SVENSK STANDARD SS-EN IEC 63012

| Fastställd | Utgåva | Sida | Ansvarig kommitté |
|---|---|---|---|
| 2020-03-18 | 1 | 1 (1+24) | SEK TK 10 |



# Isolervätskor – Specifikation för oanvända modifierade eller blandade estrar för elektriska ändamål

*Insulating liquids – Unused modified or blended esters for electrotechnical applications*

Som svensk standard gäller europastandarden EN IEC 63012:2019. Den svenska standarden innehåller den officiella engelska språkversionen av EN IEC 63012:2019.

## Nationellt förord

Europastandarden EN IEC 63012:2019

består av:

– **europastandardens ikraftsättningsdokument,** utarbetat inom CENELEC
– **IEC 63012, First edition, 2019 - Insulating liquids - Unused modified or blended esters for electrotechnical applications**

utarbetad inom International Electrotechnical Commission, IEC.

ICS 29.040.10

Denna standard är fastställd av SEK Svensk Elstandard,
som också kan lämna upplysningar om **sakinnehållet** i standarden.
Postadress: Box 1284, 164 29 KISTA
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## *Standarder underlättar utvecklingen och höjer elsäkerheten*

Det finns många fördelar med att ha gemensamma tekniska regler för bl a mätning, säkerhet och provning och för utförande, skötsel och dokumentation av elprodukter och elanläggningar.

Genom att utforma sådana standarder blir säkerhetsfordringar tydliga och utvecklingskostnaderna rimliga samtidigt som marknadens acceptans för produkten eller tjänsten ökar.

Många standarder inom elområdet beskriver tekniska lösningar och metoder som åstadkommer den elsäkerhet som föreskrivs av svenska myndigheter och av EU.

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SEK Svensk Elstandard svarar för standardiseringen inom elområdet i Sverige och samordnar svensk medverkan i internationell och europeisk standardisering. SEK är en ideell organisation med frivilligt deltagande från svenska myndigheter, företag och organisationer som vill medverka till och påverka utformningen av tekniska regler inom elektrotekniken.

SEK samordnar svenska intressenters medverkan i SEKs tekniska kommittéer och stödjer svenska experters medverkan i internationella och europeiska projekt.

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Utformningen av standarder sker i allt väsentligt i internationellt och europeiskt samarbete. SEK är svensk nationalkommitté av International Electrotechnical Commission (IEC) och Comité Européen de Normalisation Electrotechnique (CENELEC).

Standardiseringsarbetet inom SEK är organiserat i referensgrupper bestående av ett antal tekniska kommittéer som speglar hur arbetet inom IEC och CENELEC är organiserat.

Arbetet i de tekniska kommittéerna är öppet för alla svenska organisationer, företag, institutioner, myndigheter och statliga verk. Den årliga avgiften för deltagandet och intäkter från försäljning finansierar SEKs standardiseringsverksamhet och medlemsavgift till IEC och CENELEC.

## *Var med och påverka!*

Den som deltar i SEKs tekniska kommittéarbete har möjlighet att påverka framtida standarder och får tidig tillgång till information och dokumentation om utvecklingen inom sitt teknikområde. Arbetet och kontakterna med kollegor, kunder och konkurrenter kan gynnsamt påverka enskilda företags affärsutveckling och bidrar till deltagarnas egen kompetensutveckling.

Du som vill dra nytta av dessa möjligheter är välkommen att kontakta SEKs kansli för mer information.

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

# EN IEC 63012

July 2019

ICS 29.040.10

English Version

# Insulating liquids - Unused modified or blended esters for electrotechnical applications (IEC 63012:2019)

Isolants liquides - Esters neufs modifiés ou mélangés pour applications électrotechniques (IEC 63012:2019)

Isolierflüssigkeiten – Neue modifizierte oder verschnittene Ester für elektrotechnische Anwendungen (IEC 63012:2019)



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

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**



Ref. No. EN IEC 63012:2019 E

SEK Svensk Elstandard SS-EN IEC 63012, utg 1:2020

## European foreword

The text of document 10/1078/FDIS, future edition 1 of IEC 63012, prepared by IEC/TC 10 "Fluids for electrotechnical applications" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 63012:2019.

