



SLOVENSKI STANDARD
oSIST prEN IEC 62770:2023
01-junij-2023

Tekočine za elektrotehniko - Neuporabljene naravne estrske tekočine za transformatorje in podobno električno opremo

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

Flüssigkeiten für elektrotechnische Anwendungen - Neue natürliche Ester für Transformatoren und ähnliche elektrische Betriebsmittel

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

Ta slovenski standard je istoveten z: prEN IEC 62770:2023

ICS:

29.040.01	Izolacijski fluidi na splošno	Insulating fluids in general
29.180	Transformatorji. Dušilke	Transformers. Reactors

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en



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OF INTEREST TO THE FOLLOWING COMMITTEES: TC 14, SC 17A, TC 20, SC 36A, TC 38, TC 99, TC 112	PROPOSED HORIZONTAL STANDARD: <input type="checkbox"/> Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
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TITLE:

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

PROPOSED STABILITY DATE: 2027

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

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

FDIS	Report on voting
10/XXXX/FDIS	10/XXXX/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 web site 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- withdrawn,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.

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1

INTRODUCTION

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

5 This standard sets performance criteria for unused natural esters earmarked for electrical
6 applications. However, the use of natural esters is recommended only for equipment that is
7 not open to the atmosphere, e.g. sealed transformers and reactors because these liquids are
8 susceptible to rapid oxidation.

9 This International Standard does not purport to address all the safety problems associated
10 with its use. It is the responsibility of the user of the standard to establish appropriate health
11 and safety practices and determine the applicability of regulatory limitation prior to use.

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

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

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

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23 **FLUIDS FOR ELECTROTECHNICAL APPLICATIONS –**
24 **UNUSED NATURAL ESTERS FOR TRANSFORMERS**
25 **AND SIMILAR ELECTRICAL EQUIPMENT**
26
27

28 **Scope**

29 This International Standard describes specifications and test methods for unused natural
30 esters in transformers and similar liquid-impregnated electrical equipment in which a liquid is
31 required as an insulating and heat transfer medium.

32 Use of natural esters is not recommended for electrical equipment that is open to the
33 atmosphere. The exposure of natural ester to air leads to rapid deterioration of the insulating liquid.
34 Use of natural esters should be restricted to sealed units, or with conservator tank protected from the
35 contact with atmosphere by a membrane or other suitable system

36 In this standard the term “natural esters” applies to insulating liquids for transformers and
37 similar electrical equipment with suitable biodegradability and lower environmental impact.
38 Such natural esters are vegetable oils obtained from seeds and oils obtained from other
39 suitable biological materials and delivered to an agreed point, at a set date. These oils are
40 comprised of triglycerides.

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

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

46 <https://standards.iteh.ai/catalog/standards/sist/801a064f-680c-49d7-ae61->
47 This standard is applicable only to unused natural esters. Reclaimed natural esters and
natural esters blended with other insulating liquids are beyond the scope of this standard.

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

50 **Normative references**

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

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

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

59 IEC 60247, *Insulating liquids – Measurement of relative permittivity, dielectric dissipation*
60 *factor and DC resistivity of insulating fluids*

