Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड़ नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

Indian Standard

INSULATING LIQUIDS — METHODS FOR COUNTING AND SIZING PARTICLES

( First Revision )

ICS 17.220.99; 29.040.10
NATIONAL FOREWORD

This Indian Standard (First Revision) which is identical with IEC 60970 : 2007 ‘Insulating liquids — Methods for counting and sizing particles’ issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of the Fluids for Electrotechnical Applications Sectional Committee and approval of the Electrotechnical Division Council.

This standard was originally published in 1991 which was identical with IEC 60970 : 1989. The first revision of this standard has been undertaken to align it with the latest version of IEC 60970 : 2007.

The text of IEC Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain terminology and conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words ‘International Standard’ appear referring to this standard, they should be read as ‘Indian Standard’.

b) Comma (,) has been used as a decimal marker, while in Indian Standards the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards, which are to be substituted in their respective places are listed below along with their degree of equivalence for the editions indicated:

<table>
<thead>
<tr>
<th>International Standard</th>
<th>Corresponding Indian Standard</th>
<th>Degree of Equivalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 60475 Method of sampling liquid dielectrics</td>
<td>IS 6855 : 2003 Method of sampling for liquid dielectrics (first revision)</td>
<td>Technically Equivalent</td>
</tr>
<tr>
<td>ISO 4406 Hydraulic fluid power — Fluids — Method for coding the level of contamination by solid particles</td>
<td>IS 13542 : 1992 Hydraulic fluid power — Contamination analysis — Method of reporting analysis data</td>
<td>do</td>
</tr>
</tbody>
</table>

The technical committee has reviewed the provisions of the following International Standards/Other Publications referred in this adopted standard and has decided that they are acceptable for use in conjunction with this standard:

<table>
<thead>
<tr>
<th>International Standard/Other Publications</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 4407</td>
<td>Hydraulic fluid power — Fluid contamination — Determination of particulate contamination by the counting method using an optical microscope</td>
</tr>
<tr>
<td>ISO 5884</td>
<td>Aerospace — Fluid systems and components — Methods for sampling and measuring the solid particle contamination of hydraulic fluids</td>
</tr>
<tr>
<td>EN 50353</td>
<td>Insulating oil — Determination of fibre contamination by the counting method using a microscope</td>
</tr>
</tbody>
</table>

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test, shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (revised)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.
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 particle 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]. 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 \( \varnothing > 4 \, \mu m \), particles/ml with \( \varnothing > 6 \, \mu m \), particles/ml with \( \varnothing > 14 \, \mu m \). 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.


1 Figures in square brackets refer to the bibliography.
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
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 is applicable to insulating liquids and used sample containers, the disposal or decontamination of which must be done according to local regulations. Every precaution should be taken to prevent release of mineral oil into the environment.

4 Significance

It is well known that particles have a detrimental effect on the dielectric strength of insulating liquids. It has long been the practice to include in specifications of insulating liquids the requirement that the fluid be clear and free of visible particulate matter. However, there has been no standard method for quantitative estimates, so that practices have differed. This standard gives standard procedures for the test.

Filtration of insulating liquids is an established practice in the electrical industry. The procedure described may serve to assess the performance of the filter system. The results obtained are dependent upon the method used. With the automatic counter the measured values also depend on the calibration procedure and in particular on the calibration material. It is therefore essential that the methods of analysis and the calibration standards are specified when quoting results.

The particle content of a sample may depend on different transformer parameters as well as the condition of the oil itself.

Storage may affect the sample, due to sedimentation and/or coalescence of particles. Shaking of the sample before analysis will be necessary.

