

INTERNATIONAL STANDARD

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Second edition
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Paints and varnishes — Determination of resistance to neutral salt spray (fog)

*Peintures et vernis — Détermination de la résistance au brouillard salin
neutre*

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ISO 7253:1996(E)**Foreword**

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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 7253 was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

This second edition cancels and replaces the first edition (ISO 7253:1984) of which it constitutes a technical revision. The main changes are:

- a) the addition of a calibration procedure to check the corrosivity within the apparatus;
- b) more details have been given on the preparation of the scratches to be applied to the panels.

Annexes A, B and C are an integral part of this International Standard.

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Introduction

There is seldom a direct relationship between the resistance of organic coatings to the action of salt spray (fog) and the resistance to corrosion in other environments. This is because the effect of each of the several factors influencing the progress of corrosion, such as the formation of protective films, varies greatly with the conditions encountered. Therefore, the results obtained in the test should not be regarded as a direct guide to the corrosion resistance of the tested coatings in all environments where these coatings may be used. Also, performance of different coatings in the test should not be taken as a direct guide to the relative corrosion resistance of these coatings in service, even under the severe conditions of marine exposure. Nevertheless, the method described gives a means of checking that the quality of a paint or paint system is being maintained.

NOTE 1 The apparatus and operating conditions described in this International Standard comply, but do not necessarily equate, with ISO 9227:1990, *Corrosion tests in artificial atmospheres - Salt spray tests*. The minimum size of cabinet permissible for testing paints, varnishes and related products is greater (see 6.1).

Paints and varnishes — Determination of resistance to neutral salt spray (fog)

1 Scope

This International Standard is one of a series of standards dealing with the sampling and testing of paints, varnishes and related products.

It describes a method for determining the resistance of coatings to neutral salt spray (fog) in accordance with the requirements of coating or product specifications.

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 were 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 1512:1991, *Paints and varnishes — Sampling of products in liquid or paste form*

ISO 1513:1992, *Paints and varnishes — Examination and preparation of samples for testing*

ISO 1514:1993, *Paints and varnishes — Standard panels for testing*

ISO 2808:—¹⁾, *Paints and varnishes — Determination of film thickness*

ISO 3270:1984, *Paints and varnishes and their raw materials - Temperatures and humidities for conditioning and testing*

ISO 3574:1986, *Cold-reduced carbon steel sheet of commercial and drawing qualities*

ISO 3696:1987, *Water for analytical laboratory use - Specification and test methods*

ISO 4628-1:1982, *Paints and varnishes - Evaluation of degradation of paint coatings - Designation of intensity, quantity and size of common types of defect - Part 1: General principles and rating schemes*

ISO 4628-2:1982, *Paints and varnishes - Evaluation of degradation of paint coatings - Designation of intensity, quantity and size of common types of defect - Part 2: Designation of degree of blistering*

ISO 4628-3:1982, *Paints and varnishes - Evaluation of degradation of paint coatings - Designation of intensity, quantity and size of common types of defect - Part 3: Designation of degree of rusting*

ISO 4628-4:1982, *Paints and varnishes - Evaluation of degradation of paint coatings - Designation of intensity, quantity and size of common types of defect - Part 4: Designation of degree of cracking*

ISO 4628-5:1982, *Paints and varnishes - Evaluation of degradation of paint coatings - Designation of intensity, quantity and size of common types of defect - Part 5: Designation of degree of flaking*

¹⁾ To be published. (Revision of ISO 2808:1991)

3 Principle

A coated test panel is exposed to neutral salt spray (fog) and the effects of exposure are evaluated by criteria agreed in advance between the interested parties, these criteria usually being of a subjective nature.

4 Required supplementary information

For any particular application, the test method specified in this International Standard needs to be completed by supplementary information. The items of supplementary information are given in annex A.

5 Test solution

5.1 The test solution shall be prepared by dissolving sodium chloride in water of at least grade 3 purity as defined in ISO 3696 to produce a concentration of (50 ± 5) g/l. The sodium chloride shall be white, of minimum assay 99,6 % (*m/m*), and substantially free from copper and nickel; it shall contain not more than 0,1 % (*m/m*) of sodium iodide. If the pH of the solution is outside the range 6,0 to 7,0, the presence of undesirable impurities in the salt or the water or both shall be investigated.

