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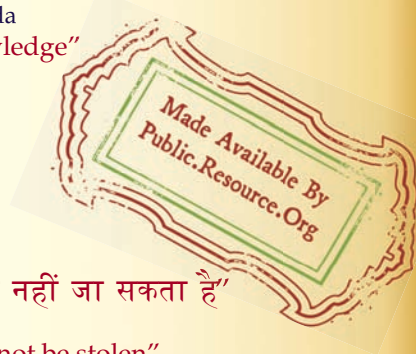
IS 10810-58 (1998): Methods of test for cables, Part 58:
Oxygen index test - [IS 10810(Part 58) [ETD 9: Power
Cables]



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IS 10810 (Part 58) : 1998

भारतीय मानक
केबल के परीक्षण की प्रणाली
भाग 58 आक्सीजन सूचकांक परीक्षण

Indian Standard
METHOD OF TESTS FOR CABLES
PART 58 OXYGEN INDEX TEST

ICS 29.060.20

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

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Price Group 2

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Power Cables Sectional Committee had been approved by the Electrotechnical Division Council.

This standard specifies the test method for determining the relative flammability of materials used in electric cables by measuring the minimum concentration of oxygen in a mixture of oxygen and nitrogen that will just support flaming combustion. This method is at present limited to the use of physically self-supporting test specimens.

While preparing this standard, assistance has been derived from the document IEC 20C (C.O.) 3 'Tests on electric cables under fire conditions — Tests on bunched wires or cables'.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

METHOD OF TESTS FOR CABLES

PART 58 OXYGEN INDEX TEST

1 SCOPE

1.1 This test method describes a procedure for determining the relative flammability of materials used in electric cables by measuring the minimum concentration of oxygen in a mixture of oxygen and nitrogen that will just support flaming combustion. This method is at present limited to the use of physically self-supporting test specimens.

2 SIGNIFICANCE

2.1 This method gives the indication of the flame resistance propagation. The higher the oxygen index, the higher the fire resistance.

3 TERMINOLOGY

3.1 Oxygen Index

The minimum concentration of oxygen, expressed as volume percent, in a mixture of oxygen and nitrogen that will just support combustion of material under the conditions of this method.

4 PRINCIPLE OF METHOD

The minimum concentration of oxygen in a mixture of oxygen and nitrogen that will just support combustion is measured under equilibrium conditions of 'candle like' burning. The balance between the heat from the combustion of the specimen and the heat lost to surroundings establishes the equilibrium.

5 APPARATUS

5.1 Test Column

Consisting of a heat-resistant glass tube of one of the following types listed below:

	Minimum Inside Diameter (mm)	Height		Restricted Upper Opening Diameter	
		Min (mm)	Max (mm)	Min (mm)	Max (mm)
Column A	75	450	—	75	—
Column B	95	210	310	40	50

The bottom of the column or the base to which the tube is attached shall contain non-combustible material to mix and distribute evenly the gas mixture entering at this base. Glass head in a bed of about 100 mm in depth, have been found suitable for this

purpose. A wire screen shall be placed above the non-combustible material to catch falling fragments and aid in keeping the base of the column clean. A typical arrangement is shown in Fig. 1.

5.2 Timer

Capable of indicating at least 10 minutes and accurate to 1 s.

5.3 Specimen Holder

Any small holding device that will support the specimen at its base and hold it vertical in the centre of the column is acceptable. For physically self-supporting specimens, a typical arrangement as shown in Fig. 1, consisting of a laboratory thermometer clamp inserted into the end of a glass tube held in place by glass beads or otherwise firmly supported. For other forms, such as film, and thin sheet, the frame in Fig. 2, shall be used and held in place by the above tube. The test specimen must be held securely along both upright edges by the frame, using clips or other means.

5.4 Gas Supplies

The gas mixture required for test may be prepared using oxygen and/or nitrogen of commercial grades or better (greater than 98 percent purity) and/or clean air as appropriate (air contains 20.9 percent oxygen). The oxygen index shall be measured at room temperature. In case of any dispute measurement shall be repeated at $27 \pm 2^\circ\text{C}$. The gas supply system shall incorporate a drying device and/or a provision for measurement of moisture content. The moisture content of the gas mixture entering the test chimney is under consideration.

