Dielectric Fluids

NEC® Requirement Guidelines
2008 Code Options for the Installation of Listed Less-Flammable Liquid-Filled Transformers

R900-20-13

CONTENTS

General Requirements .................................................................3
NEC (NFPA 70) Recognition ..........................................................3
NESC (ANSI C2) Recognition .........................................................3
General NEC Requirements ..........................................................3
Table 1: NEC Section 450.23 Requirements – Indoor Installations .................4
Table 2: NEC Section 450.23 Requirements – Outdoor Installations .................4
Indoor Installation Options .........................................................5
Transformer Rated ≤ 35 kV, in Type I or II Building ..................................5
Listing Option A – UL Requirements .................................................6
Table 3: UL® Classification Marking ................................................6
Listing Option B – FM Requirements .................................................7
FM Approved Transformer .............................................................7
Table 4: FM Pressure Relief Device Required Ratings ................................8
Table 5: FM Maximum I2t Let Through Required Ratings ..........................8
Transformer Rated ≤ 35 kV, not in Type I or II Building ...........................9
Transformer Rated > 35 kV .............................................................9
Outdoor Installation Options .......................................................10
Note on Outdoor Installations Using Conventional Mineral Oil ..................10
Table 7: Clearance Requirements From Buildings For Conventional Mineral Oil-Filled Transformers ...........................10
Outdoors On or Adjacent to Type I or Type II Buildings .........................10
Listing Option A – UL Requirements .................................................11
Listing Option B – FM Requirements .................................................11
Containment ..............................................................................11
Separation Distance ....................................................................12
Tables 7 and 8: FM Required Outdoor Separation Distance ......................12
Figure 1: Separation Between Liquid Insulated Transformer and Building ....13
Outdoors On or Adjacent to Combustible Buildings or Combustible Materials .14
FM Listing Requirement Highlights for Indoor Installations - Appendix 1 ....16
UL Listing Requirement Highlights for Indoor Installations - Appendix 2 ....17
FM Listing Requirement Highlights for Outdoor Installations - Appendix 3 ....18
UL Listing Requirement Highlights for Outdoor Installations - Appendix 4 ....20
UL Classified Less-Flammable Fluids & UL Listed & Classified Transformers - Appendix 5 .21

These guidelines represent Cooper Power Systems, Dielectric Fluids Products’ understanding and interpretation of the National Electrical Code®, UL® Classification of Envirotemp® FR3® Fluid and FM Global Property Loss Prevention Data Sheets 5-4 - Transformers, and IEEE standards in effect at the time of this publication. It does not necessarily represent the position of Cooper Power Systems on the protection and installation of less-flammable transformers.
GENERAL REQUIREMENTS

NEC (NFPA 70) Recognition: These guidelines focus on the requirements of Section 450.23 of the 2008 National Electrical Code (NEC) for the installation of Less-Flammable Liquid-Insulated Transformers. Less-flammable liquids are used in transformers where an extra margin of fire safety is important. Typical applications include installations indoors, on rooftops, near buildings, bush and forest fire-prone areas, and in pedestrian traffic areas.

Less-flammable liquids, also known as high fire point liquids, are transformer dielectric coolants that have a minimum fire point of 300 °C. Commonly used fire resistant coolants include high molecular weight hydrocarbons (HMWH), dimethysiloxane, synthetic esters (Envirotemp 200 fluid), and natural esters (Envirotemp FR3 fluid). Two Nationally Recognized Testing Laboratories (NRTL)*; Underwriters Laboratories (UL) and FM Global (FM) currently list less-flammable liquids. They also list less-flammable liquid-filled transformers.

Less-flammable liquid-filled transformers were formally recognized by the NEC for indoor installations in 1978. In 1990, the NEC integrated specific less-flammable transformer requirements for outdoor installations into Section 450.23, in effect recognizing less-flammable transformers as inherently safer than conventional oil-filled transformers. Less-flammable transformers, long recognized as an additional safeguard for indoor installations, are becoming increasingly recognized for outdoor installations as well.

NESC (ANSI C2) Recognition: Utility-owned transformer installations are typically subject to the requirements of the National Electrical Safety Code (NESC), ANSI C2, in lieu of the NEC. Since 1993, the NESC has also recognized the use of less-flammable transformer fluid as an optional fire safeguard for indoor and outdoor transformer installations in Section 152. Other optional fire safeguard methods that may be applied, depending on the degree of fire hazard present in the installation, are separation from combustible materials or structures, liquid confinement, fire resistant barriers or enclosures, or extinguishing systems.

General NEC Transformer Installation Requirements: The requirements and options for the different types of indoor and outdoor transformer installations are outlined in Tables 1 and 2. These guidelines also summarize the UL Classification and FM Global Approved installation requirements for less-flammable fluids referred to as "listing" requirements in NEC 450.23.

NEC Section 450.28, Modification of Transformers, requires that when modifications are made to transformers in existing installations that change the transformer type, the transformers must be marked to show the type of insulating liquid installed and the installations must comply with current requirements of the NEC. Examples of changes include replacing a complete transformer (retrofitting) or replacement of the fluid only (retrofilling). Askarel (PCB) and conventional mineral oil-filled transformers can be retrofitted or retrofilled using some types of less-flammable fluids like natural esters. Section 110.34 sets minimum clear work space dimensions around transformers.

* Refer to Occupational Safety & Health Administration (OSHA) for complete listing of NRTLs.
### TABLE 1
**NEC Section 450.23 Requirements - Indoor Installations**

<table>
<thead>
<tr>
<th>INSTALLATION TYPE</th>
<th>NEC OPTIONS*</th>
<th>NEC REQUIREMENT*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformer rated ≤ 35 kV, installed in a non-combustible building with no combustible materials stored in area</td>
<td>Both liquid confinement, and either of the following listing requirements A. Underwriters Laboratories B. FM Global OR Both liquid confinement and auto-extinguishment OR Vault per NEC 450, Part III</td>
<td>Vault per NEC 450, Part III</td>
</tr>
<tr>
<td>Transformer rated ≤ 35 kV, installed in a combustible building or in a building with combustible materials stored in area</td>
<td>Both liquid confinement and auto-extinguishment OR Vault per NEC 450, Part III</td>
<td>Vault per NEC 450, Part III</td>
</tr>
<tr>
<td>Transformer rated &gt; 35 kV</td>
<td>Vault per NEC 450, Part III</td>
<td></td>
</tr>
</tbody>
</table>

* No additional safeguards are required if one or more of Exceptions 1-6 of Section 450.26, Oil-Insulated Transformers Installed Indoors apply.

