
**Rubber, vulcanized rubber —
Determination of insulation resistance**

*Caoutchouc vulcanisé ou thermoplastique — Détermination de la
résistance d'isolement*

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established 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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 2, *Testing and analysis*.

This third edition cancels and replaces the second edition (ISO 2951:2012), which has been technically revised.

The main changes compared to the previous edition are as follows:

- The normative references have been updated in [Clause 2](#);
- The calibration schedule has been added as [Annex B](#).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document 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 rubbers. For general principles regarding measuring resistance, general effects of temperature and humidity, applied voltage and time of electrification, see IEC 62631-3-1, IEC 62631-3-2 and IEC 62631-3-3.

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Rubber, vulcanized rubber — Determination of insulation resistance

WARNING 1 — Persons using this document should be familiar with normal laboratory practice. This document does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to determine the applicability of any other restrictions.

WARNING 2 — Certain procedures specified in this document might involve the use or generation of substances, or the generation of waste, that could constitute a local environmental hazard. Reference should be made to appropriate documentation on safe handling and disposal after use.

1 Scope

This document specifies a method for the determination of the insulation resistance of vulcanized and thermoplastic rubbers without discrimination between the volume and surface resistances involved. This method is applicable only to the test pieces with a resistance greater than $10^8 \Omega$.

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

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

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 18899:2013, *Rubber — Guide to the calibration of test equipment*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

insulation resistance

<between two electrodes which are in contact with, or embedded in, a test piece> 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

Note 1 to entry: 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.

4 Test equipment

The insulation resistance shall be determined by measuring the current and voltage. Brief descriptions of suitable equipment are given in IEC 62631-3-3.

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.

5 Calibration

The test apparatus shall be calibrated in accordance with the schedule given in [Annex B](#).

6 Electrodes

6.1 General

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 described in [6.2](#) and [6.3](#).

6.2 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 (see IEC 62631-3-1). The liquid phase 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 strips 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 strips 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 IEC 62631-3-2).

[Figures 1](#) and [2](#) illustrate this type of electrode.

6.3 Bar electrodes (for thin sheets and tapes)

Metal bar clamps measuring about $10 \text{ mm} \times 10 \text{ mm} \times 50 \text{ mm}$ 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 3 a](#)]. Alternatively, the electrodes may be supported by the test piece or their connections to the insulated terminals [see [Figure 3 b](#)].

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 of at least $60 \text{ mm} \times 150 \text{ mm}$ (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 [Figures 3 a](#)) and 3 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 $(23 \pm 2) ^\circ\text{C}$ and $(50 \pm 5) \%$ relative humidity or $(27 \pm 2) ^\circ\text{C}$ and $(65 \pm 5) \%$ 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

At least three test pieces shall be used.

8 Procedure

8.1 If necessary, clean the test piece (see [A.1](#) for guidance) and mount it (see [A.2](#) for guidance). 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 4](#)) having the required sensitivity and an accuracy of $\pm 5 \%$. Unless otherwise specified, the applied voltage shall be $(500 \pm 10) \text{ V}$, and the time of electrification 1 min (see IEC 62631-3-3).

9 Expression of results

9.1 Test pieces 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 megaohms;

L is the measured length of the electrode, in millimetres.

9.2 Test pieces 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 megaohms;

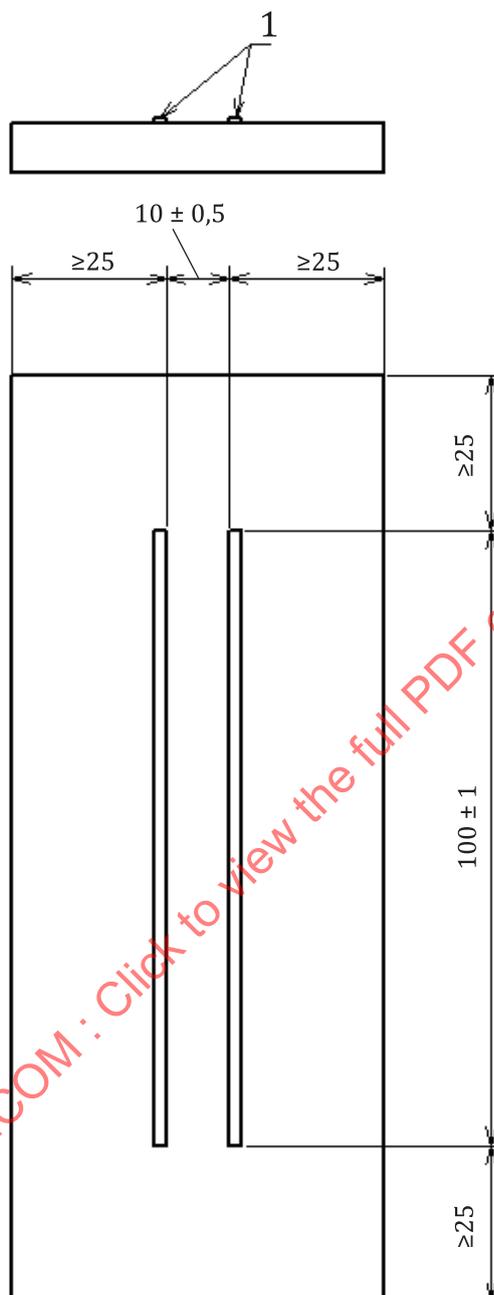
W is the measured width of the test piece, in millimetres.

