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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Method of sampling insulating liquids

Méthode d'échantillonnage des liquides isolants

IEC 60475:2022-05(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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METHOD OF SAMPLING INSULATING LIQUIDS

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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IEC 60475 has been prepared by IEC technical committee 10: Fluids for electrotechnical applications. It is an International Standard.

This third edition cancels and replaces the second edition published in 2011. This edition constitutes a technical revision.

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

a) addition of a new Annex C on sampling of oil from bushings, at the request of IEC subcommittee 36A, in order to transfer to IEC 60475 the corresponding contents of IEC TR 61464 relating to oil sampling from bushings;
b) deletion of NOTE 2 in 4.2.1.2.

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

Draft	Report on voting
10/1163/FDIS	10/1173/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

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- withdrawn,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

INTRODUCTION

General caution, health, safety and environmental protection

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 insulating oils which are the subject of this document should be handled with due regard to personal hygiene. Direct contact with the eyes can 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 document involve the use of processes that could lead to a hazardous situation. Attention is drawn to the relevant standard for guidance.

This document is applicable to mineral oils and non-mineral oils, chemicals and used sample containers.

Attention is drawn to the fact that some mineral oils in service can still be contaminated to some degree by PCBs. If this is the case, 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 regulatory requirements with regard to their impact on the environment. Every precaution should be taken to prevent release of mineral oil and non-mineral oil into the environment.

METHOD OF SAMPLING INSULATING LIQUIDS

1 Scope

This document is applicable to the sampling procedure used for insulating liquids in delivery containers and in electrical equipment such as power and instrument transformers, reactors, bushings, oil-filled cables, oil-filled tank-type capacitors, switchgear and load tap changers (LTCs).

This document applies to liquids the viscosity of which at the sampling temperature is less than 1 500 mm^2/s (or cSt). It applies to mineral oils and non-mineral oils (such as synthetic esters, natural esters, vegetable oils or silicones).

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 60567:2011, *Oil-filled electrical equipment – Sampling of gases and analysis of free and dissolved gases – Guidance*

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

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1
delivery container
container used to store, transport and deliver batches of oil

EXAMPLE Drum, rail tanker, road tanker, flexible plastic bag.

3.2
electrical equipment
equipment filled with insulating oil

EXAMPLE Power and instrument transformers, reactors, bushings, oil-filled cables, oil-filled tank-type capacitors, switchgear and load tap changers (LTCs).

3.3
sampling equipment
equipment used for sampling oil from delivery containers (e.g. sampling probes, such as dippers or siphons) and from electrical equipment (e.g. connecting tubing and drain valve adapters)

Note 1 to entry: Sampling equipment also includes sample containers, waste oil containers and other accessories.

3.4
sample container
container or other device used to store and transport samples of oil for analysis

EXAMPLE Syringe, bottle, ampoule.

Note 1 to entry: Sample containers include accessories such as valves, tubing or caps attached to the container.

4 General principles for the sampling of insulating liquids

4.1 New insulating liquids in delivery containers

4.1.1 Place of sampling

The sample shall be taken from the part of the delivery container where the insulating liquid is likely to be most heavily contaminated. To evaluate the quality of a consignment, two types of samples may be normally taken:

a) composite sample: mixture of samples taken at the same level in several containers;

b) individual sample: sample or mixture of samples taken at the same level in one container.

From a delivery, individual samples of 1 l may be taken from different containers for the electric strength test. Further tests may be carried out on these samples and a complete examination on the mixture of these (composite sample).

In certain cases, it can be useful to constitute an average sample within the container. An average sample is a mixture of samples taken at different levels in one container.

1) tankers: samples should be taken from each tanker as described in 4.1.4.2 below;

2) drums: samples should be taken as described in 4.1.4.3 below.

In the case of a single drum, this shall be sampled.

In case there is more than one drum of a lot of oil, sampling procedures should be negotiated between supplier and user. For example, samples can be taken from 10 % of drums or at least two drums, whichever the largest.

4.1.2 Quantity of sample to be taken

This depends on the tests to be performed and the procedures used.

Typically, 2 l are taken.

