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मानक

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IS 10810-15 (1984): Methods of Test for Cables, Part 15:
Hot Deformation Test [ETD 9: Power Cables]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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Indian Standard

METHODS OF TEST FOR CABLES

PART 15 HOT DEFORMATION TEST

1. Scope — Covers a method to determine the resistance of thermoplastic insulation and sheath of electric cables to deformation when subjected to mechanical pressure at high temperature.

1.1 This test is not applicable for insulation or sheath of thickness less than 0.4 mm.

2. Significance — Thermoplastic compounds tend to soften when maintained at high temperature over a sufficient period. In that condition when they are subjected to mechanical pressure, they have a tendency to get deformed at the location of pressure resulting in a reduction in thickness. Thermoplastic insulation and sheath of electric cables are subjected to such conditions while they are in continuous operation and undue deformation will impair their functional utility. This test is therefore carried out to check whether they have sufficient resistance to such deformation.

3. Terminology — 'Hot deformation' is the change in the physical dimension of a solid material when subjected to external mechanical pressure at high temperature. In the hot deformation test, the thickness retained at the point of impression expressed as a percentage of the initial thickness denotes the degree of resistance of the material to hot deformation.

4. Apparatus

4.1 Electric Oven — A thermostatically controlled electric oven in which the test temperature can be maintained with an accuracy of $\pm 2^\circ\text{C}$, mounted in such a manner as to be free from vibration.

4.2 Hot Pressure Test Apparatus — An apparatus for exerting pressure on the test specimen, as shown in Fig. 1. It shall consist of a rectangular blade with an edge 0.70 ± 0.01 mm wide, which can be pressed against the test specimen.

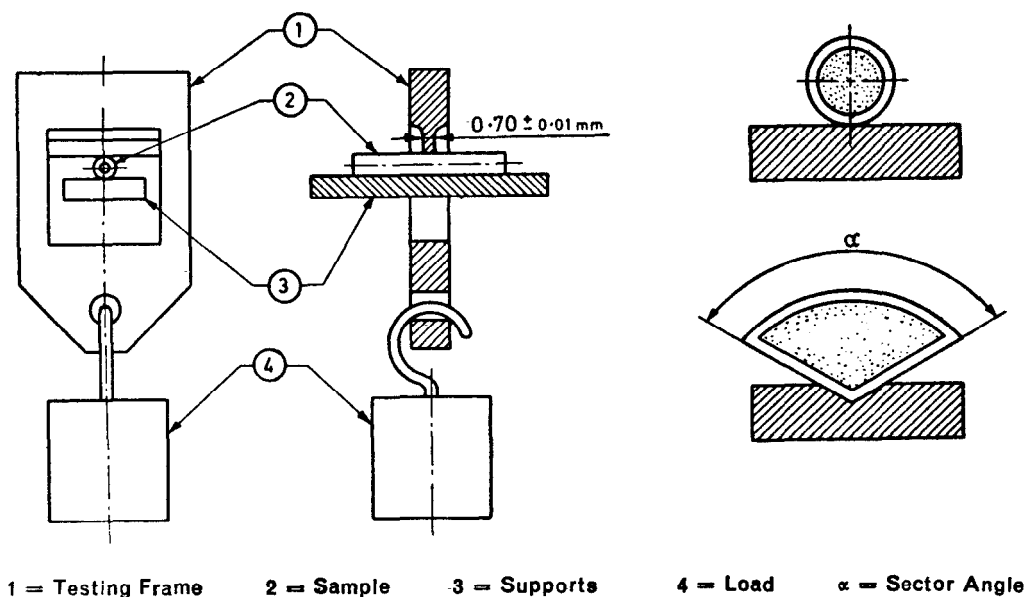


FIG. 1 HOT PRESSURE TEST APPARATUS

4.3 Smooth Metal Pin (Mandrel) or Tube and Loading Weights

4.4 Measuring Microscope or Graduated Magnifying Glass

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

6. Test Specimen

6.1 From each core or the sheath to be tested, test specimens of about 50 to 100 mm in length shall be taken from a sample having a length of 300 mm.