### TABLE 2
**NEC Section 450.23 Requirements - Outdoor Installations**

<table>
<thead>
<tr>
<th>INSTALLATION TYPE</th>
<th>NEC REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-combustible building* and no combustible materials stored in area</td>
<td>Either of the following listing requirements** A. Underwriters Laboratories B. FM Global</td>
</tr>
<tr>
<td>Combustible building* or combustible materials stored in area</td>
<td>In accordance with NEC Section 450.27, Oil Insulated Transformers Installed Outdoors i.e. space separation, fire barriers or water spray systems</td>
</tr>
</tbody>
</table>

* Refer to NFPA 220 for definition of non-combustible Type I and II building construction.
** Fine Print Note, Section 450.23, (B)(1) states: “Installations adjacent to combustible material, fire escapes, or door and window openings may require additional safeguards such as those listed in Section 450.27.”
INDOOR INSTALLATION OPTIONS
(Refer to Appendices 1 and 2)

Indoor installations using less-flammable liquid-insulated transformers must comply with NEC Section 450.23, which defines the requirements for three types of indoor transformer installations as detailed in Table 1:

- Non-combustible building* with no combustible materials stored in area
- Combustible building or combustibles stored in area
- Rating > 35 kV.

INDOOR INSTALLATIONS RATED ≤ 35 kV
Without a Vault in Type I or II Buildings in Areas Where No Combustible Materials are Stored

The installation of less-flammable liquid-insulated transformers indoors without a vault in a Type I or II non-combustible building* where no combustible materials are stored requires that:

- A liquid confinement area be provided. Liquid confinement may include:
  - Containment pan
  - Curbing
  - Room containment (e.g. door sill)

- The transformer be filled with a listed less-flammable insulating liquid with a minimum 300 °C fire point

- The installation complies with all restrictions provided for in the listing of the liquid.

If the installation cannot meet the liquid listing requirements:

- It must be provided with an automatic fire extinguishing system and a liquid containment area

- It must be installed in a vault complying with NEC 450 Part III, Transformer Vaults.

Section 450.26 may be followed in lieu of any requirements listed in Section 450.23. Exceptions to vault requirements listed in Section 450.26 are also valid for less-flammable fluid-filled installations. Construction requirements for vaults are detailed in Part III of Article 450.

Section 450.42 in Part III, Transformer Vaults, allows an exception to the 3-hour vault requirement permitting a 1-hour rated fire resistant rated room if equipped with an automatic extinguishing system.

INSTALLATION TYPE
Transformer rated ≤ 35 kV, installed in a non-combustible building with no combustible materials stored in area.

NEC OPTIONS**

- Both liquid confinement, and either of the following listing requirements:
  A. Underwriters Laboratories
  B. FM Global;
  OR
- Both liquid confinement and auto-extinguishement;
  OR
- Vault per NEC 450, Part III.

* Refer to NFPA 220 for definition of non-combustible Type I and II building construction.
** No additional safeguards are required if one or more of Exceptions 1-6 of Section 450.26, Oil-Insulated Transformers Installed Indoors apply.
LISTING OPTION – A
Underwriters Laboratories Requirements*

The UL Classification of less-flammable liquids per the NEC Section 450.23 for 3-Phase 45-10,000 kVA transformers requires:

- Transformers be equipped with tanks capable of withstanding 12 psig without rupture.
- Transformers be equipped with pressure relief devices with minimum pressure relief capacity per the UL Classification Marking.
- Transformer primaries be protected with overcurrent protection options per the UL Classification Marking.

Overcurrent Protection Option I, available exclusively with Envirotemp FR3 Fluid’s UL Classification, allows internal expulsion fuses (e.g. bay-o-net fuses) only if in series with current limiting fuses. Overcurrent Protection Option II allows stand-alone expulsion fuses, but they must be located outside the transformer tank.

To specify a UL Classified Envirotemp FR3 fluid-filled transformer for a specific kVA rating, refer to the UL Classification Marking for the fluid shown in Table 3.

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Table 3: UL Classification Marking for Envirotemp FR3 Fluid (EOVK.MH10678)

<table>
<thead>
<tr>
<th>TRANSFORMER Rating kVA</th>
<th>REQUIRED PROTECTION</th>
<th>REQUIRED PRC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Required Current Limiting Fusing (+) Maximum I²t (A²s)</td>
<td>Required Overcurrent Protection (+) Maximum I²t (A²s)</td>
</tr>
<tr>
<td>45</td>
<td>500,000</td>
<td>700,000</td>
</tr>
<tr>
<td>75</td>
<td>500,000</td>
<td>900,000</td>
</tr>
<tr>
<td>112.5</td>
<td>600,000</td>
<td>1,000,000</td>
</tr>
<tr>
<td>150</td>
<td>650,000</td>
<td>1,200,000</td>
</tr>
<tr>
<td>225</td>
<td>750,000</td>
<td>1,400,000</td>
</tr>
<tr>
<td>300</td>
<td>900,000</td>
<td>1,900,000</td>
</tr>
<tr>
<td>450</td>
<td>1,100,000</td>
<td>2,200,000</td>
</tr>
<tr>
<td>500</td>
<td>1,250,000</td>
<td>3,400,000</td>
</tr>
<tr>
<td>750</td>
<td>1,500,000</td>
<td>4,500,000</td>
</tr>
<tr>
<td>1,000</td>
<td>1,750,000</td>
<td>6,000,000</td>
</tr>
<tr>
<td>1,500</td>
<td>2,000,000</td>
<td>7,500,000</td>
</tr>
<tr>
<td>2,000</td>
<td>2,250,000</td>
<td>9,000,000</td>
</tr>
<tr>
<td>2,500</td>
<td>2,500,000</td>
<td>11,000,000</td>
</tr>
<tr>
<td>3,000</td>
<td>3,000,000</td>
<td>14,000,000</td>
</tr>
<tr>
<td>3,500</td>
<td>3,300,000</td>
<td>14,000,000</td>
</tr>
<tr>
<td>5,000</td>
<td>3,500,000</td>
<td>14,000,000</td>
</tr>
<tr>
<td>7,500</td>
<td>3,800,000</td>
<td>14,000,000</td>
</tr>
<tr>
<td>10,000</td>
<td>4,000,000</td>
<td>14,000,000</td>
</tr>
</tbody>
</table>

Legend:

(+): This is an additional requirement to the overcurrent protection required in accordance with Section 450.3 of the current National Electrical Code®.

