Specifying the proper Transformer

The international standards governing electronic equipment have specific requirements for transformers. This exclusive report describes these standards and their implications for designers. It also explains how not paying close attention to standards can result in costly, embarrassing, and time-consuming redesigns.

In today's international marketplace, manufacturers of electronic equipment are faced with a bewildering array of standards, covering everything from paint to circuit board material. If there was just one great global standard, the task of meeting its requirements would at least be relatively straightforward. Unfortunately, there are numerous standards, from a variety of agencies in the United States, Canada, and Europe, that must be accommodated. Each standard treats its subject differently, complicating matters further.

Lurking within each of these standards are requirements that specify how power transformers will be built and implemented. It pays to get to know these standards, since the alternative is conformance testing failure in the target country. This requires the manufacturer to redesign the product to comply with the standards, which can be an extremely costly task that dramatically increases time to market.

When in Rome...

The best known safety agency is Underwriters Laboratories (UL). It's the world's largest safety agency and has had more components and finished products submitted to it for testing than all other safety agencies combined. UL addresses every kind of electrical and electronic component, either exclusively in standards addressing a single product, or within a larger standard that covers equipment design. Requirements for power transformers can be found in several UL standards.

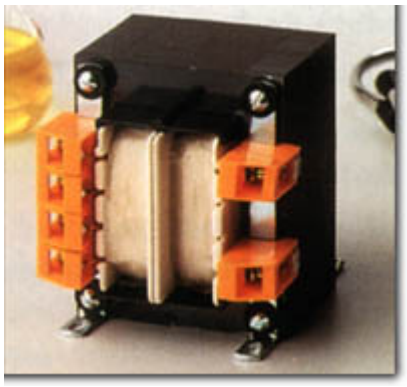
In Canada, the Canadian Standards Association (CSA) is responsible for maintaining a benchmark for safety of components and products sold throughout the country. CSA has several standards for transformers, and the process of certification is different from that of UL.

In Europe, most countries abide by either a standard from the International Electrotechnical Commission (IEC) or have their own standard based on IEC standards.

Manufacturers must sometimes also abide by the rules of a state or local agency that mandates requirements specific to it needs. For example, the County of Los Angeles, because earthquakes are an inevitability there, may require the use of current and thermal protection and non- flammable materials, even though national standards do not. Consequently, it's always best to check all likely sources of requirements at the national and local level.

Getting to Know UL

When people see the UL tag on electrical and electronic equipment, they generally say it's *UL approved*. However, UL doesn't use the word *approve* but rather has separate guidelines for finished products and the components with which they're made. If acceptable, complete products ready for the end user will be UL listed, and components meeting UL specifications will be UL recognized. Since transformers are fundamental electrical components, they can be *UL recognized* if they meet the requirements of an applicable UL standard.



This chassis-mount transformer meets UL, VDE, CSA, and IEC standards and provides isolation of 4 kV rms

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The following examples are representative of UL standards:

- **UL506:** This standard covers only "specialty" transformers, which can be broadly defined as small power transformers. The standard specifies construction methods, dielectric strengths, and a maximum operating temperature rise for power transformers rated 10 kVA or less. The great majority of transformers used throughout electrical and electronic products are covered by UL506.
- **UL1411:** Transformers used in radio, television, and other similar appliances are covered by this standard, which is similar in its requirements to UL506. The primary differences are that UL1411 requires the use of UL94V0-listed, flame-retardant material for terminal anchoring points and includes abnormal performance testing according to the type of finished product in which the transformer is used.
- **UL544:** Medical and dental equipment is covered by this standard. As might be expected, UL544 is quite detailed and stringent in its requirements, since the finished product is often used in situations that are critical to someone's health. In addition, this equipment is often connected directly to a patient, which makes isolation from hazardous voltages even more important. Also, UL544 includes a limit on primary-to-secondary leakage current and requires some means of internal thermal or current fusing or a manufacturer-specified external current fuse.
- **UL1585:** This standard covers Class 2 and 3 transformers, which are current-limited devices designed to protect the user from the consequences of an overload. The transformers covered by UL1585 can be either inherently or non-inherently limited. Inherently limited transformers are designed so that, in the event of a long-term overload, their impedance will be high enough to keep them from being destroyed and causing a fire. Most will continue to operate properly when normal conditions are restored. Transformers contain a thermal or current fuse or an external fuse specified by the manufacturer of the finished product.

It's important to note that a transformer manufacturer's entire product line is not automatically UL recognized if one or more of its individual products has met UL requirements. Custom versions of existing products must be submitted to UL for recognition, which can take up to 12 weeks depending on the governing standard. When specifying a certain product, ask the manufacturer if it's UL recognized, and to which standard. Using UL-recognized transformers is worth any effort required to obtain them because it significantly reduces the time required to get UL listing of the end product.

More on CSA and IEC

CSA's standard for specialty transformers is C22.2, No. 66-1988. It covers design and implementation of air-cooled, dry-type power transformers of 1,000 kVA or less operating with a primary voltage of 750 v or less. This standard is very similar to UL506 and includes bell-ringing transformers and transformers for Class 2 circuits. There are differences also in the way testing is conducted, as well as in marking requirements. The Canadian standard governing electromedical products (C22.2, No. 125) is quite thorough and similar to UL544.

In Europe, there are many standards, but fortunately there is commonality among them. The two main standards are IEC-950, maintained by the IEC, and EN60950, which is the European Community version of IEC-950. An additional standard, IEC-601-1, is generally accepted throughout Europe as the standard by which medical electronic equipment must comply (as UL544 is in the United States and C22.2. No. 125 is in Canada).

The trend in Europe is to consolidate standards in order to simplify the design and manufacture and subsequent marketing of products within the European Community. EN60950 is an example of this trend and is designed to provide an umbrella standard that safety agencies in various countries can use either as is or with modifications that satisfy local needs.

The German safety agency, Verband Deutscher Electrotechniker (VDE) long ago constructed a set of standards that has become widely respected throughout the world. Many countries have adopted the content of such standards as VDE0805 and VDE0750. However, as standards consolidation continues, more countries -- even Germany -- are adopting IEC and EN standards.

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In short, there are quite a few standards that specifically address the design and implementation of power transformers. It's essential for the designer and the manufacturer of electronic equipment to look at the end use of the equipment and accommodate the requirements of any applicable standard at the beginning of the design cycle. The alternative can be a costly, embarrassing, time-consuming redesign.