6.1.1 In case of twin or multi core non-sheathed flat cords, individual cores are not to be separated.

6.2 Preparation of Test Specimen

6.2.1 For insulation — From each piece of core, any covering including semi-conducting layer, if any, shall be removed mechanically. According to the type of cable, the piece may be of circular or sector-shaped cross-section.

6.2.2 For sheath — For each piece of the sheath, a strip enclosing about one-third of the circumference shall be cut in the direction of the axis of the cable, if the sheath does not have ridges.

If the sheath has ridges caused by more than 5 cores, the strip shall be cut in the same manner as above and these ridges shall be removed by grinding. If the sheath has ridges caused by five or less cores, the strip shall be cut in the direction of ridges so that it contains at least one groove which lies approximately in the middle of the strip throughout its length.

If the sheath is applied directly over the armouring or the metallic screen and therefore, it is difficult to grind or cut away the ridges (unless the diameter is large), the sheath shall not be removed and the whole cable piece shall be used as test specimen.

6.3 Number of Specimens — Two.

7. Conditioning — No special conditioning of test specimen is required. The test specimen shall be taken directly for testing at specified temperature and duration.

8. Procedure

8.1 Prior to the commissioning of the test, the test oven shall have attained the specified test temperature.

8.2 Position of Test Specimen

8.2.1 For insulation — The test piece shall be placed in the position shown in Fig. 1. Flat cords without sheath shall be laid on their flat side. Test specimen having small diameter shall be fixed on the support in such a manner that it does not curve under the pressure of the blade. Specimen of sector-shaped cores shall be placed on a support provided with a suitable angular profile as shown in Fig. 1.

The force shall be applied in a direction perpendicular to the axis of the core. The blade shall also be perpendicular to the axis of the core.

8.2.2 For sheath — The strip shall be supported by a metal pin or tube, which may be halved in the direction of its axis to make more stable support. The radius of the pin or tube shall be approximately equal to half the inner diameter of the test piece. The apparatus, the strip and the supporting pin (tube) shall be arranged so that the pin supports the strip and the blade is pressed against the outer surface of the test piece.

The force shall be applied in a direction perpendicular to the axis of the pin (or the cable when a whole cable piece is used) and the blade shall also be perpendicular to the axis of the pin or tube (or of the cable when a whole cable is used).

8.3 Calculation of Compression Force — The force F , in Newton, which shall be exerted by the blade upon the test specimen, shall be calculated by the following formula :

$$F = k \sqrt{2D \times t - t^2}$$

where

D = mean value of the outer diameter (mm) of test piece (insulation or sheath as the case may be). For sector-shaped cores, D is the diameter (mm) over the laid-up cores. In case of flat cords without sheath, D is the mean value of the minor dimension of the test specimen;

t = average thickness (mm) of the test specimen (insulation or sheath);

k = a constant, the value of which is as follows:

$k = 0.6$ for insulation and sheath of flexible cords and flexible cables;

$k = 0.6$ for cables for fixed installations having outer diameter D of core or sheath up to 10 mm; and

$k = 0.8$ for cables for fixed installations having outer diameter D of core or sheath above 10 mm.

For the above purpose, D and t shall be measured to an accuracy of 0.1 mm using any suitable mechanical or optical measuring instrument.

The calculated force may be rounded off downwards by not more than 3 percent.

However, in all cases the pressure, that is, load or force indicated include the weight of the testing frame.

8.4 Heating of Loaded Test Specimen — When the test oven has attained the specified test temperature, the loaded test specimen shall be kept in the oven for the duration as specified in relevant specification.

8.5 Cooling of Loaded Test Specimens — At the end of the test duration test specimen shall be removed from the testing apparatus and cooled within 10 s in cold water.

8.6 Measurement — Immediately after cooling, the test specimen shall be prepared for determining the thickness retained at the point of impression, that is indentation.

