



Edition 4.0 2012-02 REDLINE VERSION

INTERNATIONAL STANDARD



Fluids for electrotechnical applications – Unused mineral insulating oils for transformers and switchgear

Fluides pour applications électrotechniques – Huiles minérales isolantes neuves pour transformateurs et appareillages de connexion



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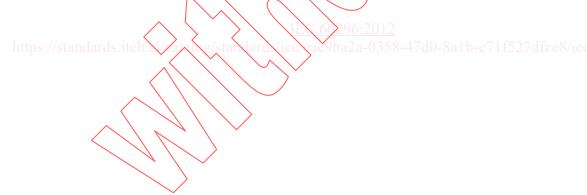
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FLUIDS FOR ELECTROTECHNICAL APPLICATIONS – UNUSED MINERAL INSULATING OILS FOR TRANSFORMERS AND SWITCHGEAR

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

This fourth edition cancels and replaces the third edition, published in 2003. This edition constitutes a technical revision.

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

- specifications for corrosive sulphur compounds that can lead to copper sulphide deposition in transformers (in non-passivated and passivated oils);
- definitions of additives in oil; and
- re-insertion of a missing note on oxidation.

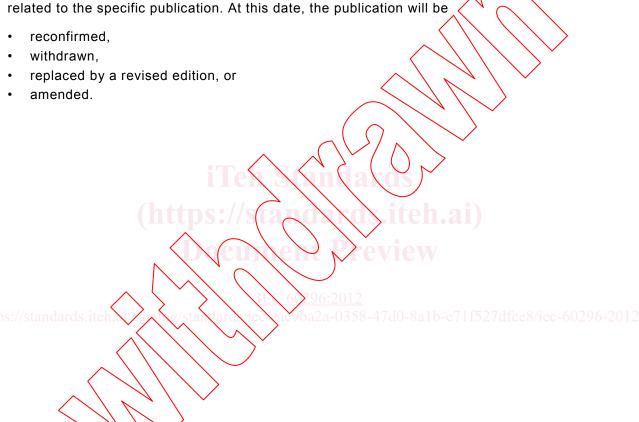
The text of this standard is based on the following documents:

FDIS	Report on voting
10/878/FDIS	10/885/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



INTRODUCTION

This International Standard does not purport to address all the safety problems associated with its use. It is the responsibility of the user of the standard 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 standard should be handled with due regard to personal hygiene. Direct contact with the eyes may 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 standard involve the use of processes that could lead to a hazardous situation. Attention is drawn to the relevant standard for guidance.

This standard 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. Every precaution should be taken to prevent release of mineral insulating oil into the environment.

FLUIDS FOR ELECTROTECHNICAL APPLICATIONS – UNUSED MINERAL INSULATING OILS FOR TRANSFORMERS AND SWITCHGEAR

1 Scope

This International Standard is applicable to specifications and test methods for unused mineral insulating oils (see Clause 3 for definitions). It applies to oil delivered to the agreed point and time of delivery, intended for use in transformers, switchgear and similar electrical equipment in which oil is required for insulation and heat transfer. These oils are obtained by refining, modifying and/or blending of petroleum products and other hydroca(bons.

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

This standard is applicable only to unused mineral insulating oils

Recycled oils are beyond the scope of this standard.,

NOTE Definitions and specifications for recycled oils will be covered by EG 62701 1.

This standard does not apply to mineral insulating oils used as impregnants in cables or capacitors.

2 Normative references

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

IEC 60076-2, Power transformers - Part 2: Temperature rise for liquid-immersed transformers

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 δ) and d.c. resistivity

IEC 60422, Mineral insulating oils in electrical equipment – Supervision and maintenance guidance

IEC 60475, Method of sampling liquid dielectrics

IEC 60628:1985, 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

¹ In preparation.

