IS 6792 (1992): Method for Determination of Electric Strength of Insulating Oils [ETD 3: Fluids for Electrotechnical Applications]

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IS 6792 : 1992

(Reaffirmed 2003)

भारतीय मानक

विद्युत रोधन तेलों की विद्युत सामर्थ्य ज्ञात करने की पद्धति

(पहला पुनरीक्षण)

Indian Standard

METHOD FOR DETERMINATION OF ELECTRIC STRENGTH OF INSULATING OILS

(First Revision)

Second Reprint FEBRUARY 1998

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

August 1992

Price Group 2

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Fluids for Electrotechnical Applications Sectional Committee had been approved by the Electrotechnical Division Council.

Test for electric strength is a conventional test intended to reveal the extent of physical pollution by water and other suspended matter, and the advisability of carrying out drying and filtration treatment before the oil is introduced into the apparatus for which it is intended.

The measured value of the electric strength depends essentially on the apparatus and procedure used.

This standard was first published in 1972. Revision of this standard has been taken up to take care of certain improvement and protection in the procedure and also the amendment issued to it.

In preparing this standard, assistance has been derived from IEC Publication 156 (1963) 'Method for the determination of the electric strength of insulating oils', issued by the International Electrotechnical Commission (IEC).

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 or analysis, 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.

Indian Standard

METHOD FOR DETERMINATION OF ELECTRIC STRENGTH OF INSULATING OILS

(First Revision)

1 SCOPE

1.1 This standard covers a method for determination of electric strength of insulating oils.

2 REFERENCES

2.1 The following Indian Standard is a necessary adjunct to this standard:

IS No.	*Title*
6855 : 1973	Method of sampling for liquid dielectrics

3 PRINCIPLE

3.1 The test method covered in this standard consists in subjecting the oil, contained in a specified apparatus, to an ac electric field with a continuously increasing voltage till the oil breaks down.

4 GENERAL

4.1 Although the test method is intended for the acceptance of new insulating oils at the time of their delivery, it is applicable, in principle, to all classes of new and used oils for transformer, circuit-breakers, oil-filled cables and capacitors. Its application, however is restricted to oils having a kinematic viscosity of less than 50 centistokes at 27°C.

5 SAMPLING

5.1 The sampling shall be done in accordance with the procedure laid down in IS 6855 : 1973.

6 CONDITION OF THE OIL

6.1 The test is carried out on the oil as received, without drying or degassing.

6.2 Test for breakdown voltage shall be made in an atmosphere of less than 50 percent relative humidity.

7 TEST CELL

7.1 The cell made of glass or rigid oil resistant plastic, shall be transparent. It shall have an effective volume between 300 ml and 500 ml. It should perferably be covered.

7.2 Two types of cells are illustrated in Fig. 1 and 2.

7.3 For set with voltage in excess of 60 kV, RMS, special larger cell may be used.

8 ELECTRODES

8.1 The copper, brass, bronze or stainless steel polished electrodes shall be either spherical (12·5 mm to 13·0 mm diameter) as given in Fig. 1 or spherical surfaced of the shape and dimensions as given in Fig. 2. The electrodes shall be mounted on a horizontal axis and shall be 2·5 mm apart.

8.2 The gap between them shall be set to an accuracy of $\pm$0·01 mm by means of thickness gauges. The axis of the electrodes is immersed to a depth of approximately 40 mm.