5 Comparison and limitation of the methods

Automatic particle counters using the light interruption principle are quick and easy to use, but the following points should be borne in mind:

- With some liquids it may be necessary to modify their viscosity to comply with the operating parameters of the instrument.
- It is necessary to choose a sensor head suitable for counting in the size range required. No single head can count both very small particles (<2 µm) and very large particles (>200 µm).
- The instrument records the light interruption area of the particle and from this calculates the diameter of a sphere having the equivalent area or the longer axis of a specified ellipsoid with the same area, as established by ISO 4407. When measurements are carried out with automatic particle counters, the reported sizes are expressed as µm(c) to indicate that the particle size has been calculated from the observed cross-sectional area. Particle sizes from optical microscope counting are expressed as µm. The relationship between the two units is described in ISO 4406:
  - 6 µm(c) corresponds to 5 µm
  - 14 µm(c) corresponds to 15 µm.
- Automatic counters give no information as to the shape of the particles, and this constitutes a limitation with respect to the recognition of fibres. Their narrow and elongated shape results in a slight light obscuration and consequently in a very small equivalent sphere diameter. The results obtained can be different from those obtained by microscope counting. When it is important to evaluate the concentration of fibres, automatic counters cannot perform this task adequately.
- When air-saturated or over-saturated liquids are shaken manually or in a shaking machine, or given high-energy ultrasonic treatment, finely dispersed micro-bubbles may be formed.
in the liquid. In the optical system of the automatic counter, these micro-bubbles will be counted as solid particles.

- These difficulties are avoided when using either of the optical microscopic methods. In addition, optical microscopy may give some information about the types of particles present. These methods are, however, much more time-consuming and operator dependent and may be very difficult to count particles of less than 5 µm.

6 Types and identification of particles

The origins of particles found in insulating liquids are manifold.

In new, unenergized, equipment the insulating liquid may contain cellulose fibres plus particles from the manufacturing process. These could include iron, aluminium, brass, welding cinder and sandblasting materials.

Insulating liquids in working transformers, at both normal and overload temperatures, slowly acquire soot and sludge particles. Localised overheating over 500 ºC could be a source of carbon. The carbon particles produced in the OLTC divider may migrate by leakage, accidents or human error into the bulk fluid compartment and contaminate the full charge.

A typical source of metallic particles is from pump bearing wear, although corrosion and arcing on metallic components may also produce particles.

Cellulose lint, sand, dust and particles of varnish, plastic or rubber can also be found in the fluid of transformers in service.

A knowledge of which particle types are present in the insulating liquid can, in certain cases, help in assessing the conditions of the equipment, in diagnosing a fault or indicating a risk of failure. The most dangerous particles are the conductive ones (metals, carbon, wet fibres, etc.). Particle identification and counting have been found to be necessary procedures of condition monitoring (CIGRE brochures 157[1] and 227[2]).

Certain particles may be identified by filtering a sample through a membrane filter and examining the residue under a microscope (EN 50353). At this stage some fibres can be identified using the dispersion staining technique and a number of metals by means of spot tests or micro chemical methods. Metallic particles can be better identified and quantified by instrumental analytical methods such as atomic absorption spectroscopy (AAS), induced coupled plasma (ICP-AES), and wet chemical analysis. A detailed description of methods for the identification of particles is, however, outside the scope of this standard.

7 Sampling

7.1 General remarks

The sample taken should only be used for the particle count determination. Further analysis may be done on the residual sample, but after the particle count determination.

The particle content of a sample is also dependant on the sampling point, time elapsed since the transformer was filled, the circulation rate and the time that the transformer has been left to stand prior to sampling.

With used liquids, oxidation products which are soluble at operating temperatures may precipitate when the sample is allowed to stand at room temperature for a prolonged period. This process, which is dependent upon the service age of the liquid, the time between sampling and analysis and the storage temperature, can affect the particle count.

For the above mentioned reasons, sampling is the main source of spreading of results.
7.2 Sampling vessels

The sampling vessels recommended in this standard are cylindrical, flat-bottomed, wide-necked, clear glass bottles fitted with a polypropylene threaded cap forming a seal with the bottle without the use of any inserts.

When an automatic particle size analyzer is used, the volume sampled shall be enough to allow a proper rinsing of the instrument’s dead volume and measuring cell before the analysis.

For microscopy, the bottles shall have at least 100 cm³ capacity and be permanently marked to indicate 100 cm³ sample size.

An alternative method for insulating liquids in service using syringes as sampling vessels is given in Annex A.