IEC 60970, Insulating liquids – Methods for counting and sizing particles

IEC 61125:1992, Unused hydrocarbon-based insulating liquids – Test methods for evaluating the oxidation stability

Amendment 1 (2004)

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

ISO 2719, Determination of flash point - Pensky-Martens closed cup method

ISO 3016, Petroleum products - 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 12185, Crude petroleum and petroleum products – Determination of density – Oscillating U-tube method

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

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

ASTM D7150, Standard Test Method for the Determination of Gassing Characteristics of Insulating Liquids Under Thermal Stress at Low temperature

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

EN 14210, Surface active agents – Determination of interfacial tension of solutions of surface active agents by the stirrup or ring method

IP 346, Determination of polycyclic aromatics in lubricant base oils and asphaltene free petroleum fractions – Dimethylsulfoxide refractive method

IP 373, Determination of the sulphur content of light and middle distillates – Oxidative microcoulometry

3 Terms and definitions

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

3.1

transformer oil

mineral insulating oil for transformers and similar electrical equipment

3.2

low temperature switchgear oil

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

3.3

mineral insulating oil

insulating oil obtained by refining, modifying and/or blending of petroleum products and other hydrocarbons

Note 1 to entry This does not include insulating liquids such as esters, synthetic aromatics or silicone fluids.

3.4

additive

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

Note 1 to entry Examples include artioxidants metal passivators, metal deactivators, electrostatic charging tendency depressants, gas absorbers, pour point depressants, anti-foam agents and refining process improvers.

3.5

antioxidant additive

additive incorporated in mineral insulating oil that improves oxidation stability

Note 1 to entry A large number of additives which improve oxidation stability, including inhibitors, peroxide decomposers, metal passivators and metal deactivators, are available and may be used in oils if declared (see 6.11.1 and 6.11.2).

3.5.1

inhibitor

antioxidant additives of the phenolic-or amine- type, such as DBPC and DBP described in IEC 60666

Note 1 to entry DBPC = 2,6-di-tert-butyl-para-cresol; DBP = 2,6-di-tert-butyl-phenol.

3.5.2

other antioxidant additive

antioxidant additive of the sulphur- or phosphorous- type

3.5.3

passivator

metal passivator additive used primarily as electrostatic charging depressant, but which may also improve oxidation stability

Note 1 to entry Metal passivators are sometimes described as metal deactivators or corrosion inhibitors.

3.6

uninhibited oil

mineral insulating oil containing no inhibitor

Note 1 to entry No inhibitor means that the total inhibitor content is below the detection limit of 0,01 % indicated in IEC 60666.

3.7

trace inhibited oil

mineral insulating oil containing less than 0,08 % of total inhibitor content as measured by IEC 60666

3.8

inhibited oil

mineral insulating oil containing a minimum of $0.08\,\%$ and a maximum of $0.40\,\%$ of total inhibitor content as measured by IEC $60666\,$

3.9

unused mineral insulating oil

mineral insulating oil not recycled as delivered by the supplier

Note 1 to entry Such an oil has not been used in, nor been in contact with electrical equipment or other equipment not required for manufacture, storage or transport. The manufacturer and supplier of unused oil will have taken all reasonable precautions to ensure that there is no contamination with polychlorinated biphenyls or terphenyls (PCB, PCT), used, reclaimed or dechlorinated oil or other contaminants.

Note 2 to entry The definition of recycled oils will be given in IEC 62701 (in preparation).

Note 3 to entry A blend of unused and recycled oil in any proportion is regarded as being recycled.

4 Properties of oil

NOTE Oil characteristics are listed in Tables 1 and 2 and in Clause 6.

4.1 Functional properties

Properties of oil that have an impact on its function as an insulating and cooling liquid.

NOTE Functional properties include viscosity, density, pour point, water content, breakdown voltage and dielectric dissipation factor.

4.2 Refining and stability

Properties of oil that are influenced by quality and type of refining and additives.

NOTE These can include appearance, interfacial tension, sulphur content, acidity, corrosive sulphur, 2-furfural and related compounds content and stray gassing.

4.3 Performance

Properties that are related to the long-term behaviour of oil in service and/or its reaction to high electric stress and temperature.

NOTE Examples include oxidation stability, gassing tendency and electrostatic charging tendency (ECT).

4.4 Health, safety and environment (HSE) properties

Oil properties related to safe handling and environment protection.

NOTE Examples can include flash point, density, PCA (polycyclic aromatics) and PCB/PCT (polychlorinated biphenyls/ terphenyls).