

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Insulating liquids – Specifications for unused liquids based on synthetic aromatic hydrocarbons

Isolants liquides – Spécifications pour les liquides neufs à base d'hydrocarbures aromatiques de synthèse

IEC 60867:2022

<https://standards.iteh.ai/catalog/standards/sist/3077c5b9-030d-45ca-b59f-0b626716370b/iec-60867-2022>



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2022 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Secretariat
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC -

webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, ...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 300 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 19 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Insulating liquids – Specifications for unused liquids based on synthetic aromatic hydrocarbons

Isolants liquides – Spécifications pour les liquides neufs à base d'hydrocarbures aromatiques de synthèse

IEC 60867:2022

<https://standards.iteh.ai/catalog/standards/sist/3077c5b9-030d-45ca-b59f-0b626716370b/iec-60867-2022>

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 29.040.10

ISBN 978-2-8322-5901-6

Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references	7
3 Terms and definitions	8
4 Identification and general delivery requirements	9
5 Sampling	9
6 Test methods.....	9
6.1 Appearance	9
6.2 Density	9
6.3 Kinematic viscosity	9
6.4 Flash point.....	9
6.5 Pour point	9
6.6 Acidity.....	9
6.7 Chlorine content.....	10
6.8 Water content	10
6.9 Corrosive and potentially corrosive sulphur	10
6.10 Additives.....	10
6.11 Breakdown voltage	10
6.12 Dielectric dissipation factor and volume resistivity.....	10
6.13 Gassing tendency	10
6.14 Polychlorinated biphenyl (PCBs) content.....	10
7 Specifications for capacitor and cable alkylbenzenes.....	10
8 Specifications for capacitor alkylidiphenylethanes	10
9 Specifications for capacitor alkyl-naphthalenes.....	11
10 Specifications for capacitor methylpolyarylmethanes	11
Annex A (informative) Test method for determination of chlorine content	15
A.1 Test method for determination of total chloride	15
A.1.1 Reagents	15
A.1.2 Apparatus.....	15
A.1.3 Procedure.....	15
A.1.4 Calculation	16
A.2 Test method for determination of organic chloride.....	16
Annex B (informative) IR spectra of typical synthetic aromatic hydrocarbons	17
B.1 IR spectra typical of the family of alkylbenzenes	17
B.2 Alkylidiphenylethanes	18
B.3 Alkyl-naphthalenes – typified by 1-methylnaphthalene	19
B.4 Methylpolyarylmethanes.....	19
Bibliography.....	21
Figure B.1 – IR spectra of branched alkylbenzenes.....	17
Figure B.2 – IR spectra of linear alkylbenzenes	18
Figure B.3 – IR spectrum of phenylxylylene (PXE)	18
Figure B.4 – IR spectrum of 1-methylnaphthalene.....	19
Figure B.5 – IR spectrum of monobenzyltoluene (MBT).....	19

Figure B.6 – IR spectrum of dibenzyltoluene (DBT)..... 20

Table 1 – Specifications for capacitor and cable alkylbenzenes 12

Table 2 – Specifications for capacitor alkyl-diphenylethanes and alkyl-naphthalenes 13

Table 3 – Specifications for capacitor methylpolyarylmethanes 14

iTeh STANDARD PREVIEW
(standards.iteh.ai)

IEC 60867:2022

<https://standards.iteh.ai/catalog/standards/sist/3077c5b9-030d-45ca-b59f-0b626716370b/iec-60867-2022>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INSULATING LIQUIDS – SPECIFICATIONS FOR UNUSED LIQUIDS
BASED ON SYNTHETIC AROMATIC HYDROCARBONS**

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.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 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.

IEC 60867 has been prepared by IEC technical committee 10: Fluids for electrotechnical applications. It is an International Standard.

This third edition cancels and replaces the second edition published in 1993. This edition constitutes a technical revision.