The conductor shall be withdrawn leaving the test piece in the form of a tube. A narrow strip shall be cut from the test specimen in the direction of the axis of the core, perpendicular to the indentation. However, small test specimen up to about 6 mm external diameter, shall be cut transversely at the indentation and also at about 10 mm from it on both sides, as shown in Fig 2 and Fig. 4.

The thickness at the point of impression (that is, indentation) and at a distance of about 10 mm on both sides of this point is measured on a longitudinal or transversal section by means of a measuring microscope or a graduated magnifying glass to an accuracy of 0.01 mm as shown in Fig. 3 and Fig. 4.

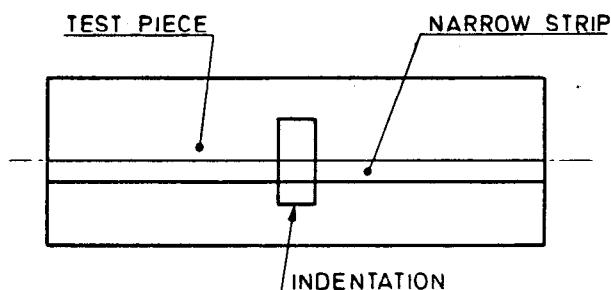


FIG. 2 NARROW STRIP FOR MEASUREMENT OF INDENTATION

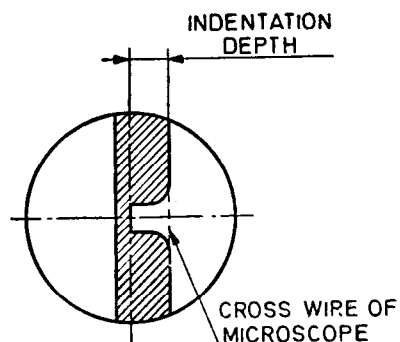


FIG. 3 VIEW IN MEASURING MICROSCOPE

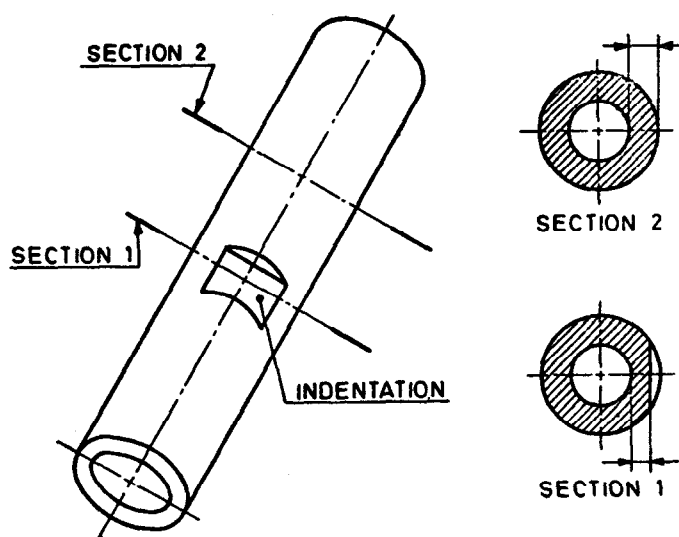


FIG. 4 MEASUREMENT OF INDENTATION FOR SMALL CORES

9. Tabulation of Observations

Test Specimen	Thickness at the Point of Indentation T_1 mm	Thickness at About 10 mm from the Point of Indentation	
		T_2' mm	T_2'' mm
1.			
2.			

10. Calculation

$$\text{Percentage thickness retained} = \frac{\Sigma T_1/2}{T_2} \times 100$$

$$\text{where } T_2 = \frac{\Sigma T_2' + \Sigma T_2''}{4}$$

Note — In case of failure, it shall be permissible to recheck the test, but the number of test specimens shall be four in place of two and the mean value of four test results shall be compared for compliance with the specified value.

11. Report**11.1 Hot Deformation Test on Thermoplastic Insulation/Sheath**

Batch No./Lot No.

Cable No./Drum No.

11.2 Results

Reference Specification, _____

	Observed Value	Specified Value
Percentage thickness retained		

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