10 Test report

The test report shall include the following information:

- a) sample details:
 - 1) a full description of the sample and its origin,
 - 2) the method of preparation of the test pieces from the sample, for example moulded or cut;
- b) test method:
 - 1) a full reference to the test method used, i.e. the number of this document (ISO 2951:2019),
 - 2) the type of test piece used;
- c) test details:
 - 1) the laboratory temperature and humidity,
 - 2) the number of test pieces used,
 - 3) the time, temperature and humidity of conditioning prior to the test,
 - 4) the type of electrode used, including the nature of the conducting paint, if used,
 - 5) details of any test piece cleaning procedure used,
 - 6) the test voltage,
 - 7) the time of electrification,
 - 8) details of any procedure not specified in this document;
- d) test results:
 - 1) the individual test results (i.e. R_{100} or R_{25} values), in megaohms,
 - 2) the median value of the insulation resistance, in megaohms;
- e) the date(s) of the test.

Dimensions in millimetres

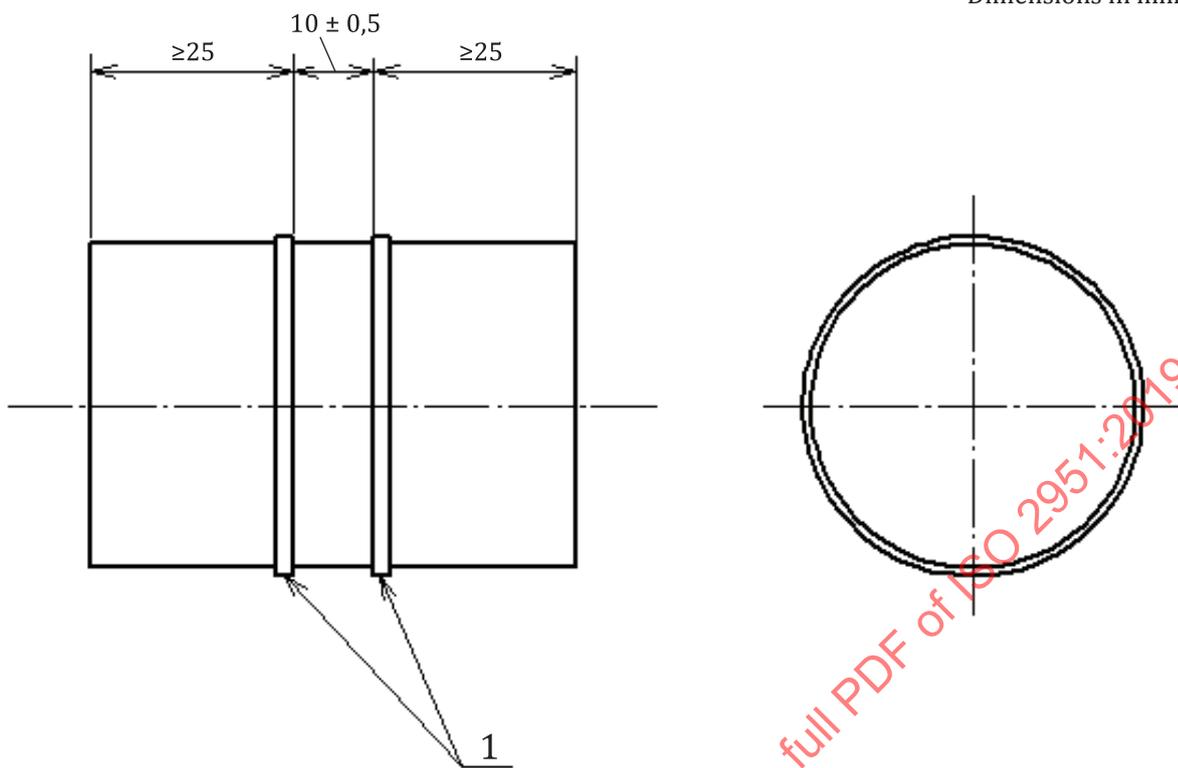


Key

- 1 conducting-paint electrodes (approximately 1 mm wide)