(++) Opening pressure, 10 psig maximum.

* UL EOVK - Transformer Fluids
LISTING OPTION - B
FM Global Requirements

The FM indoor installation requirements for all transformer and fluid types are given in FM Global Property Loss Prevention Data Sheets 5-4 - Transformers (LPD). Specific requirements for less-flammable liquid-insulated transformers are included. Refer to Section 2.2.1.2 of FM LPD for special installation requirements for network transformers.

General transformer requirements are as follows:

- Minimum 3 ft. clear from building walls, AND
- Liquid containment provisions, AND
- Room fire resistance rating based on fluid and transformer type, AND
- Room ventilation, if necessary, to prevent non-thermal damage, AND
- Smoke detection with alarm in the electrical room.

Less-flammable liquid-filled transformers must comply with one of the following:

- Be FM Approved or equivalent,
- Be located in a room with a one hour fire resistance rating,
- Have automatic sprinklers above the transformer and 20 ft. beyond with a discharge density of 0.20 gpm/sq. ft.

FM Approved Transformer:

Less-flammable liquid-filled transformers rated 5 through 10,000 kVA must be equipped with specific design and protection features to be FM Approved or equivalent. Key characteristics of this protection system are fire properties of the liquid, the ability to mechanically withstand pressure generated by a low level electrical fault and the ability of electrical protection to clear a fault before tank rupture.

According to FM Global Standard 3990, the key protection features are as listed below. Refer to the FM standard for complete requirements:

- The transformer tank rupture strength shall be a minimum of 15 psig for rectangular and 20 psig for cylindrical tanks. All transformer tanks shall be designed to withstand a pressure of 7 psig without permanent distortion, AND
- The transformer tank shall be provided with a pressure relief device to vent internal over-pressures. The device must be capable of venting a minimum specified flow rate, based on the kVA as noted in Table 4 and Section 2.3.3 of the FM Global Standard 3990. Proper pressure venting coordinated with proper tank pressure withstand rating has proven highly effective in preventing tank rupture from overpressure due to internal fault currents below the trip rating of primary circuit current limiting fuses, AND
- The unit is filled with an FM Global Less-Flammable fluid* to reduce the probability of ignition of the liquid. Less-Flammable fluids, also known as high fire point or fire resistant liquids, are dielectric coolants that have a minimum fire point of 300 °C per the ASTM D92 Cleveland Open Cup Test Method, AND
- The primary circuit shall have over-current protection which limits the let-through current ($I^2t$) to a specified maximum value as listed in Table 5 and in Section 2.3.5 of the FM Global Standard 3990. Current-limiting fusing and its functional equivalents are designed to interrupt a high current internal fault before the tank withstand pressure level is reached. If protection is designed to vent gas during operation, such as with expulsion fuses, this protection shall be located outside the transformer tank. Exception: Envirotemp FR3 fluid-immersed expulsion fusing (e.g. bay-o-net) may be mounted in the transformer tank if in series and properly coordinated with current limiting fusing, AND
- The transformer shall have an additional nameplate with the FM Global mark with the following data: tank pressure rating, fuse part number, pressure relief device part number, and requirements particular to the type of installation.

* For a listing of FM Global Less-Flammable fluids, refer to the Less Flammable Fluids section of the FM Global Approval Guide - Electrical Equipment.
LISTING OPTION - B
FM Global Requirements (continued)

- For grounded wye secondary windings of 150 volts or more and rated at 1,000 or more nominal amperes, a notification tag shall be provided by the manufacturer, secured to the low voltage neutral bushing, advising that the transformer installation requires ground fault relay protection prior to energization (if not installed at time of manufacturing), **AND**

- Indoor units greater than 500 kVA with alarm contacts only and outdoor units greater than 2,500 kVA shall be equipped with alarm contacts on the pressure relief device and a rapid-rise relay, **AND**

- Three-phase pad-mounted and substation transformers shall be equipped with an oil level gauge. Additionally, all transformers rated 750 kVA or higher shall be equipped with a liquid temperature indicator and pressure-vacuum gauge, **AND**

- Transformers shall be capable of passing Basic Lightning Impulse Insulation Level (BIL) testing at a minimum tilt of 1.5° from vertical.

### Table 4: FM Pressure Relief Device Required Ratings

<table>
<thead>
<tr>
<th>kVA Rating 3-Phase (1-Phase)</th>
<th>Flow Rate SCFM @ 15psi (103 pKa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>112.5 (37.5)</td>
<td>35</td>
</tr>
<tr>
<td>150 (50)</td>
<td>50</td>
</tr>
<tr>
<td>300 (100)</td>
<td>100</td>
</tr>
<tr>
<td>1,000 (333)</td>
<td>350</td>
</tr>
<tr>
<td>2,000 (667)</td>
<td>700</td>
</tr>
<tr>
<td>10,000 (3,333)</td>
<td>5,000</td>
</tr>
</tbody>
</table>

Note: For kVA ratings not listed use next **highest** rating in table.

### Table 5: FM Maximum \(I^2t\) Let Through Required Ratings

<table>
<thead>
<tr>
<th>kVA Rating 3-Phase (1-Phase)</th>
<th>Current Limiting Fusing</th>
<th>Other Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 (15)</td>
<td>500,000</td>
<td>700,000</td>
</tr>
<tr>
<td>75 (25)</td>
<td>500,000</td>
<td>800,000</td>
</tr>
<tr>
<td>112.5 (37.5)</td>
<td>550,000</td>
<td>900,000</td>
</tr>
<tr>
<td>150 (50)</td>
<td>600,000</td>
<td>1,000,000</td>
</tr>
<tr>
<td>225 (75)</td>
<td>650,000</td>
<td>1,200,000</td>
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<tr>
<td>300 (100)</td>
<td>750,000</td>
<td>1,400,000</td>
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<tr>
<td>500 (167)</td>
<td>900,000</td>
<td>1,900,000</td>
</tr>
<tr>
<td>750 (250)</td>
<td>1,100,000</td>
<td>2,200,000</td>
</tr>
<tr>
<td>1,000 (333)</td>
<td>1,250,000</td>
<td>3,400,000</td>
</tr>
<tr>
<td>1,500 (500)</td>
<td>1,500,000</td>
<td>4,500,000</td>
</tr>
<tr>
<td>2,000 (667)</td>
<td>1,750,000</td>
<td>6,000,000</td>
</tr>
<tr>
<td>2,500 (833)</td>
<td>2,000,000</td>
<td>7,500,000</td>
</tr>
<tr>
<td>3,000 (1,000)</td>
<td>2,250,000</td>
<td>9,000,000</td>
</tr>
<tr>
<td>3,750 (1,250)</td>
<td>2,500,000</td>
<td>11,000,000</td>
</tr>
<tr>
<td>5,000 (1,667)</td>
<td>3,000,000</td>
<td>14,000,000</td>
</tr>
<tr>
<td>7,500 (2,500)</td>
<td>3,000,000</td>
<td>14,000,000</td>
</tr>
<tr>
<td>10,000 (3,333)</td>
<td>3,000,000</td>
<td>14,000,000</td>
</tr>
</tbody>
</table>

