SVENSK STANDARD

SS-EN IEC 62770, utg 2:2025

2025-06-04

COMMENTED VERSION

Isolervätskor – Oanvända naturliga estrar för transformatorer och liknande elektrisk utrustning

Fluids for electrotechnical applications – Unused natural esters for transformers and similar electrical equipment

En så kallad ”Commented Version” (CMV) innehåller både den fastställda IEC-standarden och en kommenterad och ändringsmarkerad standard. Alla tillägg och borttagningar sedan den tidigare utgåvan är markerade med färg. Med en CMV sparar du mycket tid när du ska identifiera och förklara aktuella ändringar i standarden. SEK Svensk Elstandard kan bara ge ut CMV i de fall den finns tillgänglig från IEC.

IEC 62770

Edition 2.0 2024-10
COMMENTED VERSION

INTERNATIONAL STANDARD

colour inside

Fluids for electrotechnical applications – Unused natural esters for transformers and similar electrical equipment

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.040.01

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CONTENTS

FOREWORD 4
INTRODUCTION 6
1 Scope 7
2 Normative references 7
3 Terms, definitions and abbreviated terms 9
3.1 Terms and definitions 9
3.2 Abbreviated terms 10
4 Properties, their significance and test methods 10
4.1 General 10
4.2 Physical properties 10
4.2.1 Appearance and colour 10
4.2.2 Viscosity 10
4.2.3 Pour point 11
4.2.4 Water content 11
4.2.5 Density 12
4.3 Electrical properties 12
4.3.1 Breakdown voltage 12
4.3.2 Dielectric dissipation factor (DDF) 12
4.3.3 Relative permittivity (dielectric constant) 12
4.4 Chemical properties 12
4.4.1 Acidity 12
4.4.2 Corrosive sulfur 12
4.4.3 Additive content 12
4.4.4 Furfural content 13
4.5 Performance 13
4.5.1 General 13
4.5.2 Oxidation stability 13
4.6 Health, safety and environmental (HSE) properties 14
4.6.1 Fire point and flash point 14
4.6.2 Polychlorinated biphenyls (PCBs) 14
4.6.3 Biodegradation 14
4.6.4 Aquatic toxicity 14
5 Classification, identification, general delivery requirements, and sampling 15
5.1 Classification 15
5.2 Identification and general delivery requirements 15
5.3 Sampling 15
Annex A (normative) Summary of the test method for evaluating oxidation stability of unused natural esters 17
A.1 ~~Introductory remark~~ General 17
A.2 Test conditions 17
A.3 Precision 17
A.4 Relative repeatability (r) 17
A.5 Relative reproducibility (R) 17
~~Annex B (informative) Specifications of low-viscosity insulating fluids derived from natural esters~~ .....
Bibliography 19

List of comments 21

Table 1 – Abbreviated terms 10
Table 2 – General specifications 16
Table A.1 – Relative repeatability and relative reproducibility obtained for different parameters during RRT 17
~~Table B.1 – Specifications for low-viscosity of monoesters derived from natural esters .....~~

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FLUIDS FOR ELECTROTECHNICAL APPLICATIONS – UNUSED NATURAL ESTERS FOR TRANSFORMERS AND SIMILAR ELECTRICAL EQUIPMENT

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.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
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This commented version (CMV) of the official standard IEC 62770:2024 edition 2.0 allows the user to identify the changes made to the previous IEC 62770:2013 edition 1.0. Furthermore, comments from IEC TC 10 experts are provided to explain the reasons of the most relevant changes, or to clarify any part of the content.

A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text. Experts' comments are identified by a blue-background number. Mouse over a number to display a pop-up note with the comment.

This publication contains the CMV and the official standard. The full list of comments is available at the end of the CMV.

IEC 62770 has been prepared by IEC technical committee 10: Fluids for electrotechnical applications. It is an International Standard.

