

Listed Transformers: Choosing the Right One for Your Application

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Requiring liquid-filled distribution transformers to be listed by Underwriters Laboratories Inc.® (UL®) has been on the increase. But UL's transformer listing can often be confused with Factory Mutual Approval and UL Combination Classification/Listing which are meant to comply with the National Electric Code® (NEC®) Article 450-23, Less-Flammable Liquid Insulated Transformers. The NEC Article 450-23 provides guidelines for transformers installed indoors and adjacent to, or on, buildings.

An important consideration when reviewing the UL listing and listings meant to comply with NEC 450-23 is the intended application of the transformer. While FM® Approval and UL Combination Classification/Listing are meant for applications indoors and adjacent to, or on buildings, UL listing does not certify any adherence to NEC 450-23 nor any specific application for the transformer. Following is a summary of the requirements for UL Listing, UL Combination Classification/Listing, and FM Approval, and also how each should be specified and applied.

It is important to understand where the term "listing" and the related term "labeling" originated. The definition for "listed" equipment can be found within the NEC, Article 100, and in essence states that a qualified organization has evaluated the equipment to identified standards and maintains periodic inspections of the production of that equipment. The term "labeled" is also defined in Article 100 and is similar, except that the equipment also has an identifying mark from the evaluating organization placed on the product.

UL's listing requirements can be found within the XPLH category code guide information (XPLH.guideinfo; Transformers, Distribution, Liquid-filled

Type, Over 600 V) available on the UL website. UL defines a category code as, "An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification & Recognition Services." For liquid-filled transformers, the category codes are XPLH and XPLH7 for transformers certified for Canada. The basic standards used for the listing evaluation are:

ANSI® C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers

ANSI® C57.12.22 – Standard for Transformers - Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers with High-Voltage Bushings, 2500 kVA and Smaller: High Voltage, 34,500Grd/19,920 Volts and Below; Low-Voltage, 480 Volts and Below - Requirements

ANSI® C57.12.26 – Standard for Transformers-Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors, 34,500 Grd/19,920 Volts and Below; 2500 kVA and Smaller

ANSI® C57.12.28 – Standard for Switchgear and Transformers, Pad-Mounted Equipment – Enclosure Integrity

A UL listing is intended only to verify that transformers bearing the UL listing mark have been evaluated to, and manufactured in accordance with, the above standards. Again, UL listing does not specify the intended application for the unit, but rather relates to the condition of the transformer at the time it leaves the manufacturer's facility.

The best way to guarantee that a UL-listed transformer will be provided is to

specify one. A UL listing can be applied where the local authority having jurisdiction (AHJ) has specified in its electrical codes that only a listed and labeled transformer, or specifically a UL-listed transformer by name, can be installed and approved by electrical inspectors. These authorities can include city, county, or state governments. Sometimes a number of third-party testing organizations will be approved by an AHJ to evaluate individual transformers or transformer installations, but specifying a transformer with a UL listing generally is the most efficient, cost-effective solution for complying with relevant state and local electrical codes.

FM Approval. In contrast with a UL listing, FM Approval is intended to satisfy the requirements outlined in NEC 450-23. As stated earlier, FM Approval is utilized in installations intended to be used indoors and adjacent to, or on, buildings. FM Approval begins with FM Approval Standard 3990 for Less or Non-flammable Liquid-Insulated Transformers. This standard outlines not only the specific transformer features that must be present to comply with the standard, but also the examination and approval procedure that manufacturers must be evaluated to in order to offer FM Approved transformers.

Fundamentally, the FM 3990 Standard is intended to provide appropriate safeguards on the transformer itself, in lieu of outside safety requirements such as auto-extinguishment or a vault per NEC 450, Part C. The most important feature of a FM Approved transformer is the use of a FM Approved less-flammable fluid, having a fire point not less than 300° C. The protective features present on an FM Approved transformer act not only to prevent an outright eventful failure, but the less-flammable fluid also acts to prevent ancillary damage to the transformer's surroundings should an eventful failure take place.

The following is a brief summary of the key protective requirements in FM 3990.

- The transformer is filled with an FM Approved less-flammable fluid.
- The transformer has overcurrent protection that limits the let-through energy to a specific value based on kVA rating.
- Minimum transformer tank rupture strength.
- The transformer tank is provided with a pressure relief device to vent internal overpressures. Minimum flow rates for these devices are based on kVA rating.
- The transformer shall have an additional nameplate with the FM Approval mark specifying the following data: tank pressure rating, overcurrent device part number, pressure relief device part number, insulating fluid type, and requirements particular to the installation.

