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Vulcanized rubber – Determination of insulation resistance

Élastomères vulcanisés – Détermination de la résistance d'isolement

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up has the right to be represented on that Committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2951 was drawn up by Technical Committee ISO/TC 45, *Rubber and rubber products*, and circulated to the Member Bodies in November 1972.

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It has been approved by the Member Bodies of the following countries :

ISO 2951:1974

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| Australia | Hungary | Romania |
| Austria | India | South Africa, Rep. of |
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| Canada | Mexico | Thailand |
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No Member Body expressed disapproval of the document.

Vulcanized rubber – Determination of insulation resistance

0 INTRODUCTION

This International Standard specifies an empirical method that gives a value for insulation resistance which includes, without discrimination, both volume and surface resistance. This value can be used for the comparison of the quality of different insulating vulcanized rubbers.

For general principles regarding measuring resistance, general effects of temperature and humidity applied voltage and time of electrification, see IEC Publication 93 and IEC Publication 167.

1 SCOPE

This International Standard specifies procedures for the determination of insulation resistance without discrimination between the volume and surface resistances involved. This method should only be used for test pieces with a resistance greater than $10^8 \Omega$.

NOTE – Methods of test for test pieces with lower resistance are described in ISO 1853 and ISO 2878.

2 FIELD OF APPLICATION

Because the test pieces are simply and easily prepared, these methods are particularly useful for rapidly determining values which will give a general indication of quality when great accuracy is not required.

3 REFERENCES

ISO 1853, *Measurement of resistivity of conducting and antistatic rubbers.*

ISO 2878, *Antistatic and conductive rubber products – Determination of electrical resistance.*

IEC Publication 93, *Recommended methods of test for volume and surface resistivities of electrical insulating materials.*

IEC Publication 167, *Methods of test for the determination of the insulation resistance of solid insulating materials.*

4 DEFINITION

insulation resistance (between two electrodes which are in contact with, or embedded in, a test piece) : The ratio of the direct voltage applied to the electrodes to the total current between them at a given time after the application of that voltage. It is dependent upon both the volume and surface resistances of the test piece and is a function of the shape of the test piece.

5 TEST EQUIPMENT

5.1 The insulation resistance shall be determined either by a bridge method or by measuring the current and voltage. Brief descriptions of suitable equipment are given in IEC Publication 93.

5.2 Suitable equipment shall be provided to supply a voltage of 500 ± 10 V d.c., which is steady enough so that the charging current appearing when the voltage varies is negligible compared with the current flowing through the test piece.

6 ELECTRODES

The electrodes shall be made of such a material that they will not corrode under the conditions of test or react with the material being tested. Suitable electrodes are :

6.1 **Conducting paint electrodes** (for flat plates, tubes and rods)

Conducting paint such as conductive silver or colloidal graphite with a surface resistance of less than 100Ω may be used as an electrode material. The vehicle of the conducting paint shall be of such a nature that it will not have any effect on the insulation resistance to be measured. Apply two equidistant stripes of conducting paint approximately 1 mm wide around tubes and rods so that the nearest edges are $10 \pm 0,5$ mm apart.

NOTE – This can be easily done by mounting the tube or rod in a lathe and rotating it against a small brush or drawing pen containing the paint.

This type of electrode may also be used on plate test pieces. In this case, the electrodes shall be two parallel stripes of conducting paint approximately 1 mm wide spaced $10 \pm 0,5$ mm apart, the total length of each electrode being 100 ± 1 mm (see figures 1 and 2).

6.2 Bar electrodes (for thin sheets and tapes)

Metal bar clamps about 10 mm X 10 mm X 50 mm which are spaced $25 \pm 0,5$ mm apart (see figure 3) are suitable electrodes for thin sheet material (usually 1 mm or less in thickness) and for flexible tapes. The bar electrodes shall be mounted by means of insulating parts on a metal support to be used as a guard in the measurement of resistance (see figure 3A). Alternatively, the electrodes may be supported by the test piece or their connections to the insulated terminals (see figure 3B). For rigid materials, the bars shall have tinfoil wrapped around them and, after the bars have been clamped on to the test piece, the tinfoil shall be pressed down with a thin tool along the edge of the electrode to ensure intimate contact with the test piece.

