
**Paints and varnishes — Determination of
resistance to filiform corrosion —**

**Part 2:
Aluminium substrates**

*Peintures et vernis — Détermination de la résistance à la corrosion
filiforme —*

Partie 2: Subjectiles en aluminium

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 4623-2 was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

ISO 4623 consists of the following parts, under the general title *Paints and varnishes — Determination of resistance to filiform corrosion*:

- *Part 1: Steel substrates*
- *Part 2: Aluminium substrates*

Introduction

A scribe mark cut through a coating of paints or varnishes on metal can give rise to various types of corrosion, such as blistering of the coating, corrosion of the metal under the coating as well as filiform corrosion. Filiform corrosion tends to develop under specific conditions of temperature and relative humidity and when traces of acids, bases or salts are present either under the paint coating or at breaks in the coating. These conditions are often found in marine and/or industrial environments. A certain amount of under-corrosion of the substrate, starting from the scribe mark, will always occur. Filiform corrosion, however, is considered to be present only if the typical pattern in the form of threads is obvious.

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Paints and varnishes — Determination of resistance to filiform corrosion —

Part 2: Aluminium substrates

1 Scope

This part of ISO 4623 describes a test procedure for assessing the protective action of coatings of paints or varnishes on aluminium against filiform corrosion arising from a scribe mark cut through the coating.

It is only suitable for assessing the performance of the coating/substrate combination tested. It is not suitable for predicting the performance of the coating on different substrates.

2 Normative references

The following referenced documents are indispensable for the application 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 1513, *Paints and varnishes — Examination and preparation of samples for testing*

ISO 1514, *Paints and varnishes — Standard panels for testing*

ISO 2808, *Paints and varnishes — Determination of film thickness*

ISO 3270, *Paints and varnishes and their raw materials — Temperatures and humidities for conditioning and testing*

ISO 4628-8, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 8: Evaluation of corrosion around a scribe*

ISO 4628-10, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 10: Assessment of filiform corrosion*

ISO 15528, *Paints, varnishes and raw materials for paints and varnishes — Sampling*

3 Terms and definitions

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

3.1 filiform corrosion
type of corrosion proceeding under a coat of paint, varnish or related product, in the form of threads, generally starting from bare edges or from local damage to the coating

NOTE Usually the threads are irregular in length and direction of growth, but they may also be nearly parallel and of approximately equal length. They usually follow the extrusion direction and do not cross over one another. They need to be initiated by aggressive ions.

4 Principle

A coated test panel is scribed in a defined way. A small amount of hydrochloric acid is introduced into the scribe mark by exposure to hydrochloric acid vapour. The panel is then exposed in a test cabinet at 40 °C and a relative humidity of 82 %. The effects of exposure are then evaluated by criteria agreed in advance between the interested parties, these criteria usually being either of a subjective nature or as given in ISO 4628-10.

5 Required supplementary information

For any particular application, the test method specified in this part of ISO 4623 needs to be completed by supplementary information. The items of supplementary information are given in Annex A.

6 Sampling

Take a representative sample of the product to be tested (or of each product in the case of a multicoat system), as specified in ISO 15528.

Examine and prepare each sample for testing, as specified in ISO 1513.

7 Apparatus

Ordinary laboratory apparatus and glassware, together with the following:

7.1 Test cabinet, capable of being maintained at (40 ± 2) °C and a relative humidity of (82 ± 5) %. The cabinet shall have provision for maintaining the panels in a horizontal position (see Note) at least 20 mm apart or, if specified, provision for placing or hanging the test panels in an approximately vertical position so that the distance between the faces of adjacent panels is at least 20 mm.

NOTE Due to the hygroscopic action of the hydrochloric acid in the scribe mark, mixtures of water droplets and hydrochloric acid can be formed. Horizontal exposure will result in more corrosion which proceeds in a more regular manner along the length of each scribe mark.

7.2 Container, made of acid-resistant material, with a lid, and capable of holding the test panels at a distance of (100 ± 10) mm from the surface of the acid and at least 20 mm from each other.

7.3 Scribe tool, consisting of a sharp instrument which will produce scribe marks with the dimensions specified in 10.2 and with well-defined edges. There are many scribe tools available, and the result of the test will vary depending on the tool used. A description of the scribe tool shall be given in the test report [see Clause 13, item f)].

8 Reagents

8.1 Hydrochloric acid, of analytical grade, concentration 38 % ($\rho = 1,18 \text{ g/cm}^3$).

The quality and purity of the hydrochloric acid shall be kept constant.

9 Test panels

9.1 Material and dimensions

The test panels shall be of aluminium complying with the requirements of ISO 1514 and of minimum dimensions $100 \text{ mm} \times 70 \text{ mm} \times 0,8 \text{ mm}$, unless otherwise specified, the short dimension being in the direction of rolling of the metal.

9.2 Preparation and coating

Prepare the test panels as described in ISO 1514, unless otherwise specified, and then coat them by the specified method with the product or system under test.

Unless otherwise specified, the back and edges of the panel shall also be coated with the product or system under test.

If the coating on the back and edges of the panel differs from that of the product under test, it shall have a corrosion resistance greater than that of the product under test.

