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IS 10810-48 (1984): Methods of Test for Cables, Part 48: Dielectric Power Factor Test [ETD 9: Power Cables]

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UDC 621·315·21 : 621·317·33·6

IS : 10810 (Part 48) - 1984

(First Reprint MARCH 1998)

(Reaffirmed 2001)

Indian Standard

METHODS OF TEST FOR CABLES

PART 48 DIELECTRIC POWER FACTOR TEST

1. Scope — Covers the determination of dielectric power factor of the dielectric material of electric cable as a function of either voltage or temperature or both.

2. Significance — The power factor of the dielectric should be small in order to reduce the heating of the dielectric material and to minimize its effect on the rest of the network. The power factor is dependent on both voltage gradient and temperature. The power factor test is a sensitive test to check the dielectric of a cable for inclusion of impurities and mechanical imperfections or voids.

3. Terminology — *See* IS : 1885 (Part 32) - 1971 'Electrotechnical vocabulary : Part 32 Cables, conductors and accessories for electricity supply' and IS : 4486-1967 'Recommended methods for determination of the permittivity and dielectric dissipation factor of insulating materials at power, audio and radio frequencies including metre wavelengths'.

4. Apparatus

4.1 *Power Factor Measuring Set-up* — In accordance with IS : 4486-1967.

4.2 *High Voltage Source* — Having the adequate capacity to deliver the required kVA and similar to the one required for high voltage testing [*see* IS : 2071 (Part 2) - 1974 Methods of high voltage testing : Part 2 Test procedure].

4.3 *Current Loading Transformer or a Bath* — Capable of heating the sample upto the desired temperature or an oven capable of heating the sample upto the desired temperature.

4.4 *Insulating Mats*

4.5 *Temperature Measuring Instruments* — 0 to 100°C.

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

6. Test 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 suitably prepared.

7. Conditioning

7.1 For power factor measurement as a function of voltage, no conditioning is required except that it is to be ensured that the sample is at the ambient temperature.

7.2 For power factor measurement as function of temperature, the conductor temperature of the sample is to be maintained at the normal maximum continuous operating temperature of the cable.

8. Test Procedure

8.1 *Power Factor Measurement as a Function of Voltage*

8.1.1 The conductor of the sample is connected to the high voltage terminal and the screen/armour/metal sheath is connected to the power factor measuring instrument. It is to be ensured that the sample is insulated from ground by placing it on rubber mats.

8.1.2 The voltage is raised to 0·5 U_0 and the power factor is measured. This measurement is repeated at voltages U_0 and 2 U_0.

Note — U_0 is the rated power frequency voltage of cable between conductor and earth or metallic screen.

8.1.3 The capacitance of the sample is recorded at U_0 while power factor is being measured.

8.2 *Power Factor Measurement as a Function of the Temperature (For Extruded Solid Dielectric Cables).*

8.2.1 The sample is heated by passing current through the conductor or metallic part of the insulation screen or by putting it in a bath or oven.

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

Adopted 14 March 1984 | Gr 2

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8.2.2 The heating is to be continued in such a manner that the conductor temperature reaches the desired value.

8.2.3 The heating is discontinued and the power factor and capacitance is measured immediately afterwards at a voltage of 2 kV.

8.2.4 For PVC cables only, the dielectric constant is calculated from the capacitance and cable geometry and the product of dielectric constant and power factor obtained.

9. Tabulation of Observations

9.1 *Power Factor as a Function of Voltage*

Sample No.	*Cable Description*	*Length* m	*Ambient Temperature* °C	*Voltage* kV	*Power Factor*	*Capacitance* μF	*Rise of PF From* $0\cdot5\ U_0$ *to* $2\ U_0$
				$0\cdot5\ U_0$			
				U_0			
				$2\ U_0$			

9.2 *Power Factor as a Function of the Temperature*

Sample No.	*Cable Description*	*Length* m	*Ambient Temperature* °C	*Maximum Conductor Temperature* °C	*Voltage* kV	*Power Factor*	*Capacitance* μF

10. Calculation — The dielectric constant is calculated from the following formula:

$$\epsilon = \frac{C \times \log_{10} \frac{D}{d}}{0\cdot0241}$$

where

C = capacitance in μF/km;

ϵ = dielectric constant;

D = diameter over insulation (mm); and

d = diameter of conductor, including screen, if any (mm).

Note — In the case of shaped cores substitute D by P and d by p

where

P = periphery of shaped insulated core (mm); and

p = periphery of shaped conductor including screen, if any (mm).

11. Report

11.1 *Reference Specification* ______________________

Sample No.	*Cable Description*	*Observed Power Factor*		*Maximum Conductor Temperature Achieved* °C	*Observed Power Factor at Maximum Conductor Temperature*
		At U_0	Rise From $0\cdot5\ U_0$ to $2\ U_0$		

Observed Product of Power Factor and Dielectric Constant at Maximum Conductor Temperature	*Specified*			
	Power Factor at U_0	Rise of Power Factor From 0·5 U_0 to $2U_0$	Power Factor at Maximum Conductor Temperature	Product of Power Factor and Dielectric Constant at Maximum Conductor Temperature

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

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