7 TEST PIECES

7.1 Test pieces for conducting paint electrodes

For measurements with conducting paint electrodes, the test pieces shall be rectangular sheets having a size at least 60 mm X 150 mm (see figure 1), or rods or tubes at least 60 mm long (see figure 2).

7.2 Test pieces for bar electrodes

For measurements with bar electrodes, the test pieces in the form of tapes or thin sheets shall be 26 mm or less in width and at least 50 mm long (see figure 3A and B).

7.3 Attachment of electrodes

The electrodes shall be attached to the test pieces before conditioning.

7.4 Conditioning

Prior to the test, the test piece shall be conditioned, avoiding the application of any stress or strain by bending, twisting or compression, for at least 16 h at :

- 23 ± 2 °C 50 ± 5 % relative humidity
- or 27 ± 2 °C 65 ± 5 % relative humidity

The same temperature and humidity shall be used throughout any one test or series of tests intended to be comparable.

7.5 Number of test pieces

Three test pieces shall be tested.

8 PROCEDURE

8.1 If necessary, clean the test piece (see clause A.1 in the annex) and mount it (see clause A.2 in the annex). Measure

the resistance of each test piece individually. The measurement shall be made while the test piece is still in the conditioning atmosphere.

8.2 Measure the resistance with suitable equipment (see clause 5) having the required sensitivity and an accuracy of ± 5 %. Unless otherwise specified, the applied voltage shall be 500 ± 10 V, and the time of electrification 1 min (see IEC Publication 93).

9 EXPRESSION OF RESULTS

9.1 Specimens using conducting paint electrodes

The insulation resistance R_{100} , for a standard 100 mm electrode length is calculated using the formula

$$R_{100} = \frac{L}{100} R_x$$

where

R_x is the measured insulation resistance in megohms;

L is the measured length of electrode in millimetres.

9.2 Specimens using bar electrodes

The insulation resistance, R_{25} , for a standard 25 mm electrode length is calculated using the formula

$$R_{25} = \frac{W}{25} R_x$$

where

R_x is the measured insulation resistance in megohms;

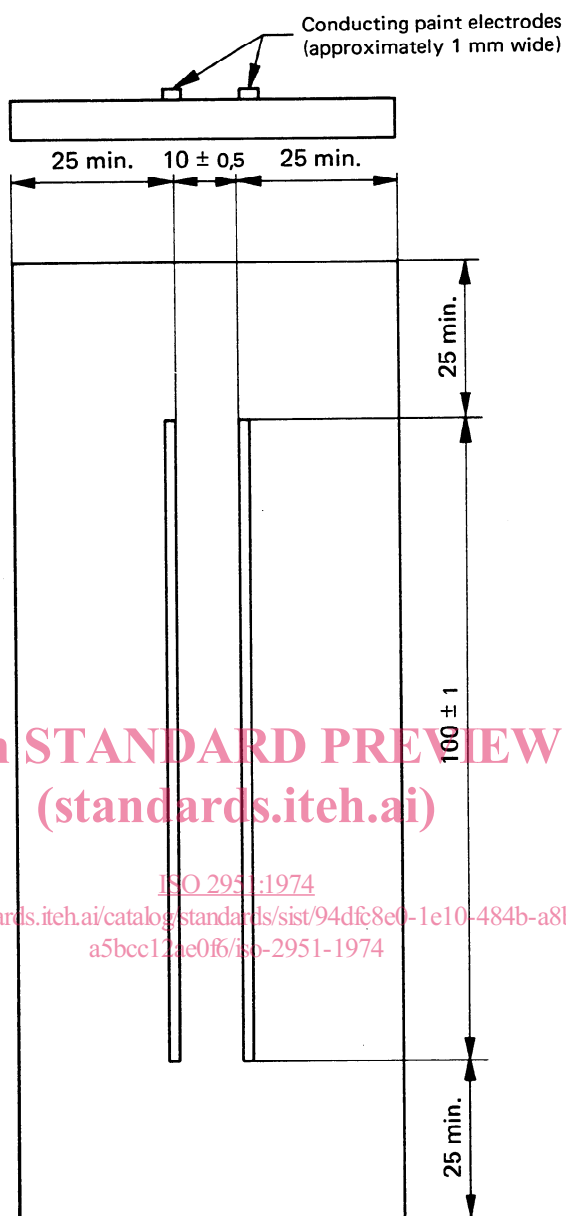
W is the measured width of the test piece, in millimetres.