In addition, FM Approved transformers are tested in accordance with all applicable **ANSI®** and **IEEE®** standards. The manufacturer's designs, facilities, and procedures are subject to periodic auditing by FM field engineers for compliance with **ANSI®/IEEE® Standard C57.12.00™**, and the manufacturer is required to provide documentation that all aspects of FM 3990 are met.

FM Approved transformers are most easily specified by name. The benefits to specifying an FM Approved transformer include the ease of specification, state-of-the-art fire safety design and construction, maximum location flexibility, and ease of compliance with the FM Property Loss Prevention Data Sheet 5-4. Most importantly, third party certification of compliance with the NEC for indoor and outdoor locations is readily verifiable by the local authority having jurisdiction.

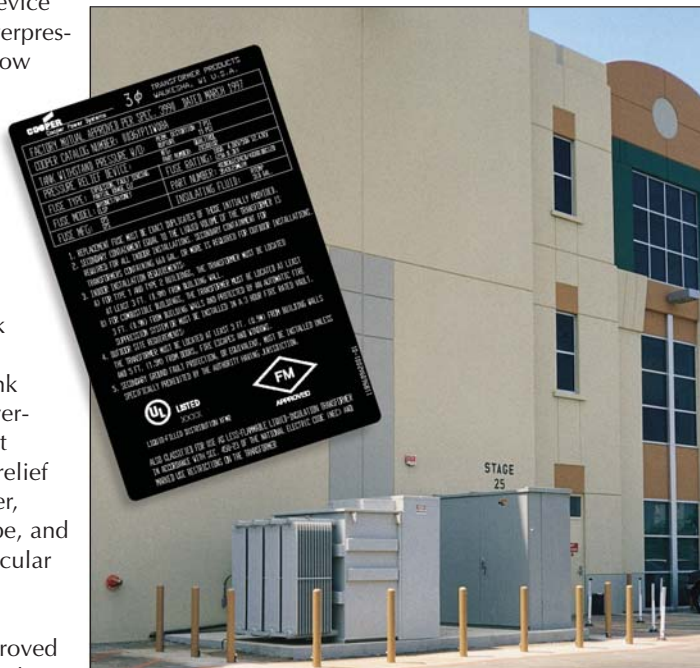
UL Combination Classification/Listing. Similar in design, and identical in application, a UL Combination Classification/Listing is another way in which to comply with NEC 450-23. This combines the UL listed transformer described above with a UL Classified Less-Flammable Liquid and complies with the use restrictions found within the liquid Classification. The following is a brief summary of the requirements that can be found

- The transformer has overcurrent protection that limits the let-through energy to a specific value based on kVA rating.
- Minimum transformer tank rupture strength.
- The transformer tank is provided with a pressure relief device to vent internal overpressures. Minimum flow rates for these devices are based on kVA rating.

Although the UL and FM methods for complying with NEC 450-23 are slightly different, both are considered equal in their application. FM has chosen to formulate a dedicated standard for transformers complying with NEC 450-23. Alternatively, UL has chosen to combine a listed transformer with a Classified fluid and place the special requirements for NEC 450-23 compliance within the Classification of the liquid. It is important to remember when using UL to comply with the NEC 450-23 that either a listed transformer or Classified liquid alone are not enough for compliance, rather it is the marriage of the two that results in NEC 450-23 compliance.

UL Combination Classification/Listing for transformers is most easily specified by name. The benefits to specifying UL Combination Classification/Listing are the same as those listed above for FM Approval including compliance with the FM Property Loss Prevention Data Sheet 5-4. Most importantly, just as with FM Approval, third party certification of compliance with the NEC for indoor and outdoor locations is readily verifiable by the local authority having jurisdiction.

Specify for the Application. It is important to consider which application the transformer is intended for at the specification stage. UL listing is a verification of the design and construction of the transformer to the **ANSI®** standards outlined earlier. What UL listing does not provide is certification to NEC 450-23. When it is known at the time of specification that a transformer will be placed indoors or adjacent to, or on, buildings, it is important to specify either FM Approval, UL Listing/Classification, or both to comply with the requirements of NEC 450-23. Transformers intended for these locations require the important design considerations and inherent safeguards that only the FM Approval or UL Listing/Classification grants you. ■



FM Approved and UL Listed transformers can be used adjacent to buildings.

within the XPLH Guide Information for transformers intended for use as less-flammable liquid-insulated transformers in accordance with NEC 450-23.

- Marked with the mandatory identifying statement, "Also classified for use as less-flammable liquid-insulated transformer in accordance with Sec. 450-23 of the National Electrical Code (NEC) and marked use restrictions on the transformer."
- Must be provided with UL Classified Less-Flammable Liquid that has a fire point not less than 300° C.
- Must follow and be marked with all use restrictions provided for in the Classification of the Less-Flammable Liquid.

The following is a brief summary of the use restrictions contained within the UL Classification of the Less-Flammable Liquid.