Note: For kVA ratings not listed use next **lowest** rating in table.
INDOOR INSTALLATIONS
RATED ≤ 35 kV
Without a Vault in Buildings Other Than Type I or II or in Areas Where Combustible Materials are Stored

INSTALLATION TYPE
Transformer rated ≤ 35 kV, installed in a combustible building or in a building with combustible materials stored in area.

NEC OPTIONS**
- Both liquid containment and auto extinguishment
  OR
- Vault per NEC 450, Part III.

The installation of less-flammable liquid-insulated transformers indoors without a vault in Type I or II non-combustible building* where no combustible materials are stored required that:
- A liquid containment area be provided, AND
- The transformer be filled with a listed less-flammable insulating liquid with a minimum 300 °C fire point, AND
- The installation comply with the listing requirements of the liquid in the transformer.

If the installation cannot meet the liquid listing requirements or one or more of the exceptions listed in 450.26, the installation must either be provided with an automatic fire extinguishing system and a liquid confinement area or the transformer must be installed in a vault, per Section 450, Part III.

Section 450.42 in Part III, Transformer Vaults, allows an exception to the three-hour vault requirement permitting a one-hour rated fire resistant rated room if equipped with an automatic extinguishing system.

INDOOR INSTALLATIONS RATED > 35 kV
INSTALLATION TYPE
Transformer rated > 35 kV

NEC REQUIREMENT**
- Vault per NEC 450, Part III.

If the installation does not comply with one or more of the exceptions listed in 450.26, the transformer must be installed in a vault complying with NEC 450, Part III Transformer Vaults. Section 450.26 may be followed in lieu of any requirements listed in Section 450.23. Exceptions to vault requirements listed in Section 450.26 would also be valid for less-flammable fluid-filled transformer installations. Construction requirements for vaults are detailed in Part III of Article 450.

Section 450.42 in Part III, Transformer Vaults, allows an exception to the three-hour vault requirement permitting a one-hour rated fire resistant rated room if equipped with an automatic extinguishing system.

*Refer to NFPA 220 for definition of non-combustible Type I and II building construction.
**No additional safeguards are required if one or more of Exceptions 1-6 of Section 450-26, OIl-Insulated Transformers Installed Indoors apply.
OUTDOOR INSTALLATION OPTIONS
(Refer to Appendices 3 and 4)

Outdoor installations attached to, adjacent to, or on the roof of buildings using less-flammable liquid-insulated transformers must comply with NEC Section 450.23. This Code Section defines the requirements for outdoor less-flammable transformer installations according to the building fire resistance rating.*

- On or adjacent or attached to Type I or II building*
- On or adjacent to a combustible building**

In addition to indoor installations, less-flammable liquid-insulated transformers are increasingly recognized as an additional safeguard by insurance underwriters and specifiers for outdoor applications. The degree of fire safety will be significantly increased when a transformer is filled with less-flammable fluid instead of conventional mineral oil. Transformers installed according to the listing requirements of less-flammable liquids will provide an even greater margin of safety.

Note on Outdoor Installations Using Conventional Mineral Oil per IEEE:

IEEE Std 979™ standard, Guide For Substation Fire Protection recommends that transformers containing conventional mineral insulating oil be located not less than the distances listed in Table 6 from buildings. Where a transformer is located less than the specified minimum distance, fire-resistant wall construction should be used.

Table 6: Clearance Requirements From Buildings For Conventional Mineral Oil-Filled Transformers (per IEEE Std 979™ standard)

<table>
<thead>
<tr>
<th>Transformer Rating</th>
<th>Recommended Minimum Distance from Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 kVA or less</td>
<td>10 ft.</td>
</tr>
<tr>
<td>76-333 kVA</td>
<td>20 ft.</td>
</tr>
<tr>
<td>More than 333 kVA</td>
<td>30 ft.</td>
</tr>
</tbody>
</table>

* Refer to NFPA 220 for definition of non-combustible Type I and II building construction.
** Per NFPA 220, the definition of combustible material refers to material not classified as non-combustible or limited-combustible.
LISTING OPTION - A
Underwriters Laboratories Requirements

The same UL Classification of less-flammable liquids per the NEC Section 450.23 for 3-Phase 45-10,000 kVA transformers applies to both indoor and outdoor applications and requires:

- Transformers be equipped with tanks capable of withstanding 12 psig without rupture, **AND**
- Transformers be equipped with pressure relief devices with minimum pressure relief capacity per the UL Classification Marking, **AND**
- Transformer primaries be protected with overcurrent protection options per the UL Classification Marking.

Overcurrent Protection Option I, available exclusively with Envirotemp FR3 Fluid’s UL Classification, allows internal expulsion fuses (e.g. bay-o-net fuses) in series with current limiting fuses. Overcurrent Protection Option II allows stand-alone expulsion fuses, but they must be located outside the transformer tank.

To specify a UL Classified Envirotemp FR3 fluid-filled transformer for a specific kVA rating, refer to the UL Classification Marking for the fluid shown in Table 3.

LISTING OPTION - B
FM Global Requirements

The outdoor installation requirements according to FM Global Property Loss Prevention Data Sheets 5-4 - Transformers consist of requirements for transformer and fluid types. Specific requirements for less-flammable liquid-insulated transformers are included.

FM outdoor installation requirements are based on the FM Approval Status of the transformer and both the volume and FM Approval Status of the fluid. If transformers filled with conventional mineral oil or non-approved fluids would expose buildings and equipment to a release of oil, the transformer must comply with FM LPD requirements. This may include containment, separation distances, fire barriers, or water spray systems. Installation of FM Approved transformers or transformers with FM Approved less-flammable fluids must comply with FM LPD requirements for containment and separation distances. The FM LPD provides detailed requirements for fire barriers in Section 2.3.1.1.2 and water spray exposure protection in Section 2.3.2.1.

