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Rubber, vulcanized or thermoplastic — Determination of tendency to adhere to and corrode metals

Caoutchouc, vulcanisé ou thermoplastique — Détermination de la tendance à adhérer aux métaux et à les corroder

Reference number
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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).

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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 fifth edition cancels and replaces the fourth edition (ISO 6505:2015), of which it constitutes a minor revision. The main changes compared to the previous edition are as follows:

— the Introduction has been deleted;

— the Normative references in Clause 2 have been updated.

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.

Rubber, vulcanized or thermoplastic — Determination of tendency to adhere to and corrode metals

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 tendency of vulcanized or thermoplastic rubbers to adhere to and to corrode metals when exposed to a specified test environment.

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 48-2, *Rubber, vulcanized or thermoplastic — Determination of hardness — Part 2: Hardness between 10 IRHD and 100 IRHD*

ISO 3310-1, *Test sieves — Technical requirements and testing — Part 1: Test sieves of metal wire cloth*

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

ISO 23529, *Rubber — General procedures for preparing and conditioning test pieces for physical test methods*

3 Terms and definitions

No terms and definitions are listed in this document.

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/

4 Principle

Rubber test pieces are held between metal test strips under specified conditions in a dry or wet atmosphere for a specified period.

Subsequent visual examination of the metal surface provides a subjective indication of the degree of adhesion to the metal by the rubber and corrosion of the metal.

5 Materials

5.1 Acetone, (for cleaning of metal) of recognized analytical quality.

5.2 Other suitable solvents, (for cleaning of rubber) of recognized analytical quality and which do not have any deleterious effects on the rubber under test.

5.3 Pumice powder, passing a test sieve of nominal aperture size 53 µm complying with the requirements of ISO 3310-1.

5.4 Distilled water, or water of equivalent purity.

5.5 Silica gel.

6 Apparatus

6.1 Usual laboratory equipment, plus the following.

6.2 Support jig, to align the metal test strips and rubber test pieces, capable of supporting the clamping force, and with a facility for setting clamps to maintain the clamping force on the assembled test piece "sandwich" throughout the test period (see Figure 1).

6.3 Test chamber, complying with the requirements specified in ISO 23529, with facilities for controlling the temperature within the tolerance limits given in ISO 23529.

For tests other than those in a "dry" atmosphere, a suitable means for controlling the humidity to within the tolerance limits given in ISO 23529 shall be provided.

For tests in a "dry" atmosphere (less than 10 % humidity), a desiccator may be used. For tests at elevated temperature, it is common practice to assume low humidity.

For tests in a "wet" atmosphere (approximately 90 % humidity), a desiccator may be used with an open vessel at the bottom containing a mixture of 33 parts by mass of glycerol and 67 parts by mass of water. The relative density of this mixture will be 1,080 6 at 20 °C. The relative humidity above its surface will be approximately 90 % at 23 °C.

6.4 Polyethylene gloves, or other suitable equipment to prevent direct contact with the test surfaces.

6.5 Magnifying glass, of magnification ×3 to ×5.

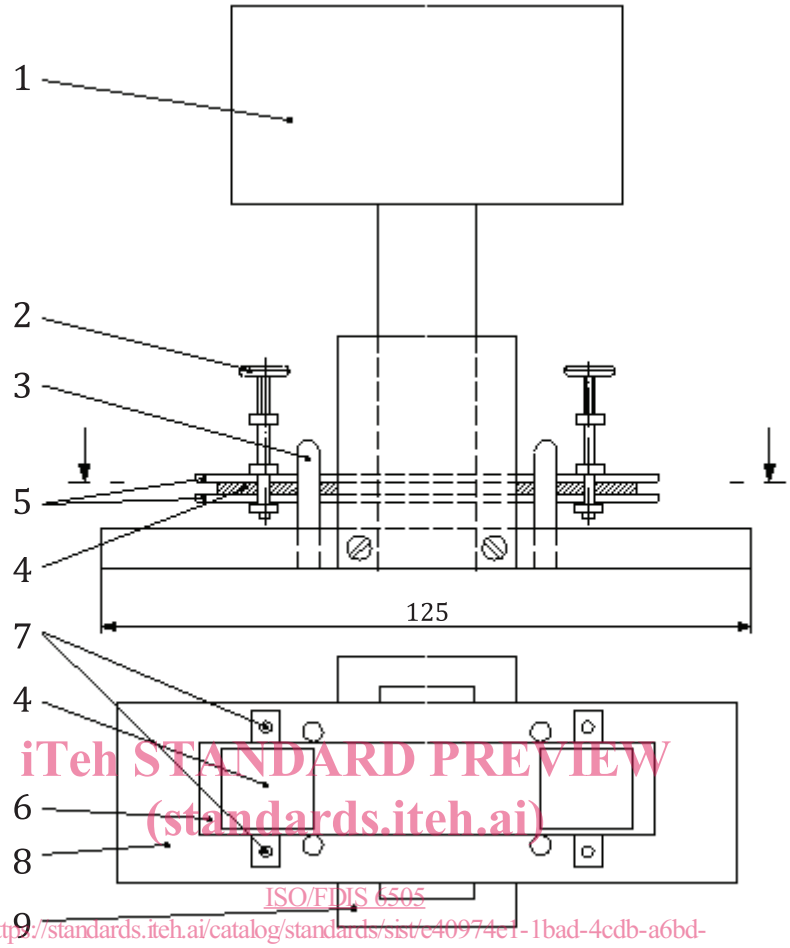
6.6 Weights, with flat bottoms.

