Examination Standard for Transformer Fluids

Class Number 6933

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Foreword

This standard is 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 a this standard is to present the criteria for examination of various types of products and services.

Examination in accorandance with this standard shall demonstrate compliance and verify that quality control in manufacturing shall ensure a consistent and reliable product.

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1 INTRODUCTION

1.1 Purpose

1.1.1 This standard states testing and certification requirements for the fire performance of transformer fluids.

1.1.2 Testing and certification criteria may include, but are not limited to, performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a surveillance program.

1.2 Scope

1.2.1 This standard applies to finished industrial fluids used in electrical transformers.

1.2.2 A transformer fluid that is intended for use in an application that allows for contamination of the certified fluid product with other fluids that are not certified is not eligible to be certified under this standard. Additionally, the use of a certified transformer fluid product in such an application will void the certification for that particular lot/batch of product.

1.2.3 This standard is intended to evaluate only those hazards investigated. Toxicity has not been evaluated.

1.3 Basis for Requirements

1.3.1 The requirements of this standard are based on experience, research and testing, and/or the standards of other organizations. The advice of manufacturers, users, trade associations, jurisdictions and/or loss control specialists was also considered.

1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of transformer fluids for the purpose of obtaining Certification. Transformer fluids having characteristics not anticipated by this standard may be certified if performance equal, or superior, to that required by this standard is demonstrated.

1.4 Basis for Certification

Certification is based upon satisfactory evaluation of the product and the manufacturer in the following major areas:

1.4.1 Examination and tests on production samples shall be performed to evaluate

- the suitability of the product;
- the performance of the product as specified by the manufacturer and required for certification; and as far as practical,
- the durability and reliability of the product.

1.4.2 An examination of the manufacturing facilities and audit of quality control procedures may be made to evaluate the manufacturer's ability to consistently produce the product which is examined and tested, and the marking procedures used to identify the product. Subsequent surveillance may be required by the certification agency in accordance with the certification scheme to ensure ongoing compliance.

1.5 Basis for Continued Certification

The basis for continual certification may include, but is not limited to, the following based upon the certification scheme and requirements of the certification agency:

- production or availability of the product as currently certified;
- the continued use of acceptable quality assurance procedures;
- satisfactory field experience;
- compliance with the terms stipulated by the certification;
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory surveillance audits conducted as part of the certification agencies product surveillance program.

1.6 Effective Date

The effective date of this certification standard mandates that all products tested for certification after the effective date shall satisfy the requirements of this standard.

The effective date of this Standard is eighteen (18) months after the publication date of the standard for compliance with all requirements.

1.7 System of Units

Units of measurement used in this Standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Conversion of U.S. customary units is in accordance with ANSI/IEEE/ASTM SI 10.

1.8 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the cited edition applies.

ANSI/IEEE/ASTM SI 10, *American National Standard for Metric Practice*

American Society for Testing and Materials

ASTM D92, Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester

ASTM D877 / D877M, Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes

ASTM D1816, Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using VDE Electrodes

ASTM D974, Standard Test Method for Acid and Base Number by Color-Indicator Titration

ASTM D2129, Standard Test Method for Color of Clear Electrical Insulating Liquids (Platinum-Cobalt Scale)

ASTM D1500, Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale)

ASTM D1533, Standard Test Method for Water in Insulating Liquids by Coulometric Karl Fischer Titration

ASTM D445, Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)

ASTM D2225, Standard Test Methods for Silicone Fluids Used for Electrical Insulation

ASTM E1252, Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis

ASTM E1642, Standard Practice for General Techniques of Gas Chromatography Infrared (GC/IR) Analysis

IEC

IEC 60156, Insulating liquids – Determination of the breakdown voltage at power frequency – Test method

IEC 60814, Insulating liquids – Oil-impregnated paper and pressboard – Determination of water by automatic coulometric Karl Fischer titration

1.9 Terms and Definitions

For purposes of this standard, the following terms apply:

Fire Point – the lowest temperature at which a liquid will give off sufficient vapors to continue to burn for at least 5 seconds once ignited.

2 GENERAL INFORMATION

2.1 Product Information

Transformer fluids are liquids that may have two or more components in their composition and consist of, but are not limited to, natural and synthetic esters, silicone, petroleum-based mineral oils, or other types of base stocks that are processed for stability and resilience. Other fluid compositions meeting the criteria of this standard may also be considered for certification. Transformer fluids are intended for use as an electrical insulation, coolant, and arc suppressor in electrical transformers. The suitability of the transformer fluid for specific use shall be determined by the manufacturer.

