IEC 61039

Edition 3.0 2025-02
COMMENTED VERSION

INTERNATIONAL STANDARD

Classification of insulating liquids

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.040.10

ISBN 978-2-8327-0242-0

Warning! Make sure that you obtained this publication from an authorized distributor.

® Registered trademark of the International Electrotechnical Commission

CONTENTS

FOREWORD 3
INTRODUCTION 5
1 Scope 6
2 Normative references 6
3 Terms and definitions 7
4 ISO classification system 7
5 Classification of electrical insulating liquids 8
5.1 General 8
5.2 Class classification 8
5.3 Category classification 8
5.4 Identifying code 9
6 Summarizing outline 11
Bibliography 14
List of comments 15

Figure 1 – Meaning of all the letters and digits present in the classification of insulating liquids 13

Table 1 – Class classification of petroleum products or related products 8
Table 2 – Examples of classification for different insulating liquids 10

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

CLASSIFICATION OF INSULATING LIQUIDS

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) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at https://patents.iec.ch. IEC shall not be held responsible for identifying any or all such patent rights.

This commented version (CMV) of the official standard IEC 61039:2025 edition 3.0 allows the user to identify the changes made to the previous IEC 61039:2008 edition 2.0. 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 61039 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 2008. This edition constitutes a technical revision.

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

a) updating of the classification of insulating liquids, taking into account the largest number possible of substances that have, or may have, a possible application in electrical components.

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

Draft	Report on voting
10/1249/FDIS	10/1258/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

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 insulating liquids which are the subject of this document should be handled with due regard to personal hygiene. Direct contact with eyes ~~may~~ can cause slight 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 involves insulating liquids, chemicals and used sample containers. The disposal of these items ~~should~~ can be ~~carried out in accordance with current national legislation~~ subject to regulatory requirements with regard to their impact on the environment.

All insulating liquids that float on water are generally a water hazard, as they reduce oxygen ingress into the water. No liquid, regardless of its classification, can be freely spilled in the environment. The handling of insulating liquids can be subject to regulatory requirements with regard to their impact on the environment **1**. Every precaution should be taken to prevent the release of insulating liquids into the environment.

CLASSIFICATION OF INSULATING LIQUIDS

1 Scope

This document establishes the detailed classification of the N family (insulating liquids) that belongs to class L (lubricants, industrial oils and related products) in accordance with ISO 8681 and ISO 6743-99, affecting product categories that include products derived from petroleum processing, synthetic chemical products and synthetic and natural esters.

This document applies to unused liquids. For liquids in service, additional testing can be required to ensure compliance with this document. **2**

2 Normative references **3**

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/TS 60076-14:2004, *Power transformers – Part 14: Design and application of liquid-immersed power transformers using high-temperature insulation materials*~~

IEC 60296~~:2003~~, *Fluids for electrotechnical applications – ~~Unused~~ Mineral insulating oils for ~~transformers and switchgear~~ electrical equipment*

~~IEC 60465:1988, *Specification for unused insulating mineral oils for cables with oil ducts*~~

~~IEC 60836:2005, *Specifications for unused silicone insulating liquids for electrotechnical purposes*~~

~~IEC 60867:1993, *Insulating liquids – Specifications for unused liquids based on synthetic aromatic hydrocarbons*~~

~~IEC 60963:1988, *Specification for unused polybutenes*~~

~~IEC 61099:1992, *Specifications for unused synthetic organic esters for electrical purposes*~~

~~ISO 1928:1995, *Solid mineral fuels – Determination of gross calorific value by the bomb calorimetric method, and calculation of net calorific value*~~

ISO 2592~~:2000~~, *Petroleum and related products – Determination of flash and fire points – Cleveland open cup method*

~~ISO 6743-99:2002, *Lubricants, industrial oils and related products (class L) – Classification – Part 99: General*~~

ISO 8681~~:1986~~, *Petroleum products and lubricants – Method of classification – Definition of classes*

OECD 301:1992, *OECD guidelines for testing of chemicals – Ready biodegradability*

ASTM D240~~-02~~, *Standard test method for heat of combustion of liquid hydrocarbon fuels by bomb calorimeter*

IEC 61039

Edition 3.0 2025-02

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Classification of insulating liquids

Classification des liquides isolants



IEC 61039:2025-02(en-fr)

CONTENTS

FOREWORD 3
INTRODUCTION 5
1 Scope 6
2 Normative references 6
3 Terms and definitions 6
4 ISO classification system 6
5 Classification of electrical insulating liquids 7
5.1 General 7
5.2 Class classification 7
5.3 Category classification 8
5.4 Identifying code 8
6 Summarizing outline 11
Bibliography 12

Figure 1 – Meaning of all the letters and digits present in the classification of insulating liquids 11

Table 1 – Class classification of petroleum products or related products 7
Table 2 – Examples of classification for different insulating liquids 10

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

CLASSIFICATION OF INSULATING LIQUIDS

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) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at https://patents.iec.ch. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 61039 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 2008. This edition constitutes a technical revision.

