# INTERNATIONAL STANDARD

# ISO 6505

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

*Caoutchouc vulcanisé ou thermoplastique — Détermination de la tendance à adhérer sur les métaux et à corroder les métaux*



Reference number
ISO 6505:1997(E)

## 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 6505 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 2, *Physical and degradation tests*.

This second edition cancels and replaces the first edition (ISO 6505:1984). It has been extended to include thermoplastic rubbers and testing in other than "dry" atmospheres.





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## Introduction

In assemblies which include both metallic and rubber components, it is essential to avoid unintentional 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 rubber, e.g. in the presence of high humidity the effects on steel in particular can be severe.

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

**WARNING — Persons using this International Standard should be familiar with normal laboratory practice. This standard 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 ensure compliance with any national regulatory conditions.**

## 1 Scope

This International Standard specifies a method for the determination of the tendency of vulcanized or thermoplastic rubbers to adhere to metals and to corrode metals when exposed to a specified test environment.

## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated are valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 209-1:1989, *Wrought aluminium and aluminium alloys - Chemical composition and forms of products - Part 1: Chemical composition*

ISO 426-1:1983, *Wrought copper-zinc alloys - Chemical composition and forms of wrought products - Part 1: Non-leaded and special copper-zinc alloys*

ISO 471:1995, *Rubber - Temperatures, humidities and times for conditioning and testing*

ISO 630:1995, *Structural steels - Plates, wide flats, bars, sections and profiles*

ISO 1337:1980, *Wrought coppers (having minimum copper contents of 99,85 %) - Chemical composition and forms of wrought products*

ISO 3310-1:1990, *Test sieves - Technical requirements and testing - Part 1: Test sieves of metal wire cloth*

ISO 3383:1985, *Rubber - General directions for achieving elevated or sub-normal temperatures for test purposes*

ISO 4661-1:1993, *Rubber, vulcanized or thermoplastic - Preparation of samples and test pieces - Part 1: Physical tests*

## 3 Principle

Rubber test pieces are held between metal test strips under specified conditions for a specified period. Subsequent visual examination of the metal surface provides an subjective indication of the degree of adhesion to the metal by the rubber and corrosion of the metal.

## 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 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 within the tolerance given in ISO 471.

For tests other than those in a "dry" atmosphere a suitable means for the control of humidity shall be provided.

Note 1 - The use of saturated salt solutions has been found suitable.

**5.3 Polyethylene gloves** or other suitable equipment to prevent direct contact with the test surfaces.

**5.4 Magnifying glass**, of magnification 3x to 5x.

## 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 209-1: Grade Al 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 mm ±0,5 mm, preferably of thickness 2,0 mm ±0,2 mm. They shall be cut or punched from sheet or from the product under evaluation in accordance with ISO 4661-1.

### 7.2 Number

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

### 7.3 Time interval between forming the material and testing

The time interval between forming the material and testing shall be in accordance with ISO 471.

### 7.4 Storage

Samples and test pieces shall be protected from light as completely as possible during the interval between forming 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 duration of test shall be selected from the following:

24 h +0/-2 h; 72 h +0/-2 h; 168 h ±2 h; or multiples of 7 days.

### 8.3 Humidity

A dry atmosphere having a relative humidity of less than 10 % shall normally be used. Where tests are required by a particular application in other environments, e.g. in atmospheres having high humidity, only like metals shall be used in the construction of the test piece "sandwich" in order to avoid electrolytic effects.

Note 2 - 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 polyethylene gloves or other protective equipment (5.3). This precaution is essential in order to minimize surface contamination of the test piece and metal strips.

### 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 rubber (e.g. 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 3 - Since cleaning of the test pieces may also remove from the rubber surface such materials as waxes, antiozonants, etc., which would normally be expected to affect the adhesion and corrosion properties of the rubber, 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 (4.4) 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 kg ±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. For tests other than those in the dry atmosphere, dry the metal surfaces with cotton wool pads. Keep the metal in an atmosphere at standard laboratory temperature with 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 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 discolouration present, but no corrosion as defined by pitting or erosion of one or both metal surfaces.

c. Corrosion as evidenced by pitting and erosion on one or both metal surfaces.

## 11 Test report

The test report shall include the following information:

a) a reference to this International Standard;

b) sample details:

1) a full description of the sample and its origin;

2) compound details and curing conditions, where appropriate;

3) method of preparation of test pieces from sample;

4) type of metal test strips used;

c) test details:

1) standard laboratory temperature and humidity used;

2) duration, temperature and test environment;

3) any deviations from the standard procedure;

d) test result:

1) details of any adhesion and/or corrosion;

e) the date of test.