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I.S. EN 60970:2008

Insulating liquids - Methods for counting and sizing particles (IEC 60970:2007 (EQV))

I.S. EN 60970:2008

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Incorporates Corrigendum January 2008

English version

**Insulating liquids -
Methods for counting and sizing particles
(IEC 60970:2007)**

Isolants liquides -
Méthodes de détermination du nombre
et de la taille des particules
(CEI 60970:2007)

Isolierflüssigkeiten -
Verfahren zur Bestimmung der Anzahl
und Größen von Teilchen
(IEC 60970:2007)

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CENELEC

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 10/695/FDIS, future edition 2 of IEC 60970, prepared by IEC TC 10, Fluids for electrotechnical applications, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60970 on 2007-08-01.

The following dates were fixed:

- | | | |
|--|-------|------------|
| – latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement | (dop) | 2008-05-01 |
| – latest date by which the national standards conflicting
with the EN have to be withdrawn | (dow) | 2010-08-01 |

Annex ZA has been added by CENELEC.

The contents of the corrigendum of January 2008 have been included in this copy.

Endorsement notice

The text of the International Standard IEC 60970:2007 was approved by CENELEC as a European Standard without any modification.

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

IEC 60422	NOTE	Harmonized as EN 60422:2006 (not modified).
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Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
-	-	Insulating oil - Determination of fibre contamination by the counting method using a microscope	EN 50353	- ¹⁾
IEC 60475	- ¹⁾	Method of sampling liquid dielectrics	-	-
ISO 4406	- ¹⁾	Hydraulic fluid power - Fluids - Method for coding the level of contamination by solid particles	-	-
ISO 4407	- ¹⁾	Hydraulic fluid power - Fluid contamination - Determination of particulate contamination by the counting method using an optical microscope	-	-
ISO 5884	- ¹⁾	Aerospace - Fluid systems and components - Methods for system sampling and measuring the solid particle contamination of hydraulic fluids	-	-

¹⁾ Undated reference.

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**INTERNATIONAL
STANDARD**

**NORME
INTERNATIONALE**

**IEC
CEI**

60970

Second edition
Deuxième édition
2007-07

**Insulating liquids – Methods for counting and
sizing particles**

**Isolants liquides – Méthodes de détermination du
nombre et de la taille des particules**



Reference number
Numéro de référence
IEC/CEI 60970:2007



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CONTENTS

FOREWORD.....	3
INTRODUCTION.....	5
1 Scope.....	6
2 Normative references	6
3 General caution, health, safety and environmental protection	6
4 Significance.....	7
5 Comparison and limitation of the methods	7
6 Types and identification of particles.....	8
7 Sampling	8
7.1 General remarks.....	8
7.2 Sampling vessels	9
7.3 Cleaning of sampling bottles	9
7.4 General directions for sampling	9
7.5 Sampling procedure	10
7.6 Labelling of samples.....	10
7.6.1 Samples from tanks.....	10
7.6.2 Samples from electrical equipment	10
8 Preparation of the samples for analysis	10
9 Method A – Automatic particle size analyzer.....	11
9.1 Summary of method	11
9.2 Apparatus and auxiliary materials.....	11
9.3 Calibration procedures	11
9.4 Preparation of the apparatus for counting.....	12
9.5 Preparation of sample before counting	12
9.6 Preparation of sample for counting	12
9.7 Counting procedures	12
9.8 Report.....	13
9.9 Precision	13
9.10 Repeatability	13
9.11 Reproducibility	13
10 Method B – Optical microscopy	14
10.1 Principle.....	14
10.2 Procedure by transmitted light.....	14
10.3 Procedure by incident light	14
Annex A (informative) Use of syringes as sampling vessels	15
Annex B (informative) Calibration of the automatic particle counters	17
Bibliography.....	18

INTERNATIONAL ELECTROTECHNICAL COMMISSION

INSULATING LIQUIDS – METHODS FOR COUNTING AND SIZING PARTICLES

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 60970 has been prepared by IEC technical committee 10: Fluids for electrotechnical applications.

This second edition cancels and replaces the first edition published in 1989. This edition constitutes a technical revision.

The significant technical changes with respect to the previous edition are as follows:

- new calibration procedures for automated laser particle;
- three figures contamination code;
- new procedure of sample pre-treatment when automated laser counter method are used.

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

FDIS	Report on voting
10/695/FDIS	10/714/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 maintenance result 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

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

INTRODUCTION

The first edition of this standard was published in 1989, and confirmed in 1996. The present edition has been found necessary for consistency with the new ISO 4406:1999, in which calibration procedures for automated particles counters have been changed from ACFTD standard to ISO-MTD standard. Specific procedures for sample preparation are described in more detail when automated particle counters are used. Results and ISO Code reporting are consistent with ISO 4406:1999 standard. Repeatability and reproducibility data are reported.

It has been demonstrated that particle contamination of insulating liquids used in electrical equipment have been responsible for major faults [1]¹. Particle analysis is recommended (as complementary test) by IEC 60422[3] for power transformers with nominal voltage above 170 kV[2].

Particle counting and sizing is usually carried out using automated counters; the calibration standard for these counters was changed in 1999. The ISO reporting code has also been changed from a two-figure to a three-figure code. This code gives information on three classes of cumulative counting: particles/ml with $\varnothing > 4 \mu\text{m}$, particles/ml with $\varnothing > 6 \mu\text{m}$, particles/ml with $\varnothing > 14 \mu\text{m}$. Particle analysis with automated particle counters has been thoroughly investigated to verify factors influencing the results and to optimize the analysis procedure. Reference figures for repeatability and Reproducibility are reported, for particle counting and for ISO Class.

Annex A provides information about sampling with syringes. Annex B reports a reference for ISO MTD calibration procedure.

¹ Figures in square brackets refer to the bibliography.

INSULATING LIQUIDS – METHODS FOR COUNTING AND SIZING PARTICLES

1 Scope

This standard describes the sampling procedures and methods for the determination of particle concentration and size distribution.

Three methods are specified. One uses an automatic particle size analyser, working on the light interruption principle. The other two use an optical microscope, in either the transmitted light or incident light mode, to count particles collected on the surface of a membrane filter. The optical microscope methods are described in ISO 4407.

All three methods are applicable to both used and unused insulating liquids.

Annex A contains an alternative sampling procedure using a syringe and Annex B reports a reference for the calibration of automatic particle counters.

NOTE 1 The methods are not intended to measure particulate matter in liquids containing sludge. While analysing solid content on oils containing sludge refers to method for sediment and sludge determination in IEC 60422, Annex C.

NOTE 2 The methods specified are only applicable to measurements related to a limited range of size and number.

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 60475: *Method of sampling liquid dielectrics*

ISO 4406: *Hydraulic fluid power – Fluids – Method for coding the level of contamination by solid particles*

ISO 4407: *Hydraulic fluid power – Fluid contamination – Determination of particulate contamination by the counting method using an optical microscope*

ISO 5884: *Aerospace – Fluid systems and components – Methods for sampling and measuring the solid particle contamination of hydraulic fluids*

EN 50353: *Insulating oil – Determination of fibre contamination by the counting method using a microscope*

3 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 insulating liquids 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

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