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) 2020-03-13
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2022-06-13

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

## Endorsement notice

The text of the International Standard IEC 63012:2019 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 60296 | NOTE | Harmonized as EN 60296 |
| IEC 60422 | NOTE | Harmonized as EN 60422 |
| IEC 61039 | NOTE | Harmonized as EN 61039 |
| IEC 61203 | NOTE | Harmonized as EN 61203 |
| IEC 61868 | NOTE | Harmonized as EN 61868 |
| IEC 62975 | NOTE | Harmonized as EN IEC 62975[1] |
| ISO 3015 | NOTE | Harmonized as EN ISO 3015 |

[1] Under preparation. Stage at the time of publication: prEN 62975.

# Annex ZA
(normative)

## Normative references to international publications with their corresponding European publications

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 edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 Where 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.

| Publication | Year | Title | EN/HD | Year |
|---|---|---|---|---|
| IEC 60156 | - | 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 | EN 60247 | - |
| IEC 60628 | - | Gassing of insulating liquids under electrical stress and ionization | HD 488 S1 | - |
| IEC 60666 | - | Detection and determination of specified additives in mineral insulating oils | EN 60666 | - |
| IEC 60814 | - | Insulating liquids - Oil-impregnated paper and pressboard - Determination of water by automatic coulometric Karl Fischer titration | EN 60814 | - |
| IEC 60897 | - | Methods for the determination of the lightning breakdown voltage of insulating liquids | - | - |
| IEC 61099 | 2010 | Insulating liquids - Specifications for unused synthetic organic esters for electrical purposes | EN 61099 | 2010 |
| IEC 61125 | - | Insulating liquids - Test methods for oxidation stability - Test method for evaluating the oxidation stability of insulating liquids in the delivered state | EN IEC 61125 | - |
| IEC/TR 61294 | - | Insulating liquids - Determination of the partial discharge inception voltage (PDIV) - Test procedure | - | - |
| IEC 61619 | - | Insulating liquids - Contamination by polychlorinated biphenyls (PCBs) - Method of determination by capillary column gas chromatography | EN 61619 | - |
| IEC 61620 | - | Insulating liquids - Determination of the dielectric dissipation factor by measurement of the conductance and capacitance - Test method | EN 61620 | - |
| IEC 62021-3 | - | Insulating liquids - Determination of acidity - Part 3: Test methods for non-mineral insulating oils | EN 62021-3 | - |
| IEC 62535 | - | Insulating liquids - Test method for detection of potentially corrosive sulphur in used and unused insulating oil | EN 62535 | - |
| IEC 62697-1 | - | Test methods for quantitative determination of corrosive sulfur compounds in unused and used insulating liquids - Part 1: Test method for quantitative determination of dibenzyldisulfide (DBDS) | EN 62697-1 | - |
| IEC 62770 | - | Fluids for electrotechnical applications - Unused natural esters for transformers and similar electrical equipment | EN 62770 | - |
| IEC 62961 | - | Insulating liquids - Test methods for the determination of interfacial tension of insulating liquids - Determination with the ring method | EN IEC 62961 | - |

