IS 10810-46 (1984): Methods of test for cables, Part 46: Partial discharge test [ETD 9: Power Cables]

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Indian Standard

(Reaffirmed 2001)

METHODS OF TEST FOR CABLES

PART 46 PARTIAL DISCHARGE TEST

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

1. Scope — Covers detection and measurement of partial discharge occurring in screened electric cables.

2. Significance — Partial discharges in voids remain unnoticed in the normal high voltage tests and could be harmful to the life of the insulant. Extruded dielectric tends to deteriorate very fast due to the discharges in small voids and cavities. It is, therefore, necessary that such voids should, as far as possible, be avoided in the extrusion process. Still certain minute voids are unavoidable and these remain in the insulation. The magnitude of the discharge in such voids is measured so as to determine whether these are within permissible limits. This test is performed on such extruded dielectrics in order to ensure that the insulation is free from partial discharges in excess of certain limits.

3. Terminology — *See* IS : 1885 (Part 32) - 1971 ' Electrotechnical vocabulary : Part 32 Cables, conductors and accessories for electricity supply ' and IS : 6209-1982 ' Methods for partial discharge measurements (*first revision*) '.

4. Apparatus

4.1 *Test Voltage Supply* — Equipment consists of a high voltage power supply having adequate (kVA) capacity for the length of cable under test and also for the coupling capacitor. The test voltage supply shall not introduce into the measuring circuit pulses of sufficient magnitude to interfere with the most sensitive measurement.

4.2 *Coupling Capacitor* — The capacitance value of the capacitor is selected in relation to other circuit components to realize the desired circuit sensitivity. The coupling capacitor shall not introduce into the circuit pulses of sufficient magnitude to interfere with the most sensitive measurement. Another coupling capacitor is also required for testing specimens of long lengths (*see* **6**).

4.3 *High Voltage Voltmeter* — Any suitable equipment to measure ac high voltage conforming to **5.1** (a) of IS : 2071 (Part 3) 1976 ' Methods of high vlotage testing : Part 3 Measuring devices '.

4.4 *Measuring Impedance* — Generally consists of a resistor or a damped tuned circuit. Usually it acts as a 4-terminal impedance. The impedance, in combination with the test object and coupling capacitor, determines the duration and shape of the measured pulses.

4.5 *Variable Resistance* — To match the characteristic impedance of the specimen.

4.6 *Measuring Instrument* — Any suitable amplifier with an oscilloscope (and, if desired, an indicating instrument) meeting the requirements of **3.4** of IS : 6209-1982 ' Methods for partial discharge measurements (*first revision*)'.

4.7 *Calibration Pulse Generator* — Any suitable equipment meeting the requirements of **4.2.1** of IS : 6209 - 1982 ' Methods for partial discharge measurements *(first revision)*'.

4.8 *Screened Enclosure* — A suitable screened enclosure may be necessary to house the equipment and the test object to avoid electrical interference from various sources. However, this may be dispensed within areas where interference is well below the required sensitivity of the test circuit.

4.9 *Test Circuit* — The basic test circuits are given in Fig. 1 and 2.

5. Material — No material other than the specimen is required except certain materials for making end terminations.

6. Specimen — When carried out as routine or acceptance test, the drum length and when carried out as a type test, 10 m length of cable shall constitute the test specimen. The ends shall be prepared so as to avoid end discharges. For long lengths, the far end of cable specimen should be terminated in its characteristic impedance. The use of another coupling capacitor is necessary in such a case.

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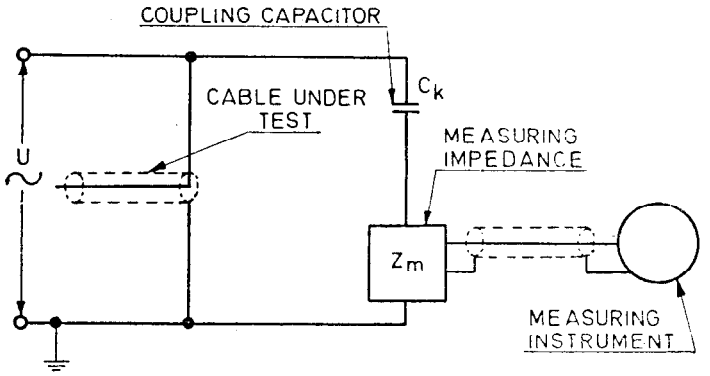