8.3 Electrodes shall be replaced as soon as pitting caused by discharges is observed.

9 PREPARATION OF THE CELL

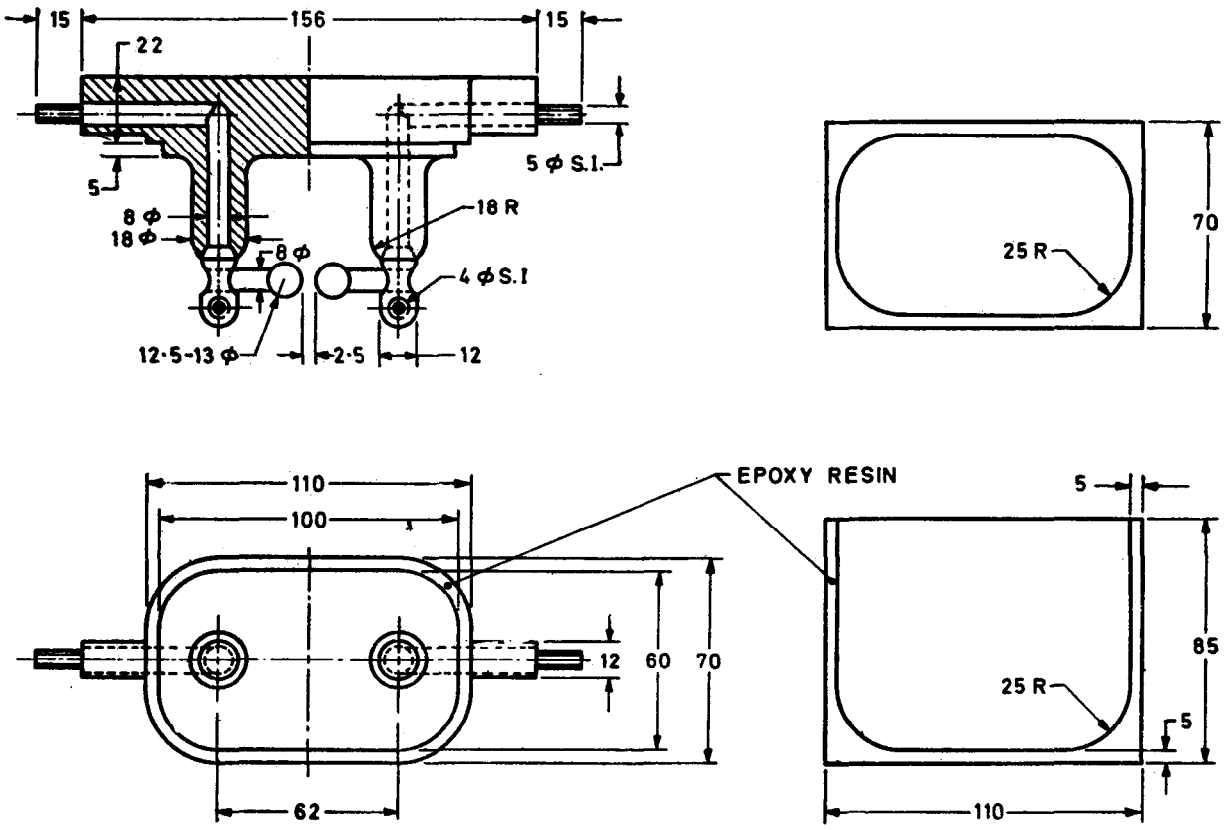
9.1 Between tests, the oil shall be poured away and the cell left in an inverted position to exclude dirt and moisture, alternatively, the cell shall be filled with oil having high electric strength, and suitably covered.

9.2 If the cell has not been used for some time, it should be thoroughly cleaned; the electrodes shall be removed, cleaned and finally rinsed with dry, clean new oil. Replacement of the electrodes should be carried out with the greatest care, avoiding all direct contact with the fingers.

9.3 Immediately before use, the cell shall be cleaned by rinsing with the test oil (at least twice) before proceeding to the final filling under the conditions laid down in **10.**

10 PREPARATION OF THE SAMPLE

10.1 The sampling vessel containing the test oil shall be gently agitated and turned over several times in such a way as to ensure as far as possible a homogeneous distribution of the impurities contained in the oil without causing the formation of air bubbles.



All dimensions in millimetres.

FIG. 1 TEST CELL

10.1.1 Immediately after this, the sample should be poured down into the test cell, slowly in order to avoid air bubbles forming (for example, by means of a clean, dry glass rod). The operation is carried out in a dry place free from dust.

10.2 The oil temperature at the time of the test shall be the same as that of the ambient air, preferably in the neighbourhood of 27°C (15 to 35°C) and noted.

11 TEST METHOD

11.1 The test consists in applying to the electrodes an increasing ac voltage of frequency 40 to 60 Hz, the rate of increase of the voltage being uniform and equal to approximately 2 kV/s, starting from zero up to the value producing breakdown.

