

7.2.1 A flexible cord of a transformer shall comply with the requirements in the standard for the end-use product in which the transformer is intended to be used and shall be rated "VW-1."

7.2.2 A power-supply cord or wiring harness shall be provided with a polarized (two-blade polarized or three-wire grounding) type attachment plug that conforms with one of the configurations covered in the Standard for Wiring Devices – Dimensional Requirements, NEMA WD-6, and in the Standard for Attachment Plugs and Receptacles, UL 498. The attachment plug shall comply with the requirements in the Standard for Cord Sets and Power-Supply Cords, UL 817.

Exception: When the product is intended to be connected to supply circuits not defined in the National Electrical Code, ANSI/NFPA 70, or for connection to supply-circuit receptacles that are not defined in the Standard for Wiring Devices – Dimensional Requirements, NEMA WD-6, the configuration of the attachment plug is to conform to the applicable Standards of the country into which the product is intended to be shipped. This exception applies only when the product is set for use on the foreign supply circuit when leaving the factory.

7.2.3 The conductors of a parallel flexible cord of a transformer shall not be split external to the transformer enclosure (end-bells).

7.3 Sleeving, tape, and tubing

7.3.1 Sleeving and tubing used on lead wires shall be rated "VW-1." Tape used on lead wires shall be flame-retardant.

7.4 Connections between leads

7.4.1 The connection between a lead, including a flexible cord, and a winding or other part of the transformer shall be soldered, welded, or otherwise securely connected. A solder joint shall be mechanically secure before soldering.

7.4.2 When a lead is rigidly held in place without the use of solder, or when it is retained in place by an acceptable means so as not to be subjected to any motion, additional mechanical security is not required. Mechanical securement of a lead is not required when separation of the connection does not result in a risk of fire or electric shock.

7.5 Strain relief

7.5.1 Strain relief shall be provided so that stress on each individual lead, including a flexible cord, is not transmitted to the connection inside the transformer. See 27.1.

7.5.2 A strain-relief means shall not depend solely on adhesion between the lead and a potting compound, unless an investigation shows it to be acceptable.

7.6 Openings for wires

7.6.1 An edge of an opening for a cord or wire connected in the primary circuit shall be free of burrs and fins that may damage the conductor insulation. Unless a bushing is provided, the edges of an opening in a sheet-metal enclosure shall be rolled or formed.

7.7 Bushings

7.7.1 A bushing shall be secured in place.

8 Interconnection of Windings

8.1 A discrete component that provides a conductive connection between the primary and secondary winding of a transformer shall have a resistance that limits the leakage current in the end use to an acceptable value that does not exceed 12-megohms. The wattage rating of the component shall be at least 1/2 watt.

8.2 The resistance mentioned in 8.1 shall not be exceeded considering the maximum tolerance of the resistor used. For example, a resistor rated 10 megohms with a 20-percent tolerance is acceptable for the 12-megohms maximum resistance application.

8.3 A capacitor with or without a built-in shunt resistor shall comply with the requirements in the Standard for Fixed Capacitors for Use in Electric Equipment – Part 14: Sectional Specifications: Fixed Capacitors for Electromagnet Interference Suppression and Connection to the Supply Mains, UL 60384-14.

9 Protective Devices

9.1 A protective device installed as part of a transformer shall comply with the requirements for the construction, performance, and use for such a device.

9.2 Protective devices covered by 9.1 include fuses, overtemperature and overcurrent protectors, eutectic materials, and similar devices intended to interrupt the flow of current as a result of transformer overload.