7 Test metals

The test metals used shall be those specified in the relevant material specification. If the metals are not so specified, they shall be cut from commercial flat sheet or bar, preferably complying with a national standard, and agreed between the interested parties.

NOTE The specific grades of metal specified in previous editions of this document are no longer available. Aluminium and mild steel are most commonly used but copper, brass or other metal might be appropriate for particular applications.

Dimensions in millimetres



Key

1	10 kg weight	4	rubber test piece	7	positions of clamps
2	screw clamp	5	metal test strips	8	support base
3	locating pin	6	bottom metal test strip	9	guides for 10 kg weight

Figure 1 — Typical support jig

The metal test strips shall have a thickness sufficient to withstand the clamping force without bending. If only thin foil is available, it shall be supported by a rigid backing material previously shown to be non-corrosive to the test metals.

The test metals shall be in the form of strips with dimensions as given in Table 1.

Table 1 — Dimensions of metal test strips

Width mm	**Length** (min.) mm	**Comments**
25 ± 1	100	For use with square test pieces measuring 20 mm × 20 mm
50 ± 1	100	For use with O-rings with an outer diameter of 18 mm to 45 mm

8 Calibration

The requirements for calibration of the test apparatus are given in Annex A.

9 Test pieces

9.1 Preparation

9.1.1 Square test pieces

Square test pieces shall be (20 ± 0,5) mm × (20 ± 0,5) mm and preferably with a thickness of (2,0 ± 0,2) mm. They shall be cut or punched from sheet or from the product under evaluation in accordance with ISO 23529.

9.1.2 O-ring test pieces

O-ring test pieces shall have a cross-sectional diameter of (3,55 ± 0,1) mm. The outer diameter of the test piece shall be min. 18 mm and max. 45 mm.

9.2 Number

At least two test pieces shall be used for each test.

9.3 Time-interval between forming the material and testing

The time-interval between forming the material and testing shall be in accordance with ISO 23529.

9.4 Storage

Samples and test pieces shall be protected from light as completely as possible during the interval between forming and testing.

10 Test conditions

10.1 Temperature

The test temperature shall be selected from the list in ISO 23529.

10.2 Test period

The duration of the test shall be selected from the following: $24^{\ 0}_{-2}$ h; $72^{\ 0}_{-2}$ h; (96 ± 2) h; (120 ± 2) h; (168 ± 2) h and multiples of 7 days.

NOTE The test period of 120 h has been included alongside periods from ISO 23529 because it is used in material specifications, especially for testing in a wet atmosphere.

10.3 Humidity

In terms of humidity, the atmosphere shall be

a) either a dry atmosphere having a relative humidity of less than 10 %, or

b) a wet atmosphere having a relative humidity of (90 ± 5) %.

NOTE This test is commonly carried out at low humidity to ensure that corrosion resulting from causes other than those due to the rubber is minimized.

11 Procedure

11.1 Precaution

In all operations, it is essential that the rubber test pieces and the metal test strips are handled only by means of the polyethylene gloves or other protective equipment (see 6.4). This precaution is essential in order to minimize surface contamination of the test piece and metal strips.

11.2 Preparation of rubber test pieces for testing

Clean all the surfaces of the rubber test pieces with cotton wool pads moistened with a suitable solvent (see 5.2) to remove surface contamination (by mould release agents, for example). The solvent to be used will depend on the rubber under test; it shall not have any deleterious effects on the rubber (e.g. acetone should not be used for nitrile rubber; isopropyl alcohol is preferred for this material).

Allow the test pieces to dry in air. When dry, store the test pieces, unless otherwise specified, in a clean desiccator over silica gel at standard laboratory temperature (see ISO 23529) for at least 24 h immediately prior to testing.

Since cleaning of the test pieces might also remove from the rubber surface materials such as waxes, antiozonants, etc., which would normally be expected to affect the adhesion and corrosion properties of the rubber, allow sufficient time in the desiccator for the re-formation of the "original" surface before testing.

11.3 Number of metal test strips

For each test, use two suitable metal test strips as specified in the material specification or selected from the metals specified in Clause 7.

For tests in a wet atmosphere, use only one type of metal in the construction of the test piece "sandwich" in order to avoid electrolytic effects.

11.4 Preparation of surfaces of metal test strips

Thoroughly scour the test surfaces of the metal test strips using a slurry of pumice powder (5.3) in water applied with a cotton wool pad until a matt surface is obtained. Thoroughly rinse the metal strips with water (5.4) and then with acetone (5.1) and finally dry in air. If the prepared metal test strips are not to be used immediately after cleaning, store them in a clean desiccator over silica gel for not more than 24 h before testing.