2.2 Certification Application Requirements

The manufacturer shall provide the following preliminary information with any request for certification consideration:

- a complete list of all product trade name(s) and/or formula designation(s);
- technical Specification and/or Technical Data literature;
- safety Data Sheet(s);
- the number and location of manufacturing facilities.
- all documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All documents shall be provided with English translation.

2.3 Requirements for Samples for Examination

2.3.1 Following authorization of a certification examination, the manufacturer shall submit samples for examination and testing based on the sample requirements to be determined by the certification agency following review of the preliminary information.

2.3.2 Requirements for samples may vary depending on design features, results of prior or similar testing, and results of any foregoing tests.

2.3.3 The manufacturer shall submit samples representative of production. Any decision to use data generated using prototypes is at the discretion of the certification agency.

3 GENERAL REQUIREMENTS

3.1 Markings

3.1.1 Marking on the product packaging or label accompanying the product, shall include the following information:

- name and address of the manufacturer or marking traceable to the manufacturer;
- date of manufacture or code traceable to date of manufacture or lot identification;
- product tradename or formula designation;
- the product Fire Point °F (°C), as determined in Section 4.1, or "Nonflammable", as determined in Section 4.1.

When hazard warnings are needed, the markings should be universally recognizable.

3.1.2 The product tradename or formula designation shall correspond with the manufacturer's catalog designation and shall uniquely identify the certification agency's mark of conformity.

3.1.3 The certification agency's mark of conformity shall be displayed visibly and permanently on the product and/or packaging as appropriate and in accordance with the requirements of the certification agency. The manufacturer shall exercise control of this mark as specified by the certification agency and the certification scheme.

3.1.4 All markings shall be legible and durable.

3.2 Manufacturer's Installation and Operation Instructions

3.2.1 The manufacturer shall provide the user with instructions for the installation, maintenance, and operation of the product. A transformer fluid is not certified if the end use application is in conflict with the manufacturer's specification and/or other written documentation such as technical bulletins.

3.3 Calibration

3.3.1 Each piece of equipment used to verify the test parameters shall be calibrated within an interval determined on the basis of stability, purpose, and usage. A copy of the calibration certificate for each piece of test equipment is required. The certificate shall indicate that the calibration was performed against working standards whose calibration is certified and traceable to an acceptable reference standard and certified by an ISO/IEC 17025 accredited calibration laboratory. The test equipment shall be clearly identified by label or sticker showing the last date of the calibration and the next due date. A copy of the service provider's accreditation certificate as an ISO/IEC 17025 accredited calibration laboratory should be available.

3.3.2 When the inspection equipment and/or environment is not suitable for labels or stickers, other methods such as etching of control numbers on the measuring device are allowed, provided documentation is maintained on the calibration status of thus equipment.

3.4 Observation of Test Sample Production

3.4.1 At the discretion of the certification agency, a representative of the certificaiton agency may witness the production of transformer fluids to be evaluated.

3.4.2 At the discretion of the certificaiton agency, components of a transformer fluid may require a witness of production if the component is considered critical and may affect the results of the performance testing.

4 PERFORMANCE REQUIREMENTS

4.1 Determination of Fire Point

4.1.1 Requirement:

The ASTM D92 test method shall be used to determine fire point temperature. Each transformer fluid product submitted shall be screen tested to determine a fire point or verify that the fluid will boil prior to obtaining a fire point.

Transformer fluids not having a fire point shall be subjected to one (1) ASTM D92 fire point test. The fluid shall not exhibit any fire point up to its boiling point.

Transformer fluids having a fire point shall be subjected to three (3) ASTM D92 fire point tests. The average result will be determined and reported. The average fire point shall be at least 572 °F (300 °C).

4.1.2 Test/Verification:

ASTM D92, Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester.

4.2 Determination of Fluid Specifications (Optional)

4.2.1 If requested, the following specifications of a fluid shall be determined and reported per the test methods listed in 4.2.2:

- Dielectric breakdown voltage;
- Neutralization number;
- Color;
- Water content; and
- Viscosity

For silicone fluids, the properties above shall be determined utilizing ASTM D2225.

Note: These tests are optional and are conducted for identification purposes. No limits are placed on the values obtained.

