

STN	Minerálne izolačné oleje v elektrických zariadeniach Návod na kontrolu a údržbu	STN EN IEC 60422 34 6435
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Mineral insulating oils in electrical equipment - Supervision and maintenance guidance

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 11/24

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English Version

**Mineral insulating oils in electrical equipment - Supervision and
maintenance guidance
(IEC 60422:2024)**

Huiles minérales isolantes dans les matériels électriques -
Lignes directrices pour la maintenance et la surveillance
(IEC 60422:2024)

Isolieröle auf Mineralölbasis in elektrischen Betriebsmitteln -
Leitlinie zur Überwachung und Wartung
(IEC 60422:2024)

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

EN IEC 60422:2024 (E)**European foreword**

The text of document 10/1233/FDIS, future edition 5 of IEC 60422, prepared by TC 10 "Fluids for electrotechnical applications" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 60422:2024.

The following dates are fixed:

- latest date by which the document has to be implemented at national (dop) 2025-05-22 level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting with the (dow) 2027-08-22 document have to be withdrawn

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In the official version, for Bibliography, the following notes have to be added for the standard indicated:

IEC 60567	NOTE	Approved as EN IEC 60567
IEC 60599	NOTE	Approved as EN IEC 60599
IEC 61198	NOTE	Approved as EN 61198
IEC 61620	NOTE	Approved as EN 61620

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60156	-	Insulating liquids - Determination of the breakdown voltage at power frequency - Test method	EN 60156	-
IEC 60247	-	Insulating liquids - Measurement of relative permittivity, dielectric dissipation factor (tan δ) and d.c. resistivity	EN 60247	-
IEC 60296	2020	Fluids for electrotechnical applications - Mineral insulating oils for electrical equipment	EN IEC 60296	2020
IEC 60475	-	Method of sampling insulating liquids	EN IEC 60475	-
IEC 60666	2010	Detection and determination of specified additives in mineral insulating oils	EN 60666	2010
IEC 60814	-	Insulating liquids - Oil-impregnated paper and pressboard - Determination of water by automatic coulometric Karl Fischer titration	EN 60814	-
IEC 60970	-	Insulating liquids - Methods for counting and sizing particles	EN 60970	-
IEC 61125	2018	Insulating liquids - Test methods for oxidation stability - Test method for evaluating the oxidation stability of insulating liquids in the delivered state	EN IEC 61125	2018
IEC 61619	-	Insulating liquids - Contamination by polychlorinated biphenyls (PCBs) - Method of determination by capillary column gas chromatography	EN 61619	-
IEC 62021-1	-	Insulating liquids - Determination of acidity - Part 1: Automatic potentiometric titration	EN 62021-1	-
IEC 62021-2	-	Insulating liquids - Determination of acidity - Part 2: Colourimetric titration	EN 62021-2	-

EN IEC 60422:2024 (E)

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 62535	2008	Insulating liquids - Test method for detection of potentially corrosive sulphur in used and unused insulating oil	EN 62535	2009
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 dibenzylidene disulfide (DBDS)	EN 62697-1	-
IEC 62961	-	Insulating liquids - Test methods for the determination of interfacial tension of insulating liquids - Determination with the ring method	EN IEC 62961	-
ISO 2049	-	Petroleum products - Determination of colour (ASTM scale)	-	-
ISO 2719	-	Determination of flash point - Pensky-Martens closed cup method	EN ISO 2719	-
ISO 3016	-	Petroleum and related products from natural or synthetic sources - Determination of pour point	EN ISO 3016	-
ISO 3104	-	Petroleum products – Transparent and opaque liquids – Determination of kinematic viscosity and calculation of dynamic viscosity	EN ISO 3104	-
ISO 3675	-	Crude petroleum and liquid petroleum products - Laboratory determination of density - Hydrometer method	EN ISO 3675	-
ISO 6247	-	Petroleum products - Determination of foaming characteristics of lubricating oils	-	-
ISO 9120	-	Petroleum and related products - Determination of air-release properties of steam turbine and other oils - Impinger method	-	-
ISO 12185	-	Crude petroleum and petroleum products - Determination of density - Oscillating U-tube method	EN ISO 12185	-
ASTM D7042	-	Standard Test Method for Dynamic Viscosity and Density of Liquids by Stabinger Viscometer (and the Calculation of Kinematic Viscosity)	-	-
ASTM D971	-	Standard Test Method for Interfacial Tension of Oil Against Water by the Ring Method	-	-
DIN 51353	-	Testing of insulating oils; detection of corrosive sulfur; silver strip test	-	-



