INTERNATIONAL STANDARD 2878

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Rubber, vulcanized — Antistatic and conductive products — Determination of electrical resistance

Caoutchouc vulcanisé — Produits antiélectrostatiques et conducteurs — Détermination de la résistance électrique

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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 2878 was developed by Technical Committee ISO/TC 45, *Rubber and rubber products*, and was circulated to the member bodies in September 1975.

It has been approved by the member bodies of the following countries :

Australia	India	Thailand
Belgium	Italy	Turkey
Brazil	Mexico	United Kingdom
Bulgaria	Netherlands	U.S.A.
Canada	New Zealand	U.S.S.R.
France	Romania	Yugoslavia
Germany	Sweden	
Hungary	Switzerland	

No member body expressed disapproval of the document.

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Rubber, vulcanized — Antistatic and conductive products — Determination of electrical resistance

0 INTRODUCTION

The elimination or reduction of static voltages and charges on rubber products is important in many applications. By providing suitable leakage paths the charge can be dissipated but reduction of voltage may also be obtained by increasing the capacity of the system. The antistatic properties of an article are also influenced by its electrostatic charging characteristics. This International Standard deals only with methods involving the use of leakage paths.

The addition of carbon black to a polymer in sufficient quantities causes a conducting network of carbon particles to be formed within the mixture, and materials with a wide range of electrical conductivity can be produced. The conducting network is sensitive to strain, and the electrical resistance of the material varies according to the degree of strain and the time and temperature history after strain. Antistatic properties may also be conferred on rubber materials by incorporating ionizable materials into the rubber mix.

A method for the measurement of the resistivity of specially prepared test pieces of antistatic and conducting rubber is described in ISO 1853.

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies a method of test to determine the electrical resistance of antistatic and conductive articles and products manufactured wholly or in part from rubber, whose electrical resistance measured between defined points, when new, does not exceed 3×10^8 Ω.

It applies neither to articles the relevant surfaces of which are composed of mixtures of insulating and conducting areas nor to articles with a substantial surface area of insulating material.

The tests are carried out on the finished product using a defined system of electrodes, by a system suited to factory inspection or service testing.

2 REFERENCES

ISO 471, *Rubber — Standard temperatures and humidities for the conditioning and testing of test pieces.*

ISO 1853, *Conducting and antistatic rubbers — Measurement of resistivity.*

ISO 2882, *Rubber, vulcanized — Antistatic and conductive products for hospital use — Electrical resistance limits.*[1)]

ISO 2883, *Rubber, vulcanized — Antistatic and conductive products for industrial use — Electrical resistance limits.*

3 APPARATUS

3.1 Testing instruments

Except for the method given in 6.9, the test shall be made preferably with an ohm meter having a nominal open circuit voltage of 500 V d.c. or with any other instrument known to give comparable results.

The instrument shall be sufficiently accurate to determine the resistance within 10 % and shall not dissipate more than 1 W in the specimen.

The resistance values obtained will vary with the applied voltage, and errors may occur when low test voltages are involved. In case of dispute, the voltage applied to the test piece shall be not less than 40 V.

3.2 Electrodes and contacts

Except for the method given in 6.9, electrodes shall be formed on the surface by means of a conductive silver lacquer, colloidal graphite or a conductive liquid (see note).

When a conductive liquid is used, the electrode contact area shall be completely wetted and shall remain so until the end of the test.

The conductive silver lacquer or colloidal graphite shall be dried in air at room temperature; the surface resistance of the dried film should be below 100 Ω.

Clean metal contacts shall be applied to the electrodes so that the contact area is approximately the same size as, but no greater than, the electrodes except where otherwise stated.

1) At present at the stage of draft.

The surface of the product shall not be deformed either during the application of the contacts or during the test, except as necessary to comply with 6.5.1 and 6.5.2. The products shall be supported on an insulating surface except when specified.

NOTE – The conductive liquid shall consist of :

- anhydrous polyethylene glycol of relative molecular mass 600 : 800 parts by mass;
- water : 200 parts by mass;
- wetting agent : 1 part by mass;
- potassium chloride : 10 parts by mass.

