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Withdrawn

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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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FLUIDS FOR ELECTROTECHNICAL APPLICATIONS –

UNUSED MINERAL INSULATING OILS FOR TRANSFORMERS AND SWITCHGEAR

FOREWORD

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

This third edition cancels and replaces the second edition, published in 1982 and its amendment 1 (1986), and constitutes a technical revision.

Main changes with regard to previous edition include: the three classes of previous edition have been replaced by only two: transformer oil and low temperature switchgear oil, but a new concept, the lowest cold start energizing temperature, has been included; new properties have been added (i.e. charging tendency); values for properties have been revised.

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

FDIS	Report on voting
10/566/FDIS	10/569/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 2008. At this date, the publication will be

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- withdrawn;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

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INTRODUCTION

General caution – Health, safety and environmental protection

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 gives rise to mineral insulating oils, chemicals and used sample containers. The disposal of these items shall be carried out according to the local regulations with regard to the impact on the environment. Every precaution should be taken to prevent release of mineral insulating oil into the environment.

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FLUIDS FOR ELECTROTECHNICAL APPLICATIONS –

UNUSED MINERAL INSULATING OILS FOR TRANSFORMERS AND SWITCHGEAR

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1 Scope

This International Standard covers specifications and test methods for unused mineral insulating oils. 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 as an insulant and for heat transfer. These oils are obtained by distillation and refining of crude petroleum.

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

This standard is applicable only to unused mineral insulating oils.

Reclaimed oils are beyond the scope of this standard.

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

NOTE Mineral insulating oils complying with the requirements of this standard, of the same class and containing no additives (see 3.4), are considered to be compatible with one another and can be mixed in any proportion. This does not apply to oils containing additives. Where the user wishes to mix such oils, a check is recommended to be made to ensure that the mixture meets the requirements of this standard.

2 Normative references

The following referenced documents are indispensable for the application 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 60076-2, *Power transformers – Part 2: Temperature rise*

IEC 60156, *Insulating liquids – Determination of the breakdown voltage at power frequency – Test method*

IEC 60247, *Measurement of relative permittivity, dielectric dissipation factor and d.c. resistivity of insulating liquids*

IEC 60422, *Supervision and maintenance guide for mineral insulating oils in electrical equipment*

IEC 60475, *Method of sampling liquid dielectrics*

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

IEC 60666, *Detection and determination of specified anti-oxidant additives in insulating oils*

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

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

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*

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 6295, *Petroleum products – Mineral oils – Determination of interfacial tension of oil against water – Ring 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*

3 Terms and definitions

For the purposes of this document, the following definitions apply:

3.1
transformer oil
mineral insulating oil for transformers and similar electrical equipment where normal oxidation resistance is required

3.2
low temperature switchgear oil
mineral insulating oil for oil-filled switchgear for outdoor application in very cold climatic conditions

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3.3
additive
suitable chemical substance which is deliberately added to a mineral insulating oil in order to improve certain characteristics

NOTE Examples include antioxidants, pour point depressants, electrostatic charging tendency depressants such as benzotriazole (BTA), anti-foam agents, refining process improvers, etc.

3.4
antioxidant additive
additive incorporated in an insulating oil to improve oxidation stability

NOTE A large number of antioxidant additives are available. For this standard, these are limited to those identified in IEC 60666.

3.5
uninhibited oil
mineral insulating oil, containing no antioxidant additives, but which may contain other additives

3.6
trace inhibited oil
mineral insulating oil containing up to 0,08 % antioxidant additive together with other additives as mentioned in 3.4

3.7
inhibited oil
mineral insulating oil containing a minimum of 0,08 % and a maximum of 0,40 % antioxidant additive together with other additives as mentioned in 3.3

3.8
unused mineral insulating oil
mineral insulating oil as delivered by the supplier

NOTE 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.

3.9
reclaimed oil
mineral insulating oil used in electrical equipment which has been subjected to chemical and/or physical processing to eliminate soluble and insoluble contaminants

NOTE A blend of unused and reclaimed oil in any proportion is regarded as being reclaimed.

4 Properties of oil

Characteristics are listed in Tables 1 and 2 and in Clause 7.

4.1 Functional properties

Properties of oil which have 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.

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4.2 Refining and stability

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

NOTE This can include appearance, interfacial tension, sulfur content, acidity, corrosive sulfur, 2-furfural content.

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), PCB/PCT (polychlorinated biphenyls/terphenyls).

5 Classification, identification, general delivery requirements and sampling

5.1 Classification

5.1.1 Classes

For the purpose of this standard, mineral insulating oils are classified into two classes:

– transformer oils;
– low temperature switchgear oil.

5.1.2 Antioxidant additive (inhibitor) content

Transformer oils are classified into three groups, according to their content of antioxidant additive:

– uninhibited transformer oils: marked with U;
– trace inhibited transformer oils: marked with T;
– inhibited transformer oils: marked with I.

5.1.3 Lowest cold start energizing temperature (LCSET)

After the inhibitor marking, the LCSET shall be indicated.

Standard LCSET in this standard is –30 °C; optionally other LCSET can be selected according to Table 1.

Example: Transformer oil I –40 °C, transformer oil T –30 °C, transformer oil U 0 °C.

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