SLOVENSKI STANDARD
oSIST prEN IEC 60156:2023

01-oktober-2023

Izolacijske tekočine - Ugotavljanje prebojne napetosti pri mrežni frekvenci - Testna metoda

Insulating liquids - Determination of the breakdown voltage at power frequency - Test method

Isolants liquides - Détermination de la tension de claquage à fréquence industrielle - Méthode d’essai

Ta slovenski standard je istoveten z: **prEN IEC 60156:2023**

ICS:

29.040.01	Izolacijski fluidi na splošno	Insulating fluids in general

oSIST prEN IEC 60156:2023 **en**

10/1201/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER: **IEC 60156 ED4**	
DATE OF CIRCULATION: **2023-08-04**	CLOSING DATE FOR VOTING: **2023-10-27**
SUPERSEDES DOCUMENTS: **10/1190/CD, 10/1200/CC**	

IEC TC 10: FLUIDS FOR ELECTROTECHNICAL APPLICATIONS	
SECRETARIAT: Italy	SECRETARY: Mr Massimo Pompili
OF INTEREST TO THE FOLLOWING COMMITTEES: TC 14, SC 17A, TC 20, SC 36A, TC 38	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.

FUNCTIONS CONCERNED:

☐ EMC ☐ ENVIRONMENT ☒ QUALITY ASSURANCE ☐ SAFETY

☒ SUBMITTED FOR CENELEC PARALLEL VOTING **Attention IEC-CENELEC parallel voting** The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting. The CENELEC members are invited to vote through the CENELEC online voting system.	☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING

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TITLE:

Insulating liquids – Determination of the breakdown voltage at power frequency – Test method

PROPOSED STABILITY DATE: 2028

NOTE FROM TC/SC OFFICERS:

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INSULATING LIQUIDS – DETERMINATION OF THE BREAKDOWN VOLTAGE AT POWER FREQUENCY – TEST METHOD

FOREWORD

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International Standard IEC 60156 has been prepared by IEC technical committee TC 10: Fluids for electrotechnical applications.

This fourth edition cancels and replaces the third edition published in 2018. This edition constitutes a technical revision and, mainly, confirms the content of the previous edition even if some advances are included. The test method has not been changed for practical reason due to the very large number of instrumentations disseminated around the world.

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

FDIS	Report on voting
10/XXXX/FDIS	10/XXXX/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

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

The National Committees are requested to note that for this document the stability date is 20xx. THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE DELETED AT THE PUBLICATION STAGE.

INTRODUCTION

As normally applied, breakdown voltage of insulating liquids is not a basic material property but an empirical test procedure intended to indicate the presence of contaminants such as water and solid suspended matter and the advisability of carrying out drying and filtration treatment.

The AC breakdown voltage value of insulating liquids strongly depends on the particular set of conditions used in its measurement. Therefore, standardized testing procedures and equipment are essential for the unambiguous interpretation of test results.

The method described in this document applies to either acceptance tests on new deliveries of insulating liquids, or testing of treated liquids prior to or during filling into electrical equipment, or to the monitoring and maintenance of insulating liquid -filled apparatus in service. It specifies rigorous sample-handling procedures and temperature control that should be adhered to when certified results are required. For routine tests, especially in the field, less stringent procedures may be practicable and it is the responsibility of the user to determine their effect on the results.

Annex A (informative) describes, for comparison, an alternative test method which could be introduced in the future. Annex B (informative) describes special test methods, using cells which may include low volume samples. Annex C (informative) describes a reference material for a performance test and check according to IEC 60060-3 [1][1].

1 Numbers in square brackets refer to the Bibliography.

INSULATING LIQUIDS – DETERMINATION OF THE BREAKDOWN VOLTAGE AT POWER FREQUENCY – TEST METHOD

1 Scope

This document specifies the method for determining the dielectric breakdown voltage of insulating liquids at power frequency. The test procedure is performed in a specified apparatus, where the oil sample is subjected to an increasing AC electrical field until breakdown occurs. The method applies to all types of insulating liquids of nominal viscosity up to 350 mm^2/s at 40 °C. It is appropriate both for acceptance testing on unused liquids at the time of their delivery and for establishing the condition of samples taken in monitoring and maintenance of equipment.

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 60475, *Method of sampling liquid dielectrics*

3 Terms and definitions

No terms and definitions are listed in this document.

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

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

4 Electrical apparatus

4.1 General

The electrical apparatus consists of the following units:

1) voltage regulator,
2) step-up transformer,
3) switching system,
4) current-limiting resistors,
5) measuring device.

Two or more of these units may be integrated in any equipment system.

4.2 Voltage regulator

The test voltage shall be increased with an automatic control of the required uniform voltage rate of rise. The device should not introduce harmonics disturbances (< 3%) and the AC source should be free from harmonics.