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INTERNATIONAL STANDARD

NORME INTERNATIONALE



Mineral insulating oils in electrical equipment – Supervision and maintenance guidance

Huiles minérales isolantes dans les matériels électriques – Lignes directrices pour la maintenance et la surveillance

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IEC 60422

Edition 5.0 2024-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Mineral insulating oils in electrical equipment – Supervision and maintenance guidance

Huiles minérales isolantes dans les matériels électriques – Lignes directrices pour la maintenance et la surveillance

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CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	9
2 Normative references	9
3 Terms and definitions	11
4 Properties and deterioration or degradation of oil	12
5 Categories of equipment.....	12
6 Sampling of oil from equipment.....	13
7 In-service oil diagnostic tests.....	14
7.1 General.....	14
7.2 Colour.....	15
7.3 Appearance	15
7.4 Breakdown voltage (BDV)	15
7.5 Water content	16
7.5.1 Water content in the oil and paper system	16
7.5.2 Influence of water on the solid and liquid dielectric system	16
7.5.3 Water in oil	17
7.5.4 Water in the solid insulation.....	18
7.5.5 Interpretation of results.....	19
7.6 Acidity.....	20
7.7 Dielectric dissipation factor (DDF) and resistivity	21
7.8 Inhibitor content.....	22
7.8.1 Oxidation stability	22
7.8.2 Monitoring of uninhibited and inhibited oils	22
7.9 Sediment	22
7.10 Sludge	23
7.11 Interfacial tension (IFT).....	23
7.12 Particles	23
7.13 Flash point.....	24
7.14 Compatibility	24
7.14.1 General	24
7.14.2 Compatibility between different insulating mineral oils (miscibility).....	24
7.15 Pour point	25
7.16 Density	25
7.17 Viscosity	26
7.18 Polychlorinated biphenyls (PCBs)	26
7.19 Corrosive sulphur in mineral insulating oil	26
7.19.1 General	26
7.19.2 Corrosive sulphur	27
7.19.3 Potentially corrosive sulphur.....	27
7.19.4 Dibenzyl disulphide (DBDS).....	27
7.20 Metal passivator.....	28
7.21 Air release and foaming	28
8 Evaluation of mineral insulating oil in new equipment	28
9 Evaluation of oil in service	29
9.1 General.....	29

9.2	Frequency of examination of oils in service	30
9.3	Testing procedures	31
9.3.1	General	31
9.3.2	Field tests.....	31
9.3.3	Laboratory tests.....	32
9.4	Classification of the condition of oils in service	32
9.4.1	General	32
9.4.2	Transformers	32
9.4.3	Tap-changers	32
9.4.4	Instrument and protection transformers.....	33
9.4.5	Circuit breakers and switchgear.....	33
9.4.6	Oil filled and OIP bushings	33
9.5	Corrective action.....	34
10	Interpretation of results.....	35
11	Handling and storage.....	45
12	Replacement of oil in electrical equipment.....	46
12.1	Replacement of oil in transformers with an U_m below 72,5 kV and in switchgear and associated equipment.....	46
12.2	Replacement of oil in transformers with an U_m of 72,5 kV and above.....	46
12.3	Replacement of oil in electrical equipment contaminated with PCBs	47
13	Addition of metal passivators to in-service oil	47
14	Treatment.....	47
14.1	Warning	47
14.2	Classification of treatment processes	48
14.2.1	General	48
14.2.2	Off-line (de-energized) vs on-line (energized) treatment	48
14.2.3	Batch vs continuous mode treatment	49
14.3	Reconditioning (degassing, drying and filtration).....	49
14.3.1	General	49
14.3.2	Reconditioning equipment.....	50
14.3.3	Application to electrical equipment	52
14.4	Reclaiming.....	53
14.4.1	General	53
14.4.2	Reclaiming by percolation with single use sorbents	54
14.4.3	Reclaiming process using reactivating sorbents.....	54
14.4.4	Renewal of additives	56
14.5	Removal of PCBs using dehalogenation and related processes	56
14.5.1	General	56
14.5.2	Dehalogenation processes using sodium and lithium derivatives	56
14.5.3	Dehalogenation processes using polyethylene glycol and potassium hydroxide (KPEG).....	56
14.5.4	Dehalogenation in continuous mode by closed circuit process	56
14.5.5	Corrosive sulphur removal using KPEG	57
14.6	Criteria for oil reclamation and treatments.....	57
Annex A (normative)	Criteria for reclamation and treatments	58
A.1	General.....	58
A.2	Key parameters to measure before and after reclamation	58
A.3	Addition of inhibitor after reclamation	59

