
International Standard



6505

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Rubber, vulcanized — Determination of adhesion to, and corrosion of, metals

Caoutchouc vulcanisé — Détermination de l'adhérence aux métaux et de la corrosion des métaux

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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.

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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 6505 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*.

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Rubber, vulcanized — Determination of adhesion to, and corrosion of, metals

0 Introduction

In assemblies which include both metallic and rubber components, it is essential to avoid adhesion of rubber to metal, and corrosion of the metal by the rubber. Adhesion occurs only where there is direct contact between the metal and the rubber, but corrosion may also arise, within a closed system, on metal components remote from the rubber, such corrosion being due to volatile materials emanating from the rubber.

Since some metals corrode more readily than others, it is not possible to specify an optimum test condition for assessing the resistance to corrosion of all metals or alloys. Furthermore, the ranking of a metal's susceptibility to corrosion will depend upon the environment in which it is exposed to the vulcanizate.

1 Scope and field of application

This International Standard specifies a method for the determination of the adhesion to, and corrosion of, metals by vulcanized rubber when exposed to a specified test environment.

2 References

ISO/R 209, *Composition of wrought products of aluminium and aluminium alloys — Chemical composition (per cent).*

ISO 426/1, *Wrought copper-zinc alloys — Chemical composition and forms of wrought products — Part 1: Non-lead and special copper-zinc alloys.*

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

ISO 630, *Structural steel.*

ISO 1337, *Wrought coppers (having minimum copper contents of 99,85 %) — Chemical composition and forms of wrought products.*

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

ISO 3383, *Rubber — General directions for achieving elevated or sub-normal temperatures for tests.*

3 Principle

Rubber test pieces are held between metal test strips under specified conditions in a specified test atmosphere for a specified period. Removal of the rubber, and visual examination of the metal surface provides an indication of the degree of adhesion and corrosion.

The test metal is either that specified in the relevant material specification or one of four standard metals.

4 Materials

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

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

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

4.4 Distilled water or water of equivalent purity.

5 Apparatus

Usual laboratory equipment, and

5.1 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 the figure).

5.2 Test chamber, complying with the requirements specified in ISO 3383, with facilities for controlling the temperature to within ± 1 °C.

5.3 Medical fingercots¹⁾, **polyethylene gloves** or **polypropylene forceps.**

5.4 Magnifying glass, of magnification X 3 to X 5.

1) Details of a suitable, commercially available product can be obtained from the Secretariat of ISO/TC 45 (BSI) or from ISO Central Secretariat.

6 Test metals

The test metals to be used shall be those specified in the relevant material specification. If the metals are not specified, they shall be selected from the standard test metals specified in the table.

Table

Standard test metal	Description
Aluminium	ISO/R 209: Grade A1 Cu4 Si Mg, condition TF
Brass	ISO 426/1: Grade Cu Zn 37, HA or HB temper
Copper	ISO 1337: Grade Cu-ETP, HA or HB temper
Carbon steel	ISO 630: Grade Fe 360A

The test metals shall be in the form of strips 25 mm wide and at least 100 mm long. The thickness of any strip shall be 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.

7 Rubber test pieces

7.1 Preparation

The rubber test pieces shall be in the form of squares of side $20 \pm 0,5$ mm. They shall be cut or punched from vulcanized sheet, preferably of thickness $2,0 \pm 0,2$ mm.

7.2 Number

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

7.3 Time lapse between vulcanization and testing

For all test purposes, the minimum time between vulcanization and testing shall be 16 h.

For non-product tests, the maximum time between vulcanization and testing shall be 4 weeks, and for evaluations intended to be comparable, the test should, as far as possible, be carried out after the same time lapse.

For product tests, whenever possible, the time lapse between vulcanization and testing should not exceed 3 months. In other cases, tests shall be made within 2 months of the date of receipt of the product by the customer.

7.4 Storage

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

8 Test conditions

8.1 Temperature

The test temperature shall be selected from the list in ISO 471.

8.2 Test period

The period of test shall be selected from the following:

22 ± 2 h, 70 ± 2 h, 166 ± 2 h or multiples of 7 days.

8.3 Humidity

For tests at elevated temperatures, a dry atmosphere having a relative humidity of less than 10 % should be used. Other humidities may be used as required by the particular application. If tests are to be carried out in atmospheres having high humidities, only like metals shall be used in the construction of the test piece "sandwich".

NOTE — This test is commonly carried out at low humidities to ensure that corrosion resulting from causes other than that of the rubber is minimized.

9 Procedure

9.1 Precaution

In all operations, it is essential that the rubber test pieces and the metal test strips are handled only by means of the medical fingercots, polyethylene gloves or polypropylene forceps (5.3). This precaution is necessary in order to minimize surface contamination.