11.5 Determination

11.5.1 Tests in a dry atmosphere

11.5.1.1 Tests using sheet material (square test pieces)

Take two rubber test pieces as specified in 9.1.1, prepared as specified in 11.2, and two metal strips of dimensions 25 mm by 100 mm, prepared as specified in 11.4. Place the two pieces of rubber between the prepared surfaces of the metal strips so that they are approximately 40 mm apart and equidistant from the ends (see Figure 1). Align the rubber/metal sandwich so formed in the support jig and apply a (10 ± 0,1) kg weight (equivalent to 122,5 kPa acting on the rubber) to the test piece sandwich. Tighten the two screws, one at each end of the sandwich, with just sufficient force to maintain the clamping force when the 10 kg weight is removed. Remove the 10 kg weight from the jig, place the sandwich in the test chamber (6.3) and maintain it at the test temperature for the test period (see Clause 10).

At the end of the test period, remove the sandwich from the test chamber, allow to cool, if appropriate, to standard laboratory temperature and maintain it at this temperature for at least 1 h. Release the

screw clamps and carefully separate the metal strips from the rubber test pieces. Examine the surface of the metal previously in contact with the rubber for signs of adhesion and corrosion. Use a magnifying glass (6.5) in examining for corrosion.

11.5.1.2 Tests using O-rings

Take two O-rings of the same size, as specified in 9.1.2, prepared as specified in 11.2, and two metal strips of dimensions 50 mm by 100 mm, prepared as specified in 11.4. Place the O-rings between the prepared surfaces of the metal strips so that they are approximately 40 mm apart and approximately equidistant from the ends of the metal strips. Align the metal/rubber sandwich so formed in the support jig and apply a load *L* in accordance with Table 2 to the test piece sandwich. Tighten the two screw clamps, one at each end of the sandwich, with just sufficient force to maintain the clamping force when the load is removed. Remove the load from the jig, place the sandwich in the test chamber (6.3) and maintain it at the test temperature for the test period (see Clause 10).

At the end of the test period, remove the sandwich from the test chamber, allow to cool, if appropriate, to standard laboratory temperature and maintain it at this temperature for at least 1 h. Release the screw clamps and carefully separate the metal strips from the rubber O-rings. Examine the surface of the metal previously in contact with the rubber for signs of adhesion and corrosion. Use a magnifying glass (6.5) in examining for corrosion.

11.5.2 Tests in a wet atmosphere

11.5.2.1 Tests using sheet material (square test pieces)

Take two rubber test pieces as specified in 9.1.1, prepared as specified in 11.2, and two metal strips of dimensions 50 mm by 100 mm, prepared as specified in 11.4. Place the two pieces of rubber between the prepared surfaces of the metal strips so that they are approximately 40 mm apart and equidistant from the ends (see Figure 1). Align the rubber/metal sandwich so formed in the support jig and apply a (10 ± 0,1) kg weight (equivalent to 122,5 kPa acting on the rubber) to the test piece sandwich. Tighten the two screws, one at each end of the sandwich, with just sufficient force to maintain the clamping force when the 10 kg weight is removed. Remove the 10 kg weight from the jig, place the sandwich in the test chamber (6.3) and maintain it at the standard laboratory temperature and a relative humidity of (90 ± 5) % for the test period (see 10.2).

At the end of the test period, remove the sandwich from the test chamber, release the screw clamps and carefully separate the metal strips from the rubber test pieces. Keep the metal strips in an atmosphere at standard laboratory temperature and a relative humidity of (50 ± 5) % for 16 h to 24 h. At the end of this period, examine the surface of the metal previously in contact with the rubber for signs of adhesion and corrosion. Use a magnifying glass (6.5) in examining for corrosion.

11.5.2.2 Tests using O-rings

Take two O-rings of the same size, as specified in 9.1.2, prepared as specified in 11.2, and two metal strips of dimensions 50 mm by 100 mm, prepared as specified in 11.4. Place the O-rings between the prepared surfaces of the metal strips so that they are approximately 40 mm apart and approximately equidistant from the ends of the metal strips. Align the metal/rubber sandwich so formed in the support jig and apply a load *L* in accordance with Table 2 to the test piece sandwich. Tighten the two screw clamps, one at each end of the sandwich, with just sufficient force to maintain the clamping force when the load is removed. Remove the load from the jig and place the sandwich in the test chamber (6.3) and maintain it at the standard laboratory temperature and a relative humidity of (90 ± 5) % for the test period (see 10.2).

At the end of the test period, remove the sandwich from the test chamber, release the screw clamps and carefully separate the metal strips from the rubber O-rings. Keep the metal strips in an atmosphere at standard laboratory temperature and a relative humidity of (50 ± 5) % for 16 h to 24 h. At the end of this period, examine the surface of the metal previously in contact with the rubber for signs of adhesion and corrosion. Use a magnifying glass (6.5) in examining for corrosion.