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

a) updating of the classification of insulating liquids, taking into account the largest number possible of substances that have, or may have, a possible application in electrical components.

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

Draft	Report on voting
10/1249/FDIS	10/1258/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

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 insulating liquids which are the subject of this document should be handled with due regard to personal hygiene. Direct contact with eyes can cause slight 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 involves 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.

All insulating liquids that float on water are generally a water hazard, as they reduce oxygen ingress into the water. No liquid, regardless of its classification, can be freely spilled in the environment. The handling of insulating liquids can be subject to regulatory requirements with regard to their impact on the environment. Every precaution should be taken to prevent the release of insulating liquids into the environment.

CLASSIFICATION OF INSULATING LIQUIDS

1 Scope

This document establishes the detailed classification of the N family (insulating liquids) that belongs to class L (lubricants, industrial oils and related products) in accordance with ISO 8681 and ISO 6743-99, affecting product categories that include products derived from petroleum processing, synthetic chemical products and synthetic and natural esters.

This document applies to unused liquids. For liquids in service, additional testing can be required to ensure compliance with this document.

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 60296, *Fluids for electrotechnical applications – Mineral insulating oils for electrical equipment*

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

ISO 8681, *Petroleum products and lubricants – Method of classification – Definition of classes*

OECD 301:1992, *OECD guidelines for testing of chemicals – Ready biodegradability*

ASTM D240, *Standard test method for heat of combustion of liquid hydrocarbon fuels by bomb calorimeter*

SOMMAIRE

AVANT-PROPOS 15
INTRODUCTION 17
1 Domaine d’application 18
2 Références normatives 18
3 Termes et définitions 18
4 Système de classification de l'ISO 18
5 Classification des liquides isolants électriques 19
5.1 Généralités 19
5.2 Classification de classe 19
5.3 Classification de catégorie 20
5.4 Code identifiant 20
6 Contour de regroupement 23
Bibliographie 24

Figure 1 – Signification de toutes les lettres et de tous les chiffres présents dans la classification des liquides isolants 23

Tableau 1 – Classification de classe des produits pétroliers ou des produits connexes 19
Tableau 2 – Exemples de classification pour différents liquides isolants 22

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

_____

CLASSIFICATION DES LIQUIDES ISOLANTS

AVANT-PROPOS

1) La Commission Électrotechnique Internationale (IEC) est une organisation mondiale de normalisation composée de l'ensemble des comités électrotechniques nationaux (Comités nationaux de l'IEC). L'IEC a pour objet de favoriser la coopération internationale pour toutes les questions de normalisation dans les domaines de l'électricité et de l'électronique. À cet effet, l'IEC – entre autres activités – publie des Normes internationales, des Spécifications techniques, des Rapports techniques, des Spécifications accessibles au public (PAS) et des Guides (ci-après dénommés "Publication(s) de l'IEC"). Leur élaboration est confiée à des comités d'études, aux travaux desquels tout Comité national intéressé par le sujet traité peut participer. Les organisations internationales, gouvernementales et non gouvernementales, en liaison avec l'IEC, participent également aux travaux. L'IEC collabore étroitement avec l'Organisation Internationale de Normalisation (ISO), selon des conditions fixées par accord entre les deux organisations.
2) Les décisions ou accords officiels de l'IEC concernant les questions techniques représentent, dans la mesure du possible, un accord international sur les sujets étudiés, étant donné que les Comités nationaux de l'IEC intéressés sont représentés dans chaque comité d'études.
3) Les Publications de l'IEC se présentent sous la forme de recommandations internationales et sont agréées comme telles par les Comités nationaux de l'IEC. Tous les efforts raisonnables sont entrepris afin que l'IEC s'assure de l'exactitude du contenu technique de ses publications; l'IEC ne peut pas être tenue responsable de l'éventuelle mauvaise utilisation ou interprétation qui en est faite par un quelconque utilisateur final.
4) Dans le but d'encourager l'uniformité internationale, les Comités nationaux de l'IEC s'engagent, dans toute la mesure possible, à appliquer de façon transparente les Publications de l'IEC dans leurs publications nationales et régionales. Toutes divergences entre toutes Publications de l'IEC et toutes publications nationales ou régionales correspondantes doivent être indiquées en termes clairs dans ces dernières.
5) L'IEC elle-même ne fournit aucune attestation de conformité. Des organismes de certification indépendants fournissent des services d'évaluation de conformité et, dans certains secteurs, accèdent aux marques de conformité de l'IEC. L'IEC n'est responsable d'aucun des services effectués par les organismes de certification indépendants.
6) Tous les utilisateurs doivent s'assurer qu'ils sont en possession de la dernière édition de cette publication.
7) Aucune responsabilité ne doit être imputée à l'IEC, à ses administrateurs, employés, auxiliaires ou mandataires, y compris ses experts particuliers et les membres de ses comités d'études et des Comités nationaux de l'IEC, pour tout préjudice causé en cas de dommages corporels et matériels, ou de tout autre dommage de quelque nature que ce soit, directe ou indirecte, ou pour supporter les coûts (y compris les frais de justice) et les dépenses découlant de la publication ou de l'utilisation de cette Publication de l'IEC ou de toute autre Publication de l'IEC, ou au crédit qui lui est accordé.
8) L'attention est attirée sur les références normatives citées dans cette publication. L'utilisation de publications référencées est obligatoire pour une application correcte de la présente publication.
9) L'IEC attire l'attention sur le fait que la mise en application du présent document peut entraîner l'utilisation d'un ou de plusieurs brevets. L'IEC ne prend pas position quant à la preuve, à la validité et à l'applicabilité de tout droit de brevet à cet égard. À la date de publication du présent document, l'IEC n'a pas reçu notification qu'un ou plusieurs brevets pouvaient être nécessaires à sa mise en application. Toutefois, il y a lieu d'avertir les responsables de la mise en application du présent document que des informations plus récentes sont susceptibles de figurer dans la base de données de brevets, disponible à l'adresse https://patents.iec.ch. L'IEC ne saurait être tenue pour responsable de l'identification de ces droits de brevet.

