INTERNATIONAL STANDARD

ISO 4623-1

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Paints and varnishes — Determination of resistance to filiform corrosion —

Part 1: Steel substrates

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

Partie 1: Subjectiles en acier

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 part of ISO 4623 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 4623-1 was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

This first edition of ISO 4623-1 cancels and replaces ISO 4623:1984, of which it constitutes a minor technical revision.

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*

Annex A forms a normative part of this part of ISO 4623. Annex B is for information only.

Introduction

A scribed mark cut through a coating of paints or varnishes on steel can give rise to filiform corrosion. This corrosion tends to develop when the relative humidity is high and when traces of salts are present either under the paint coating or at breaks in the coating. A certain amount of under-rusting of the substrate, starting from the scribed mark, will always occur. Filiform corrosion, however, is considered to be present only if the typical pattern in the form of threads is obvious.

Paints and varnishes — Determination of resistance to filiform corrosion —

Part 1:
Steel substrates

1 Scope

This part of ISO 4623 is one of a series of standards dealing with the sampling and testing of paints, varnishes and related products.

It describes a test procedure for assessing the protective action of coatings of paints or varnishes on steel against filiform corrosion arising from a scribed mark cut through the coating.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 4623. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 4623 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 483, *Plastics — Small enclosures for conditioning and testing using aqueous solutions to maintain relative humidity at constant value*.

ISO 1513, *Paints and varnishes — Examination and preparation of samples for testing*.

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

ISO 2409, *Paints and varnishes — Cross-cut test*.

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 3696, *Water for analytical laboratory use — Specification and test methods*.

ISO 4628-10, *Paints and varnishes — Evaluation of degradation of coatings — Part 10: Designation of intensity, quantity and size of common types of defect*.

ISO 7253, *Paints and varnishes — Determination of resistance to neutral salt spray (fog)*.

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

3 Term and definition

For the purposes of this part of ISO 4623, the following term and definition apply.

3.1
filiform corrosion
a 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 1 Usually the threads are irregular in length and direction of growth, but they may also be nearly parallel and of approximately equal length.

NOTE 2 Filiform corrosion can also occur under other protective coatings.

4 Principle

A coated test panel is scribed in a defined way. A small amount of sodium chloride is introduced into the scribed mark, either by dipping the panel in a solution of the salt or by exposure to salt-fog. The panel is then exposed in a test cabinet at 40 °C and a relative humidity of 80 %. The effects of exposure are evaluated by criteria agreed in advance between the interested parties, these criteria either being 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 multi-coat 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 (80 ± 5) %, and having 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 If a cabinet with automatic humidity control is not available, the specified humidity may be obtained by means of a saturated aqueous solution of ammonium sulfate. This gives a constant relative humidity of 79 % at 40 °C (see ISO 483). Further details and guidance are given in annex B.

8 Reagents

8.1 Sodium chloride solution (for the dipping technique).

Unless otherwise specified, prepare the solution by dissolving 1 g of analytical grade sodium chloride in 1 litre of distilled or demineralized water of at least grade 3 as defined in ISO 3696. Place the solution in a vessel suitable for complete immersion of the test panel (see 9.1 and 10.3.2).

9 Test panels

9.1 Material and dimensions

The test panels shall be of burnished steel complying with the requirements of ISO 1514 and of minimum dimensions 150 mm × 75 mm × 0,3 mm, unless otherwise specified.

9.2 Preparation and coating

Prepare the test panels by burnishing 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 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 conditions 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 Number of determinations

Carry out all tests in duplicate unless otherwise agreed.

10.2 Scribing the test panels

Unless otherwise specified, make two scribed marks at least 30 mm long on each test panel using a suitable tool (see note). Make the scribed marks perpendicular to each other and arranged in such a way that their distance from each other or from the edge of the panel is not less than 20 mm (see Figure 1). Ensure that the cutting edge completely penetrates the coating. Remove the debris from the scribed marks. Ensure that the metal is clearly visible over the entire length of the scribed marks by use of a magnifying glass of ×10 magnification.

NOTE It has been found that the use of a mechanical scribing device gives a better scribe and has better repeatability than a hand-held scribing tool. The precise nature of the scribing tool is not critical provided that it produces a thin line with well-defined edges. A sharp blade such as the single-blade cutting tool defined in ISO 2409 has been found to be suitable.