4.2.2 Test/Verification:

ASTM D877 / D877M, Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes OR ASTM D1816, Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using VDE Electrodes OR IEC 60156, Insulating liquids – Determination of the breakdown voltage at power frequency – Test method

ASTM D974, Standard Test Method for Acid and Base Number by Color-Indicator Titration

ASTM D1500, Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale) OR ASTM D2129, Standard Test Method for Color of Clear Electrical Insulating Liquids (Platinum-Cobalt Scale)

ASTM D1533, Standard Test Method for Water in Insulating Liquids by Coulometric Karl Fischer Titration OR IEC 60814, Insulating liquids - Oil-impregnated paper and pressboard - Determination of water by automatic coulometric Karl Fischer titration

ASTM D445, Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)

ASTM D2225, Standard Test Methods for Silicone Fluids Used for Electrical Insulation

4.3 Identification Test – Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis, ASTM E1252

4.3.1 Requirement:

For transformer fluids and/or other components as applicable, FTIR spectra shall be determined and reported at the sole discretion of the certification agency.

Note: These tests are conducted for identification purposes. No limits are placed on the values obtained.

4.3.2 Test/Verification:

ASTM E1252, Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis

4.4 Identification Test – FM Approvals Thermal Desorption Gas Chromatography Mass Spectrometry (TD/GC/MS)

4.4.1 Requirement:

For transformer fluids and/or other components as applicable, TD/GC/MS Spectrograms shall be determined and reported at the sole discretion of the certification agency.

Note: These tests are conducted for identification purposes. No limits are placed on the values obtained.

4.4.2 Test/Verification:

ASTM E1642, Standard Practice for General Techniques of Gas Chromatography Infrared (GC/IR) Analysis

4.5 Additional Tests

Additional tests may be required, at the disecretion of the certification agency, depending on the design features and results of any foregoing tests.

Any test following a failure shall be acceptable only at the discretion of the certificaiton agency and with a technical justification of the conditions or reasons for failure.

5 OPERATIONS REQUIREMENTS

5.1 Demonstrated Quality Control Program

5.1.1 A quality assurance program is required to assure that subsequent batches of lots of transformer fluid produced by the manufacturer shall present the same quality and reliability as the specific fluid examined. Design quality, conformance to design, and performance are the areas of primary concern.

- Design quality is determined during the examination and tests and may be documented in the certification report.
- Continued conformance to this standard is verified by the Surveillance Audit.
- Quality of performance is determined by field performance and by periodic re-examination and testing.

5.1.2 The manufacturer shall demonstrate a quality assurance program which specifies controls for at least the following areas:

- existence of corporate quality assurance guidelines;
- incoming quality assurance, including testing;
- in-process quality assurance, including testing;
- final inspection and tests;
- equipment calibration;
- drawing and change control;
- packaging and shipping; and
- handling and disposition of non-conforming materials.

5.1.3 Documentation/Manual

There should be an authoritative collection of procedures/policies. It should provide an accurate description of the quality management system while serving as a permanent reference for implementation and maintenance of that system. The system should require that sufficient records are maintained to demonstrate achievement of the required quality and verify operation of the quality system.

5.1.4 Records

To assure adequate traceability of materials and products, the manufacturer shall maintain a record of all quality assurance tests performed, for a minimum period of two years from the date of manufacture.

5.1.5 Drawing and Change Control

- The manufacturer shall establish a system of product configuration control that shall allow no unauthorized changes to the product. Changes to critical documents, identified in the certification report, may be required to be reported to, and authorized by the certification agency prior to implementation for production.
- Records of all revisions to all certified products shall be maintained.

5.2 Surveillance Audit

5.2.1 An audit of the manufacturing facility may be part of the certification agencies surveillance requiremetns to verify implementation of the quality assurance program. Its purpose is to determine that the manufacturer's equipment, procedures, and quality program are maintained to insure a uniform product consistent with that which was tested and certified.

5.2.2 Certified products or services shall be produced or provided at, or provided from, location(s) disclosed as part of the certification examination. Manufacture of products bearing a certification mark is not permitted at any other location prior to disclosure to the certification agency.

5.3 Manufacturer's Responsibilities

5.3.1 The manufacturer shall notify the certification agency of changes in product construction, components, raw materials, physical characteristics, coatings, component formulation or quality assurance procedures prior to implementation.

6 BIBLIOGRAPHY

ISO/IEC 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*.