This second edition cancels and replaces the first edition published in 2013. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition: 1

a) Introduction of IEC 63012 which details other liquids not covered by this document. IEC 63012 was published in 2019 after the first edition of IEC 62770 (2013).
b) New Table 1 inserted which clarifies definitions.
c) Appearance and colour requirements now merged.
d) Pour point: Introduction of the importance of LCSET with advice on cold temperature behaviour of natural esters.
e) Additives: new agreed wording inserted on the declaration of additives
f) Flash and fire points: now only determined by Cleveland Open Cup method, since the Pensky-Martens closed cup method was identified as problematic with natural esters.
g) Toxicity: Aquatic toxicity now emphasized.
h) Annex B removed as it is no longer needed since the publication of IEC 63012.

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

Draft	Report on voting
10/1215/FDIS	10/1243/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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

- reconfirmed,
- withdrawn, or
- revised.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Because of their higher fire points and ~~better~~ lower environmental ~~compatibility~~ impact relative to hydrocarbon petroleum derived insulating mineral oil, the use of vegetable oils and other natural esters is on the rise as insulating and heat transfer fluids in electrical devices such as transformers.

This document sets performance criteria for unused natural esters earmarked for electrical applications. However, the use of natural esters is recommended only for equipment that is not open to the atmosphere, for example sealed transformers and reactors because these ~~fluids~~ liquids are ~~prone~~ susceptible to ~~rapid~~ oxidation.

This document does not purport to address all the safety problems associated with its use. It is the responsibility of the user of the document to establish appropriate health and safety practices and determine the applicability of regulatory limitations prior to use.

Unused natural esters which are the subject of this document should be handled with due regard to personal hygiene. Direct contact with eyes should be avoided. In case of eye contact, irrigation with copious amounts of clean running water should be carried out and medical advice sought.

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

~~The disposal of natural esters, chemicals and sample containers mentioned in this standard should be carried out in accordance with current national legislation with regard to the impact on the environment. Every precaution should be taken to prevent the release of natural esters into the environment.~~ **2**

FLUIDS FOR ELECTROTECHNICAL APPLICATIONS – UNUSED NATURAL ESTERS FOR TRANSFORMERS AND SIMILAR ELECTRICAL EQUIPMENT

1 Scope

This document describes specifications and test methods for unused natural esters in transformers and similar ~~oil-impregnated~~ liquid-immersed electrical equipment in which a liquid is required as an insulating and heat transfer medium. The exposure of natural ester to air leads to deterioration of the insulating liquid. Use of natural esters is ~~not recommended for electrical equipment that is open to the atmosphere~~ therefore restricted to sealed units, or with the conservator tank protected from the contact with atmosphere by a membrane or other suitable system. **3**

In this document the term "natural esters" applies to insulating ~~fluids~~ liquids for transformers and similar electrical equipment with suitable biodegradability and lower environmental ~~compatibility~~ impact. Such natural esters are vegetable oils obtained from seeds, and oils obtained from other suitable biological materials ~~and delivered to an agreed point, at a set time period~~. These oils are comprised of triglycerides.

Natural esters with additives are within the scope of this document. Because of their different chemical composition, natural esters differ from insulating mineral oils and other insulating ~~fluids~~ liquids that have high fire points, such as synthetic esters or silicone fluids.

Natural ester-derived insulating ~~fluids~~ liquids with low viscosity have been introduced but are not covered by this document. ~~Pertinent properties of such fluids are given in Annex B.~~ IEC 63012 covers these liquids. **4**

This document is applicable only to unused natural esters. Reclaimed natural esters and natural esters blended with ~~non-natural esters fluids~~ other insulating liquids are beyond the scope of this document.

NOTE The chemical nomenclature and scientific notations used in the document are in accordance with the IUPAC handbook (Quantities, Units and Symbols in Physical Chemistry).