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

- a) The Scope has been changed from applications in electrical equipment to applications limited to cables and capacitors.
- b) IEC 62021-1, IEC 62021-2 and IEC 62021-3 are all acceptable for synthetic aromatic hydrocarbons and references to individual parts have been replaced by references to the IEC 62021 series.

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

Draft	Report on voting
10/1186/FDIS	10/1188/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/standardsdev/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,
- replaced by a revised edition, or
- amended.

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

WARNING – Health and safety

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

The synthetic aromatic hydrocarbon insulating liquids which are the subject of this document should be handled with due regard to personal hygiene. Direct contact with the eyes can cause irritation. In the case of eye contact, irrigation with copious quantities of clean running water should be carried out and medical advice sought. Some of the tests specified in this document involve the use of processes that could lead to a hazardous situation. Attention is drawn to the relevant standard for guidance.

WARNING – Environment

This document is applicable to synthetic aromatic hydrocarbon insulating liquids, chemicals and used sample containers. The disposal of these items can be subject to regulatory requirements with regard to their impact on the environment. Every precaution should be taken to prevent release of insulating liquids into the environment.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

IEC 60867:2022

<https://standards.iteh.ai/catalog/standards/sist/3077c5b9-030d-45ca-b59f-0b626716370b/iec-60867-2022>

INSULATING LIQUIDS – SPECIFICATIONS FOR UNUSED LIQUIDS BASED ON SYNTHETIC AROMATIC HYDROCARBONS

1 Scope

This document covers specifications and test methods for unused synthetic aromatic hydrocarbons intended for use as insulating liquid in cables and capacitors.

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 60475, *Method of sampling insulating liquids*

IEC 60628, *Gassing of insulating liquids under electrical stress and ionization*

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

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

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 (all parts), *Insulating liquids – Determination of acidity*

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

ISO 2592, *Petroleum and related products – Determination of flash point – Cleveland open cup method (PMOC)*

ISO 3016, *Petroleum and related products from natural or synthetic sources – 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 9562, *Water quality – Determination of adsorbable organically bound halogens (AOX)*

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

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

ASTM D4929, *Standard Test Method for Determination of Organic Chloride Content in Crude Oil*

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

ASTM D7536, *Standard Test Method for Chlorine in Aromatics by Monochromatic Wavelength Dispersive X-ray Fluorescence Spectrometry*

DIN 51353, *Testing of insulating oils; detection of corrosive sulfur; Silver strip test*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1 **alkylbenzenes**

insulating liquids consisting of a benzene ring and an alkyl group where the alkyl group can be a straight chain or a branched-chain type

Note 1 to entry: Examples of IR spectra are given in Annex B.

3.2 **alkyldiphenylethanes**

insulating liquids consisting of diphenylethanes derivatives where the two aryl groups normally carry short alkyl groups

Note 1 to entry: Examples of IR spectra are given in Annex B.

3.3 **alkylnaphthalenes**

insulating liquids consisting of a naphthalene structure with substituent alkyl groups

Note 1 to entry: Examples of IR spectra are given in Annex B.

3.4 **methylnpolyarylmethanes**

insulating liquids consisting of methylnpolyarylm ethanes derivatives mainly based on a blend of mono/di-benzyl toluene (M/DBT)

Note 1 to entry: Examples of IR spectra are given in Annex B.

4 Identification and general delivery requirements

Identification and general delivery requirements are as follows:

- a) The synthetic aromatic hydrocarbons type of liquid is normally delivered in bulk, rail-tank cars, tank containers or packed in drums or intermediate bulk containers (IBC). These shall be clean and suitable for this purpose to avoid any contamination. The supplier shall take all the precautions to ensure the delivery product will be in accordance with the requirements of this document.
- b) Drums and sample containers shall carry at least the following markings:
 - supplier's designation;
 - labelling in accordance with the Globally Harmonized System of Classification and Labelling of Chemicals (GHS);
 - liquid quantity.
- c) As agreed between the supplier and purchaser each liquid delivery shall be accompanied by a document specifying the supplier's designation, labelling and compliance certificate. A delivery shall be traceable to a manufactured batch.
- d) The supplier shall declare the generic type of all additives, and the concentrations in the case of antioxidants and passivators.