7.3 Cleaning of sampling bottles

It is recommended that the bottles be cleaned to achieve a blank count of less than 200 particles above 5 µm per 100 cm³. The test should be performed on the filtered solvent used in the last stage of the cleaning process.

A cleaning method is given for guidance, but other methods can be used provided they achieve a similar or greater degree of cleanliness.

a) Wash with warm water containing a detergent  
b) Rinse with warm water and drain  
c) Rinse thoroughly with 0.45 µm membrane filtered acetone to remove water  
d) Rinse with 0.45 µm membrane filtered petroleum ether 40 °C to 70 °C or with another suitable solvent. Leave 1 cm³ or 2 cm³ of solvent in the bottle and close the bottle.

If ultrasonic agitation is used before counting particles, the cleaning procedure must include ultrasonic treatment. Reject the procedure outlined in stage c) and instead place the sample bottle, filled with 0.45 µm membrane filtered acetone, in an ultrasonic bath for 1 min.

A residue of solvent in the bottle creates a positive pressure in the bottle helping to prevent contamination from the atmosphere when opening the bottle.

Warning: Attention is called to national regulations associated with the use of solvents.

The use of purchased sample bottles cleaned in accordance with ISO 5884 is allowed.

7.4 General directions for sampling

It is difficult to obtain representative samples from a drum. If sampling is found to be necessary, the procedure given in Annex A may be used or, alternatively, the procedures given in IEC 60475. In the case of sealed power transformers and instrument transformers or similar equipment with small liquid volume, the manufacturer’s instructions on sampling procedure and quantity shall be followed. A sample from a transformer should preferably be taken during fluid circulation or immediately afterwards. The analysis obtained may depend on the sampling point selected. Confirmatory or follow-up samples should therefore always be taken from the same point.

Every precaution shall be taken when sampling not to contaminate the sample.

Outdoor sampling of insulating liquids in rain, fog, snowfall or high wind is only permitted if all precautions are taken to avoid contamination of the samples. In this special case the use of a cover is necessary.
Ensure that sampling is done by an experienced person.

7.5 Sampling procedure

Prior to taking the sample, the exterior of the sampling valve and the adjacent parts shall be thoroughly cleaned using lint-free wiping materials.

- Connect a length of plastic tubing, which is resistant to the liquid being sampled, to the sampling valve.
- If the sampling bottle contains filtered solvent, it may be necessary at low ambient temperature to warm the bottle with the hands, in order to create a positive pressure and thereby prevent the ingress of atmospheric particulate matter.
  
  Warning: Petroleum ether, as well as many of its alternatives, is a highly flammable solvent, and appropriate safety measures must be observed when the bottle is opened.
- Thoroughly flush the valve and by draining a sufficient quantity of liquid into a waste container. The adequate draining volume depends on the total oil volume of the equipment (for big power units 5 l is recommended).
- Remove the cap from the bottle; do not empty out the solvent. Without interrupting the flow from the valve, substitute the bottle for the waste container and collect the required volume of sample as quickly as possible. Then remove the sample bottle and replace the waste container.
- Replace the bottle cap without over tightening.
- Close the sampling valve and replace any protection. Label the sample.

The sample shall be protected against light during transportation and storage.

7.6 Labelling of samples

7.6.1 Samples from tanks

Labels shall carry the following markings:

- tank identification;
- sampling point;
- type of insulating liquid;
- date of sampling.

7.6.2 Samples from electrical equipment

Labels shall carry the following markings:

- equipment identification;
- sampling point;
- equipment in factory/in service;
- liquid identification;
- temperature of liquid;
- date of sampling.

8 Preparation of the samples for analysis

Samples should be processed as soon as possible after sampling, because their long storage will generally lead to sedimentation of particles. Fine particles may also coalesce to form larger particles. For the above mentioned reasons, a shaking procedure will be necessary.
When automatic particle analysers are used, a detailed procedure for sample treatment is described in Clause 9 (Method A – Automatic particle size analyzer).