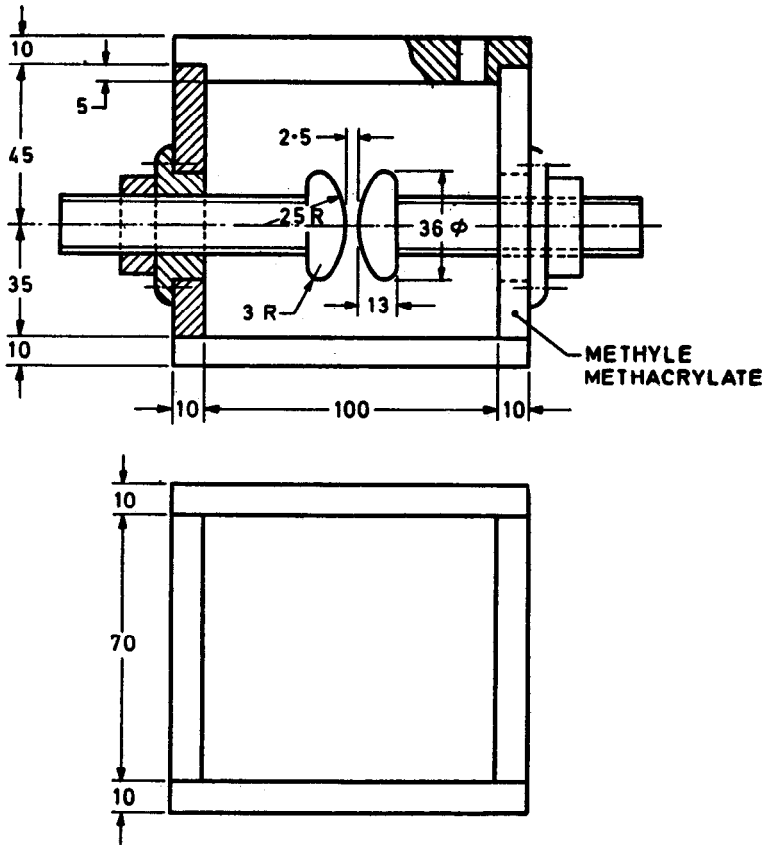
11.2 The circuit is opened manually if a transient spark (audible, or visible) occurs between the electrodes or automatically if an established arc occurs.

11.2.1 In the latter case the tripping circuit shall break the voltage within 0·02 second.

11.2.2 The breakdown voltage is the voltage reached during the test at the time the first spark occurs between electrodes, whether it be transient or established.

11.3 The test shall be carried out six times on the same cell filling.

11.3.1 The first application of the voltage is made as quickly as possible after the cell has been filled, provided there are no longer any air bubbles in the oil, or at the latest 10 minutes after filling. After each breakdown the oil is gently stirred so as to keep away the carbon particles between the electrodes, avoiding as far as possible the production of air bubbles. For the subsequent five tests, the voltage is re-applied one minute after the disappearance of any air bubbles that may have been formed. If the observation of the disappearance of air bubbles is not possible, it is necessary to wait for five minutes before a new breakdown test is started.



All dimensions in millimetres.

FIG. 2 TEST CELL

11.3.2 The electric strength shall be arithmetic mean of the six results which have been obtained.

12 ELECTRICAL APPARATUS

12.0 General

The characteristics of the electric apparatus shall comply with the following requirements.

12.1 Transformer

12.1.1 The test voltage may be obtained by using a step-up transformer supplied from an ac (40 to 60 Hz) low-voltage source. The primary voltage is gradually increased, either manually or by an automatic control device.

12.1.2 The voltage applied to the electrodes of the oil filled test cell should be nearly sinusoidal and the peak factor shall be within the limits of 1·34 and 1·48 ($\sqrt{2} \pm 3$ percent).

12.1.3 The transformer and associated equipment shall be rated for a minimum short-circuit current of 20 mA for valtages higher than 15 kV. To avoid damage to the electrodes, the short-circuit current shall be limited to a maximum of 1·0 A, if necessary by adding an external series resistances.

12.2 Circuit Protection

The primary test circuit shall be adequately protected by suitable means so as to limit the duration of the current flowing into the breakdown channel to 20 ms or less. It is to be ensured that the test voltage applications always starts from zero value. This can be achieved either manually or through a no volt release coil.

12.3 Voltage Regulation

12.3.1 Voltage regulation may be ensured by one of the following methods:

a) Variable-ratio auto-transformer,

b) Generator-field regulation, and

c) Induction regulator.

12.3.2 The rate of application of voltage with time shall be reasonably uniform. This can be accomplished effectively using a motor driven system, however, manual operation is not precluded.

12.4 Measurement of Test Voltage

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

12.4.2 This voltage may be measured by means of a peak-voltmeter, alternatively by means of another type of voltmeter connected to the input or output side of the testing transformer, or to a special winding provided thereon; the instrument then used shall be calibrated against a sphere-gap up to the full voltage which it is desired to measure.

12.4.3 The ratio of the voltage derived from the sphere-gap to the voltage indicated on the auxiliary instrument may be dependent upon the presence of the test cell of the sphere-gap and it is important that the test cell (or an equivalent load) should be in the circuit during the calibration.