9.2 Preparation of rubber test pieces for test

Clean all the surfaces of the rubber test pieces with cotton wool pads moistened with a suitable solvent (4.2) 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 vulcanizate (for example, acetone should not be used for nitrile rubber; isopropyl alcohol is preferred for this material.)

Allow the test piece 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 471) for at least 24 h immediately prior to testing.

NOTE — Since cleaning of the test pieces may also remove from the rubber surface such material as waxes, antioxidants, etc., which would normally be expected to affect the adhesion and corrosion properties of the vulcanizate, sufficient time should be allowed in the desiccator for the re-formation of the "original" surface before testing.

9.3 Number of metal test strips

For each test, use two appropriate metal test strips as specified in the material specification or selected from the metals specified in clause 6. The two strips may be of the same metal or dissimilar metals.

9.4 Preparation of surfaces of metal test strips

Thoroughly scour the test surfaces of the metal test strips using a pumice powder (4.3) water slurry applied with a cotton wool pad until a matt surface is obtained. Thoroughly rinse the metal strips with water and then with acetone (4.1) and finally dry in air. If the prepared metal test strips are not to be used immediately after cleaning, they should be stored in a clean desiccator over silica gel for not more than 24 h before testing.

9.5 Determination

Place two rubber test pieces prepared as specified in 9.2 between the surfaces of two metal strips prepared as specified in 9.4, so that the rubber test pieces are approximately 40 mm apart and approximately equidistant from the ends of the metal strips (see the figure). Align the metal/rubber/metal sandwich so formed in the support jig and apply a mass of $10 \pm 0,1$ kg (equivalent to 122,5 kPa on the rubber) 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 10 kg mass is removed. Remove the 10 kg mass from the jig, place the sandwich in the test chamber (5.2) and maintain at the test temperature for the test period (see clause 8).

At the end of the test period, remove the sandwich from the test environment, allow to cool, if appropriate, to standard laboratory temperature and maintain at this temperature for at least 1 h, release the screw clamps and carefully separate the metal strips from the rubber test pieces. Keep the metal in an atmosphere at standard laboratory temperature with a relative humidity of 50 ± 5 %, for 16 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 the magnifying glass (5.4) in examining for corrosion.

10 Expression of results

10.1 Degree of adhesion

Evaluate the degree of adhesion according to the following criteria:

- a) Complete separation from both metal surfaces. No indication of adhesion.

- b) Considerable force necessary to separate metal surfaces. Particles of rubber remain adhering to one or both metal surfaces.