If high-energy ultrasonic treatment or higher shear mixing is used, there is a risk that the particle count determined will be enhanced owing to breakdown of sludge and other large particles and also that finely dispersed micro bubbles are formed in the liquid. If too high a vacuum is applied to air-saturated liquids, more micro bubbles may be released from the liquid.

NOTE It is advisable that the agitation and vacuum procedure developed be tested for effectiveness. This can be done by taking several samples simultaneously. One sample is tested immediately after sampling, with no agitation or vacuum treatment at all, another after treatment and a third after some storage time. The test should be applied to liquids with a varying degree of particle content, state of ageing and air content.

For optical microscopy systems shaking can be done manually, in a shaking machine, or by ultrasonic treatment (see Clause 10: Method B – Optical microscopy).

9 Method A – Automatic particle size analyzer

9.1 Summary of method

The sample is agitated to suspend the particles, then passed at an optimum flow rate through the sensor unit of the particle counter. After the required fluid volume has been passed through the sensor the count is terminated and the results recorded.

9.2 Apparatus and auxiliary materials

- An automatic particle counter fitted with a sensor operating on the light interruption principle and suitable for counting within the range of 2.0 µm to greater than 200 µm. The automatic particle counter shall be capable of:
  - Sorting particles into at least > 4 µm, > 6 µm, > 14 µm size ranges.
  - Providing a specific particle count and distribution for a measured quantity of reference material to a precision of ±10 % of the total count.
  - Not saturating (i.e. providing a lower than expected count as a result of particle coincidence within the sensing zone) when analysing a suspension containing less than 2 000 particles per millilitre of fluid.

NOTE Alternative detectors may be used to extend the size range of the particles measured.

- Compressed gas – a pressurized source of air or nitrogen free from oil or water contamination filtered through a 0.45 µm membrane filter. The capacity, pressure range and constant pressure controls should meet the requirements of the particular equipment in use.
- Solvent dispenser fitted with a 0.45 µm membrane filter at the outlet.
- Solvent – petroleum ether with a boiling-range of 40 °C to 70 °C, or suitable alternative filtered through a 0.45 µm membrane filter.
- Detergent – liquid, water soluble, commercial grade.
- Calibration standard ISO MTD.
- Ultrasonic bath.

9.3 Calibration procedures

The calibration of the instrument shall be carried out using one of the procedures given in Annex B.

Calibration should be advisably carried out annually or when any repair/change is made to the sensor or whenever results are suspect. It is recommended to check instrument’s performance at least each 6 months, by analysing a standard sample of standard reference material (SRM). The results must be consistent with the reproducibility in 9.11.
NOTE Laboratory reference materials (LRM) can be used for instrument’s checks if their stability and uncertainty are demonstrated to be equivalent to standard reference materials.

9.4 Preparation of the apparatus for counting

Check that the instrument is set to the calibration numbers for the required size ranges in accordance with the procedure given in the instrument manual.

When the instrument has been switched off, the check procedure shall be carried out prior to use or daily, whichever is less frequent.

If the instrument is permanently switched on, the check procedure shall be carried out at least monthly.

9.5 Preparation of sample before counting

– Remove any visible contamination from the exterior of the bottle.
– Samples which are found on visual examination to contain water or suspended solids (e.g. sludge) likely to affect the performance of the sensor shall be rejected.
– Sample dilution should be avoided as far as possible. However, if in order to comply with the instrument operating parameters dilution is necessary then a liquid of the same type as the sample, or a compatible solvent, may be used. The solvent must be filtered through a 0.45 µm membrane before mixing. Then record the dilution ratio.

NOTE In order to meet the instrument operating parameters, the viscosity of the liquid may be modified by heating. In this case, due regard to the instrument manufacturer’s recommendations regarding sensor life should be noted. It should also be established that the precision obtained is acceptable. If sample heating is applied, note the analysis temperature on the Report of results.

9.6 Preparation of sample for counting

– Detach particles coalesced on the vessel by immersing the bottle in an ultrasonic bath for 5 min.
– Shake vigorously by hand for 30 s.