4.1.3 Sampling equipment

4.1.3.1 General

Since the results of the tests included in IEC requirements for insulating liquids can greatly depend on the impurities in the sample, it is essential to observe the following precautions:

– separate sampling equipment shall be reserved exclusively for each type of liquid. All seals and tubing used should be compatible with the insulating liquid to be sampled;

– the equipment shall be clean and dry, following the cleaning procedures described in 4.2.1.6. Particular care should be taken to ensure the absence of any traces of solid impurities, such as dust, fibres. The use of rags for cleaning is not permitted.

4.1.3.2 Sampling probes

As examples, four types of sampling probes are described below. Other probes may also be used, provided they do not introduce any contamination. Stainless steel and aluminium are suitable.

a) Sampling from tankers

The thief dipper shown in Figure 1 is suitable for taking samples at the bottom of the container. This is a dipper constructed of stainless steel or aluminium tubes and castings, machine-finished all over. It shall be sufficiently heavy to sink in the liquid. It should always be suspended by means of a metal wire or chain. String or other fibrous materials shall not be used.

The cream dipper is used for taking top samples of insulating liquids. This probe shall be constructed as shown in Figure 2 and shall be of stainless steel.

Dimensions in millimetres

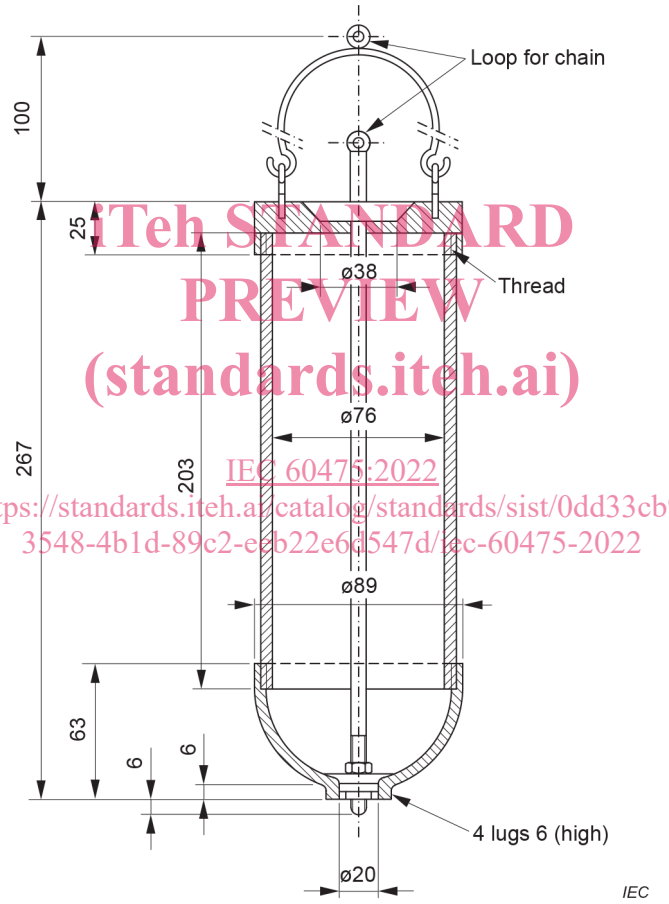

Figure 1 – Thief dipper

Dimensions in millimetres

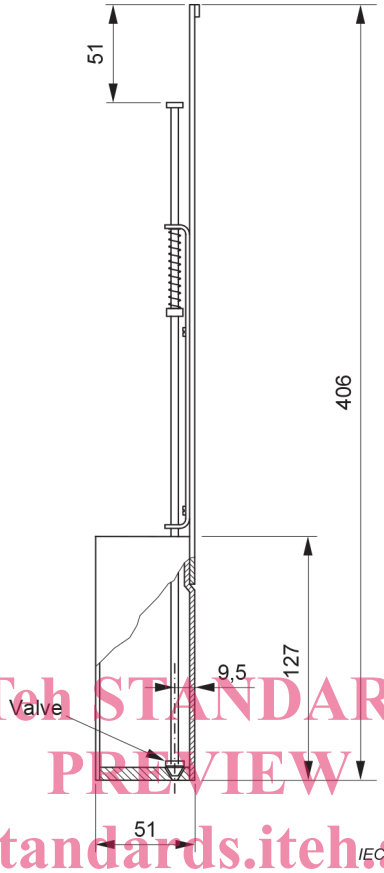

Figure 2 – Cream dipper

b) Sampling from drums

The pipette shown in Figure 3 enables samples to be taken at the bottom of drums. This pipette has a capacity of about 500 ml.