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. **5**

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

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 d) and d.c. resistivity ~~of insulating fluids~~*

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

IEC 60475, *Method of sampling ~~liquid dielectrics~~ insulating liquids*

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

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

~~IEC 61100, *Classification of insulating liquids according to fire-point and net calorific value*[1]~~

IEC 61125~~:1992~~, ~~*Unused hydrocarbon-based insulating fluids*~~ *Insulating liquids – Test methods for oxidation stability – Test method for* evaluating the oxidation stability *of insulating liquids in the delivered state*

IEC 61198, *Mineral insulating oils – Methods for the determination of 2-furfural and related compounds*

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*[2]

IEC 62535~~:2008~~, *Insulating liquids – Test method for detection of potentially corrosive sulphur in used and unused insulating oil*

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)*

ISO 2049, *Petroleum products – Determination of colour (ASTM 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 and related products from natural or synthetic sources – Determination of pour point*

ISO 3104, *Petroleum products – Transparent and opaque fluids – 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*

~~[1] Withdrawn in 2009 and partially replaced by IEC 61039.~~

~~[2] To be published.~~

~~ASTM D 1275, *Standard Test Method for Corrosive Sulfur in Electrical Insulating Oils*~~

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

ASTM D7042, *Standard Test Method for Dynamic Viscosity and Density of Liquids by Stabinger Viscometer (and the Calculation of Kinematic Viscosity)*

~~OECD 201-203, *Test Guidelines for ecotoxicity*~~

~~OECD 301, *Guideline for testing of chemicals adopted by European Council on July 17th 1992*~~

~~US EPA, *Office of Prevention, Pesticides and Toxic Substances (OPPTS)*~~

~~835.311, *Fate, Transport and Transformation Test Guidelines*~~

SVENSK STANDARD

SS-EN IEC 62770, utg 2:2025

Fastställd	Sida	Ansvarig kommitté
2025-06-04	1 (20)	SEK TK 10

Isolervätskor – Oanvända naturliga estrar för transformatorer och liknande elektrisk utrustning

Fluids for electrotechnical applications – Unused natural esters for transformers and similar electrical equipment

Som svensk standard gäller europastandarden EN IEC 62770:2024. Den svenska standarden innehåller den officiella engelska språkversionen av EN IEC 62770:2024.

Nationellt förord

Europastandarden EN IEC 62770:2024

består av:

– **europastandardens ikraftsättningsdokument,** utarbetat inom CENELEC
– **IEC 62770, Second edition, 2024 - Fluids for electrotechnical applications - Unused natural esters for transformers and similar electrical equipment**

utarbetad inom International Electrotechnical Commission, IEC.

Tidigare fastställd svensk standard SS-EN 62770, utg 1:2014 med eventuella tillägg, ändringar och rättelser gäller ej fr o m 2027-11-30.

ICS 29.040.01

Denna standard är fastställd av SEK Svensk Elstandard,
som också kan lämna upplysningar om **sakinnehållet** i standarden.
Postadress: Box 1042, 172 21 Sundbyberg
Telefon: 08 - 444 14 00.
E-post: sek@elstandard.se. Internet: elstandard.se

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.

SEK är Sveriges röst i standardiseringsarbetet inom elområdet

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.

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Stora delar av arbetet sker internationellt

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.

SEK Svensk Elstandard

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN IEC 62770

November 2024

ICS 29.040.01

Supersedes EN 62770:2014

English Version

Fluids for electrotechnical applications - Unused natural esters for transformers and similar electrical equipment (IEC 62770:2024)

Fluides pour applications électrotechniques - Esters naturels neufs pour transformateurs et matériels électriques analogues
(IEC 62770:2024)

Flüssigkeiten für elektrotechnische Anwendungen - Neue natürliche Ester für Transformatoren und ähnliche elektrische Betriebsmittel
(IEC 62770:2024)

This European Standard was approved by CENELEC on 2024-11-12. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

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 62770:2024 E

SEK Svensk Elstandard

SS-EN IEC 62770, utg 2:2025

European foreword

The text of document 10/1215/FDIS, future edition 2 of IEC 62770, prepared by TC 10 "Fluids for electrotechnical applications" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 62770:2024.

