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Edition 3.0 2015-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Specifications for unused silicone insulating liquids for electrotechnical purposes

Spécifications pour liquides isolants silicones neufs pour usages électrotechniques

IEC 60836:2015-07(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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SPECIFICATIONS FOR UNUSED SILICONE INSULATING LIQUIDS FOR ELECTROTECHNICAL PURPOSES

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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The International Standard IEC 60836 has been prepared by IEC technical committee 10: Fluids for electrotechnical applications.

This third edition cancels and replaces the second edition published in 2005. This edition constitutes a technical revision.

This edition includes the following major technical changes with regard to the second edition:

a) classification of liquids according to IEC 61039 have been adapted with respect to the latest edition of IEC 61039:2008;
b) classification of liquids according to IEC 61100:1992 have been removed as IEC 61100 has been withdrawn;
c) minimum requirements for other silicone liquids for electrotechnical purposes have been added.

The text of this standard is based on the following documents:

FDIS	Report on voting
10/961FDIS	10/968/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

SPECIFICATIONS FOR UNUSED SILICONE INSULATING LIQUIDS FOR ELECTROTECHNICAL PURPOSES

1 Scope

This International Standard covers specifications and test methods for unused silicone liquids intended for use in transformers and other electrotechnical equipment.

The specified characteristics of silicone transformer liquid classified as L-NTUK-8360300 (in accordance with IEC 61039) are described in Table 1.

Besides the standard transformer applications there are other applications of silicone liquids, such like cable accessories, capacitors, electrical magnets etc. The specified characteristics and minimum requirements for these liquids are described in Table 2.

NOTE Maintenance of used silicone liquid in electrotechnical equipment is covered in a separate publication IEC 60944.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60156:1995, *Insulating liquids – Determination of the breakdown voltage at power frequency – Test method*

IEC 60247, *Insulating liquids – Measurement of relative permittivity, dielectric dissipation factor (tan δ) and d.c. resistivity*

IEC 60296, *Fluids for electrotechnical applications – Unused mineral insulating oils for transformers and switchgear*

IEC 60475, *Method of sampling insulating liquids*

IEC 60628, *Gassing of insulating liquids under electrical stress and ionization*

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

IEC 60944, *Guide for the maintenance of silicone transformer liquids*

IEC 61039:2008, *Classification of insulating liquids*

IEC 62021-3, *Insulating liquids – Determination of acidity – Part 3: Test methods for non-mineral insulating oils*

ISO 2211, *Liquid chemical products – Measurement of colour in Hazen units (platinum-cobalt scale)*

ISO 2592, *Determination of flash and fire points – Cleveland open cup method*

ISO 2719, *Determination of flash point – Pensky Martens closed cup method*

ISO 3016, *Petroleum products – Determination of pour point*

ISO 3104, *Petroleum products – Transparent and opaque liquids – Determination of kinematic viscosity and calculation of dynamic viscosity*

ISO 3675, *Crude petroleum and liquid petroleum products – Laboratory determination of density – Hydrometer method*

ISO 5661, *Petroleum products – Hydrocarbon liquids – Determination of refractive index*

ISO 12185, *Crude petroleum and petroleum products – Determination of density – Oscillating U-tube method*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
silicone insulating liquids
liquid organopolysiloxanes whose molecular structure consists mainly of linear chains of alternating silicon and oxygen atoms, with hydrocarbon groups attached to the silicon atoms

3.2
silicone transformer liquid
polydimethyl siloxane, without additives, primarily for use in transformers

Note 1 to entry: According to IEC 61039, this type is classified as L-NTUK-8360300.

3.3
other silicone liquids for electrotechnical purposes
polydimethyl siloxane, without additives, applied for electrotechnical purposes

Note 1 to entry: Classification of other fluids for electrotechnical purposes according to IEC 61039 shall be made in relation to their main application and their fire point, e.g. a liquid for capacitors with a fire point of less than 300 °C is classified as L-NCUO-8360300.

4 Properties

4.1 General properties

As defined in 3.2, silicone liquid for transformers has high flash and fire points and is therefore difficult to ignite. If combustion occurs, heat release rate is much lower than that of hydrocarbon oils.

In addition to use at similar working temperatures to those of transformers containing mineral transformer oil, silicone insulating liquids may also be used in appropriately designed electrotechnical equipment operating at higher temperatures.

The solubility of water in silicone liquids is greater than in mineral oils. Other physical characteristics which are important for the design of electrotechnical equipment, e.g. heat transfer, may also be different from those of mineral transformer oil and will need to be taken fully into account by the designer.

4.2 Properties relating to health, safety and environment (HSE)

4.2.1 Handling

Silicone liquids ultimately degrade in nature to simple, naturally occurring substances. Their handling is not hazardous to health.