Another probe to take samples at the bottom is shown in Figure 4; it is a siphon with a glass, stainless steel or aluminium tube having an internal diameter of about 13 mm for taking off the sample liquid, and a metal tube (internal diameter 5 mm) for applying pressure. Both tubes are set in an oil-resistant bung whose dimensions correspond to the diameter of the bung hole in the drum. Commercial versions of this equipment are available. When possible, glass is preferable for probes illustrated in Figure 3 and Figure 4.

The cream dipper (Figure 2) may be used for taking top samples.

Dimensions in millimetres

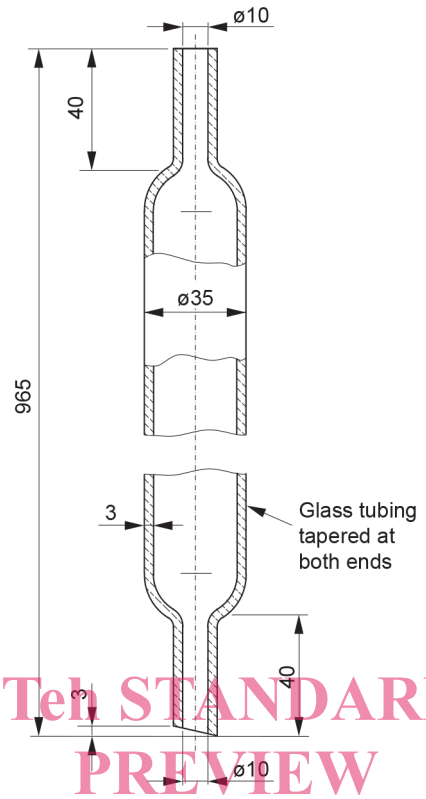

Figure 3 – Pipette

Dimensions in millimetres

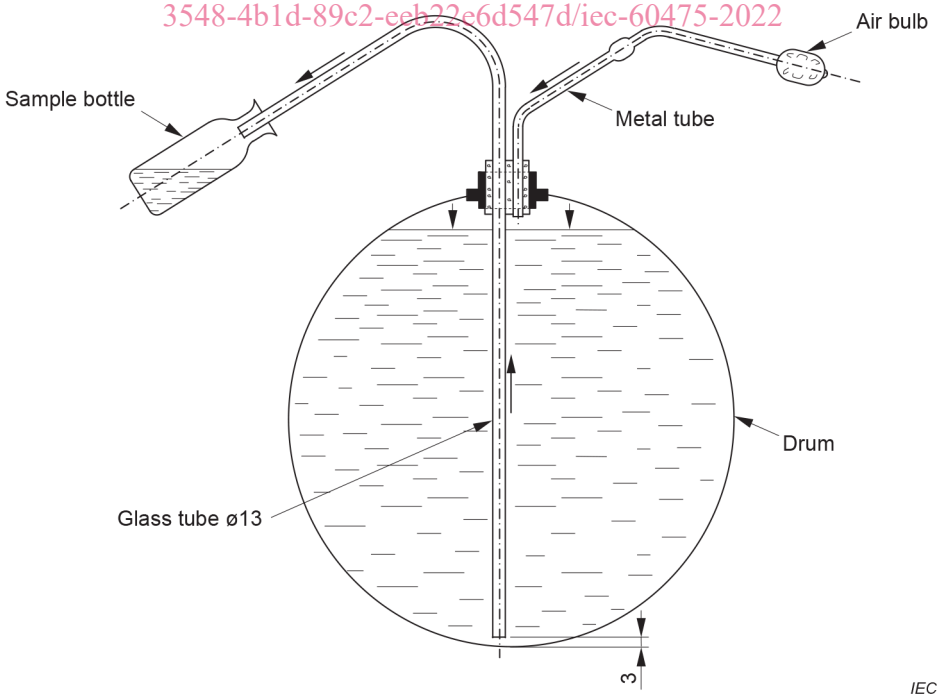

Figure 4 – Siphon

4.1.3.3 Sample containers

For storing and transporting samples, depending on the oil test to be performed, sample containers of appropriate volume shall be used. Different types of sample containers are indicated in 4.2.1.5.