5 Sampling

Sampling shall be carried out in accordance with the procedure described in IEC 60475.

6 Test methods

6.1 Appearance

Appearance shall be evaluated by examining, in transmitted light, a representative sample of the liquid having a thickness of approximately 10 cm, at ambient temperature.

6.2 Density

Density shall be measured in accordance with ISO 12185 (reference method). ISO 3675 and ASTM D7042 are acceptable.

6.3 Kinematic viscosity

Kinematic viscosity shall be measured according to ISO 3104 (reference method) or ASTM D7042.

6.4 Flash point

Flash point shall be determined according to ISO 2592.

6.5 Pour point

Pour point shall be determined according to ISO 3016.

6.6 Acidity

Acidity shall be measured according to the IEC 62021 series. Any part of the IEC 62021 series (IEC 62021-1 or IEC 62021-2 or IEC 62021-3) can be used.

6.7 Chlorine content

Chlorine content shall be determined using a test method according to ISO 9562 for the determination of adsorbable organically bound halogens (AOX) or ASTM D4929 for the determination of organic chloride content in crude oil or ASTM D7536 for the determination of chlorine in aromatics by monochromatic wavelength dispersive X-ray fluorescence spectrometry. The method described in Annex A can also be used.

6.8 Water content

Water content shall be determined according to IEC 60814.

6.9 Corrosive and potentially corrosive sulphur

Corrosive and potentially corrosive sulphur shall be determined according to DIN 51353 and ASTM D1275 and IEC 62535.

6.10 Additives

The chemical family of all additives shall be declared in product data sheets and certificates of compliance. For antioxidant additives and passivators (IEC 60666), their concentrations shall also be stated.

6.11 Breakdown voltage

Breakdown voltage shall be determined according to IEC 60156.

6.12 Dielectric dissipation factor and volume resistivity

The properties shall be determined according to IEC 60247 (reference method) or IEC 61620.

6.13 Gassing tendency

The gassing shall be determined by Method A of IEC 60628.

NOTE Synthetic aromatic hydrocarbon compositions have been used as additive to improve the gassing tendency of insulating liquids.

6.14 Polychlorinated biphenyl (PCBs) content

Synthetic aromatic hydrocarbons shall be free from PCBs. The reference test method is IEC 61619.

NOTE Acceptable limits of total or individual PCBs are specified in national and local regulations. Further European specifications are described in Directive 96/59/EC and UN Guidelines for the identification of PCBs and materials containing PCBs.

7 Specifications for capacitor and cable alkylbenzenes

When tested in accordance with the methods specified in Clause 6, the properties of insulating liquids based on alkylbenzenes which are intended for use as impregnant in capacitors and hollow-core cables shall meet the requirements and specifications given in Table 1.

8 Specifications for capacitor alkyldiphenylethanes

When tested in accordance with the methods specified in Clause 6, the properties of insulating liquids based on alkyldiphenylethanes used as impregnant in capacitors shall meet the requirements and specifications given in Table 2.

9 Specifications for capacitor alkyl naphthalenes

When tested in accordance with the methods specified in Clause 6 the properties of insulating liquids based on alkyl naphthalenes used as impregnant in capacitors shall meet the requirements and specifications given in Table 2.

10 Specifications for capacitor methyl polyarylmethanes

When tested in accordance with the methods specified in Clause 6, the properties of insulating liquids based on methyl polyarylmethanes used as impregnant in capacitors shall meet the requirements and specifications given in Table 3.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

IEC 60867:2022

<https://standards.iteh.ai/catalog/standards/sist/3077c5b9-030d-45ca-b59f-0b626716370b/iec-60867-2022>