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) 2025-11-30
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2027-11-30

This document supersedes EN 62770:2014 and all of its amendments and corrigenda (if any).

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.

Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website.

Endorsement notice

The text of the International Standard IEC 62770:2024 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 standard indicated:

IEC 60076-14 NOTE Approved as EN 60076-14

IEC 60296 NOTE Approved as EN IEC 60296

IEC 60422 NOTE Approved as EN IEC 60422

IEC 61039 NOTE Approved as EN 61039

IEC 61099 NOTE Approved as EN 61099

IEC 61868 NOTE Approved as EN 61868

IEC 63012 NOTE Approved as EN IEC 63012

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.cencenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60156	-	Insulating liquids - Determination of the breakdown voltage at power frequency - Test method	EN IEC 60156	-
IEC 60247	-	Insulating liquids - Measurement of relative permittivity, dielectric dissipation factor (tan d) and d.c. resistivity	EN 60247	-
IEC 60475	-	Method of sampling insulating liquids	EN IEC 60475	-
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 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 61198	-	Mineral insulating oils - Methods for the determination of 2-furfural and related compounds	EN 61198	-
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	-
ISO 2049	-	Petroleum products - Determination of colour (ASTM scale)	-	-
ISO 2592	-	Petroleum and related products - Determination of flash and fire points - Cleveland open cup method	EN ISO 2592	-
ISO 3016	-	Petroleum and related products from natural or synthetic sources - Determination of pour point	EN ISO 3016	-
ISO 3104	-	Petroleum products - Transparent and opaque fluids - 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	-
ASTM D1500	-	Standard Test Method for ASTM Color of Petroleum Products (ASTM Colour Scale)	-	-
ASTM D7042	-	Standard Test Method for Dynamic Viscosity and Density of Liquids by Stabinger Viscometer (and the Calculation of Kinematic Viscosity)	-	-

IEC 62770

Edition 2.0 2024-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Fluids for electrotechnical applications – Unused natural esters for transformers and similar electrical equipment

Fluides pour applications électrotechniques – Esters naturels neufs pour transformateurs et matériels électriques analogues

INTERNATIONAL
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CONTENTS

FOREWORD 4
INTRODUCTION 6
1 Scope 7
2 Normative references 7
3 Terms, definitions and abbreviated terms 8
3.1 Terms and definitions 8
3.2 Abbreviated terms 9
4 Properties, their significance and test methods 9
4.1 General 9
4.2 Physical properties 9
4.2.1 Appearance and colour 9
4.2.2 Viscosity 10
4.2.3 Pour point 10
4.2.4 Water content 10
4.2.5 Density 10
4.3 Electrical properties 11
4.3.1 Breakdown voltage 11
4.3.2 Dielectric dissipation factor (DDF) 11
4.3.3 Relative permittivity (dielectric constant) 11
4.4 Chemical properties 11
4.4.1 Acidity 11
4.4.2 Corrosive sulfur 11
4.4.3 Additive content 11
4.4.4 Furfural content 12
4.5 Performance 12
4.5.1 General 12
4.5.2 Oxidation stability 12
4.6 Health, safety and environmental (HSE) properties 12
4.6.1 Fire point and flash point 12
4.6.2 Polychlorinated biphenyls (PCBs) 12
4.6.3 Biodegradation 13
4.6.4 Aquatic toxicity 13
5 Classification, identification, general delivery requirements, and sampling 13
5.1 Classification 13
5.2 Identification and general delivery requirements 13
5.3 Sampling 13
Annex A (normative) Summary of the test method for evaluating oxidation stability of unused natural esters 15
A.1 General 15
A.2 Test conditions 15
A.3 Precision 15
A.4 Relative repeatability (r) 15
A.5 Relative reproducibility (R) 15
Bibliography 16

Table 1 – Abbreviated terms 9
Table 2 – General specifications 14
Table A.1 – Relative repeatability and relative reproducibility obtained for different parameters during RRT 15

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FLUIDS FOR ELECTROTECHNICAL APPLICATIONS – UNUSED NATURAL ESTERS FOR TRANSFORMERS AND SIMILAR ELECTRICAL EQUIPMENT

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.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
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IEC 62770 has been prepared by IEC technical committee 10: Fluids for electrotechnical applications. It is an International Standard.