A.4 Time and location of sampling.....	60
Annex B (informative) General guideline for moisture %RS for continuous online monitoring.....	61
Annex C (informative) Normalizing water in oil for comparison and trending (historical practice)	62
C.1 General.....	62
C.2 Sampling temperature at or above 35 °C.....	62
Annex D (informative) Material compatibility	64
Annex E (informative) Test method for determination of sediment and sludge	66
E.1 Sediment determination	66
E.2 Sludge determination	66
Annex F (informative) Contamination of oils with silicone	67
Bibliography.....	68
 Figure 1 – Water solubility curves for unused mineral oil as adapted from literature [5] (according to Formula (3))	18
Figure 2 – Hysteresis loops of %RS vs. oil temperature in transformers with 3 different water content levels [5]	20
Figure 3 – Correlation between resistivity and dissipation factor [6]	21
Figure C.1 – Normalization factors according to Formula (C.2)	63
 Table 1 – Categories of equipment	13
Table 2 – Tests for in-service mineral insulating oils	14
Table 3 – Recommended limits for mineral insulating oils after filling in new electrical equipment prior to first energization at site	29
Table 4 – Recommended frequency of testing	31
Table 5 – Transformers and reactors – Application and interpretation of tests.....	35
Table 6 – Tap-changers – Application and interpretation of tests	41
Table 7 – Instrument and protection transformers – Application and interpretation of tests	42
Table 8 – Circuit breakers and switchgear – Application and interpretation of tests.....	43
Table 9 – Oil filled and OIP bushings – Application and interpretation of tests	44
Table 10 – Summary of typical actions.....	45
Table 11 – Conditions for processing mineral insulating oils (both inhibited and uninhibited).....	50
Table 12 – Beta ratio related to filter efficiency	51
Table A.1 – Parameters where limits should be agreed upon	58
Table A.2 – Parameters where limits should not necessarily be set but should be measured for baseline and trending	59
Table B.1 – Moisture %RS, continuous online monitoring, general guideline	61

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**MINERAL INSULATING OILS IN ELECTRICAL EQUIPMENT –
SUPERVISION AND MAINTENANCE GUIDANCE****FOREWORD**

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IEC 60422 has been prepared by IEC technical committee 10: Fluids for electrotechnical applications. It is an International Standard.

This fifth edition cancels and replaces the fourth edition published in 2013. This edition constitutes a technical revision.

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

- a) This new edition represents a major revision of the fourth edition, bringing this document in line with the latest developments in oil condition monitoring. New interpretation tables have been created, containing limits for oil parameters specific to plant type with suggested corrective actions in the tables and new test methods.
- b) The action limits for all oil tests have been revised and changes made where necessary to enable users to use current methodology and comply with requirements and regulations affecting safety and environmental aspects.

- c) Category O has been removed and is now incorporated within category A.
- d) Online moisture interpretation is now incorporated.
- e) More guidance on oil treatment (including reclamation criteria) is now available.
- f) Guidance has been updated regarding corrosive sulphur.
- g) In addition, this document incorporates changes introduced in associated standards since the fourth edition was published.

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

Draft	Report on voting
10/1233/FDIS	10/1239/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

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INTRODUCTION

Insulating mineral oils are used in electrical equipment employed in the generation, transmission, distribution, and use of electrical energy.