Fluid containment requirements as detailed in Section 2.3.1.2 of the FM LPD are:

- A release of mineral oil would expose buildings
  **OR**
- More than 500 gal (1.9 m$^3$) of mineral oil could be released
  **OR**
- More than 1320 gal (5 m$^3$) of FM Approved less-flammable fluid could be released
  **OR**
- More than 2,640 gal (10 m$^3$) of biodegradable FM Approved less flammable fluid could be released.

For this purpose: 1) the fluid must be certified as a biodegradable fluid by the government environmental protection agency, 2) a release of the fluid must not expose navigable waterways (see Appendix A for definition) and 3) the transformer must be properly labeled.
LISTING OPTION - B
FM Global Requirements (continued)

Separation Distance: Separation distance requirements are based on whether the transformer is FM Approved or equivalent, or the volume of fluid, and if the fluid is FM Approved. For FM Listed less-flammable fluids, horizontal distance is measured from transformer; for non-listed fluids, horizontal distance is measured from inside of the outer edge of containment. (See Figure 1.)

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### TABLE 7. FM Required Separation Distance Between Outdoor Liquid Insulated Transformers and Buildings.*

<table>
<thead>
<tr>
<th>Liquid</th>
<th>FM Approved Transformer or Equivalent</th>
<th>Liquid Volume gal/(m³)</th>
<th>Horizontal Distance**</th>
<th>Vertical Distance ft/(m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fire Resistant ft/(m)</td>
<td>Non-Combustible ft/(m)</td>
</tr>
<tr>
<td>Less-Flammable (Approved)</td>
<td>Yes</td>
<td>N/A</td>
<td>3 (0.9)</td>
<td>3 (0.9)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>≤10,000 (38)</td>
<td>5 (1.5)</td>
<td>5 (1.5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;10,000 (38)</td>
<td>15 (4.6)</td>
<td>15 (4.6)</td>
</tr>
<tr>
<td>Mineral Oil</td>
<td>N/A</td>
<td>&lt;500 (1.9)</td>
<td>5 (1.5)</td>
<td>15 (4.6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>500-5,000 (1.9-19)</td>
<td>15 (4.6)</td>
<td>25 (7.6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;5,000 (19)</td>
<td>25 (7.6)</td>
<td>50 (15.2)</td>
</tr>
</tbody>
</table>

* FM Global Loss Prevention Data Sheet 5-4, Table 2a
** All transformer components must be accessible for inspection and maintenance.

---

### TABLE 8. FM Outdoor Fluid Insulated Transformers Equipment Separation Distance.*

<table>
<thead>
<tr>
<th>Liquid</th>
<th>FM Approved Transformer or Equivalent</th>
<th>Fluid Volume gal/(m³)</th>
<th>Distance** ft/(m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less-Flammable (Approved)</td>
<td>Yes</td>
<td>N/A</td>
<td>3 (0.9)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>≤10,000 (38)</td>
<td>5 (1.5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;10,000 (38)</td>
<td>25 (7.6)</td>
</tr>
<tr>
<td>Mineral Oil</td>
<td>N/A</td>
<td>&lt;500 (1.9)</td>
<td>6 (1.5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>500-5,000 (1.9-19)</td>
<td>25 (7.6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;5,000 (19)</td>
<td>50 (15.2)</td>
</tr>
</tbody>
</table>

* FM Global Loss Prevention Data Sheet 5-4, Table 2b
** All transformer components must be accessible for inspection and maintenance.
Figure 1.
Separation between liquid insulated transformer and building. (Drawing excerpted from FM Global Loss Prevention Data Sheet 5-4.)

$H_1 =$ Transformer less than 500 gal. and where ground slopes away from building, dike not needed. Horizontal distance is measured from transformer to building.

$H_2 =$ Where ground is flat or slopes to building, dike should be provided. Horizontal distance is measured from dike to building.
OUTDOORS ON OR ADJACENT TO COMBUSTIBLE BUILDINGS OR COMBUSTIBLE MATERIALS

INSTALLATION TYPE
For installations other than Type I and Type II* buildings or for installations that do not comply with all the restrictions provided for in the listing of the liquid.

NEC REQUIREMENT
Per NEC Section 450.27, Oil-Insulated Transformers Installed Outdoors.

Section 450.23 refers to Section 450.27, Oil Insulated Transformers Outdoors, for installation requirements when less-flammable liquid-filled transformers are installed on or adjacent to combustible buildings or near combustible materials. As for conventional oil-filled transformers, it requires the safeguarding of combustible material, combustible buildings, fire escapes and door and window openings. Recognized safeguards include space separation, fire barriers, spray extinguishing systems and confinement areas for spilled fluid. The NEC requires that one or more of the above safeguards be applied according to the degree of fire hazard present in cases where the installation presents a fire hazard. Obviously, less-flammable fluid-filled transformers significantly reduce the possibility that the installation presents a fire hazard compared to conventional mineral oil.

* Refer to NFPA 220, Section 2.1 for the definition of combustible building construction.
This page intentionally left blank.
Less-Flammable Liquid-Insulated Transformers

Compliance to NEC 2008 Section 450.23 per FM Listing

Requirement Highlights for Indoor Installations

FM Approved Fluids include: **
- Envirotex FR3 Fluid (natural ester)
- ABB BIOTEMP® (natural ester)
- M&I Materials MIDEL® 7131 (synthetic ester)
- Shell Diala® HFX (fire resistant hydrocarbon)
- Dow Chemical L-305, Y-7582 (silicone)
- DSI Alpha-1™, Beta® (hydrocarbon)
- Dow Corning® 561 (silicone)

* Refer to NFPA 220 for definition of non-combustible Type I and II building construction

FM Approved Transformers include: **
- Cooper Power Systems
- ABB
- Siemens
- Eaton Cutler-Hammer

Appendix 1
Less-Flammable Liquid-Insulated Transformers
Compliance to NEC 2008 Section 450.23 per UL Listing

Requirement Highlights for Indoor Installations

Transformer ≤ 35 kV and Liquid Confinement Area Available

Non-Combustible Building (Type I or Type II)* and No Combustibles in the Area

UL Classified Transformer Fluid**

Installation Incorporates UL Classification** Marking Requirements

UL OPTION I
- Pressure Relief Device
- Minimum 12 psig Tank Pressure Rupture Withstand
- Primary Current Limiting Fusing Per UL Classification Marking.**

UL OPTION II
- Pressure Relief Device
- Minimum 12 psig Tank Pressure Rupture Withstand
- Overcurrent Protection Per UL Classification Marking.**

NOTE: Devices that vent during operation such as bay-o-net fuses may not be liquid-immersed.