9.3 Drying and conditioning

Dry (or stove) and age (if applicable) each coated test panel for the specified time under the specified conditions, and, unless otherwise specified, condition them at the standard temperature and relative humidity defined in ISO 3270 for at least 16 h, with free circulation of air and without exposing them to direct sunlight. The test procedure shall then be carried out as soon as possible.

9.4 Thickness of coating

Determine the thickness, in micrometres, of the dried coating by one of the non-destructive procedures described in ISO 2808.

10 Procedure

10.1 Determination

Carry out all tests in duplicate unless otherwise agreed.

10.2 Scribing the test panels

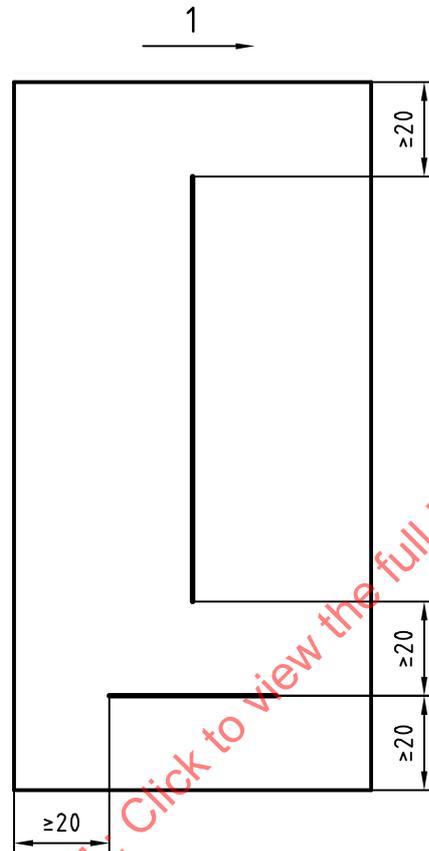
Unless otherwise specified, make two scribe marks, each at least 30 mm long, on each test panel, making the scribe marks perpendicular to each other. The distance between the scribe marks and from the scribe marks to the edge of the panel shall be not less than 20 mm (see Figure 1). The scribe marks shall be of width $(1 \pm 0,1) \text{ mm}$ unless otherwise agreed.

Remove the debris from the scribe marks. Ensure that the metal is clearly visible over the entire length of the scribe marks by use of a magnifying glass of $\times 10$ magnification.

If the aluminium has surface cladding, then the scribe mark shall penetrate through the cladding layer by 0,05 mm to 0,1 mm.

Different scribing devices produce different amounts of corrosion in the scribe mark, therefore the manner of scribing and the type of tool used shall be reported.

Dimensions in millimetres



Key
 1 rolling direction

Figure 1 — Positions of scribe marks

10.3 Testing

Into the container (7.2), place (20 ± 2) ml of hydrochloric acid (8.1) per litre of container volume. Place the test panels in the container, face down, with the scribe marks exposed to the vapour. The distance between the test panels and the surface of the liquid shall be (100 ± 10) mm, and they shall be at least 20 mm apart from each other. Place the lid on the container and keep for (60 ± 5) min at a temperature of (23 ± 2) °C. Remove the test panels, allow them to stand at the standard conditions defined in ISO 3270 for 15 to 30 minutes and then immediately place them in the test cabinet (7.1) at (40 ± 2) °C and (82 ± 5) % relative humidity until the end of the specified test period.

NOTE It is recommended that a control specimen prepared from a paint of known durability be included with each series of test panels.

10.4 Inspection of test panels

Where appropriate, at the specified intervals and on completion of the test, inspect the test panels for filiform corrosion (see Clause 11). During inspection, the panels shall not be allowed to remain out of the cabinet for more than 30 min, as a longer time may affect the development of the filiform corrosion.

If the coating is removed (by stripping) at specified intervals, make sure that enough test panels are placed in the cabinet at the beginning of the test.

11 Evaluation of the degree of filiform corrosion

Determine the length of the longest filament M and the most frequently occurring length m of the filiform threads as described in ISO 4628-10.

Report the results for the two scribe marks separately, as the scribe mark which is perpendicular to the rolling direction will show much more and longer filiform corrosion.

If specified, determine corrosion other than filiform about the scribe marks as described in ISO 4628-8.

If specified, remove the coating with a non-corrosive paint remover and re-examine the substrate.

NOTE Photographs of the test panels taken at the end of the test may be helpful in assessing the extent of the filiform corrosion.

12 Precision

No relevant precision data are currently available.

ISO/TC 35 intends to obtain precision data for all relevant standards, including this part of ISO 4623. When precision data are available, they will be incorporated in this document.

13 Test report

The test report shall contain at least the following information:

- a) all details necessary to identify the product tested;
- b) a reference to this part of ISO 4623 and its year of publication (ISO 4623-2:2003);
- c) the items of supplementary information referred to in Annex A;
- d) a reference to the international or national standard, product specification or other document supplying the information referred to in c);
- e) the duration of the test (see 10.3 and Annex A) and the intervals of inspection (see 10.4);
- f) a description of the scribe tool used and the dimensions and location of each scribe mark;
- g) the results of the test as indicated in Clause 11;
- h) any deviations, by agreement or otherwise, from the test procedure described;
- i) the dates of the test.