Figure 1 — Plate test piece with conducting-paint electrodes

Dimensions in millimetres



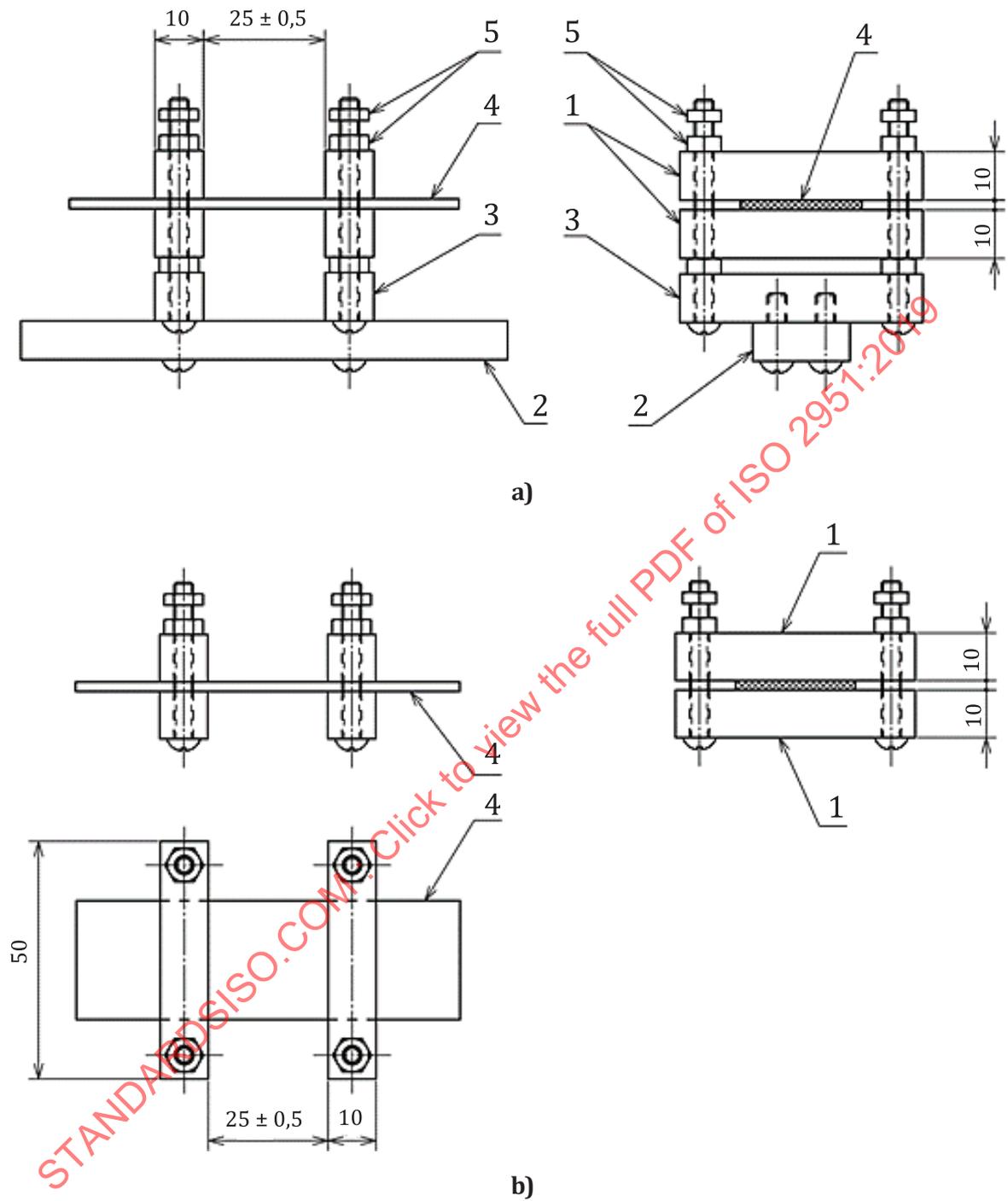
Key

- 1 conducting-paint electrodes (approximately 1 mm wide)

Figure 2 — Tube or rod test piece with conducting-paint electrodes

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Dimensions in millimetres



Key

- 1 metal electrodes
- 2 metal support and guard
- 3 insulating material
- 4 test piece
- 5 nuts

Figure 3 — Bar electrodes for tapes or thin sheet material [SOURCE: IEC 62631-3-3:2015]

Annex A (informative)

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 before conditioning with an alcohol and ether mixture or other suitable solvent which does not materially affect the resistance of the rubber and, thereafter, the surfaces should not be handled with bare fingers (acetate rayon gloves are recommended).

A.2 Mounting

In mounting the test pieces for measurement, it is important that there 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 62631-3-1.

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