

INTERNATIONAL STANDARD

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Fluids for electrotechnical applications – Mineral insulating oils for electrical equipment

Fluides pour applications électrotechniques – Huiles minérales isolantes pour matériel électrique



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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
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INTERNATIONALE

ICS 29.040.10

ISBN 978-2-8322-8377-6

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**FLUIDS FOR ELECTROTECHNICAL APPLICATIONS –
MINERAL INSULATING OILS FOR ELECTRICAL EQUIPMENT**

FOREWORD

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International Standard IEC 60296 has been prepared by IEC technical committee 10: Fluids for electrotechnical applications.

This fifth edition cancels and replaces the fourth edition published in 2012. This edition constitutes a technical revision.

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

- This International Standard is applicable to specifications and test methods for unused and recycled mineral insulating oils in the delivered state.
- Within the transformer insulating oils, two groups, Type A and Type B, are defined, based on their performance.
- A new method for stray gassing under thermo-oxidative stress of mineral insulating oils, which has been tested in a joint round robin test (RRT) between CIGRE D1 and IEC technical committee 10, has been included.

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

FDIS	Report on voting
10/1117/FDIS	10/1118/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.

The committee has decided that the contents of this document 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 document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

WARNING – 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 mineral insulating oils which are the subject of this document should be handled in compliance with local regulations and suppliers safety data-sheets.

This document is applicable to mineral insulating oils, chemicals and used sample containers. The disposal of these items should be carried out according to local regulations with regard to their impact on the environment.

FLUIDS FOR ELECTROTECHNICAL APPLICATIONS – MINERAL INSULATING OILS FOR ELECTRICAL EQUIPMENT

1 Scope

This document provides specifications and test methods for unused and recycled mineral insulating oils (see Clause 3 for definitions). It applies to mineral oil delivered according to the contractual agreement, intended for use in transformers, switchgear and similar electrical equipment in which oil is required for insulation and heat transfer. Both unused oil and recycled oil under the scope of this document have not been used in, nor been in contact with electrical equipment or other equipment not required for manufacture, storage or transport.

Unused oils are obtained by refining, modifying and/or blending of petroleum products and other hydrocarbons from virgin feedstock.

Recycled oils are produced from oils previously used as mineral insulating oils in electrical equipment that have been subjected to re-refining or reclaiming (regeneration) by processes employed offsite. Such oils will have originally been supplied in compliance with a recognized unused mineral insulating oil specification. This document does not differentiate between the methods used to recycle mineral insulating oil. Oils treated on-site (see IEC 60422) are not within the scope of this document.

Oils with and without additives are both within the scope of this document.

This document does not apply to mineral insulating oils used as impregnating medium in cables or 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 60422:2013, *Mineral insulating oils in electrical equipment – Supervision and maintenance guidance*

IEC 60475, *Method of sampling liquid dielectrics*

IEC 60567:2011, *Oil-filled electrical equipment – Sampling of gases and analysis of free and dissolved gases – Guidance*

IEC 60628:1985, *Gassing of insulating liquids under electrical stress and ionization*

IEC 60666:2010, *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 60970, *Insulating liquids – Methods for counting and sizing particles*

IEC 61125:2018, *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 61868, *Mineral insulating oils – Determination of kinematic viscosity at very low temperatures*

IEC 62021-1, *Insulating liquids – Determination of acidity – Part 1: Automatic potentiometric titration*

IEC 62021-2, *Insulating liquids – Determination of acidity – Part 2: Colourimetric titration*

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

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 dibenzyl disulfide (DBDS)*

IEC 62961, *Insulating liquids – Test methods for the determination of interfacial tension of insulating liquids – Determination with the ring method*

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

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 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 3819, *Laboratory glassware – Beakers*

ISO 8754, *Petroleum products – Determination of sulphur content – Energy-dispersive X-ray fluorescence spectrometry*

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

ISO 14596, *Petroleum products – Determination of sulphur content – Wavelength-dispersive X-ray fluorescence spectrometry*

ASTM D971, *Standard Test Method for Interfacial Tension of Oil Against Water by the Ring Method*

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

ASTM D6591, *Standard Test Method for Determination of Aromatic Hydrocarbon Types in Middle Distillates – High Performance Liquid Chromatography Method with Refractive Index Detection*

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

ASTM D7896, *Standard Test Method for Thermal Conductivity, Thermal Diffusivity and Volumetric Heat Capacity of Engine Coolants and Related Fluids by Transient Hot Wire Liquid Thermal Conductivity Method*

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

IP 346, *Determination of polycyclic aromatics in unused lubricating base oils and asphaltene free petroleum fractions – Dimethyl sulfoxide extraction refractive index method*

3 Terms and definitions

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

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

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

3.1

mineral insulating oil

insulating liquid for transformers and similar electrical equipment (e.g. switchgear, tap-changers), derived from petroleum products and/or other hydrocarbons

Note 1 to entry: Mineral insulating oils include unused (3.8) and recycled (3.9) mineral insulating oils.

[SOURCE: IEC 60050-212:2010, 212-17-02, modified – "for transformers and similar electrical equipment, (e.g. switchgear, tap-changers)" added, "crudes" replaced with "petroleum products and/or other hydrocarbons" and note to entry added.]

3.2

low temperature switchgear oil

mineral insulating oil for oil-filled switchgear for outdoor applications in very cold climatic conditions

3.3

additive

chemical substance that is added to mineral insulating oil in order to improve certain characteristics