4 CONDITIONS OF TEST

All tests shall be carried out under one of the following laboratory conditions in accordance with ISO 471 :

23 ± 2 °C and 50 ± 5 % relative humidity;

or

27 ± 2 °C and 65 ± 5 % relative humidity.

However, where very large articles are being tested, it is permissible, by agreement between supplier and customer, to use the conditions prevailing in the factory, warehouse or laboratory, provided that the relative humidity is not more than 70 %.

5 PROCEDURE

5.1 Conditioning

The articles shall be conditioned for at least 16 h under one of the following standard laboratory conditions in accordance with ISO 471 :

23 ± 2 °C and 50 ± 5 % relative humidity;

or

27 ± 2 °C and 65 ± 5 % relative humidity.

However, where very large articles are being tested, it is permissible, by agreement between supplier and customer, to use the conditions prevailing in the factory, warehouse or laboratory, provided that the relative humidity is not more than 70 %.

5.2 Cleaning

The surfaces of the test piece shall be clean; if necessary, they may be cleaned by rubbing with fuller's earth (aluminium magnesium silicate) and water, washing with distilled water and allowed to dry. Do not use organic materials which attack or swell the rubber, and do not buff or abrade the test surfaces.

5.3 Application of electrodes

Immediately apply the electrodes and metal contacts as appropriate to the article to be tested and as described in clause 6.

5.4 Reconditioning

Recondition the article for not less than 5 min and not more than 2 h as described in 5.1.

5.5 Testing

Apply the voltage in the manner appropriate to the article and as described in clause 6, taking the resistance reading 1 min after the application of the voltage.

NOTE – As some materials are sensitive to moisture, take care to avoid breathing on the samples prior to and during the test.

6 PROCEDURAL DETAILS APPLICABLE TO DIFFERENT ARTICLES

6.1 Tests on one surface

Apply electrodes to two areas, each approximately 25 mm square, located on the same face of the article to be tested and situated so that the distance between their nearest edges is at least 25 % of the width of the article or 10 mm, whichever is the smaller. Alternatively, conductive silver or colloidal graphite strips 100 mm long and approximately 1 mm wide may be substituted for the 25 mm square electrodes but care should be taken to avoid the cracking of the strips.

Apply the metal contacts to the electrodes and measure the resistance.

6.2 Tests between two surfaces

Apply electrodes to two areas, each approximately 25 mm square. The test areas shall be so located that the results represent the electrical resistance of the normal discharge path in the working conditions anticipated.

Apply the metal contacts to the electrodes and measure the resistance.

6.3 Tests on products bonded or clamped to metal parts

6.3.1 *Products bonded or clamped to one metal part*

Apply an electrode to an area approximately 25 mm square on the working surface of the product; the area shall not be extended beyond this surface towards the metal part.

Apply a metal contact to the electrode and measure the resistance from this contact to the bonded or clamped metal.

NOTE – For tyres for hospital furniture, the test may be carried out by placing the tyre on an insulated wet metal plate and measuring the resistance between the plate and the hub of the wheel.

6.3.2 *Products bonded or clamped to two metal parts*

Measure the resistance between the metal parts.

6.4 Tests on hose and tubing

6.4.1 *Tests between inside surface and outside surface*

Two tests shall be carried out in accordance with 6.4.1.1 and 6.4.1.2.

6.4.1.1 Apply electrodes on the inside surface at one end (A) of the tube and on the outside surface at the other end (B). Apply electrodes 25 mm wide and extending round the complete circumference.

Apply the metal contacts to the electrodes and measure the resistance.

6.4.1.2 Proceed as in 6.4.1.1, with the electrode situated on the inside surface at B and outside surface at A.

NOTE – Ensure that there are no stray leakage paths in parallel with the test piece resistance.

6.4.2 *Tests on hose and tubing over 6 m in length, on ends only*

Apply electrodes on the inside surface at one end of the tube and on the outside surface at distances of 3 m and 6 m from the same end. Apply electrodes 25 mm wide and extending round the complete circumference. Apply the metal contacts to the inside electrode and to the electrode at 3 m. Measure the resistance, R_a.

Repeat the test between the inside electrode and the electrode at 6 m. Measure the resistance, R_b. The difference between the values R_a and R_b shall be regarded as the resistance for 3 m of the hose, provided that no reading exceeds 10^7 Ω. If any reading exceeds 10^7 Ω, thoroughly check all electrodes and repeat the test.

