

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Natural esters – Guidelines for maintenance and use in electrical equipment

Esters naturels – Lignes directrices pour la maintenance et l'utilisation dans les matériels électriques



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

NATURAL ESTERS – GUIDELINES FOR MAINTENANCE AND USE IN ELECTRICAL EQUIPMENT

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International Standard IEC 62975 has been prepared by IEC technical committee 10: Fluids for electrotechnical applications.

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

FDIS	Report on voting
10/1123/FDIS	10/1126/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 website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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INTRODUCTION

Natural esters are increasingly being used in transformers and electrical equipment employed in electrical power generation, transmission, distribution and industrial applications.

The use of natural esters is recommended for equipment where the liquid does not remain in continuous contact with ambient air, such as hermetically sealed units, units with closed conservators equipped with a rubber bag (bladder) or external expansion elements (external bag), units with a headspace having either a nitrogen blanket or a confined volume of air (distribution transformers).

Monitoring and maintaining liquid quality are essential to ensure the reliable operation of natural ester 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 criteria. It is possible, however, to compare the value and significance of standardized liquid tests and to recommend uniform criteria for the evaluation of test data.

If a certain amount of liquid deterioration (by degradation or contamination) is exceeded, there is inevitably some erosion of safety margins and the question of the risk of premature 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 liquid quality deterioration as is available, so that they can make informed decisions on inspection and maintenance practices.

Unused natural ester liquids are sustainable resources and are readily available. Natural esters are, by most regulations, deemed to be regulated and/or controlled waste. If spills occur, the user should refer to the regulations applicable to their specific location and requirements set by their local authorities.

This document, while 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 should be exerted in seeking the best compromise between technical requirements and economic factors.

Application of natural ester liquids in large power transformers at this time is still relatively limited after 20 years although a very large number of units is operating. While the collection of operating data has allowed for the development of this document, care should be used when applying the recommended values. Manufacturers of natural ester liquids should be contacted with specific questions or concerns.

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 natural esters which are the subject of this document should be handled in compliance with local regulations and supplier's safety datasheets.

This document is applicable to natural esters, chemicals and used sample containers. The disposal of these items should be carried out according to local regulations regarding their impact on the environment.

NATURAL ESTERS – GUIDELINES FOR MAINTENANCE AND USE IN ELECTRICAL EQUIPMENT

1 Scope

This document provides procedures and guidelines that are intended for the use and maintenance of natural ester liquid in sealed transformers and other electrical equipment.

This document is applicable to natural esters, originally supplied conforming to IEC 62770 and other applicable standards (e.g. ASTM D6871 [1]¹) in transformers, switchgear and electrical apparatus where liquid sampling is practical and where the normal operating conditions specified in the equipment specifications apply.

At present, there is a limited amount of information available for electrical equipment other than transformers.

This document is also intended to assist the power equipment operator to evaluate the condition of the natural ester 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 the liquid, when necessary.

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 insulating liquids*

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

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*

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

¹ Numbers in square brackets refer to the bibliography.

IEC 61125, *Insulating liquids – Test methods for oxidation stability – Test method for evaluating the oxidation stability of insulating liquids in the delivered state*

IEC 62021-3, *Insulating liquids – Determination of acidity – Part 3: Test methods for non-mineral insulating oils*

IEC 62770, *Fluids for electrotechnical applications – Unused natural esters for transformers and similar electrical equipment*

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 2592, *Petroleum products – Determination of flash and fire points – Cleveland open 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 12185, *Crude Petroleum and petroleum products – Determination of density – Oscillating U-tube method*

ISO 21018-3, *Hydraulic fluid power – Monitoring the level of particulate contamination of the fluid – Part 3: Use of the filter blockage technique*

ASTM D92, *Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester*

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

ASTM D1544, *Standard Test Method for Color of Transparent Liquids (Gardner Color Scale)*

ASTM D3455, *Standard Test Methods for Compatibility of Construction Material with Electrical Insulating Oil of Petroleum Origin*

ASTM D6922, *Standard Test Method for Determination of Homogeneity and Miscibility in Automotive Engine Oils*

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

ASTM D7155, *Standard Practice for Evaluating Compatibility of Mixtures of Turbine Lubricating Oils*

ASTM D7647, *Standard Test Method for Automatic Particle Counting of Lubricating and Hydraulic Fluids Using Dilution Techniques to Eliminate the Contribution of Water and Interfering Soft Particles by Light Extinction*

ASTM D7752, *Standard Practice for Evaluating Compatibility of Mixtures of Hydraulic Fluids*