| | | | | |
|---|---|---|---|---|
| ISO 2049 | - | Petroleum products - Determination of colour (ASTM scale) | - | - |
| ISO 2211 | - | Liquid chemical products - Measurement of colour in Hazen units (platinum-cobalt scale) | - | - |
| ISO 2592 | - | Petroleum products - Determination of flash and fire points - Cleveland open cup method | - | - |
| ISO 2719 | - | Determination of flash point - Pensky-Martens closed cup method | EN ISO 2719 | - |
| ISO 3016 | - | Petroleum products - Determination of pour point | EN ISO 3016 | - |
| 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 12185 | - | Crude petroleum and petroleum products - Determination of density - Oscillating U-tube method | EN ISO-12185 | |
| | | Surface active agents - Determination of interfacial tension of solutions of surface active agents by the stirrup or ring method | EN 14210 | |
| ASTM D1275 | - | Methods A and B: Standard test method for corrosive sulfur in electrical insulating oils | - | - |
| ASTM D1903 | - | Standard practice for determining the coefficient of thermal expansion of electrical insulating liquids of petroleum origin, and askarels | - | - |
| ASTM D3300 | - | Standard test method for dielectric breakdown voltage of insulating oils ofpetroleum origin under impulse conditions | - | - |
| ASTM D4172 | - | Standard test method for wear preventive characteristics of lubricating fluid (four-ball method) | - | - |
| ASTM D7150 | - | Standard test method for the determination of gassing characteristics of insulating liquids under thermal stress at low temperature | - | - |
| ASTM D7896 | - | Standard test method for thermal conductivity, thermal diffusivity and volumetric heat capacity of engine coolants and related fluids by transient hot wire liquid thermal conductivity method | - | - |
| ASTM E1269 | - | Standard test method for determining specific heat capacity by differential scanning calorimetry | - | - |
| DIN 51350-1 | - | Testing of lubricants - Testing in the four-ball tester - Part 1: General working principles | - | - |
| DIN 51350-2 | - | Testing of lubricants - Testing in the four-ball tester - Part 2: Determination of welding load of liquid lubricants | - | - |
| DIN 51350-3 | - | Testing of lubricants - Testing in the four-ball tester - Part 3: Determination of wearing characteristics of liquid lubricants | - | - |
| OECD 301-B | - | OECD Guidelines for the testing of chemicals - Section 3: Environmental fate and behaviour - 301 Ready biodegradability - 301 B: CO2 Evolution test | - | - |
| OECD 301-C | - | OECD Guidelines for the testing of chemicals - Section 3: Environmental fate and behaviour - 301 Ready biodegradability - 301 C: Modified MITI test | - | - |
| OECD 301-F | - | OECD Guidelines for the testing of chemicals - Section 3: Environmental fate and behaviour - 301 Ready biodegradability - 301 F: Manometric respirometry test | - | - |
| EPA 712-C-98-076 | | US EPA OPPTS Series 835: Fate, transport and transformation test guidelines - Group C: Laboratory biological transformation test guidelines - 835.3110 Ready biodegradability | - | - |

# CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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# INSULATING LIQUIDS – UNUSED MODIFIED OR BLENDED ESTERS FOR ELECTROTECHNICAL APPLICATIONS

## 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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9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 63012 has been prepared by IEC Technical Committee 10: Fluids for electrotechnical applications.

The text of this International Standard is based on the following documents:

| FDIS | Report on voting |
|---|---|
| 10/1078/FDIS | 10/1082/RVD |

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

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

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

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

# INTRODUCTION

Electrical insulation and heat transfer are essential functions of insulating liquids for electrotechnical applications. Until recently, these liquids have been normally homogeneous, selected from different categories, such as most common mineral oils or newer synthetic esters, natural esters or silicone liquids. The continuous research for improvement of performance characteristics of equipment drives an interest in exploring benefits from combinations of liquids. Some known examples of desired improved characteristics include optimized liquid cost, increased cooling performance, improved flash point, extended insulation life or reduced environmental impacts.

Currently, international standards exist for specifically defined liquid categories (mineral oils, synthetic esters, natural esters, silicone liquids). None of them cover chemically modified natural ester liquids or blends of various esters. Moreover, the existing standards do not cover synthetic esters whose characteristics may go beyond the limits defined in IEC 61099.

Some modified esters or their blends are already available as commercial products by liquid suppliers. Examples are:

- Palm fatty acid ester with low viscosity of 5 $mm^2/s$ at 40 °C and with flash point of 176 °C.
- Blend of triglycerides (50 %) and monoesters (50 %) with low viscosity of 17 $mm^2/s$ at 40 °C and with flash point of 200 °C.

The number of sources for ester liquids or their blends is expected to grow over the coming years. Such liquids need to be characterized to confirm suitability for the intended application by the user. Performance characteristics of blends should not be solely assumed from performance characteristics of their individual components. This document is to provide minimum requirements on characterization of new compositions.

WARNING

This document sets performance criteria for unused modified/synthetized or blended esters earmarked for electrical applications. This document does not purport to address all the safety problems associated with their use. It is the responsibility of the user of this document to establish appropriate health and safety practices and determine the applicability of regulatory limitation prior to use.

Performance of some of the tests mentioned in this document could lead to a hazardous situation. Attention is drawn to the relevant standard test method for guidance.

The disposal of liquids, chemicals and sample containers mentioned in this document should be carried out in accordance with current local and national legislation with regards to the impact on the environment. Every precaution should be taken to prevent the release of the liquid into the environment.