For the mixing of different samples, a special sample container made of glass with a capacity of at least 6 l shall be used. These special sample containers shall be closed in a manner that allows them to be sealed, by means of oil-resistant plastic or compatible rubber tubing or screw caps equipped with a polytetrafluoroethylene (PTFE) lining. Natural rubber tubing and/or seals are not permitted. PTFE and polypropylene (PP) seals are acceptable.

Each sample container shall have a label on which are marked all the indications necessary to identify the contents, i.e. the markings of the drums or tanks, date of sampling and the name of the recipient.

4.1.3.4 Cleaning of sampling equipment

Sampling equipment shall be cleaned following the procedures described in 4.2.1.6.

4.1.4 Sampling procedure

4.1.4.1 General remarks

According to general principles for sampling (see 4.1.1), samples of new insulating liquid shall be taken from the bottom of the delivery container, where the contamination is likely to be the greatest. But in certain cases, an average sample is also of interest.

NOTE 1 To obtain an average sample, samples are taken at intermediate levels in tanks or drums. Examples of procedures are given in Annex A. A procedure is indicated in the NOTE in 4.1.4.2 a) for obtaining the equivalent of an average sample.

In Table 1 different cases are considered:

Table 1 – Types of samples of new insulating liquids

Type of delivery	Recommended sampling	Equipment to be used	Procedure	Recommended quantity
Drums	Composite	Pipette (Figure 3) or Siphon (Figure 4)	4.1.4.2	3 × 2 l
	Individual		4.1.4.2	1 l or 2 l
Tankers	Individual	Thief dipper (Figure 1) or None (valve)	4.1.4.1 b) 4.1.4.1 a)	3 × 2 l
Drums	Average	Pipette or Siphon (Figure 3 and Figure 4)	Annex A	3 × 2 l
Tankers	Average	Thief dipper (Figure 1) or None (valve)	4.1.4.1 a)	

NOTE 2 Before sampling from tankers, sufficient oil is pumped from the end of the delivery pipe, as indicated in 4.1.4.2.

Every precaution shall be taken during sampling in order to avoid contamination of the insulating liquids. Outdoor sampling of insulating liquids in rain, fog or high wind is only permitted if all precautions have been taken to avoid contamination of the liquid. In this special case, the use of a cover is necessary.

Condensation shall be avoided by warming the sampling equipment so as to be above the ambient air temperature. Before use, the equipment shall be rinsed with the liquid being sampled. The operator shall be warned not to let their hands come into contact with the surfaces of sampling equipment subsequently in contact with the oil. The insulating liquids shall be protected against light irradiation during transportation and storage.

On arrival at the laboratory, the sampling container shall not be opened immediately. It is necessary to wait until the temperature of the sample is the same as the room temperature.

4.1.4.2 Sampling from tankers

Insulating liquids may be sampled either through the tank outlet or by a thief dipper or by a cream dipper.

a) Sampling through the tank outlet

By this procedure, it is possible to obtain a sample representative of the bottom of the tank after the tank has been allowed to stand for at least 1 h after the vehicle has arrived.

NOTE It may be possible, by this procedure, to obtain the equivalent of an average sample, if the sampling is done directly after the vehicle has arrived.