Direct contact with the eyes may cause slight irritation. Safety glasses should be worn to avoid splashing the eyes. In the case of eye contact, irrigation with large quantities of clean running water should relieve any irritation. If irritation persists, seek medical advice.

Detailed information on safe handling of these liquids can be obtained from manufacturers or suppliers.

4.2.2 Disposal

Local regulations shall be complied with. The preferred means of disposal is recycling by a qualified contractor. Waste liquid may be incinerated. Spillages should be cleaned using adsorbent media. Small quantities of liquid entering the environment present no special hazard.

5 General delivery requirements and identification

Transport of silicone insulating liquid shall be in clean hermetically sealed containers whose lining does not interact with the contents.

Each container shall display the following information:

– number of this standard;
– supplier's designation;
– batch number;
– any notices required by local regulatory authorities.

Electrotechnical equipment filled with silicone insulating liquid should be labelled for identification with respect to the insulation used.

6 Storage and maintenance

Storage should preferably be indoors and shall be in sealed containers to prevent ingress of moisture and dirt. If accidentally contaminated by water and/or solid particles during storage, the liquid can usually be restored to acceptable quality by the procedures described in IEC 60944.

7 Sampling

The liquid shall be sampled in accordance with IEC 60475, using the procedure consistent with the density of the liquid being sampled. Isopropyl alcohol is suitable for cleaning the sampling equipment.

8 Properties and test methods

8.1 Colour and appearance

8.1.1 Colour

This property shall be measured according to ISO 2211.

8.1.2 Appearance

This property shall be evaluated by examining a representative sample of approximately 100 mm in thickness, in transmitted light and at ambient temperature.

8.2 Density

This property shall be measured at 20 °C according to ISO 3675 but measurement according to ISO 12185 is accepted as well.

8.3 Kinematic viscosity

This property shall be measured at 40 °C according to ISO 3104.

8.4 Flash point

This property shall be measured according to ISO 2719.

8.5 Fire point

This property shall be measured according to ISO 2592.

8.6 Refractive index

This property shall be measured according to ISO 5661.

8.7 Pour-point

This property shall be measured according to ISO 3016.

8.8 Water content

This property shall be measured according to IEC 60814.

8.9 Acidity

This property shall be measured according to IEC 62021-3.

8.10 Breakdown voltage

This property shall be measured according to IEC 60156 and with particular attention to IEC 60156:1995, 3.4.2.

8.11 Dielectric dissipation factor, permittivity, d.c. resistivity

These properties shall be determined at 90 °C by the methods described in IEC 60247. Isopropyl alcohol or acetone are suitable for cleaning the test cell.

8.12 Gassing under electrical stress and ionization

This property shall be measured according to IEC 60628.

8.13 Flammability

Fire hazard measurement of insulating liquids is now studied by IEC technical committee 89.

9 Individual specifications

9.1 General

The specifications given in Table 1 and Table 2 applies only to unused silicone liquids intended for use in electrotechnical equipment, as received from the supplier and before any treatment or introduction into electrotechnical equipment. The liquid sampled in accordance with Clause 7 shall be tested in accordance with the appropriate test methods given in Clause 8. The characteristics of the liquid when tested shall comply with the requirements given in Table 1 and Table 2.

9.2 Silicone transformer liquid

This liquid is polydimethyl siloxane without additives, primarily for use in transformers. According to IEC 61039, it is classified as L-NTUK-8360300.

When tested in accordance with the methods specified in Clause 8, the properties of silicone transformer liquid shall meet the requirements given in Table 1.

Table 1 – Specification of silicone transformer liquid

Property	Test method (clause or subclause)	Permissible values	Notes
Colour	8.1.1	Max.35	
Appearance	8.1.2	Clear, free from suspended matter and sediment	
Density at 20 °C (kg/dm^3)	8.2	0,955 to 0,970	
Kinematic viscosity at 40 °C (mm^2/s)	8.3	40 ± 4	
Flash point (°C)	8.4	Min. 240	
Fire point (°C)	8.5	Min. 340	
Refractive index at 20 °C	8.6	1,404 ± 0,002	
Pour point (°C)	8.7	Max. –50	
Water content (mg/kg)	8.8	Max. 50	see NOTE
Acidity (mg KOH/g)	8.9	Max. 0,01	see NOTE
Breakdown voltage (kV)	8.10	Min. 40	see NOTE
Dielectric dissipation factor (DDF) at 90 °C and 50 Hz	8.11	Max. 0,001	see NOTE
Permittivity at 90 °C	8.11	2,55 ± 0,05	see NOTE
DC resistivity at 90 °C (GΩ × m)	8.11	Min. 100	see NOTE
NOTE For untreated liquid, as received.			