

BS EN 60836:2015



BSI Standards Publication

Specifications for unused silicone insulating liquids for electrotechnical purposes

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National foreword

This British Standard is the UK implementation of EN 60836:2015. It is identical to IEC 60836:2015. It supersedes BS EN 60836:2005 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GEL/10, Fluids for electrotechnical applications.

A list of organizations represented on this committee can be obtained on request to its secretary.

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EUROPEAN STANDARD

EN 60836

NORME EUROPÉENNE

EUROPÄISCHE NORM

September 2015

ICS 29.040.10

Supersedes EN 60836:2005

English Version

Specifications for unused silicone insulating liquids
for electrotechnical purposes
(IEC 60836:2015)

Spécifications pour liquides isolants silicones neufs
pour usages électrotechniques
(IEC 60836:2015)

Anforderungen an ungebrauchte Silikonisierflüssigkeiten
für elektrotechnische Anwendungen
(IEC 60836:2015)

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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European foreword

The text of document 10/961/FDIS, future edition 3 of IEC 60836, prepared by IEC/TC 10 "Fluids for electrotechnical applications" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60836:2015.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2016-05-20
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2018-08-20

This document supersedes EN 60836:2005.

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Endorsement notice

The text of the International Standard IEC 60836:2015 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60076-14	NOTE	Harmonized as EN 60076-14.
IEC 60695-1-40	NOTE	Harmonized as EN 60695-1-40.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60156	1995	Insulating liquids - Determination of the breakdown voltage at power frequency - Test method	EN 60156	1995
IEC 60247	-	Insulating liquids - Measurement of relative permittivity, dielectric dissipation factor ($\tan \delta$) and d.c. resistivity	EN 60247	-
IEC 60296	-	Fluids for electrotechnical applications - Unused mineral insulating oils for transformers and switchgear	EN 60296	-
IEC 60475	-	Method of sampling insulating liquids	EN 60475	-
IEC 60628	-	Gassing of insulating liquids under electrical stress and ionization	HD 488 S1	-
IEC 60814	-	Insulating liquids - Oil-impregnated paper and pressboard - Determination of water by automatic coulometric Karl Fischer titration	EN 60814	-
IEC 60944	-	Guide for maintenance of silicone transformer liquids	-	-
IEC 61039	2008	Classification of insulating liquids	EN 61039	2008
IEC 62021-3	-	Insulating liquids - Determination of acidity - Part 3: Test methods for non-mineral insulating oils	EN 62021-3	-
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	EN ISO 2592	-
ISO 2719	-	Determination of flash point - Pensky-Martens closed cup method	EN ISO 2719	-

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
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	EN ISO 3104	-
ISO 3675	-	Crude petroleum and liquid petroleum products - Laboratory determination of density - Hydrometer method	EN ISO 3675	-
ISO 5661	-	Petroleum products - Hydrocarbon liquids - Determination of refractive index	-	-
ISO 12185	-	Crude petroleum and petroleum products - Determination of density - Oscillating U-tube method	EN ISO 12185	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**SPECIFICATIONS FOR UNUSED SILICONE INSULATING
LIQUIDS FOR ELECTROTECHNICAL PURPOSES**

FOREWORD

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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 ($\tan \delta$) 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.			

9.3 Other silicone liquids for electrotechnical purposes

Other silicone liquids are available and may be used for electrotechnical purposes. These liquids are polydimethyl siloxanes without additives and may have either a higher or a lower viscosity than liquids as per 9.2.

When tested in accordance with the methods specified in Clause 8, the properties of these liquids shall meet the minimum requirements given in Table 2.

Table 2 – Minimum requirements for silicone liquids

Property	Test method (clause or subclause)	Permissible values	Notes
Fire point (°C) ^a	8.5	As a function of the target classification according to IEC 61039	
Pour point (°C)	8.7	< -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
DC resistivity at 90 °C (GΩ × m)	8.11	Min. 100	see NOTE
NOTE For untreated liquid, as received.			
^a The minimum value of the fire point shall be selected as a function of the target classification according to IEC 61039. If classification "class K" is required the fire point shall be above 300 °C; fluids with a fire point of less than or equal to 300 °C shall be classified "class O"; silicone liquids with a lower viscosity exhibit a lower fire point; selection shall be made with respect to local standards and minimum requirements for the intended application of the liquid; the minimum flash point of the chosen liquid shall be in accordance with IEC 60296.			

Bibliography

IEC 60076-14, *Power transformers – Part 14: Liquid-immersed power transformers using high-temperature insulation materials*

IEC 60695-1-40, *Fire hazard testing – Part 1-40: Guidance for assessing the fire hazard of electrotechnical products – Insulating liquids*

IEC TS 60695-8-3, *Fire hazard testing – Part 8-3: Heat release – Heat release of insulating liquids used in electrotechnical products*

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