5.5 Concentration of Oxygen Measurement

The concentration of oxygen shall be measured by either of the following methods. In case of dispute, method (i) shall be used:

- i) The concentration of oxygen in the mixed gases shall be determined by measuring paramagnetism of the oxygen.
- ii) Measuring and control devices shall be used which will measure and control the composition of the gas mixture in the test chimney so that the concentration of oxygen in the gas mixture is known to an accuracy of ± 0.5 percent by volume of the mixture.

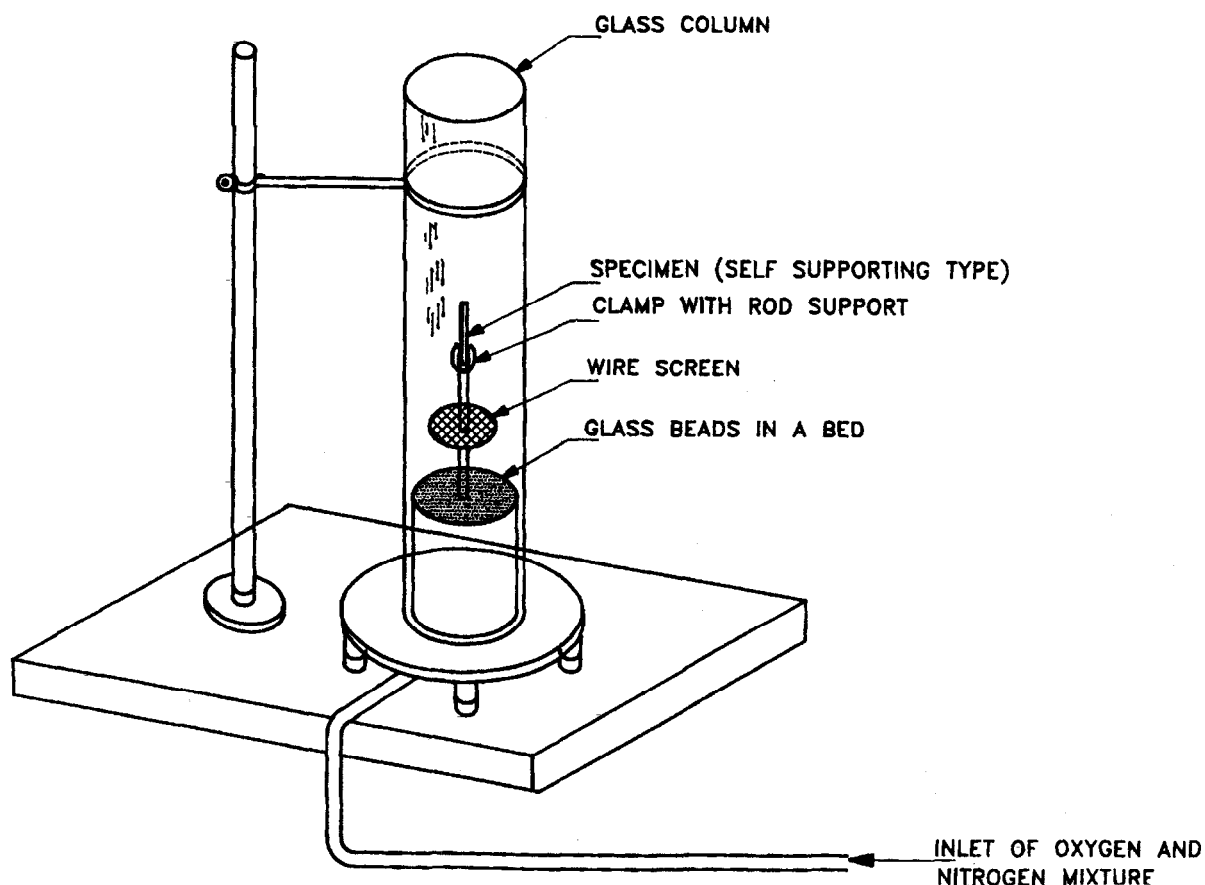
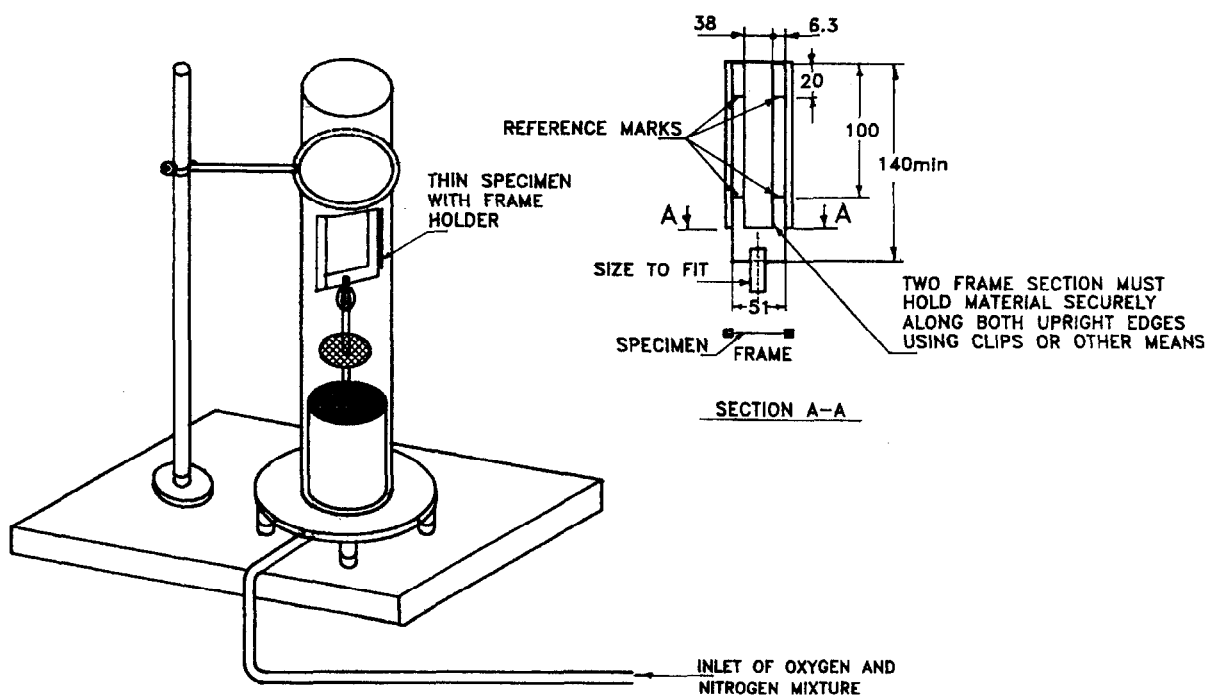


