

Insulating liquids - Test methods for the determination  
of interfacial tension of insulating liquids -  
Determination with the ring method

## EESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

See Eesti standard EVS-EN IEC 62961:2018 sisaldab Euroopa standardi EN IEC 62961:2018 ingliskeelset teksti.	This Estonian standard EVS-EN IEC 62961:2018 consists of the English text of the European standard EN IEC 62961:2018.
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English Version

Insulating liquids - Test methods for the determination of  
interfacial tension of insulating liquids - Determination with the  
ring method  
(IEC 62961:2018)

Isolants liquides - Méthodes d'essai pour la détermination  
de la tension interfaciale des isolants liquides -  
Détermination par la méthode à l'anneau  
(IEC 62961:2018)

Isolierflüssigkeiten - Prüfverfahren zur Bestimmung der  
Grenzflächenspannung von Isolierflüssigkeiten -  
Bestimmung der Grenzflächenspannung mittels  
Ringmethode  
(IEC 62961:2018)

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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

## European foreword

The text of document 10/1062/FDIS, future edition 1 of IEC 62961, prepared by IEC/TC 10 "Fluids for electrotechnical applications" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 62961:2018.

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) 2019-07-25
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2021-10-25

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In the official version, for Bibliography, the following note has to be added for the standard indicated:

IEC 60422      NOTE      Harmonized as EN 60422

## 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](http://www.cenelec.eu).

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
ISO 862	-	Surface active agents - Vocabulary	-	-
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 14370	-	Surface active agents - Determination of surface tension	EN 14370	-

## CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	8
2 Normative references .....	8
3 Terms and definitions .....	8
4 Principle.....	8
5 Apparatus.....	9
5.1 Tensiometer.....	9
5.2 Ring.....	10
5.3 Measuring vessel.....	10
6 Preparation of apparatus .....	10
6.1 Cleaning of the measuring vessel .....	10
6.2 Cleaning of the ring.....	11
6.3 Water used for the test.....	11
7 Procedure.....	11
7.1 General.....	11
7.2 Calibration and taring.....	11
7.3 Determination of the surface tension of water used for the test .....	12
7.4 Determination of interfacial tension between water and insulating liquid.....	12
8 Test report.....	12
9 Precision .....	13
9.1 Repeatability.....	13
9.2 Reproducibility .....	13
Annex A (informative) Determination of the interfacial tension of insulation liquids by the drop volume method .....	14
A.1 General.....	14
A.2 Principle of the method .....	14
A.2.1 Basics .....	14
A.2.2 Effect of adsorption (surface age) on the values obtained.....	15
A.3 Apparatus .....	15
A.4 Procedure .....	15
A.4.1 Preparation of apparatus .....	15
A.4.2 Calibration .....	15
A.4.3 Preparation of the test sample .....	15
A.4.4 Determination .....	16
A.4.5 Evaluation/expression of results .....	16
A.4.6 Correlation of results obtained with drop volume method to results obtained with ring method.....	16
A.5 Precision.....	17
A.6 Test report .....	17
Annex B (informative) Investigative tests for differentiating between aged insulating liquids.....	18
B.1 General.....	18
B.2 Application .....	19
Bibliography.....	20

Figure 1 – Typical development of interfacial tension values of new and service aged mineral insulating liquids.....	6
Figure 2 – Typical development of interfacial tension values of a new and a service aged ester insulating liquid .....	7
Figure 3 – Dimensions of platinum-iridium alloy ring in mm .....	10
Figure B.1 – Plot of the data from Table B.1 according to Kezdy-Swinbourne method .....	19
Table 1 – Repeatability ( $r$ ) as a % for the measurement of interfacial tension at approximately 180 s with both manual and motor driven instruments .....	13
Table 2 – Reproducibility ( $R$ ) as a % for the measurement of interfacial tension at approximately 180 s with both manual and motor driven instruments .....	13
Table A.1 – Comparison of interfacial values by measurement at 180 s and at 300 s to 400 s between the drop volume and ring methods.....	17
Table B.1 – Interfacial tension measured in constant equal time intervals .....	18
Table B.2 – Comparison of interfacial tension values by measurement at 180 s with equilibrium values according to Kezdy-Swinbourne method .....	19

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

# INSULATING LIQUIDS – TEST METHODS FOR THE DETERMINATION OF INTERFACIAL TENSION OF INSULATING LIQUIDS – DETERMINATION WITH THE RING METHOD

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International Standard IEC 62961 has been prepared by IEC technical committee 10: Fluids for electrotechnical applications.

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

FDIS	Report on voting
10/1062/FDIS	10/1066/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.