L'IEC 61039 a été établie par le comité d'études 10 de l'IEC: Fluides pour applications électrotechniques. Il s'agit d'une Norme internationale.

Cette troisième édition annule et remplace la deuxième édition parue en 2008. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) mise à jour de la classification des liquides isolants, en tenant compte d'un nombre maximal de substances qui ont, ou peuvent avoir, des applications possibles dans les composants électriques.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
10/1249/FDIS	10/1258/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/publications.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous webstore.iec.ch dans les données relatives au document recherché. À cette date, le document sera

- reconduit,
- supprimé, ou
- révisé.

INTRODUCTION

AVERTISSEMENT – Hygiène et sécurité

Le présent document ne vise pas à répondre à tous les problèmes de sécurité associés à son utilisation. Il incombe à l'utilisateur du présent document de mettre en place les pratiques d'hygiène et de sécurité adéquates, et de vérifier avant utilisation si des contraintes réglementaires s'appliquent.

Il convient de manipuler les liquides isolants dont traite le présent document en respectant l'hygiène personnelle. Un contact direct avec les yeux peut provoquer une légère irritation. En cas de contact oculaire, il est recommandé de laver abondamment à l'eau courante propre, et de consulter un médecin.

Certains des essais spécifiés dans le présent document impliquent des opérations qui peuvent conduire à une situation dangereuse. L'attention est attirée sur la norme à consulter pour obtenir des recommandations.

AVERTISSEMENT – Environnement

Le présent document concerne les liquides isolants, les produits chimiques et les récipients d'échantillons usagés. L'élimination de ces éléments peut être soumise à des exigences réglementaires en lien avec leur impact sur l'environnement.

Tous les liquides isolants qui flottent sur l'eau constituent généralement un danger dans la mesure où ils réduisent la pénétration de l'oxygène dans l'eau. Aucun liquide, quelle que soit sa classification, ne peut être déversé librement dans l'environnement. La manipulation des liquides isolants peut être soumise à des exigences réglementaires en lien avec leur impact sur l'environnement. Il convient de prendre des précautions pour éviter de rejeter des liquides isolants dans l’environnement.

CLASSIFICATION DES LIQUIDES ISOLANTS

1 Domaine d’application

Le présent document établit la classification détaillée de la famille N (liquides isolants) qui appartient à la classe L (lubrifiants, huiles industrielles et produits connexes) conformément aux normes ISO 8681 et ISO 6743-99, concernant les catégories de produit qui incluent des produits dérivés du traitement du pétrole, les produits chimiques synthétiques et les esters naturels et synthétiques.

Ce document s’applique aux liquides neufs. Pour les liquides en service, des essais complémentaires peuvent être exigés pour assurer la conformité à la présente norme.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu’ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l’édition citée s’applique. Pour les références non datées, la dernière édition du document de référence s’applique (y compris les éventuels amendements).

IEC 60296*, Fluides pour applications électrotechniques – Huiles minérales isolantes pour matériel électrique*

ISO 2592, *Pétrole et produits connexes – Détermination des points d'éclair et de feu – Méthode Cleveland à vase ouvert*

ISO 8681, *Produits pétroliers et lubrifiants – Système de classification – Définition des classes de produits*

OECD 301:1992, *Ligne directrice de l'OCDE pour les essais des produits chimiques – Biodégradabilité facile*

ASTM D240, *Standard test method for heat of combustion of liquid hydrocarbon fuels by bomb calorimeter* (disponible en anglais seulement)