NOTE Suitable mechanical apparatus can be used for shaking several samples at the same time

– After shaking the sample must be degassed by immersing the bottle in an ultrasonic bath for 5 min.

NOTE Vacuum degassing can either be used, if a sufficient repeatability can be achieved (see 9.10). It is advisable, when using automatic bottle sampling apparatus, that the sensor uptake tube be filled with the test fluid before applying the vacuum.

– Count the sample immediately after the degassing stage. If unable to count within 2 min then the particle suspension shall be maintained by continuous rolling of the sample container.

9.7 Counting procedures

– The counting procedure shall be carried out in accordance with the instrument manufacturer’s operating instructions, paying particular attention to the required flow rate and selecting the cumulative mode of counting.
– The sample shall be counted in at least three equal volumes, greater than or equal to 10 millilitres. These three counts should agree within 10 % in the smallest size range (> 4 µm). If this requirement is not attained the sample shall be discarded or re-agitated and re-counted.

NOTE The above minimum count of 20 particles ensures that the counting reproducibility is in accordance with 9.11 of this standard.
– After each sample has been counted remove the sample bottle and flush the system with solvent, filtered through a 0.45 µm membrane filter. It is not recommended that the sensor be dried out after flushing.
– Calculate the particle concentration in each size range from the mean of the counts obtained for each sample aliquot, taking into account the volume of the aliquot and the dilution ratio.
9.8 Report

Report the cumulative number of particles per millilitre of the original sample in at least the following size ranges (see notes):

- ISO code, expressed according to ISO 4406:
  - (AA)/BB/CC
  - AA is the scale number representing the number of particles equal to or larger than 4 µm(c) per millilitre of fluid
  - BB is the scale number representing the number of particles equal to or larger than 6 µm(c) per millilitre of fluid
  - CC is the scale number representing the number of particles equal to or larger than 14 µm(c) per millilitre of fluid

NOTE 1 The µm(c) notation of the size ranges means that the measurement is carried out using an automatic particle counter which has been calibrated in accordance with ISO 11171[4] (ISO MTD calibration).

NOTE 2 When the raw data in one of the size ranges results in an actual particle count of fewer than 20 particles, the scale number for that size range should be labelled as: ≥ scale number (e.g.: a code of 14/12/≥7 signifies that the counting for size range of 14 µm(c) was more than 0,64 and up to and including 1,3 particles, but less than 20 particles were counted).

NOTE 3 When the raw data in one of the size ranges is ‘too numerous to count’ report a «*» sign (e.g.: a code of ‘22/7’).

NOTE 4 When no counts are detected in one of the size ranges report a «-» sign (e.g.: a code of 12/9/-).

NOTE 5 According to ISO 4406, size ranges of 6 µm(c) and 14 µm(c) are equivalent to the old 5 µm and 15 µm particle sizes obtained using the now defunct ISO 4402:1991[5] method of calibrating automatic particle counters.

- Total number of particles (where \(p\) is the diameter in micrometers)
  - \(p > 4\) µm(c)
  - \(p > 6\) µm(c)
  - \(p > 14\) µm(c)

- The report shall also include the following:
  - method of calibration;
  - date of sampling;
  - date of analysis.

9.9 Precision

Precision data for this method has been provided by a round robin test performed on three samples of mineral insulating oil taken from transformers with different levels of particle contamination.

NOTE Repeatability and reproducibility are referred to a 95 % confidence level.

9.10 Repeatability

The repeatability has been estimated independently by different laboratories by preparing sample batches of mineral oil and making 7 to 10 replications of the analysis.

When the same laboratory analyses twice the same sample, the difference in each one of the three scale numbers of the ISO code should not exceed 1.

9.11 Reproducibility

The reproducibility has been estimated on the results provided by different laboratories on the same samples.
When different laboratories analyse the same sample, the difference in each one of the three scale numbers of the ISO code should not exceed 2.

10 Method B – Optical microscopy

10.1 Principle
A known volume of insulating liquid is filtered under vacuum conditions through a membrane filter to collect contaminants on the filter surface. The membrane is then mounted between glass slides and examined microscopically by transmitted or incident light to measure, count and size particles according to their largest dimension.