This second edition cancels and replaces the first edition published in 2013. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) Introduction of IEC 63012 which details other liquids not covered by this document. IEC 63012 was published in 2019 after the first edition of IEC 62770 (2013).
b) New Table 1 inserted which clarifies definitions.
c) Appearance and colour requirements now merged.

d) Pour point: Introduction of the importance of LCSET with advice on cold temperature behaviour of natural esters.

e) Additives: new agreed wording inserted on the declaration of additives

f) Flash and fire points: now only determined by Cleveland Open Cup method, since the Pensky-Martens closed cup method was identified as problematic with natural esters.

g) Toxicity: Aquatic toxicity now emphasized.

h) Annex B removed as it is no longer needed since the publication of IEC 63012.

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

Draft	Report on voting
10/1215/FDIS	10/1243/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

Because of their higher fire points and lower environmental impact relative to hydrocarbon petroleum derived insulating mineral oil, the use of vegetable oils and other natural esters is on the rise as insulating and heat transfer fluids in electrical devices such as transformers.

This document sets performance criteria for unused natural esters earmarked for electrical applications. However, the use of natural esters is recommended only for equipment that is not open to the atmosphere, for example sealed transformers and reactors because these liquids are susceptible to oxidation.

This document does not purport to address all the safety problems associated with its use. It is the responsibility of the user of the document to establish appropriate health and safety practices and determine the applicability of regulatory limitations prior to use.

Unused natural esters which are the subject of this document should be handled with due regard to personal hygiene. Direct contact with eyes should be avoided. In case of eye contact, irrigation with copious amounts of clean running water should be carried out and medical advice sought.

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

FLUIDS FOR ELECTROTECHNICAL APPLICATIONS – UNUSED NATURAL ESTERS FOR TRANSFORMERS AND SIMILAR ELECTRICAL EQUIPMENT

1 Scope

This document describes specifications and test methods for unused natural esters in transformers and similar liquid-immersed electrical equipment in which a liquid is required as an insulating and heat transfer medium. The exposure of natural ester to air leads to deterioration of the insulating liquid. Use of natural esters is therefore restricted to sealed units, or with the conservator tank protected from the contact with atmosphere by a membrane or other suitable system.

In this document the term "natural esters" applies to insulating liquids for transformers and similar electrical equipment with suitable biodegradability and lower environmental impact. Such natural esters are vegetable oils obtained from seeds, and oils obtained from other suitable biological materials. These oils are comprised of triglycerides.

Natural esters with additives are within the scope of this document. Because of their different chemical composition, natural esters differ from insulating mineral oils and other insulating liquids that have high fire points, such as synthetic esters or silicone fluids.

Natural ester-derived insulating liquids with low viscosity have been introduced but are not covered by this document. IEC 63012 covers these liquids.

This document is applicable only to unused natural esters. Reclaimed natural esters and natural esters blended with other insulating liquids are beyond the scope of this document.

NOTE The chemical nomenclature and scientific notations used in the document are in accordance with the IUPAC handbook (Quantities, Units and Symbols in Physical Chemistry).

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 d) and d.c. resistivity*

IEC 60475, *Method of sampling insulating liquids*

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

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

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

IEC 61198, *Mineral insulating oils – Methods for the determination of 2-furfural and related compounds*

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

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

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

ISO 3016, *Petroleum and related products from natural or synthetic sources – Determination of pour point*

ISO 3104, *Petroleum products – Transparent and opaque fluids – 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*

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

ASTM D7042, *Standard Test Method for Dynamic Viscosity and Density of Liquids by Stabinger Viscometer (and the Calculation of Kinematic Viscosity)*