FIG. 1 TYPICAL TEST ARRANGEMENT



All dimensions in millimetres.

FIG. 2 FRAME DESIGN AND TEST ARRANGEMENT FOR FILM AND THIN SHEET

5.6 Ignition Source

The igniter should be a suitable butane LPG gas torch, with attachments as suitable for the type of gas. The flame length should be approximately 30 mm measured in air from the top of the shield.

5.7 Extractor Fan

To ensure the removal of smoke, soot and toxic fumes the apparatus shall be installed in an area having excellent exhaust facilities that do not interfere with the test results.

6 TEST SPECIMEN

6.1 Three test specimens of flat rectangular sheets having the following dimensions:

Length	—	70 mm to 150 mm
Width	—	6.5 ± 0.5 mm
Thickness	—	3.0 ± 0.5 mm

6.2 The specimens may be obtained by moulding, cutting, or machining from those cable constituents to be tested. Where this is not possible with a cable containing vulcanized material, a moulded and vulcanized slab prepared from material sampled during manufacture of the same production patch shall be used.

6.3 The edges of the test pieces shall be smooth and free from fuse or burrs of material from machining or peripheral flash from moulding.

7 PROCEDURE

7.1 Each specimen shall be marked with two lines 8 mm and 58 mm from the top. For ease of viewing each line should be marked at least on two adjacent faces. For white or coloured specimens an ordinary ball-point pen can be used. For black specimens a contrasting ink should be used. The ink shall be allowed to dry before the test.