Dimensions in millimetres

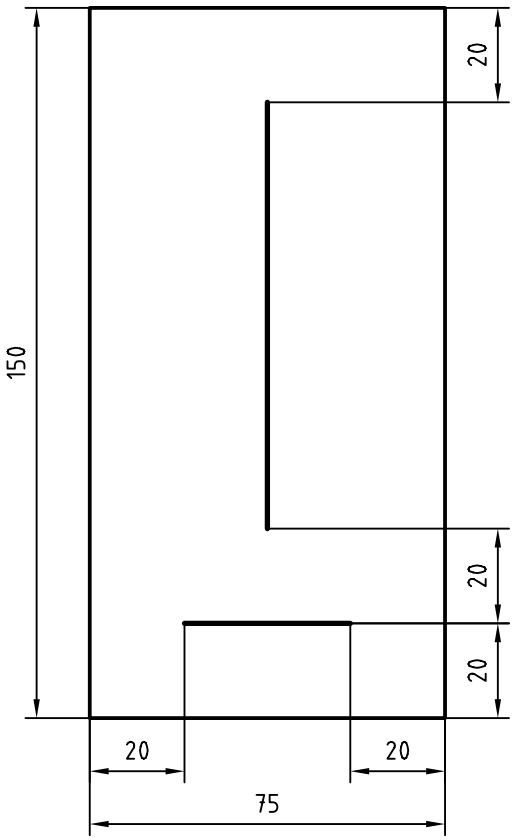

Figure 1 — Arrangement of scribes on test panel

10.3 Testing

10.3.1 General

Two alternative procedures are available, based on initiation by dipping in sodium chloride solution or by exposure to salt-fog respectively. The dipping technique is generally preferable for air-drying and low-durability materials. For high-durability systems such as automobile finishes applied to phosphated steel, the dipping technique may not produce filiform corrosion and for these systems it is preferable to adopt the salt-fog technique. In such cases, the necessary period of exposure to salt-fog will depend on the durability of the material under test but should rarely need to exceed 24 h. It should be noted that salt-fog exposure is not normally suitable for low-durability materials since with such systems it commonly produces heavy general corrosion spreading from the scribed marks and the filiform corrosion is suppressed.

10.3.2 Dipping technique

Immerse the scribed test panels for 30 s to 60 s in the sodium chloride solution (8.1).

Take the panels out of the solution and remove any drops of liquid remaining on the surface, taking care not to remove the solution from the scribed marks.

Place the panels in the test cabinet (7.1) maintained at (40 ± 2) °C and (80 ± 5) % relative humidity. Repeat the immersion procedure, as specified above, every 3 or 4 days until the end of the specified test period.

10.3.3 Salt-fog technique

Expose the scribed test panels to neutral salt-fog as described in ISO 7253 for the specified period.

Take the panels out of the salt-fog cabinet and remove any drops of liquid remaining on the surface, taking care not to remove the solution from the scribed marks.

Place the panels in the test cabinet (7.1) maintained at $(40 \pm 2)\,^{\circ}C$ and $(80 \pm 5)\,\%$ relative humidity for the specified test period.

10.4 Inspection of test panels

Where appropriate, at the specified intervals of re-immersion and on completion of the test, inspect the test panels for filiform corrosion (see ISO 4628-10). Do not allow the test panels to become completely dry at any time during the test period or during inspection, as this may affect the development of the filiform corrosion.

11 Evaluation of the degree of filiform corrosion

Evaluation of the degree of filiform corrosion is normally carried out subjectively and reported in general terms such as “slight”, “moderate” or “severe” as in ISO 4628-10. If specified, determine the maximum extent of the filiform corrosion as described in ISO 4628-10.

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

NOTE Photographs of the test panels at the conclusion of the test may be useful in assessing the extent of 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 (ISO 4623-1);

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 results of the test as indicated in clause 11;

f) any deviation, by agreement or otherwise, from the test procedure described;

g) complete details of the scribing tool and scribe mark made (see 10.2);

h) the date of the test.

Annex A
(normative)

Required supplementary information

The items of supplementary information listed in this annex shall be supplied as appropriate to enable the method to be carried out.

NOTE The information required should preferably be agreed between the interested parties and may be derived, in part or totally, from an international or national standard or other document related to the product under test.

a) The material, thickness and surface preparation of the substrate (see 9.1 and 9.2).

b) The method of application of the test coating and details of the sealing of the edges and backs of the test panels (if required) (see 9.2).

c) The thickness, in micrometres, of the dry coating, including the method of measurement in accordance with ISO 2808 and whether it is a single coating or a multicoat system (see 9.4).

d) The duration and conditions of drying (or stoving) and ageing (if applicable) of the coated test panels before testing (see 9.3).

e) The method of producing, and the dimensions of, the scribe mark (see 10.2).

f) The method used to initiate corrosion, including the period of exposure (see 10.3).

g) The duration of the test (see 10.3.2 and 10.3.3).

h) How inspection of the test coating is to be carried out and what characteristics are to be considered in evaluating its resistance to filiform corrosion (see 10.4 and clause 11).

Annex B
(informative)

Guidance notes on maintaining exposure conditions using saturated ammonium sulfate solution

B.1 General arrangements

A shallow dish filled with distilled or demineralized water and an excess of ammonium sulfate is placed at the bottom of the cabinet which should be airtight. A suitable arrangement is for the test cabinet to consist of a glass tank with a flat ground rim, covered with a plane sheet of glass. Alternatively, a desiccator vessel may be used, containing the saturated ammonium sulfate solution in the lower compartment, instead of the desiccant. The test cabinet may be maintained at the specified temperature by placing it in a suitable laboratory oven.

B.2 Precautions

The following precautions need to be taken in order to ensure that the specified exposure conditions are maintained:

a) The dish containing the saturated ammonium sulfate solution should cover most of the bottom of the cabinet but should not interfere with the arrangements for heating and air circulation.

b) The ammonium sulfate solution should remain saturated. It is advisable to ensure that the solution is saturated at 50 °C and then allow it to cool to the specified test temperature.

c) The ammonium sulfate solution and the air in the test cabinet should be at the same temperature. The solution should therefore not be separately heated.

d) The test panels should be as close as possible to the ammonium sulfate solution but should not be allowed to come into contact with it.

e) The temperature and relative humidity should be measured inside the closed test cabinet.

f) The test cabinet should be as small as possible to assist in maintaining equilibrium. Cabinets of volume much larger than 10 litres may need to be provided with air circulation. Observation of the relative humidity in the cabinet will indicate whether this is necessary.

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