IS 10810-8 (1984): Method of test for cables, Part 8: Breaking strength and elongation at break for impregnated paper insulation [ETD 9: Power Cables]

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"पुनर्मुद्रित १९९६"

(Reaffirmed 2001)

METHODS OF TEST FOR CABLES

PART 8 BREAKING STRENGTH AND ELONGATION AT BREAK FOR IMPREGNATED PAPER INSULATION

[Ref : Doc : ETDC 59 (2240)] Power Cables Sectional Committee, ETDC 59; Panel for Methods of Tests for Cables, ETDC 59/P-1

1. Scope — Covers the method for determining breaking strength and elongation at break of impregnated paper insulation taken from a completed electric cable.

2. Significance — During the process of manufacture and during installation, electric cables are unavoidably subjected to mechanical stresses, particularly bending. Impregnated paper insulation in the cable is also subjected to these stresses and strains. This test is carried out to determine the resistance to pull of paper and the percentage elongation the paper undergoes before fracture.

3. Terminology — As given in **3** of IS : 10810 (Part 7)-1984 ' Methods of test for cables : Part 7 Tensile strength and elongation at break of thermoplastic and elastomeric insulation and sheath ' and the following.

3.1 *Breaking Load* — The load at which a test specimen fractures.

3.2 *Breaking Strength* — It is computed from breaking load in newtons per millimetre thickness and specified width of the test specimen.

3.3 *Percentage Elongation at Break* — The increase in gauge length of a tensile test specimen at fracture, expressed as a percentage of the original gauge length.

4. Apparatus

4.1 *Tensile Testing Machine* — The machine shall be automatic. It shall have the capacity to meet the requirement of this test and shall have the rate of separation of jaws as specified in **8.1**. The grips shall be such as to firmly hold the test specimen. The elongation may be measured manually or with an automatic device.

4.2 *Micrometer* — A flat faced micrometer capable of measuring thickness to the nearest 0·001 mm.

4.3 *Precision Dial Micrometer* — This instrument is provided with two parallel plane faces between which the paper can be placed for measurement. One of the faces should be capable of movement in a direction perpendicular to the other, which is fixed. The movable face or pressure foot should be circular. The fixed face or anvil should also be circular and of such size that the whole area of the pressure foot is in contact with the anvil in the zero position.

To ensure that the pressure between the faces is uniform within the limits given, the use of a dead weight rather than a spring is preferred.

The instrument should be calibrated in accordance with the procedure detailed in Appendix A and should conform to the following:

Characteristics	*Value*
Diameter of pressure foot	16 ± 0·5 mm
Area of pressure foot	200 mm² (Nominal value)
Pressure exerted by pressure foot	100 ± 10 kN/m²
Repeatability of measurement (standard deviation)	0·002 5 mm or 0·5 percent whichever is greater
Indication error	± 0·002 5 mm or 0·5 percent whichever is greater
Error of parallelism of pressure foot and anvil	0·005 0 mm or 1 percent whichever is greater

Adopted 14 March 1984 Gr 2

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5. Material — No material other than the test specimen is required for performing this test.

6. Test Specimen

6.1 The core sample shall be taken from the cable after first removing at least 300 mm length of cable from the end. Crease free impregnated paper tapes shall be taken from completed cable and not less than 250 mm long pieces shall be taken from these tapes. If width of the tapes is more than 15 mm then test specimen of 15 mm width shall be cut from these strips. If the width is less than 15 mm, then the whole strip shall be used as test specimen.

6.2 *Number of Specimens* — Six.

7. Conditioning — All the specimens shall be conditioned for 24 ± 1 hour at a relative humidity of 65 ± 2 percent and temperature of 27 ± 2°C.

8. Procedure

8.1 After conditioning the specimens, compound shall be removed and the thickness of each specimen measured to the nearest 0·001 mm. The specimen shall then be tested in a tensile testing machine, keeping the distance between grips at 200 ± 20 mm. The gauge length shall be measured accurately and noted. The load shall then be applied gradually and uniformly till the specimen fractures. The rate of separation of the jaws of the machine shall be 20 to 30 mm per minute.

8.2 The load and the distance (separation) between the grips when the specimen breaks shall be noted.

9. Tabulation of Observations

Description	*Symbol*	*Unit*	*Observed Values*					
			1	2	3	4	5	6
Width of specimen	W	mm						
Thickness of specimen	T	mm						
Gauge length	G_1	mm						
Separation at break	G_2	mm						
Load at break	F	N						

10. Calculation

10.1 Elongation at break, percent $= \frac{G_2 - G_1}{G_1} \times 100$

10.2 Breaking strength in N/mm of thickness, for a width of 15 mm $= \frac{F}{T} \times \frac{15}{W}$

10.3 The maximum and minimum of the six values are to be discarded and the average of the remaining four is considered as test result.

11. Report

11.1 *Breaking Strength and Elongation Test on Impregnated Paper:*

Cable Type

Batch No./Lot No.

Cable No./Drum No.

11.2 *Reference Specification* _____

Test	*Observed Value*	*Specified Value*
Breaking strength (N/mm of thickness) for a width of 15 mm		
Elongation at break, percent		

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

APPENDIX A

(*Clause* 4.3)

CALIBRATION OF THE INSTRUMENT

A-0. General

A-0.1 For instruments in frequent use, the calibration should be checked daily for repeatability and accuracy and monthly for parallelism and foot pressure.

A-0.2 For very thin paper, it is necessary to check the instrument at the same temperature at which it is to be used.

A-0.3 If the instrument is not within the tolerances for any test, it should be corrected before succeeding tests are done.

A-0.4 Checking should be carried out as described in **A-1** to **A-4.**

A-1. Planarity of Foot and Anvil — The pressure foot and anvil should be carefully wiped and parted slightly so that the gap can be seen against a bright light. The gap should be quite even when observed in two directions at right angles.

A-2. Pressure Exerted by the Foot — Any suitable means of checking its accuracy and uniformity may be used.

A-3. Repeatability of Measurement and Determination of Indication Error

A-3.1 Set the instrument correctly at zero before commencing.

A-3.2 Use a set of feeler gauges of different thicknesses which have previously been checked.

A-3.3 Insert these individually between the anvil and the pressure foot and note the corresponding reading on the scale.

A-3.4 Check the instrument at approximately 10, 30, 50, 70 and 90 percent of the full scale reading and, in particular, the range of normal working.

A-3.5 A series of at least five readings should be taken at the zero position followed by at least five readings on each feeler gauge and finally a further set of at least five readings at the zero position.

A-3.6 The instrument should not be reset to zero during the procedure.

A-3.7 For each check point on the scale:

a) repeatability of measurement is the standard deviation of the five or more readings taken, and

b) indication error is the difference between the mean of the five or more readings and the feeler gauge thickness.

A-4. Parallelism of Foot and Anvil

A-4.1 Insert a feeler gauge on the edge at one side of the pressure foot and note the thickness shown on the scale.

A-4.2 Insert the same feeler gauge on the edge of the opposite side and note again the thickness on the scale.

A-4.3 Repeat the procedure at right angles to the original position.

A-4.4 Repeat the procedure with other gauges at approximately 10, 30, 50, 70 and 90 percent of the full scale reading, and check in particular the range of normal working.

A-4.5 The error of parallelism is defined as half the square root of the sum of the squares of the difference between the opposite readings at the ends of the two perpendicular diameters, that is:

$$\frac{1}{2}\sqrt{d_1^2 + d_2^2}$$

where

d_1 and d_2 are the differences between the measurements at two opposite points of the same diameters.