61 IEC 60475, *Method of sampling liquid dielectrics*

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

- 63 IEC 60814, *Insulating liquids – Oil-impregnated paper and pressboard – Determination of*
64 *water by automatic coulometric Karl Fischer titration*
- 65 IEC 61125, *(Unused hydrocarbon-based insulating fluids – Test methods for evaluating the*
66 *oxidation stability*
- 67 IEC 61198, *Mineral insulating oils – Methods for the determination of 2-furfural and related*
68 *compounds*
- 69 IEC 61619, *Insulating liquids – Contamination by polychlorinated biphenyls (PCBs) – Method*
70 *of determination by capillary column gas chromatography*
- 71 IEC 61620, *Insulating liquids – Determination of the dielectric dissipation factor by*
72 *measurement of the conductance and capacitance – Test method*
- 73 IEC 62021-3, *Insulating liquids – Determination of acidity – Part 3: Test methods for non*
74 *mineral insulating oils*
- 75 IEC 62535:2008, *Insulating liquids – Test method for detection of potentially corrosive sulfur*
76 *in used and unused insulating oils*
- 77 IEC 62697-1, *Test method for quantitative determination of corrosive sulfur compounds in*
78 *unused and used insulating liquids – Part 1: Test method for quantitative determination of*
79 *dibenzyl disulfide (DBDS)*
- 80 IEC 63012 *Insulating liquids - Unused modified or blended esters for electrotechnical*
81 *applications*
- 82 ISO 2049 *Petroleum products — Determination of colour (ASTM scale)*
<https://standards.iteh.ai/catalog/standards/sist/801a064f-680c-49d7-ae61-411111111111/iso-2049-2002>
- 83 ISO 2592, *Determination of flash and fire point – Cleveland open cup method*
- 84 ISO 3016, *Petroleum products – Determination of pour point*
- 85 ISO 3104, *Petroleum products – Transparent and opaque fluids – Determination of kinematic*
86 *viscosity and calculation of dynamic viscosity*
- 87 ISO 3675, *Crude petroleum and liquid petroleum products – Laboratory determination of*
88 *density – Hydrometer method*
- 89 ISO 12185, *Crude petroleum and petroleum products – Determination of density – Oscillating*
90 *U-tube method*
- 91 ASTM D1500 *Standard Test Method for ASTM Color of Petroleum Products (ASTM Color*
92 *Scale)*
- 93 OECD 201-203, *Test Guidelines for ecotoxicity*
- 94 OECD 301, *Guideline for testing of chemicals adopted by European Council on July 17th 1992*
- 95 US EPA, *Office of Prevention, Pesticides and Toxic Substances 835.311, Fate, Transport and*
96 *Transformation Test Guidelines*

97 3 Terms and definitions

98 For the purposes of this document, the following definitions apply.

99 3.1

100 additives

101 Chemical substances which are deliberately added to natural ester insulating liquids in order
102 to improve certain characteristics,

103 3.2 natural esters

104 vegetable oils obtained from seeds and oils obtained from other suitable biological materials
105 and comprised of triglycerides

106 3.3 unused natural esters

107 natural esters as delivered by the supplier

108 Note 1 to entry: Such a liquid has not been used in, nor been in contact with electrical equipment or other
109 equipment not required for its manufacture, storage or transport.

110 Properties, their significance and test methods

111 4.1 General

112 Salient characteristics of unused natural esters are listed in Table 1.

113 NOTE Additional information on natural esters for transformers and similar electrical equipment is available in
114 CIGRE brochure 436 and IEEE report C57.147. IEEE C57.166 will supersede C57.147 shortly

115 4.2 Physical properties

116 4.2.1 Appearance & Colour

117 A visual inspection of unused natural esters (with light transmitted through glass transparent
118 beaker approximately 10 cm thickness of natural esters at ambient temperature) indicates the
119 presence of visible contaminants, free water and suspended matter.

120 The colour of an insulating oil is determined in transmitted light and is expressed by a
121 numerical value based on comparison with a series of colour standards. Colour shall be
122 measured following ISO 2049 (reference method) or ASTM D1500.

123 4.2.2 Viscosity

124 Viscosity influences heat transfer and therefore affects the increase of temperature in the
125 transformer and other equipment. The lower the viscosity, the easier the liquid circulates
126 leading to better heat transfer. Viscosities at lower temperatures is a critical factor for cold
127 start of transformers with ON cooling (absence of circulation can lead to possible overheating
128 at hot spots). It can have negative impact on the speed of moving parts such as on-load tap
129 changer mechanism, pumps and regulators. Due consideration should be given to viscosity at
130 the lowest cold start energizing temperature (LCSET). Viscosity at 40 °C and 100 °C shall be
131 measured according to ISO 3104.

132 4.2.3 Pour point

133 The pour point of liquids is the lowest temperature at which the liquid will just flow. The pour
134 point shall be measured in accordance with ISO 3016.

135 It shall be considered that, with natural ester liquids, longer dwell times (weeks or months)
136 below 0°C can lead to an increase of the pour point, correspondingly an increase of viscosity
137 of the liquid in comparison to the original state (the so-called “cold-and-hold behaviour”). It
138 depends on the individual molecular formulation and the time the liquid is exposed to the low
139 temperature. Whilst natural ester liquids show pour points in the region -15 to -31°C, it has
140 been noticed that they can show a tendency to precipitate ester crystals if held for extended