Clamp the specimen in the holder vertically in the approximate centre of the column with the top of the specimen at least 100 mm below the top of the open column.

If a restricted opening column is used as specified in 5.1 the top of the specimen shall be at least 40 mm below the opening.

7.2 The test shall be carried out at room temperature. Pre-conditioning of the sample shall be done at $27 \pm 2^\circ\text{C}$ and relative humidity 50 ± 5 percent for 24 hours. In case of dispute, test shall be repeated at $27 \pm 2^\circ\text{C}$.

7.3 Set the desired initial concentration of oxygen flowing through the column. The gas flow rate in the column shall be 40 ± 10 mm/s as calculated at laboratory conditions from the total flow of gas in cubic millimetres per second divided by the area of the column in square millimetres.

7.4 Allow the gas to flow for at least 30 seconds to purge the system.

7.5 Apply the ignition source so that 6 mm (approximately) of the flame shall impinge on the top of the specimen. As the specimen burns, the ignition source shall be lowered to maintain the flame impingement of 6 mm approximately. The oxygen concentration shall not be adjusted after lighting the test piece.

The ignition flame shall be applied till the specimen has burnt down to the 8 mm line. It shall then be removed and timing commenced.

7.6 i) If the specimen burns for 3 min or longer, or for a length of 50 mm or longer, the specimen shall be extinguished and the concentration shall be recorded at or after 3 min or at or after 50 mm.

ii) If the specimen stops burning before 3 min and before 50 mm the concentration of oxygen shall be taken as being low. The extinguishing time shall be recorded.

7.7 Insert a new specimen. (A specimen may be re-used if cooled and the burnt end cut off, provided it complies with 6.2 and 7.2.)

Adjust the oxygen concentration based on the results of 7.6. Repeat test procedure at 7.4 to 7.6.

7.8 Continue the test according to 7.7 with one test only at each oxygen concentration until two concentrations are obtained which satisfy the conditions given in items (a), (b) and (c) below:

- The first oxygen concentration gives the result that the specimen burns for at least 3 minutes or along a length of at least 50 mm;
- The second oxygen concentration gives the result that the specimen extinguishes itself within less than 3 minutes and burns along a length of less than 50 mm; and
- The numerical difference between the percent oxygen concentration found in items (a) and (b) shall not exceed 0.25.

The oxygen concentration corresponding to item (a) above is taken as the approximate oxygen index value at this stage.

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7.9 Conformatory tests shall now be carried out using the following criteria:

At each oxygen concentration tried, the majority result of three determinations shall be recorded as the result for that concentration. (Results from the original series, obtained in 7.8 shall be included).

The first concentration tried should be the approximate oxygen index value obtained in 7.8. Tests shall be then be continued in steps not exceeding ± 0.25 percent oxygen concentration either up or down depending on the majority result at this approximate oxygen index value.

When majority results are obtained which satisfy 7.8 (a), (b) and (c), testing shall be discontinued.

The majority result corresponding to 7.8(a) is taken as the absolute oxygen index value of the material under test.

8 TABULATION OF OBSERVATION

Sl No.	Specimen	Observations
i)		
ii)		
iii)		
iv)		
v)		

9 REPORT

The report shall include the following:

- The absolute oxygen index value.
- A description of any unusual behaviour observed during test.

10 CONFORMATION OF MINIMUM OXYGEN INDEX

The procedure which has been described is for determining the absolute value of the oxygen index. Where it is required to check that the oxygen index is above a minimum specified value, the procedure outlined in 7.3, 7.4 and 7.5 shall be adopted and the requirement is satisfied of 7.6 (ii) is applicable.

NOTES

1 Test Column

It has been found that if the glass test column becomes unduly hot, lower oxygen index values may be obtained. It is, therefore, suggested that two test columns should be available for use.

2 Calibration

Suitable methods of calibration and degree of accuracy of equipment are under consideration.

3 Flowmeters

If flowmeters are used which are calibrated for air, corrections shall be made for the densities of the gases.

11 CONCLUSION

Specimen meets/does not meet the requirements of the specification.

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