# INSULATING LIQUIDS – UNUSED MODIFIED OR BLENDED ESTERS FOR ELECTROTECHNICAL APPLICATIONS

## 1 Scope

This document defines requirements for the characterization of unused modified esters or blends of unused esters used as insulating liquids for electrotechnical applications. It does not cover liquids that contain any proportion of used liquids.

The liquids covered by this document are intended mainly for transformer applications.

Unused modified/synthetized esters are derived from a natural or synthetic base, or are blends of both. This document covers a variety of ester liquids not covered by other standards specific to natural esters (IEC 62770) or synthetic esters (IEC 61099).

As it addresses various categories of liquids, this document also covers a wide range of values for certain performance characteristics. An important property is viscosity, which can affect the design and cooling performance of electrical equipment. A categorization is defined based on the kinematic viscosity of the different liquids. The category of low viscosity ester liquids is established.

## 2 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 edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60156, *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 60666*, Detection and determination of specified additives in mineral insulating oils*

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 60897, *Methods for the determination of the lightning impulse breakdown voltage of insulating liquids*

IEC 61099:2010, *Insulating liquids – Specifications for unused synthetic organic esters for electrical purposes*

IEC 61125, *Insulating liquids – Test methods for oxidation stability – Test method for evaluating the oxidation stability of insulating liquids in the delivered state*

IEC TR 61294, *Insulating liquids – Determination of the partial discharge inception voltage (PDIV) – Test procedure*

IEC 61619*, Insulating liquids – Contamination by polychlorinated biphenyls (PCBs) – Method of determination by capillary column gas chromatography*

IEC 61620, *Insulating liquids – Determination of the dielectric dissipation factor by measurement of the conductance and capacitance – Test method*

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

IEC 62535, *Insulating liquids – Test method for detection of potentially corrosive sulphur in used and unused insulating oil*

IEC 62697-1, *Test method for quantitative determination of corrosive sulfur compounds in unused and used insulating liquids – Part 1: Test method for quantitative determination of dibenzyldisulfide (DBDS)*

IEC 62770*, Fluids for electrotechnical applications – Unused natural esters for transformers and similar electrical equipment*

IEC 62961*, Insulating liquids – Test methods for the determination of interfacial tension of insulating liquids – Determination with the ring method*

ISO 2049, *Petroleum products – Determination of colour (ASTM scale)*

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

ISO 2592, *Petroleum and related products – 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 12185, *Crude petroleum and petroleum products – Determination of density – Oscillating U-tube method*

EN 14210*, Surface active agents – Determination of interfacial tension of solutions of surface active agents by the stirrup or ring method*

ASTM D1275, *Standard test method for corrosive sulphur in electrical insulating liquids*

ASTM D1903, *Standard practice for determining the coefficient of thermal expansion of electrical insulating liquids of petroleum origin, and askarels*

ASTM D3300, *Standard test method for dielectric breakdown voltage of insulating oils of petroleum origin under impulse conditions*

ASTM D4172*, Standard test method for wear preventive characteristics of lubricating fluid (four-ball method)*

ASTM D7150, *Standard test method for the determination of gassing characteristics of insulating liquids under thermal stress*

ASTM D7896, *Standard test method for thermal conductivity, thermal diffusivity and volumetric heat capacity of engine coolants and related fluids by transient hot wire liquid thermal conductivity method*

ASTM E1269, *Standard test method for determining specific heat capacity by differential scanning calorimetry*

DIN 51350-1, *Testing of lubricants – Testing in the four-ball tester – Part 1: General working principles*

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DIN 51350-3, *Testing of lubricants – Testing in the four-ball tester – Part 3: Determination of wearing characteristics of liquid lubricants*

OECD 301-B, *OECD Guidelines for the testing of chemicals – Section 3: Environmental fate and behaviour – 301 Ready biodegradability – 301 B: $CO_2$ Evolution test*

OECD 301-C, *OECD Guidelines for the testing of chemicals – Section 3: Environmental fate and behaviour – 301 Ready biodegradability – 301 C: Modified MITI test*

OECD 301-F, *OECD Guidelines for the testing of chemicals – Section 3: Environmental fate and behaviour – 301 Ready biodegradability – 301 F: Manometric respirometry test*

U.S. Environmental Protection Agency, EPA 712-C-98-076*, US EPA OPPTS Series 835: Fate, transport and transformation test guidelines – Group C: Laboratory biological transformation test guidelines – 835.3110 Ready biodegradability*