4.3 Step-up transformer

The test voltage is obtained by using a step-up or resonant transformer supplied from an AC source using 48 Hz to 62 Hz (sinusoidal waveform). The voltage source value is constantly increased. The controls of the variable low-voltage source shall be capable of varying the test voltage smoothly, uniformly and without overshoots or transients. Incremental increases (produced, for example, by a variable auto-transformer or an amplifier) shall not exceed 2% of the expected breakdown voltage.

The centre-point of the secondary winding of the transformer should be connected to earth.

4.4 Switching system

The circuit shall be opened automatically if a sustained arc between the electrodes occurs and the voltage between the electrodes collapses.

NOTE: Typically, voltage collapse is detected in the range of 500V.

The primary circuit of the step-up transformer shall be fitted with a circuit-breaker operated by the current sensing device, resulting from the breakdown of the sample and shall break the voltage within 10 ms.

The sensitivity of the current or voltage sensing element depends on the energy-limiting device employed and only approximate guidance can be given.

A cut-off time of < 100 µs, as given in the previous edition of this document, is needed to perform multiple breakdowns on silicone liquids.

4.5 Current-limiting resistors

To protect the equipment and to avoid excessive decomposition at the instant of breakdown of liquids, such as silicone or ester liquids, a resistance limiting the breakdown current shall be inserted in series with the test cell.

The short-circuit current of the transformer and associated circuits shall be within the range of 10 mA to 25 mA for all voltages higher than 15 kV. This may be achieved by a combination of resistors in either or both the primary and secondary circuits of the high-voltage transformer.

4.6 Measuring system

For the purpose of this document, the magnitude of the test voltage is defined as its peak value divided by $\sqrt{2}$.

The output voltage of the step-up transformer may be measured by means of a measuring system consisting of a voltage divider or a measuring winding of the step-up transformer coupled with a peak-voltmeter. The measuring system shall be calibrated up to the upper scale voltage to be measured. A method of calibration which has been found satisfactory is the use of a transfer standard. This is an auxiliary measuring device which is connected in place of the test cell between the high-voltage terminals to which it presents an impedance similar to the one of the sample liquids. The auxiliary device is separately calibrated against a primary standard [2,3].

5 Test assembly

5.1 General

The breakdown voltage test is performed following the method described herewith as a routine test.

5.2 Test cell

The volume of the cell shall be between 350 ml and 600 ml.

The cell shall be made from electrically insulating materials, that are not hygroscopic. The cell shall be transparent and chemically inert, resistant to the insulating liquid and to the cleaning agent that shall be used. Whilst glass is a commonly used material other suitable materials such as plastics or polymers are appropriate provided they have high chemical resistance to the insulating liquids (including mineral oils, ester liquids, etc.).

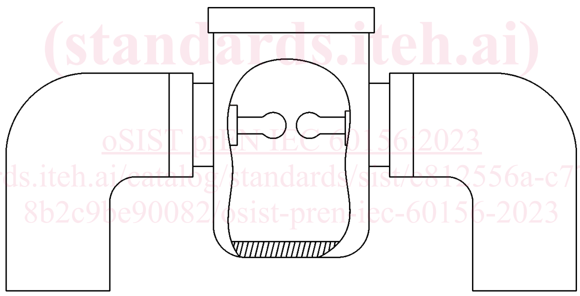
The cell shall be provided with a cover and shall be designed to permit easy removal of the electrodes for cleaning and maintenance. To improve homogenization of the test liquid, a rounded bottom shape of the cell is recommended. Containers and covers shall be cleaned by washing with a suitable solvent or clean insulating liquid to remove residues of an earlier sample. After cleaning, containers shall be immediately capped and kept closed until used again. Electrodes shall be stored in clean insulating liquids.

NOTE: It is preferable, in the case of esters to use similar liquid to store the electrodes.

Different shape of electrodes gives different results. The partially spherical electrode is to be used unless otherwise stated.

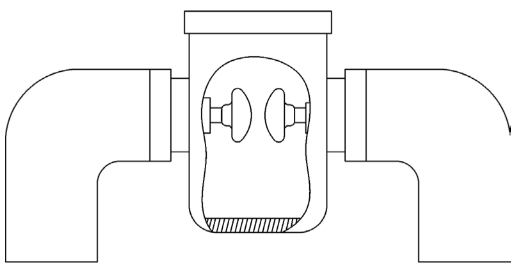
NOTE: if the difference in shape of electrodes is minimal, also the results difference is minimal.

Examples of suitable cell designs are given in Figures 1 and 2.



NOTE: Stirring can be mounted on the top or on the bottom.

Figure 1 – Example of test cell with spherical electrodes 12,5 mm to 13,0 mm diameter



NOTE: Stirring can be mounted on the top or on the bottom.

Figure 2 – Example of test cell with partially spherical electrodes with 25 mm radius and diameter of 36 mm

5.3 Electrodes

The electrodes shall be made either of brass, bronze or austenitic stainless steel. They shall be polished and, in shape, either spherical (12,5 mm to 13,0 mm diameter) as shown in Figure 1or in partially spherical shape (25 mm ± 0,25 mm radius) as shown in Figure 2. The axis of the