NOTE – Ensure that there are no stray leakage paths in parallel with the test piece resistance.

6.4.3 *Tests on hose with conducting lining only*

Apply electrodes on the inside surface at each end of the hose. Apply electrodes 25 mm wide and extending round the complete circumference.

Apply the metal contacts to the electrodes and measure the resistance.

6.4.4 *Tests on hose with conducting cover only*

Apply electrodes on the outside surfaces at each end of the hose. Apply electrodes 25 mm wide and extending round the complete circumference.

Apply the metal contacts to the electrodes and measure the resistance.

NOTE – Ensure that there are no stray leakage paths in parallel with the test piece resistance.

6.4.5 *Tests on non wire reinforced hose with permanently attached metal end cleats*

Measure the resistance between the cleats.

6.5 Tests on anaesthetic breathing bags

6.5.1 *Bag with loop and neck*

Apply electrodes on the loop of the bag (not to extend to the body of the bag) and inside the neck of the bag. The latter electrode shall be a 25 mm band around the circumference.

Suspend the bag by the loop on a 6 mm diameter metal rod and insert in the neck of the bag a metal tube 5 to 10 % larger in diameter than the neck.

Measure the resistance between the rod and the tube.

6.5.2 *Bag with two necks*

Two tests shall be carried out :

6.5.2.1 Apply electrodes inside the necks of the bag and to an area approximately 25 mm square in the centre of the outside surface of the bag. The electrodes inside the necks shall be 25 mm bands around the circumference. Insert in each neck of the bag a metal tube 5 to 10 % larger in diameter than the neck.

6.5.2.2 Apply the metal contacts to the central electrode and to one of the tubes. Measure the resistance. Then measure the resistance from the central electrode to the other tube.

6.6 Tests on furniture feet

Apply electrodes to the whole of the bottom surface in contact with the main structure of the furniture and to the whole of the surface normally in contact with the floor.

Apply the metal contacts to the electrodes and measure the resistance.

6.7 Tests on furniture buffers, textile cots and aprons

Apply electrodes to the surfaces which would normally make the contacts to provide the electrical path so that the resistance through the article is measured. The dimensions of the electrodes shall be as large as practicable but should not extend beyond the contacting areas, and should not exceed 25 mm square.

Apply the metal contacts to the electrodes and measure the resistance.

6.8 Tests on detachable tyres having tread-to-rim conduction

Apply electrodes to three areas each approximately 25 mm square. One test area shall be located on the external portion of each bead of the tyre which will be in contact with the flange of the rim, and the third on the centre line of the tread.

Apply metal contacts to the electrode on the centre line and to each of the others in turn and measure the resistance.

6.9 Tests of footwear

6.9.1 *Wet/wet electrode system*

Apply a metal contact to a liquid electrode (see 3.2) 25 mm square situated in the sole or heel area of the inside of the footwear and place the footwear on a wetted metal plate as the other electrode. Measure the resistance between the electrodes using an applied voltage of not less than 200 V.

NOTE – This reading should not be below the specified minimum value for antistatic footwear and should not be above the specified maximum value for conducting footwear (see ISO 2882 and ISO 2883).

6.9.2 *Wet/dry electrode system*

Apply a metal contact to a liquid electrode (see 3.2.) 25 mm square situated in the sole or heel area of the inside of the footwear and place the footwear on a clean dry metal plate as the other electrode. Measure the resistance between the electrodes using an applied voltage of not less than 200 V.

NOTE – This reading should not be above the specified maximum value for antistatic footwear (see ISO 2882 and ISO 2883).

In the case of dispute, the maximum resistance shall be that obtained with a force of 45 N applied to the 25 mm square electrode.

NOTE – Combined electrodes consisting of a metal electrode enclosed in a moistened pad may be used in place of the metal electrode/liquid system.

7 TEST REPORT

The test report shall include the following particulars :

a) full identification of the article tested;

b) reference to the method of test used (for example, ISO 2878, 6.8);

c) temperature and humidity of conditioning;

d) temperature and humidity of testing;

e) electrode material and size;

f) distance between the nearest edges of the electrodes;

g) each individual test result;

h) the average test result.