Automatic Fire Extinguishing System Available

In Accordance with One or More of the Exceptions of NEC 450.26

Vault Requirements Per NEC 450, Part III

COMPLIANCE WITH NEC 450.23

☐ NEC Code Requirements
☐ UL Listing Requirements

UL Classified Transformer Fluids:**
Envirotemp FR3 Fluid (natural ester), Option I or Option II
Dow Corning® 561 (silicone), Option II only

* Refer to NFPA 220 for definition of non-combustible Type I and II building construction
** Transformer Fluids (EOVK), Underwriters Laboratories Certifications Directory

NOTE: UL Classification Dielectric Mediums (EOUV) states that "Liquids intended for use as dielectric and cooling mediums in electrical transformers are covered under Transformer Fluids (EOVK)."
Less-Flammable Liquid-Insulated Transformers

Compliance to NEC 2008 Section 450.23 per FM*** Listing

Requirement Highlights for Outdoor Installations

Non-Combustible Building (Type I or Type II)* and No Combustibles in the Area

FM Approved Less-Flammable Fluid

Installation Incorporates FM LPD Sheet*** Requirements

Requirements per Liquid Listing

See Page 19 for FM Requirements Detail

COMPLIANCE WITH NEC 450.23

FM Approved Fluids: **

- Envirotex FR3 Fluid (natural ester)
- ABB BIOTEMP® (natural ester), ETV status
- M&I Materials Ltd. MIDEL® E7131 (synthetic ester)
- Shell Diala® Oil HFX (fire resistant hydrocarbon)
- Dow Chemical L-305, Y-7582 (silicone)
- DSI Alpha-1™, Beta® (hydrocarbon)
- Dow Corning® 561 (silicone)

* Refer to NFPA 220 for definition of non-combustible Type I and II building construction

FM Approved Transformers: **

- Cooper Power Systems
- ABB
- Siemens
- Eaton Cutler-Hammer

** FM Global Approval Guide
*** FM Global Property Loss Prevention Data Sheets 5-4 — Transformers

NOTE: NEC Section 110.3 (b) applies if the listing chosen for compliance specifically addresses outdoor application.

Appendix 3
Less-Flammable Liquid-Insulated Transformers
Compliance to NEC 2008 Section 450.23 per FM Listing

Requirement Highlights for Outdoor Installations

FM Requirements Detail

FM Approved Less-Flammable fluid*

More than 1320 gallons

US EPA Environmental Technology Verification** status for Ready Biodegradation

More than 2640 gallons

Containment per FM LPD*** Section 2.3.1.2

FM Approved Transformer* or equivalent

Minimum separation distances per FM LPD*** Section 2.3.1.1.1 Tables 2A & 2B
- 3 feet horizontal
- 5 feet vertical

Minimum separation distances per FM LPD*** Section 2.3.1.1.1 Tables 2A & 2B
- 5-50 feet horizontal
- 25-50 feet vertical

Spill exposure to building (ground sloping toward building or level)

More than 500 gallons

Containment per FM LPD*** Section 2.3.1.2

FM LPD*** Installation Options for Mineral Oil or Non-Approved Fluid
- Minimum separation distances per Section 2.3.1.1.1 Tables 2A & 2B
  - 5-100 feet horizontal
  - 25-100 feet vertical
- Fire barriers per Section 2.3.1.1.2
- Water Spray Protection per Section 2.3.1.1.2

COMPLIANCE WITH NEC 450.23

---

* FM Global Approval Guide
** Environmental Technology Verification Program, U.S. Environmental Protection Agency (Envirotemp FR3 fluid and BIOTEMP® fluid have ETV status for Ready Biodegradation)
*** FM Global Property Loss Prevention Data Sheets 5-4 — Transformers

Appendix 3
Less-Flammable Liquid-Insulated Transformers
Compliance to NEC 2008 Section 450.23 per UL Listing

Requirement Highlights for Outdoor Installations

Non-Combustible Building (Type I or Type II) and No Combustibles in the Area

Yes

UL Classified Less-Flammable Fluid

No

Yes

Installation Incorporates UL Classification** Marking Requirements

No

Requirements Per NEC 450.27
If installation presents fire hazard one or more of the following safeguards shall be applied:
• Space Separation
• Fire Barriers
• Automatic Water Spray
• Enclosure

UL OPTION I
• Pressure Relief Device
• Minimum 12 psig Tank Pressure Rupture Withstand
• Primary Current Limiting Fusing Per UL Classification Marking.**

Yes

UL OPTION II
• Pressure Relief Device
• Minimum 12 psig Tank Pressure Rupture Withstand
• Overcurrent Protection Per UL Classification Marking.**

NOTE: Devices that vent during operation such as bay-o-net fuses may not be liquid-immersed.

Yes

COMPLIANCE WITH NEC 450.23

---

UL Classified Transformer Fluids:*
Envirotex FR3 Fluid (natural ester), Option I or Option II
Dow Corning® 561 (silicone), Option II only

** Refer to NFPA 220 for definition of non-combustible Type I and II building construction
Transformer Fluids (EOVK), Underwriters Laboratories Certifications Directory

NOTES: UL Classification Dielectric Mediums (EOUV) states that "Liquids intended for use as dielectric and cooling mediums in electrical transformers are covered under Transformer Fluids (EOVK)."

---

Appendix 4
UL Classified Less-Flammable Fluids &
UL Listed & Classified Transformers

Important Information to Assure Code Compliance
Part A: Dielectric Coolants

Not all UL Classified dielectric coolants applied in transformers meet NEC Section 450.23 requirements. Simply specifying that a transformer be filled with a UL Classified dielectric coolant is not sufficient to assure the transformer meets NEC Section 450.23 listing requirements.

UL has two classification categories for dielectric coolants:
- EOUV: Dielectric Mediums (See page 24 for EOUV.guideinfo)
- EOVK: Transformer Fluids (See page 26 for EOVK.guideinfo)

To assure compliance with NEC Section 450.23 listing requirements of UL, the dielectric coolant must be Classified as an EOVK Transformer Fluid as detailed in Part A2 of this appendix.