In this case, the sampling procedure shall be as follows:

– remove the outlet valve shield, if fitted;
– remove all visible dirt and dust from the valve by means of lint-free clean cloths or oil-resistant synthetic sponges;
– the outlet system (pump, delivery pipe), if incorporated, shall be started or opened as appropriate in order to get a sample;
– open the valve and allow to flow, slowly, at least 10 l of insulating liquid into a waste oil container. In any case, discard at least an amount of oil equivalent to the volume of the pipe;
– rinse sampling bottles with the insulating liquid;
– fill sampling bottles at constant flow to avoid turbulence.

b) Sampling with a thief dipper or a cream dipper

This sampling should be carried out after the tank has been allowed to stand for at least 1 h after the vehicle has arrived.

1) Procedure with the thief dipper (Figure 1) (bottom samples)

For taking bottom samples (i.e. within 1 cm to 2 cm from the bottom of the tank) the dipper is lowered until the projecting stem of the valve rod strikes the bottom of the tank. The dipper then fills. Filling is complete when no more air bubbles escape. The dipper is then withdrawn and its contents poured into the sample container (in the case of an individual sample) or into the special glass sample container for collecting and mixing the various samples taken (in the case of a composite sample). In this latter case, the sample container(s) is (are) filled with the mixture so obtained. During pouring of the liquid, avoid forming air bubbles by pouring too quickly.

2) Procedure with the cream dipper (Figure 2) (top samples)

With the valve closed, fill the cream dipper by slowly immersing it in the liquid to be sampled until the rim is just below the surface of the liquid so that it will flow slowly into the dipper. Discard the first filling. Refill the dipper as above and transfer the sample to the sample container by allowing it to flow from the bottom orifice against the side of the sample container and not in a stream into the bottom of the sample container. Repeat the operation until sufficient liquid is obtained to fill the sample container (individual sample) or the special glass sample container used for mixing samples depending on the type of sample to be obtained.

4.1.4.3 Sampling from drums

Samples should be taken after the drums have been allowed to stand for at least 8 h with the bung uppermost, protected against rain and rainwater. For sampling the bottom (i.e. 3 mm up), the pipette (Figure 3) or the siphon pressure thief (Figure 4) may be used.

For taking a sample from the surface layer of the liquid, the cream dipper (Figure 2) may be used.

Examples of procedures:

a) Use of pipette (Figure 3) (bottom samples)
   - block the upper orifice of the pipette with the thumb, and then immerse the pipette in the liquid to the bottom of the drum;
   - remove the thumb to allow liquid to enter the pipette;
   - again close the upper end of the pipette with the thumb and withdraw the pipette;
   - the first filling is used for rinsing the pipette; transfer the next fillings into either a sample container (individual sample) or the special glass sample container for mixing samples (composite sample) (see 4.1.4.2 b)) taking care not to form air bubbles during pouring the liquid.

b) Use of siphon (Figure 4) (bottom samples)
   - fit the bung in which are set the riser and pressure tubes into the bung hole of the drum and ensure that this seal is airtight;
   - dip the lower end of the riser tube to about 3 mm from the bottom of the drum;
   - raise the pressure inside the drum by means of the air bulb;
   - run off enough liquid to rinse the tube and then run off the required quantity directly into the sample container (individual sample) or the special glass sample container for mixing samples (composite sample) (see 4.1.4.2 b)) taking care not to form air bubbles during pouring of the liquid.

c) Use of cream dipper device (Figure 2) (top samples)

See 4.1.4.2 b).

4.1.4.4 Sampling report

The sampling report shall give all the information necessary for identifying the sample as well as any details or special information likely to be of help to those entrusted with the tests. The type of sample (i.e. composite, individual or average sample) shall be specified. A copy of the report shall accompany each sample. The distribution of samples shall be in accordance with the agreed procedure, for example as given in the sales contract.

4.2 Sampling of oil from oil-filled equipment

4.2.1 General remarks

4.2.1.1 Safety and quality of sampling

The manufacturer's instructions for taking oil samples from the electrical equipment shall be followed. Particular attention shall be paid to the safety precautions to be taken.

Ensure that the oil in the energized electrical equipment is not under a negative pressure when taking an oil sample, since this could introduce air bubbles in the oil, induce electrical short-circuits in the equipment and put the sampling personnel at risk.

During sampling of oil, precautions should be taken to deal with any sudden release of oil and avoid oil spillage.