10.2 Procedure by transmitted light
Counting and sizing of particulate matter microscopically by transmitted light shall be made according to the procedure described in ISO 4407.

10.3 Procedure by incident light
Counting and sizing of particulate matter by incident light shall be made according to the procedure described in ISO 4407.
Annex A
(informative)

Use of syringes as sampling vessels

A.1 Type of syringe

Syringes shall be made of glass, polypropylene or other suitable polymeric materials and have a volume of at least 150 cm³ when using automatic counters. For microscopy, the syringe capacity shall be at least 100 cm³.

NOTE This will, however, reduce the accuracy of the result. For liquids with a high particle content one syringe with 50 cm³ capacity may suffice.

A.2 Cleaning of syringes

The same procedure as for bottles (see 7.2) can be used, except that no solvent shall be left in the syringe.

A.3 General directions for sampling

The same considerations given in 7.4 apply here.

A.4 Sampling from apparatus or tank with sampling valve

Prior to taking the sample, the exterior of the sampling valve and the adjacent parts shall be thoroughly cleaned with lint-free wiping materials.

– Connect the sampling valve directly to a two-way cock with a plastic tube resistant to the liquid.
– Thoroughly flush the sampling valve, the tube and the two-way cock by draining a sufficient quantity of liquid into a waste container.
– Connect the syringe directly to the two-way cock and take the sample.
– Disconnect the syringe and plug its bottom.
– Close the sampling valve and replace any protection.
– The sample shall be protected against light during transportation and storage.

A.5 Sampling from tank or drum without bottom valve

– Connect a two-way cock to a plastic tube resistant to the liquid.
– Plunge the tube into the container.
– Connect a syringe to the two-way cock.
– Suck a sufficient quantity of liquid to rinse the system, by repeatedly filling and emptying the syringe.
– Replace the syringe with a new one and take the sample.
– Disconnect the syringe and plug its bottom.

The sample shall be protected against light during transportation and storage.
A.6 Labelling of samples
See 7.6.

A.7 Preparation of the samples for analysis
See Clause 8.
Annex B  
(informative)

Calibration of the automatic particle counters

Calibration of automatic particle counters should be done with ISO MTD material (NIST standard reference material SRM 2806) and accomplished according to ISO 11171.
Bibliography


Bureau of Indian Standards

BIS is a statutory institution established under the Bureau of Indian Standards Act, 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publications), BIS.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of ‘BIS Catalogue’ and ‘Standards: Monthly Additions’.

This Indian Standard has been developed from Doc No.: ETD 03 (6362).

Amendments Issued Since Publication

<table>
<thead>
<tr>
<th>Amendment No.</th>
<th>Date of Issue</th>
<th>Text Affected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BUREAU OF INDIAN STANDARDS

Headquarters:
Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402
Website: www.bis.org.in

Regional Offices:

Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg
NEW DELHI 110002 (2323 7617, 2323 3841)

Eastern : 1/14, C.I.T. Scheme VII M, V.I.P. Road, Kankurgachi
KOLKATA 700054 (2337 8499, 2337 8561, 2337 8626, 2337 9120)

Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022 (260 3843, 260 9285)

Southern : C.I.T. Campus, IV Cross Road, CHENNAI 600113 (2254 1216, 2254 1442, 2254 2519, 2254 2315)

Western : Manakalaya, E9 MIDC, Marol, Andheri (East)
MUMBAI 400093 (2832 9295, 2832 7858, 2832 7891, 2832 7892)

Branches: AHMEDABAD, BANGALORE, BHOPAL, BHUBANESHWAR, COIMBATORE, DEHRADUN, FARIDABAD, GHAZIABAD, GUWAHATI, HYDERABAD, JAIPUR, KANPUR, LUCKNOW, NAGPUR, PARWANOO, PATNA, PUNE, RAJKOT, THIRUVANATHAPURAM, VISAKHAPATNAM.

Published by BIS, New Delhi