Part A1: UL Classification EOUV Dielectric Mediums

This category is a fire hazard rating only. All Classified Dielectric Mediums have the same fire hazard ratings, "Classed 4 to 5 less hazardous paraffin oil in respect to fire hazard". Included in the EOUV Classification are requirements for minimum ignition temperature, fire point, and closed cup flash point. This Classification makes no reference to NEC 450.23, and does not classify the fluid as a "less-flammable liquid" in accordance with Section 450.23.

Table A1 - UL Classified EOUV Dielectric Mediums

<table>
<thead>
<tr>
<th>EOUV Dielectric Medium</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooper Power Systems Envirotemp FR3</td>
<td>natural ester</td>
</tr>
<tr>
<td>ABB Power Technologies BIOTEMP®</td>
<td>natural ester</td>
</tr>
<tr>
<td>Momentive Performance Materials SF97-50</td>
<td>silicone</td>
</tr>
<tr>
<td>Sopus Products Diala® HFX</td>
<td>HMWH</td>
</tr>
<tr>
<td>DSI Ventures Beta® HFX</td>
<td>HMWH</td>
</tr>
<tr>
<td>Dow Corning® 561</td>
<td>silicone</td>
</tr>
</tbody>
</table>

This category covers liquids intended for use as dielectric and cooling mediums. Liquids intended for use as dielectric and cooling mediums in electrical transformers are covered under Transformer Fluids (EOVK).

Part A2: UL Classification EOVK Transformer Fluids

In addition to giving the requirements for minimum ignition temperature, fire point, and closed cup flash point, this category gives the UL Use Restrictions required for compliance with NEC 450.23 for the listed less flammable fluids.

Table A2 gives the fluids listed in the UL Directory having EOVK Classification.

Table A2 - UL Classified EOVK Transformer Fluids

<table>
<thead>
<tr>
<th>EOVK Transformer Fluids</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooper Power Systems Envirotemp FR3 fluid</td>
<td>natural ester</td>
</tr>
<tr>
<td>Dow Corning® 561</td>
<td>silicone</td>
</tr>
</tbody>
</table>

This category covers liquids intended for use as dielectric and cooling mediums in electrical transformers.
UL Classified Less-Flammable Fluids &
UL Listed & Classified Transformers

Important Information to Assure Code Compliance
Part B: UL Listed Transformers

Not all UL listed and classified transformers meet NEC Section 450.23 requirements.

Simply specifying that a transformer be UL Listed is not sufficient to assure the transformers meet NEC Section 450-23 listing requirements.

To assure UL Listed transformers meet NEC Section 450-23 requirements, the transformer must use an EOVK Transformer Fluid and meet its Use Restrictions (see Part A2).

Part B1: XPLH Transformers, Distribution, Liquid-filled Type, Over 600 Volts

UL transformer listing requirements, detailed in UL Guidelined XPLH, allow the use of mineral oil and other transformer coolants regardless of Classification status. These transformers are required to comply with various IEEE C57.12.00 standards listed in the XPLH.Guidelined sheet. This guide states that transformers with the UL Listing mark are: "intended for installations with the requirements of NFPA 70, National Electrical Code". Table B1 shows the manufacturers of UL Listed liquid-insulated transformers.

Table B1 - UL XPLH Listed Transformers

<table>
<thead>
<tr>
<th>XPLH Transformer Manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooper Power Systems</td>
</tr>
<tr>
<td>ABB Inc, South Boston VA</td>
</tr>
<tr>
<td>ABB Inc, Jefferson City MO</td>
</tr>
<tr>
<td>GE Co., Shreveport LA</td>
</tr>
<tr>
<td>Howard Industries Inc</td>
</tr>
<tr>
<td>Pacific Crest Transformers Inc</td>
</tr>
<tr>
<td>Pauwels Transformers Inc, Washington MO</td>
</tr>
<tr>
<td>Prolec GE, Monterrey MX</td>
</tr>
<tr>
<td>Square D, Nashville TN</td>
</tr>
<tr>
<td>Virginia Transformer Corp, Roanoke VA</td>
</tr>
</tbody>
</table>

These transformers will display a single UL Listing Mark, the UL symbol, together with the word “LISTED,” a control number, and the product name “Liquid-Filled Distribution Transformer” as in Figure B1.

![UL Listed XPLH.E234598 Liquid-Filled Distribution Xfmr](image)

Figure B1 – Example transformer mark for a UL Listed ANSI-compliant transformer.

Appendix 5
UL Classified Less-Flammable Fluids &
UL Listed & Classified Transformers

Important Information to Assure Code Compliance

Part A: Dielectric Coolants

Part B2: UL Listed and Classified Transformers for use as Less-Flammable Liquid-Insulated Transformer In Accordance With Sec. 450.23 of the NEC **

UL uses the same XPLH GuidelInfo sheet noted above for transformers intended to meet the requirements of NEC section 450.23. However, the sub-header “USE AND INSTALLATION” adds the following requirements:

- Transformer must be provided with UL Classified “Less-Flammable Liquid, having a fire point of not less than 300°C”
- Transformer must be Marked to:
  - identify the product name and flammability rating of the liquid
  - indicate whether the liquid may evolve flammable gases when decomposed by an electric arc (as applicable)
  - list all the use restrictions provided for in the UL Classification of the liquid.

A UL Listed and Classified Transformer must display both a Listing mark and a Classification mark. See Figure B2.

CENTER

LISTED XPLH.E234598 Liquid-Filled Distribution Xfmr
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

Figure B2
Example transformer mark for a UL Listed and Classified transformer filled with an UL EOVK Transformer Fluid and complying with its Use Requirements.

Cooper Power Systems Inc. manufacturers UL listed and Classified Transformers for use as less-flammable liquid-insulated transformers in accordance with NEC Section 450.23. UL does not currently publish which transformer manufacturers offer the dual marking. Purchasers and users should confirm their UL Listed transformers also are UL Classified and the units have both respective UL logos for units that are intended for use in complying with NEC Section 450.23.

The transformer listing by UL should be referred to as an “UL Listed And Classified Transformer for Use as Less-Flammable Liquid-Insulated Transformer in Accordance with Sec. 450.23 Of The National Electric Code (NEC)”.

** The source of the information of this section is the UL online certification Directory, XPHL.GuidelInfo -Transformers, Distribution, Liquid-filled Type, Over 600 Volts on November 12, 2008. Copyright © Underwriters Laboratories Inc®.
UL Classified Less-Flammable Fluids &
UL Listed & Classified Transformers

Important Information to Assure Code Compliance
EOUV.GuidelInfo
Dielectric Mediums

USE

This category covers liquids intended for use as dielectric and cooling mediums. The liquids are not intended to replace mineral oil unless equipment is also designed for the specific liquid.