Monitoring and maintaining oil quality is essential to ensure the reliable operation of oil-filled electrical equipment. Codes of practice for this purpose have been established by electrical power authorities, power companies and industries in many countries.

A review of current experience reveals a wide variation of procedures and guidance. It is possible, however, to compare the value and significance of standardized oil tests and to recommend uniform criteria for the evaluation of test data.

If a certain amount of oil deterioration (by degradation or contamination) is exceeded, there is inevitably some erosion of safety margins and the question of the risk of failure should be considered. While the quantification of the risk can be very difficult, a first step involves the identification of potential effects of increased deterioration. The philosophy underlying this document is to furnish users with as broad a base of understanding of oil quality deterioration as is available, so that they can make informed decisions on inspection and maintenance practices.

Mineral oils are valuable resources and should be utilised accordingly. Used mineral oils are, by most regulations, deemed to be controlled waste. If spills occur, this can have a negative environmental impact especially if the oil is contaminated by persistent organic pollutants such as polychlorinated biphenyls (PCBs).

This document, whilst technically sound, is mainly intended to serve as a common basis for the preparation of more specific and complete codes of practice by users in the light of local circumstances. Sound engineering judgement will have to be exerted in seeking the best compromise between technical requirements and economic factors.

Reference should also be made to instructions from the equipment manufacturer.

General caution

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 handling of mineral oils can be subject to local regulatory requirements and suppliers' safety datasheets.

Environment, health, and safety

This document is applicable to mineral oils, chemicals and used sample containers. The disposal of these items can be subject to local regulatory requirements regarding their impact on the environment.

Attention is drawn to the fact that, at the time of writing this document, some mineral oils in service are known to be contaminated to some degree with other liquids, for example, silicone oils and PCBs.

Because of this, safety countermeasures should be taken to avoid risks to workers, the public and the environment during the life of the equipment, by strictly controlling spills and emissions. The disposal or decontamination of these oils can be subject to local regulatory requirements. Every precaution should be taken to prevent release of mineral oil into the environment.

Typically, each country has specific regulations around health and safety. Safety Data Sheets (SDS) are normally used by the industry internationally and are usually written in accordance with an international regulation set (such as REACH [1]¹). Please consult the SDS from the suppliers of the insulating product that is used. These documents provide essential information regarding health, safety, and environmental impacts.

¹ Numbers in square brackets refer to the Bibliography.

MINERAL INSULATING OILS IN ELECTRICAL EQUIPMENT – SUPERVISION AND MAINTENANCE GUIDANCE

1 Scope

This document provides monitoring guidance and procedures that are required for the use and maintenance of mineral insulating oils and other hydrocarbon-based liquids in transformers and other electrical equipment, including strategic spares and tanks for holding spare parts and components.

This document is applicable to mineral insulating oils, originally supplied conforming to IEC 60296, in transformers, switchgear and other electrical apparatus where oil sampling is reasonably practicable, and where the normal operating conditions specified in the equipment specifications apply.

This document is also intended to assist the power equipment operator to evaluate the condition of the oil and maintain it in a serviceable condition. It also provides a common basis for the preparation of more specific and complete local codes of practice.

The document includes recommendations on tests and evaluation procedures, and outlines methods for reconditioning and reclaiming oil, and the decontamination of oil contaminated with PCBs.

NOTE The condition monitoring of electrical equipment, for example by analysis of dissolved gases, furanic compounds or other means, is outside the scope of 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 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 60296:2020, *Fluids for electrotechnical applications – Mineral insulating oils for electrical equipment*

IEC 60475, *Method of sampling insulating liquids*

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 61619, *Insulating liquids – Contamination by polychlorinated biphenyls (PCBs) – Method of determination by capillary column gas chromatography*

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 oil*

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 dibenzyldisulfide (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 6247, *Petroleum products – Determination of foaming characteristics of lubricating oils*

ISO 9120, *Petroleum and related products – Determination of air-release properties of steam turbine and other oils – Impinger method*

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

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

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

DIN 51353, *Testing of insulating oils – Detection of corrosive sulphur – Silver strip test*

koniec náhľadu – text ďalej pokračuje v platenej verzii STN