10 TEST REPORT

The test report shall contain the following information as a minimum :

- a) identification of the material tested;
- b) dimensions of test piece;
- c) method of test and type of electrodes, including nature of conducting paint, if used;
- d) cleaning procedure if any;
- e) conditions during measurement;
- f) test voltage;
- g) time of electrification;
- h) individual values of insulation resistance (i.e. R_{100} or R_{25} values) in megohms;
- j) the median value of insulation resistance of the three test pieces, in megohms.

Dimensions in millimetres



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FIGURE 1 – Plate test pieces with conducting paint electrodes

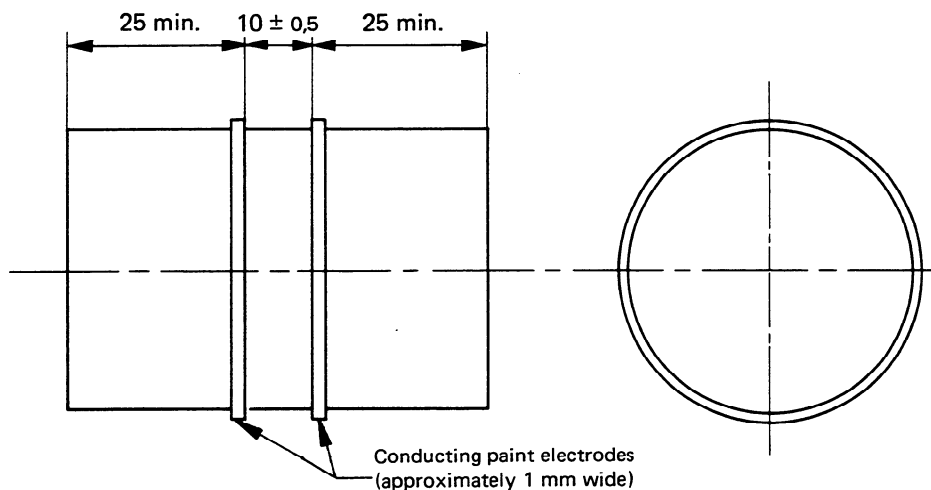


FIGURE 2 – Tube or rod test piece with conducting paint electrodes

Dimensions in millimetres

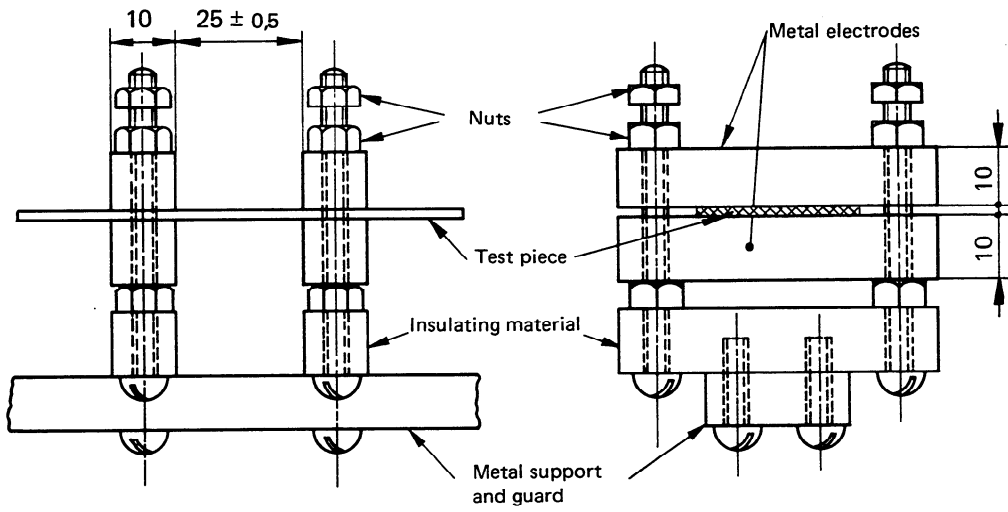


FIGURE 3A

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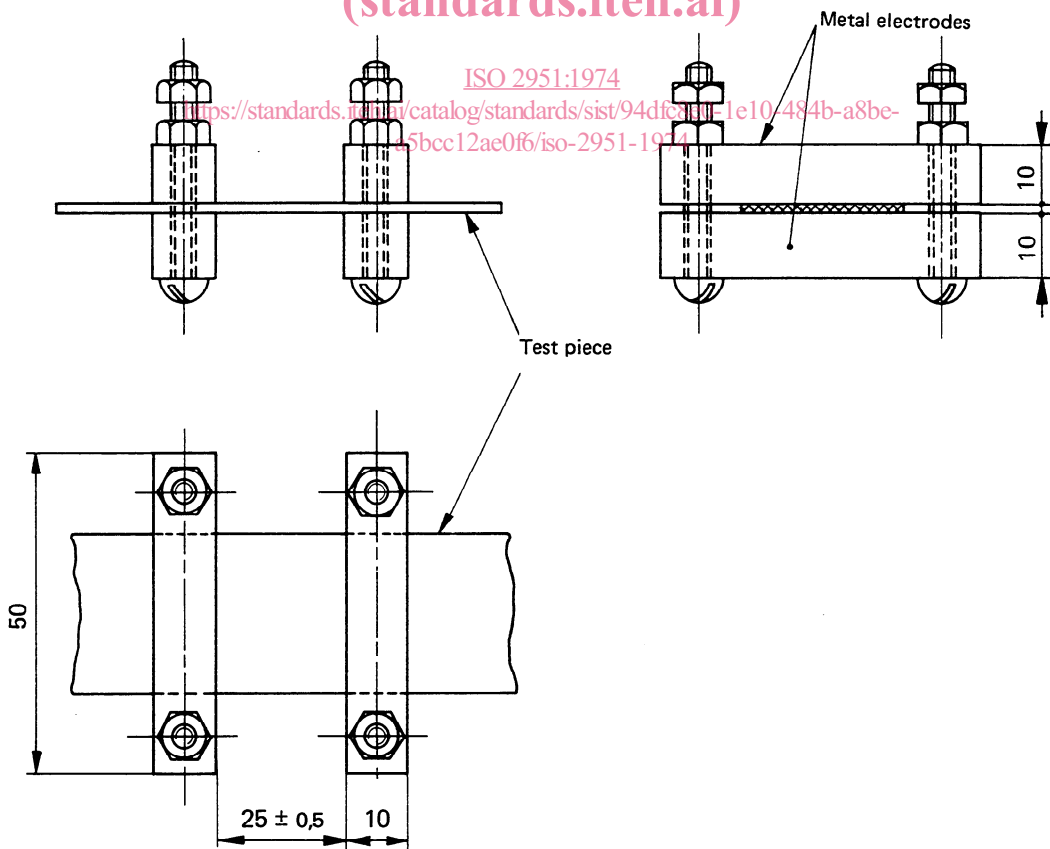


FIGURE 3B

FIGURE 3 – Bar electrodes for tapes or thin sheet material

ANNEX

CLEANING AND MOUNTING OF TEST PIECES

A.1 CLEANING

In many cases, it is desirable to test the material in the condition in which it is to be used after handling and processing. In this event, the test pieces should not be cleaned. If cleaning is desired, the surfaces of the test pieces should be cleaned with an alcohol and ether mixture or other suitable material which does not materially affect the resistance of the rubber before conditioning and should not be handled with the bare fingers (acetate rayon gloves are recommended).

A.2 MOUNTING

In mounting the test pieces for measurement, it is important that there should be no conducting path between the electrodes other than those associated with the test piece. The supporting material should have a resistance greater than $10^{12} \Omega$. When the mounting supports require guarding, this should be done in accordance with the principles given in IEC Publication 93.

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