These products have been Classified as to their fire hazard only, using Underwriters Laboratories’ method for Classification of the fire hazard of liquids. They have been rated on a numerical scale of hazard ranging from 0 to 100 as indicated in the table below:

<table>
<thead>
<tr>
<th>General Classification</th>
<th>Numerical Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diethyl ether</td>
<td>100</td>
</tr>
<tr>
<td>Gasoline</td>
<td>90 to 100</td>
</tr>
<tr>
<td>Ethyl alcohol</td>
<td>60 to 70</td>
</tr>
<tr>
<td>Kerosene</td>
<td>30 to 40^a</td>
</tr>
<tr>
<td>Paraffin oil</td>
<td>10 to 20^b</td>
</tr>
<tr>
<td>Water or nonflammable</td>
<td>0 or nonflammable</td>
</tr>
</tbody>
</table>

^a A standard kerosene of 100°F (37.8°C) flash point (closed cup) is rated 30 to 40.
^b A paraffin oil of 440°F (226.7°C) flash point (closed cup) is rated 10 to 20.

RELATED PRODUCTS

Liquids intended for use as dielectric and cooling mediums in electrical transformers are covered under Transformer Fluids (EOVK).

ADDITIONAL INFORMATION

For additional information, see Electrical Equipment for Use in Ordinary Locations (AALZ) and Flammable and Combustible Liquids and Gases Equipment (AAPQ).

REQUIREMENTS

The basic standard used to investigate products in this category is UL 340, "Tests for Comparative Flammability of Liquids."

UL MARK

The Classification Mark of Underwriters Laboratories Inc. on the product container is the only method provided by UL to identify products manufactured under its Classification and Follow-Up Service. The Classification Mark for these products includes the UL symbol, the word "CLASSIFIED" above the UL symbol (as illustrated in the Introduction of this Directory), and the following additional information:

[PRODUCT IDENTITY]
CLASSED
AS TO FIRE HAZARD ONLY
Control No.

Appendix 5
UL Classified Less-Flammable Fluids &
UL Listed & Classified Transformers

Important Information to Assure Code Compliance
EOUV.GuideInfo
Dielectric Mediums

USE

The Classification Mark may also include the following statement as appropriate:

MAY EVOLVE FLAMMABLE GASES WHEN DECOMPOSED BY AN ELECTRIC ARC

Last Updated on 2008-01-24.

Notice of Disclaimer

The appearance of a company’s name or product in this database does not in itself assure that products so identified have been manufactured under UL’s Follow-Up Service. Only those products bearing the UL Mark should be considered to be Listed and covered under UL’s Follow-Up Service. Always look for the Mark on the product.

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Appendix 5
UL Classified Less-Flammable Fluids &
UL Listed & Classified Transformers

Important Information to Assure Code Compliance
EOUV.GuideInfo
Transformer Fluids
(Dielectric Mediums) Transformer Fluids
USE

This category covers liquids intended for use as dielectric and cooling mediums in electrical transformers.

These products have been Classified as to their fire hazard only, using Underwriters Laboratories’ method for Classification of the fire hazard of liquids. They have been rated on a numerical scale of hazard ranging from 0 to 100 as indicated in the table below:

<table>
<thead>
<tr>
<th>General Classification</th>
<th>Numerical Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diethyl ether</td>
<td>100</td>
</tr>
<tr>
<td>Gasoline</td>
<td>90 to 100</td>
</tr>
<tr>
<td>Ethyl alcohol</td>
<td>60 to 70</td>
</tr>
<tr>
<td>Kerosene</td>
<td>30 to 40(^\text{a})</td>
</tr>
<tr>
<td>Paraffin oil</td>
<td>10 to 20(^\text{b})</td>
</tr>
<tr>
<td>Water or nonflammable</td>
<td>0 or nonflammable</td>
</tr>
</tbody>
</table>

\(^{a}\) A standard kerosene of 100°F (37.8°C) flash point (closed cup) is rated 30 to 40.

\(^{b}\) A paraffin oil of 440°F (226.7°C) flash point (closed cup) is rated 10 to 20.

USE RESTRICTIONS

Products Classified as “less-flammable liquid” may have use restrictions on the product container. Certain fluids have fuse use restrictions which require that the fuse must be either a type which does not vent under normal operation, or it must be installed external to the transformer tank.

ADDITIONAL INFORMATION

For additional information, see Dielectric Mediums (EOUV), Electrical Equipment for Use in Ordinary Locations (AALZ) and Flammable and Combustible Liquids and Gases Equipment (AAPQ).

REQUIREMENTS

The basic standard used to investigate products in this category is UL 340, "Tests for Comparative Flammability of Liquids."

These products are also Classified as a "less-flammable liquid" or "nonflammable fluid" in accordance with Sections 450.23 or 450.24 of ANSI/NFPA 70, "National Electrical Code."

UL MARK

The Classification Mark of Underwriters Laboratories Inc. on the product container is the only method provided by UL to identify products manufactured under its Classification and Follow-Up Service. The Classification Mark for these products includes the UL symbol, the word "CLASSIFIED" above the UL symbol (as illustrated in the Introduction of this Directory), and the following additional information:

[PRODUCT IDENTITY]
CLASSED
AS TO FIRE HAZARD ONLY
Control No.

Appendix 5
UL Classified Less-Flammable Fluids &
UL Listed & Classified Transformers

Important Information to Assure Code Compliance
EOUV.GuideInfo
Transformer Fluids
(Dielectric Mediums) Transformer Fluids
USE

The Classification Mark may also include the following statement as appropriate:

MAY EVOLVE FLAMMABLE GASES WHEN DECOMPOSED BY AN ELECTRIC ARC
ALSO CLASSIFIED AS A "LESS-FLAMMABLE LIQUID"
IN COMPLIANCE WITH THE NATIONAL ELECTRICAL CODE
WITH THE FOLLOWING "USE RESTRICTIONS"
ALSO CLASSIFIED AS A "NONFLAMMABLE FLUID"
IN COMPLIANCE WITH THE NATIONAL ELECTRICAL CODE
WITH THE FOLLOWING "USE RESTRICTIONS"

Notice of Disclaimer

The appearance of a company’s name or product in this database does not in itself assure that products so identified have been manufactured under UL’s Follow-Up Service. Only those products bearing the UL Mark should be considered to be Listed and covered under UL’s Follow-Up Service. Always look for the Mark on the product.

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Appendix 5