FIG. 1 TEST CIRCUIT FOR TESTING SHORT LENGTHS OF CABLE (UP TO 300 m)

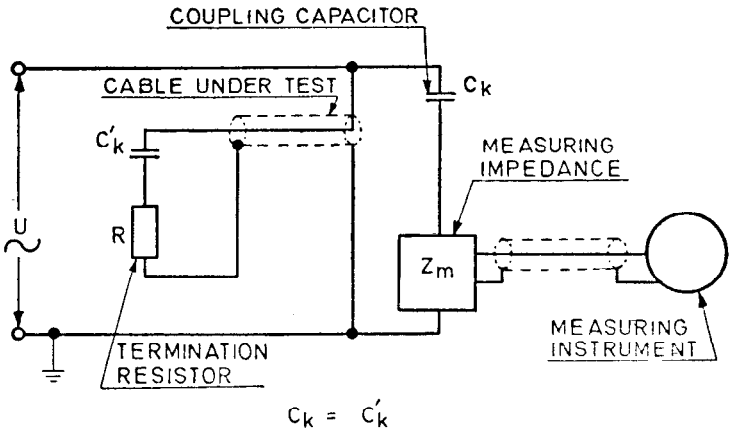

FIG. 2 TEST CIRCUIT FOR TESTING LONG LENGTHS OF CABLE

7. Conditioning — No special conditioning is necessary except that it must be ensured that the test specimen has attained the ambient temperature.

8. Procedure

8.1 *Calibration* — With the cable under test connected to the detection circuit, the detection response sensitivity of the apparatus shall be checked with the calibration pulse injected first at one end of the cable and then at the other. The lowest response in these two cases is taken as the overall response to establish the response ratio, that is, number of picocoulombs of the calibrating pulse per millimetre deflection on an oscilloscope screen or the rate of picocoulombs of the calibrating pulse to deflection in picocoulomb meter.

8.2 *Sensitivity*

8.2.1 *Sensitivity of the test circuit* — (With the given instruments), it is defined as the minimum detectable discharge pulse, q_{Min} (pC) that can be seen in the presence of background noise.

In order to be detectable, a discharge pulse shall be at least twice the apparent noise height, h_n (h_n is the noise magnitude in millimetres if an oscilloscope is used, or the noise deflection in picocoulombs if a picocoulomb meter is used).

Therefore, $q_{Min} = 2\ k.\ h_n$ (pC).

8.2.2 *For routine tests* — The sensitivity shall be 20 pC or less for polyethylene (PE), cross-linked polyethylene (XLPE), ethylene-propylene rubber (EPR), and 40 pC or less for polyvinyl chloride (PVC).

8.2.3 *For type tests* — The sensitivity shall be 5 pC or less for all materials.

8.3 Unless the calibrating capacitor of the calibration pulse generator is rated for use at the test voltages involved, it is necessary for the primary calibration circuit to be disconnected before the high voltage test transformer is energized. The amplifier gain shall not be readjusted after this has been done.

8.4 The test voltage shall be applied between conductor and screen. It shall be raised to and held, for not more than 1 min, at a value which is 0·25 U_0 above the voltage at which the measurement of partial discharge is to be made (where U_0 is the rated voltage of the cable between conductor and earth or metallic screen).

For example, if the relevant cable specification requires the partial discharge to be measured at 1·5 U_0, the voltage shall first be raised to 1·75 U_0.

The test voltage shall then be gradually reduced to, and the measurement of partial discharge made at, the voltage specified for the measurement in the relevant cable specification.

9. Tabulation of Observations

Sample No.	*Cable Description*	*Length* m	*Temperature* °C	*Sensitivity* pC	*Discharge Magnitude* pC

10. Calculation — No calculation is involved.

11. Report

11.1 *Reference Specification* _____

Sample No.	*Description of Sample*	*Sensitivity* pC	*Discharge Magnitude*	
			Observed pC	Specified pC

11.2 *Conclusion* — The specimen meets/does not meet the requirements of the specification.