

**Approval Standard  
for  
Less Flammable Transformer  
Fluids**

**Class Number 6933**

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# Foreword

FM Approvals are intended to verify that the products and services described will meet stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of FM Approval Standards is to present the criteria for FM Approval of various types of products and services, as guidance for FM Approvals personnel, manufacturers, users and authorities having jurisdiction.

Products submitted for Approval shall demonstrate that they meet the intent of the Approval Standard, and that quality control in manufacturing and/or applications shall ensure a consistently uniform and reliable product or service. FM Approval Standards strive to be performance-oriented and to facilitate technological development.

For examining equipment, materials and services, FM Approval Standards:

- a) must be useful to the ends of property conservation by preventing, limiting or not causing damage under the conditions stated by the Approval listing; and
- b) must be readily identifiable.

Continuance of Approval and Listing depends on compliance with the Approval agreement, satisfactory performance in the field, on successful re-examinations of equipment, materials, and services as appropriate, and on periodic follow-up audits of the manufacturing facility or service/application.

FM Approvals LLC reserves the right in its sole judgement to change or revise its standards, criteria, methods, or procedures.

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# TABLE OF CONTENTS

<b>I INTRODUCTION</b> .....	1
<b>II REQUIREMENTS</b> .....	1
<b>III PERFORMANCE TESTS</b> .....	2
3.1 Fire Point .....	2
3.2 Fluid Properties .....	2
<b>IV MARKINGS</b> .....	2



## I INTRODUCTION

1.1 A less flammable transformer fluid is one whose combustibility has been reduced to an acceptable degree consistent with the installation and protection requirements of FM Global Property Loss Prevention Data Sheet 5-4S/14-8S.

1.2 FM Approval is based on satisfactory evaluation of the product and manufacturer in these major areas:

1.2.1 Examination and tests to evaluate:

- (1) The suitability of product;
- (2) The performance of the product as required by FM Approvals and, as far as practical;
- (3) The reliability of the product.

1.2.2 Audit inspection of the manufacturing facilities to evaluate:

- (1) The manufacturer's ability to produce the product as examined and approved;
- (2) The quality control procedures applied to the product; and
- (3) The marking procedures used to identify the product.

1.2.3 Periodic re-examination and audit inspection to evaluate

- (1) Continued conformity to requirements originally evaluated under paragraphs 1.2.1 and 1.2.2.

1.3 Continued approval is based upon:

- (1) Production availability of the product as currently approved;
- (2) Continued use of acceptable quality control procedures; and
- (3) Satisfactory field experience.

1.4 The requirements of this standard identify FM Approval tests and practices. Products which do not conform to these requirements may be approved if they meet the intent of the standard. Conversely, those that do conform may not be approved if other conditions prevail.

## II REQUIREMENTS

Three basic requirements are necessary to qualify for FM Approval.

2.1 The fluid shall have a fire point of at least 572°F (300°C).

2.2 The following fluid specifications, under the control of the fluid manufacturer's surveillance program, shall be determined:

- (1) Dielectric breakdown voltage;
- (2) Neutralization number;
- (3) Color;
- (4) Water content; and
- (5) Viscosity.

2.3 The fluid shall have convective and radiative heat release rates, expressed in Btu/ft<sup>2</sup>-min (kW/m<sup>2</sup>), which find practical applications through the use of FM Global Property Loss Prevention Data Sheet 5-4S/14-8S.

### III PERFORMANCE TESTS

#### 3.1 Fire Point

The fire point of the sample transformer fluid shall be determined according to ASTM-D92-72 (Cleveland Open Cup).

#### 3.2 Fluid Properties

The following shall be determined by the appropriate ASTM procedures. However, silicone based fluids shall be tested only to paragraph 3.2.6.

- 3.2.1 Dielectric breakdown voltage - ASTM D-877-76
- 3.2.2 Neutralization number - ASTM D-974-64
- 3.2.3 Color - ASTM D-1500-64
- 3.2.4 Water content - ASTM E-123-64
- 3.2.5 Viscosity - ASTM D-1824-66
- 3.2.6 Silicone fluids - ASTM D-2225-68 (above properties only).

#### 3.3 Convective and Radiative Heat Release Rates

Each less flammable fluid shall be subjected to a series of three (3) pool fire tests and these results averaged to determine the specific convective and radiative heat release rates  $\text{Btu/ft}^2\text{-min}$  ( $\text{kW/m}^2$ ), of the fluid.

A 5.7 ft (1.7 m) dia. circular pool fire pan, 3 in. (76 mm) deep, shall be filled (approx. 40 gal [ $151.4 \text{ dm}^3$ ]) with sample fluid; surrounding the transformer fluid pool fire pan is a 5.7 in. (145 mm) wide and 3 in. (76 mm) deep ignitor trough filled with 12 gal ( $45 \text{ dm}^3$ ) water and 4 gal ( $15.0 \text{ dm}^3$ ) of n-heptane which serves as the ignition source. Overhead at 25 ft (7.6 m) elevation, thermocouples and velocity probes are mounted on a cross bar positioned directly over the center of the fire pan to collect data to determine the convective heat release rate. A radiometer mounted off to the side of the test pan is used to sense data which is needed to ascertain the radiative heat release rate. The 5.7 in. (145 mm) ignitor trough around the sample fluid test pan is ignited manually and allowed to burn completely. During this period, the sample fluid pool will have been ignited. Actual test time of the sample fluid pool will be four (4) minutes duration which begins approximately 3 minutes after flaming of the ignitor trough ceases and a steady rate of burning is reached.

### IV MARKINGS

- 4.1 A less flammable transformer fluid shall be provided in a tight container which shall be marked with the manufacturer's name, address, product model/type number, batch number, the product fire point ( $^{\circ}\text{F}/^{\circ}\text{C}$ ), the convective and radiant heat release rates ( $\text{Btu/ft}^2\text{-min}$  [ $\text{kW/m}^2$ ]) and the FM Approvals' Mark of Approval.
  - 4.1.1 The heat release rates shall be identified as intended for use with FM Global Property Loss Prevention Data Sheet 5-4S/14-8S.