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Indian Standard

METHODS OF TEST FOR CABLES

PART 25 CONDUCTIVITY OF WATER EXTRACT TEST OF INSULATING PAPER

Power Cables Sectional Committee, ETDC 59; Panel for Methods of Tests for Cables, ETDC 59 / P1 [Ref : Doc : ETDC 59 (2240)]

1. Scope — Covers a method to detect the presence of electrolytic impurities in the water extract of insulating paper for electric cables.

2. Significance — The conductivity of water extract indicates the amount of ionic impurities present in insulating paper. If the ionic impurities are higher than the specified value, it may induce higher dielectric loss and consequently result break down of the insulation. This test provides the measure of ionic impurities present in the insulating paper.

3. Terminology

3.1 *Water Extract Conductivity of Insulating Paper* — The amount of electrolytes present that may be extracted in hot water under prescribed conditions. This is expressed as micromhos/centimetre.

4. Apparatus

4.1 *Conductivity Bridge* — 50 Hz ac conductivity bridge or resistance indicator, capable of measuring resistances up to 1 000 000 ohms with an accuracy of 5 percent.

4.2 *Constant Temperature Bath* — A water-bath maintained at 27 ± 2°C.

4.3 *Beakers* — Acid and alkali resistant glass beakers, capacity 500 ml or any beakers of such dimensions that when the dip cell is immersed in 100 ml of liquid contained therein, the electrodes are fully covered.

4.4 *Flask Fitted with a Ground Reflux Condenser* — Acid and alkali resistant glass, wide mouth, 250 ml Erlenmeyer flasks.

4.5 *Funnel* — Acid and alkali resistant glass funnel having a top diameter of 100 mm and made with approximate 60 deg angle.

4.6 *Electric Hot Plate*

4.7 *Conductivity Cell* — A dip type cell with platinum electrodes securely mounted.

4.7.1 *Calibration of conductivity cell* — To determine the cell constant, place a beaker containing 0·01 N KCl solution in the constant temperature bath maintained at 27 ± 2°C. After thermal equilibrium is established, measure the resistance of this solution.

4.7.2 The cell constant K may be calculated as follows:

$$K = C \times R$$

where

R = Resistance measured, and

C = Conductivity of the potassium chloride solution. The value for C, at 27°C, is $1{\cdot}41 \times 10^{-3}$ mhos/cm

5. Material

5.1 *Distilled Water* — Shall have conductivity not exceeding 5 micromhos/centimetre at 27 ± 2°C when tested in accordance with the procedure given, in the absence of paper sample.

5.2 *Potassium Chloride Solution 0·01 N* — Prepare a 0·01 N solution with reagent grade potassium chloride (KCl) which has been dried for 2 hours at 110°C. After cooling, dissolve 0·745 5 g of the dried salt in distilled water and make up to 1 litre in a volumetric flask at 27°C.

6. Test Specimen

6.1 Samples weighing at least 5 g, cut into small pieces approximately 1 cm^2 are thoroughly mixed avoiding any contamination during handling.

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6.2 *Number of Specimens* — Two.

7. Conditioning — Specimen shall be conditioned by first partial drying it by subjecting it to a temperature of 60°C for 10 minutes and then freely exposing it in an atmosphere having a relative humidity of 65 ± 2 percent and a temperature of 27 ± 2°C for a period of not less than 24 hours.

8. Procedure

8.1 Five grams of specimen after conditioning shall be placed in a flask together with 100 ml of distilled water. The flask shall be fitted with a ground reflux condenser. The water shall be boiled gently for 10 minutes, then cooled to room temperature and filtered through a washed filter paper. Transfer the filtrate to a beaker in which the conductance measurement is to be made later. Cover the beaker with an aluminium foil and place in the water bath maintained at 27 ± 2°C.

As soon as thermal equilibrium is established, place the dip cell in the extract solution making certain that the electrodes are completely immersed. Measure the resistance on the most sensitive scale of the bridge. Move the cell up and down in the solution several times and repeat the measurements until readings are constant.

Before each measurement, rinse the cell thoroughly in distilled water and gently shake off any water clinging to the surfaces.

8.2 *Blank* — Correct the conductivity of the extract solution for the blank error. Determine this correction by running a blank in parrallel with the actual determination, using the same volume of distilled water.

8.3 Repeat similar procedure in the second sample and if the results vary by 10 percent or more, the experiment is to be repeated on fresh sample.

9. Tabulation of Observations

Sample No.	*Cell Constant* K	*Resistance, ohms*	
		Water Extract R_1	Blank R_2

10. Calculation — The conductivity of the extract solution (based on the mass of 5 g of the air-dry sample) shall be as follows:

Conductivity of Water Extract (micromhos/cm) = $(K/R_1 - K/R_2) \times 10^6$

11. Report

11.1 *Conductivity of Water Extract Test of Insulating Paper*

Cable Type

Batch No /Lot No.

Cable No./Drum No

Date of Testing

11.2 *Results*

Reference specification _____

Specimen Number	*Conductivity of Water Extract (micromhos/cm)*	
	Observed	Specified

11.3 *Conclusion* — Specimen meets/does not meet the requirement of the specification.

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