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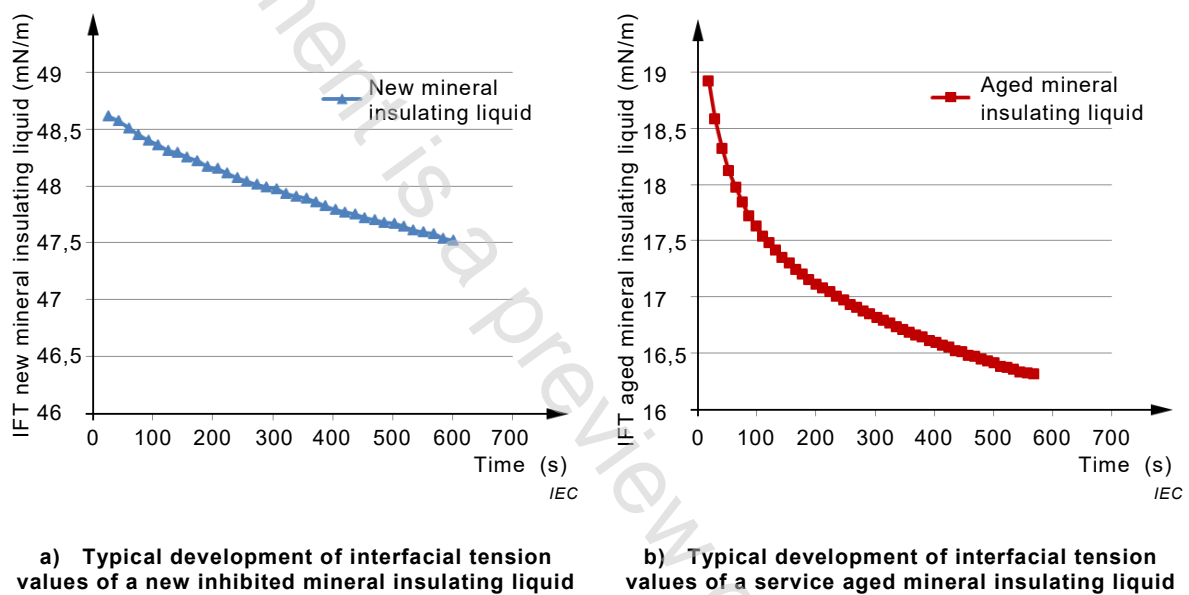
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## INTRODUCTION

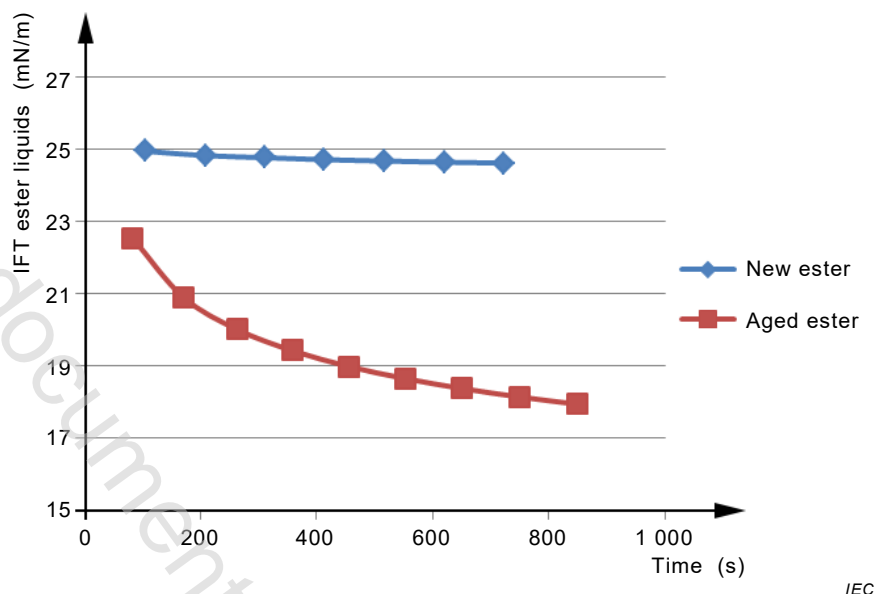
Interfacial tension (IFT) of insulating liquid against water has been used for a long time as a criterion for ageing evaluation. Statistical values that are used as orientation values and for their interpretation have been published in IEC 60422 [1] <sup>1</sup>.

The interfacial tension of insulating liquids changes with time depending on the type and nature of the ageing products. This process is more pronounced with aged than with new insulating liquids. It is well known that the interfacial tension of insulating liquids depends on the interfacial concentration of the surface active amphiphilic aged products at the time of measuring (dynamic interfacial tension), see Figure 1. The adsorption procedures, and thus the attaining of a state of equilibrium, can take several minutes or even hours. With the so-called static measuring methods – e.g. the Du Noüy ring [2]– measurements are repeated on the same sample surface until no further change occurs.



**Figure 1 – Typical development of interfacial tension values of new and service aged mineral insulating liquids**

<sup>1</sup> Numbers in square brackets refer to the Bibliography.



**Figure 2 – Typical development of interfacial tension values of a new and a service aged ester insulating liquid**

The interfacial tension of insulating liquids measured by the existing method ASTM D971 [3], working in non-equilibrium modus, provides only a single value within quite a short time (60 s) and hence might be quite different from the static interfacial value, particularly in the case of aged insulating liquids. In addition, the error of the time measurement might become a more important aspect than the performance of the measurement itself. These weaknesses of ASTM D971 could be generally compensated by replacing it with EN 14210 [4]. However, for the practical work in the laboratory, the requirement of repeating tests until "static" conditions are obtained can increase the test time dramatically.

The scope of this document is to find a compromise between the less accurate but fast ASTM D971 method and the precise, but time consuming EN 14210 procedure. Experience of the round robin tests shows clearly that the slope of the time-dependent interfacial tension curve decreases significantly over a period of 180 s in the case of both mineral insulating liquids (Figure 1 a), Figure 1 b)) and insulating synthetic and natural esters (Figure 2). A measurement is carried out after a surface age of approximately 180 s in order to obtain a value that provides a more realistic expression of the real interfacial tension, and that is less sensitive to the timing of the measurement taken, and does not overly increase the test time.

The proposed surface age of 180 s allows the distinction between differently aged ester liquids, which is not possible with ASTM D971.

The drop volume method for the determination of interfacial tension can deliver similar results as the ring method if adapted concerning the surface age. This method is described in Annex A.

Experience and results of round robin tests have shown that the deviation of tests repeated after 10 min is less than 1 mN/m per min. Such tests can be necessary in case of further comparative investigations of aged mineral and ester insulating liquids, and are described in Annex B.