12.4.4 The sphere-gap may be disconnected during the actual test if its presence is known to have a negligible influence on the voltage ratio.

12.4.5 The accuracy of measurement of voltage shall be better than $\pm$ 4 percent.

13 RESULTS

13.1 The report of results shall include the following information:

a) Reference to this Indian Standard,
b) Breakdown voltages obtained during each test,
c) Average of the breakdown voltages,
d) Type of electrodes,
e) Frequency of the test voltage, and
f) Oil temperature.

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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 Handbook' and 'Standards Monthly Additions'.

This Indian Standard has been developed from Doc: No. ETD 03 (3301)

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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AMENDMENT NO. 1 APRIL 2006
TO
IS 6792 : 1992 METHOD FOR DETERMINATION OF ELECTRIC STRENGTH OF INSULATING OILS

(First Revision)

(*Page* 2, *clause* **11.1**, *lines* 2 *and* 3) — Substitute '48 to 62 Hz' *for* '40 to 60 Hz'.

(*Page* 3, *clause* **12.1.1**, *line* 3) — Substitute '(40 to 60 Hz)' *for* '(48 to 62 Hz)'.

(*Page* 3, *clause* **12.1.2**, *line* 4) — Substitute '1.41 ± 0.07' *for* '1.34 and 1.48 ($\sqrt{2} \pm 3$ percent)'.

(*Page* 4, *clause* **13**) — Insert the following new clause at the end of the clause:

14 TEST DATA DISPERSION

The scatter of individual breakdown voltages has been found to be very dependent on the value of the result. The graphical representation of Fig. 3 indicates the values of standard deviation/mean ratio which have been found in a large body of test data in several laboratories using transformer oil.

The full line in the graph shows the distribution of the median value of SD/mean as function of the value of the mean. The dotted lines indicate the expected 95 percent range of values of SD/mean as a function of the value of the mean.

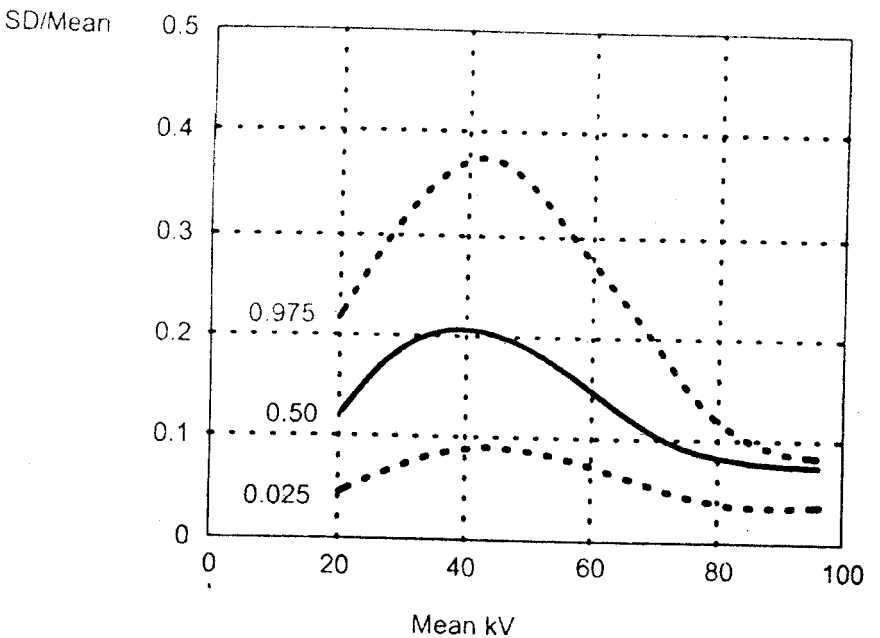

FIG. 3 GRAPHICAL REPRESENTATION OF COEFFICIENT OF VARIATION (STANDARD DEVIATION/MEAN RATIO) *VERSUS* MEAN BREAKDOWN VOLTAGE

(ET 03)

Reprography Unit, BIS, New Delhi, India

AMENDMENT NO. 2 MAY 2007
TO
IS 6792 : 1992 METHOD FOR DETERMINATION OF ELECTRIC STRENGTH OF INSULATING OILS

(First Revision)

[*Page* 3, *clause* **12.1.1**, *line* 3 (*see also Amendment No.* 1)] — Substitute '(48 to 62 Hz)' *for* '(40 to 60 Hz)'.

(ET 03)

Reprography Unit, BIS, New Delhi, India