10.2 Degree of corrosion

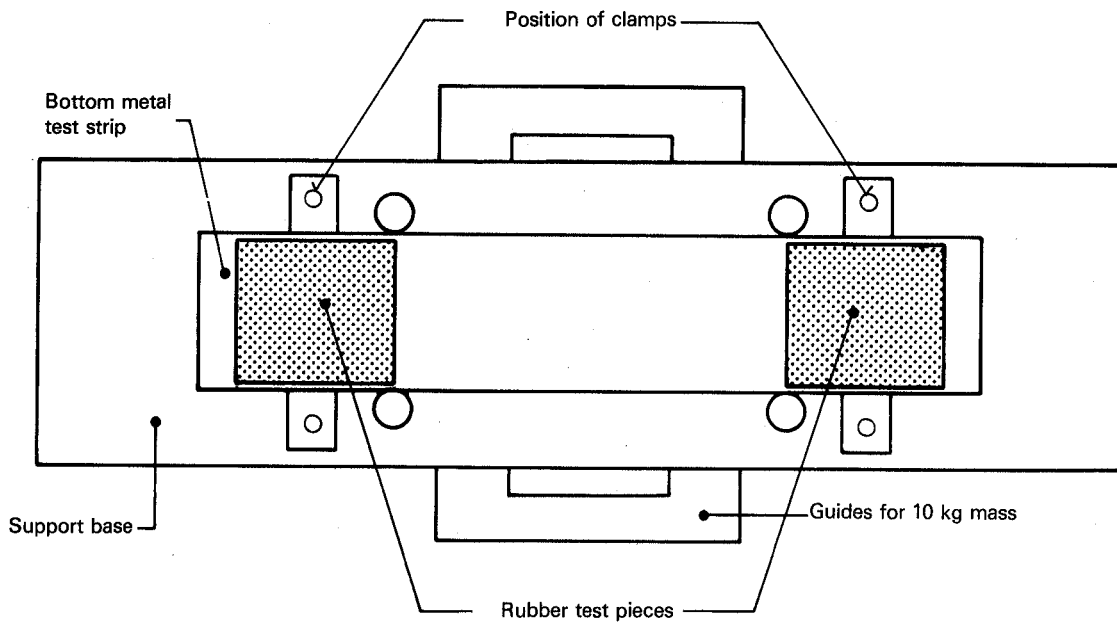
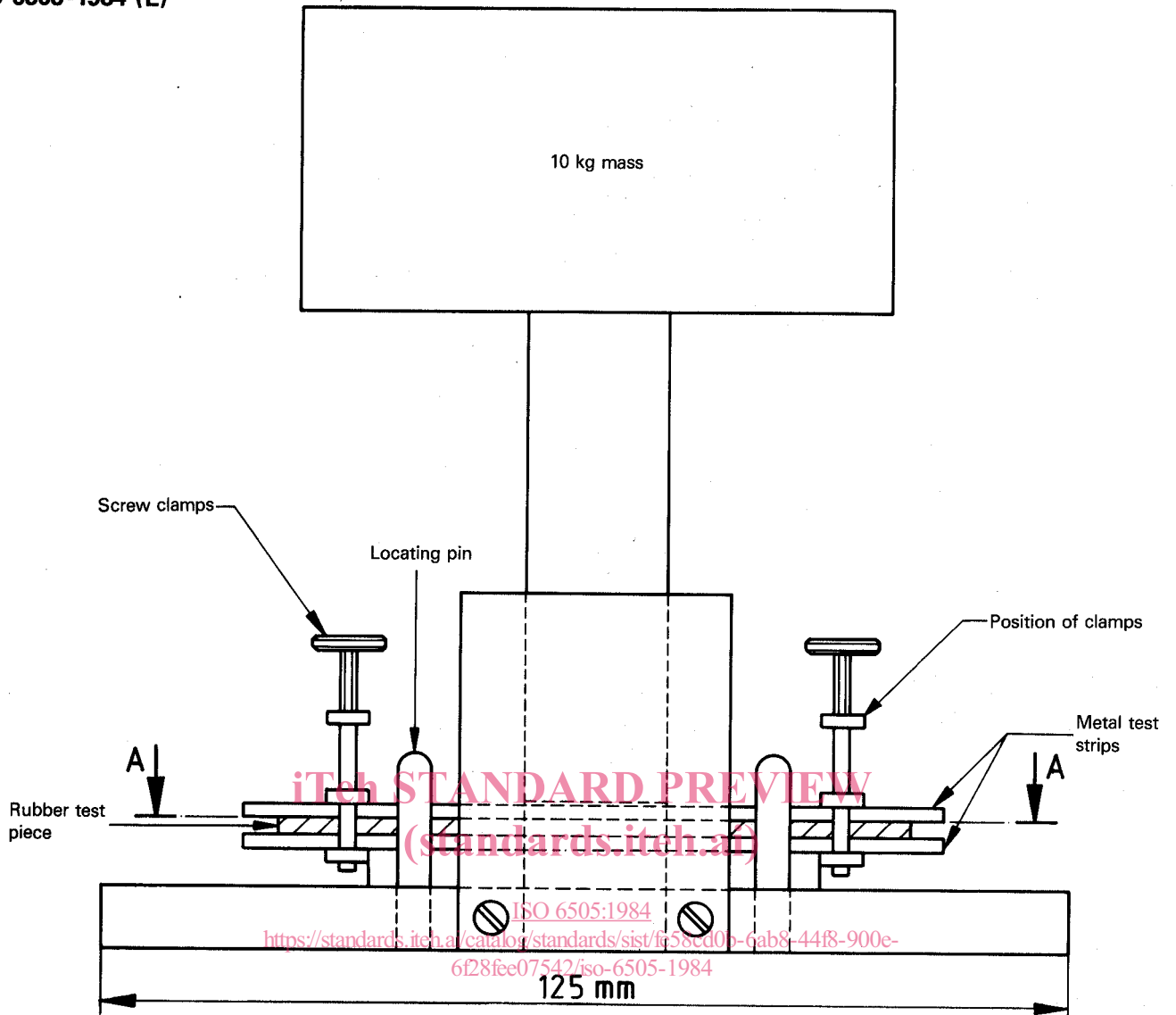
Evaluate the degree of corrosion according to the following criteria:

- a) No surface stain or corrosion.
- b) Surfaces stain or discoloration present, but no corrosion as defined by pitting or erosion of one or both metal surfaces.
- c) Corrosion as evidenced by pitting and erosion of one or both metal surfaces.

11 Test report

The test report shall include the following information:

- a) sample details:
 - 1) a full description of the sample and its origin,
 - 2) compound details, cure time and temperature, where appropriate,
 - 3) method of preparation of test pieces from the sample,
 - 4) type of metal test strips used;
- b) test method and test details:
 - 1) the reference of this International Standard,
 - 2) the standard laboratory temperature,
 - 3) the duration, temperature and humidity of test,
 - 4) any deviations from the procedure specified;
- c) test result (details of any adhesion and/or corrosion);
- d) date of test.



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Figure — Typical support jig