5.2 The pH of the test solution (5.1) shall be adjusted so that the pH of sprayed solution collected within the test cabinet (see clause 6) shall be between 6,5 and 7,2. Any necessary adjustment to the pH shall be made by additions of solutions of either hydrochloric acid or sodium bicarbonate of analytical grade.

NOTE 2 Attention is drawn to the possible changes in pH resulting from loss of carbon dioxide from the test solution when it is sprayed. Such changes may be avoided by reducing the carbon dioxide content of the solution by, for example, heating it to a temperature above 35 °C before it is placed in the apparatus or by making the solution from freshly boiled water.

5.3 The test solution shall be filtered before it is placed in the reservoir of the apparatus, in order to remove any solid matter which might block the nozzle(s) of the spraying device.

6 Apparatus

Ordinary laboratory apparatus and glassware, together with the following:

6.1 A spray cabinet, made of, or lined with, material resistant to corrosion by the spray and with a roof which prevents condensed moisture dripping on to the test panels. The cabinet shall have a capacity of not less than 0,4 m³ since, with smaller volumes, difficulties are experienced in ensuring even distribution of spray.

The size and shape of the cabinet shall be such that the quantity of solution collected in the spray-collecting devices (6.4) is within the limits stated in 10.2.

Cabinets with a volume greater than 2 m³ will be difficult to operate unless careful consideration is given to their design and construction. Factors which shall be taken into consideration are given in annex B.

6.2 Adjustable heater, adequate to maintain the cabinet and its contents at the specified temperature (see 10.1). The temperature shall be controlled by a thermostat element placed within the cabinet at least 100 mm from the walls. A thermometer, capable of being read from the outside, shall be placed wholly within the cabinet at least 100 mm from the walls, roof or floor.

6.3 Spraying device, comprising a supply of clean compressed air of constant pressure and humidity, a reservoir containing the solution to be sprayed and one or more spray nozzles made of material resistant to the solution.

The compressed air supply to each spray nozzle shall be passed through a filter to remove all traces of oil or solid matter and shall be at a pressure of 70 kPa to 170 kPa²⁾. In order to prevent evaporation of the spray droplets, the air shall be humidified before entering each nozzle by passage through a saturation column containing water of at least grade 3 purity as defined in ISO 3696 at a temperature several degrees Celsius higher than that of the cabinet. The actual temperature of the water will depend on the pressure used and on the type of spray nozzle, and shall be adjusted so that the rate of collection of spray in the cabinet and the sodium chloride concentration of the spray collected are kept within the specified limits (see 10.2).

The reservoir containing the test solution shall be made of material resistant to the solution and shall be provided with a means of delivering a constant volume of solution to the spray nozzles at all times.

The spray nozzles shall be made of inert material, for example glass or plastic.

The cabinet shall be vented to ensure that there is no build up of pressure within the cabinet and in such a way that the environment outside the cabinet does not influence that inside the cabinet.

NOTE 3 Baffles may be used to prevent direct impingement of spray on the test panels, and the use of adjustable baffles is helpful in obtaining uniform distribution of spray throughout the cabinet.

6.4 Spray-collecting devices, of chemically inert material (see note 4). The collecting devices shall be placed in the zone of the cabinet where the test panels are placed, at least one close to a spray nozzle and one remote from a spray nozzle. They shall be placed so that only spray is collected, and not liquid dripping from test panels or parts of the holders or cabinet. The number of collecting devices shall be at least twice the number of spray nozzles.

NOTE 4 — Glass or plastic funnels with their stems inserted into graduated cylinders have been found to be suitable collecting devices. Funnels with a diameter of 100 mm have a collecting area of approximately 80 cm².

6.5 Test panel holders, capable of supporting the test panels at an angle of between 15° and 25° to the vertical, normally racks made of inert non-metallic material such as glass, plastic or suitably coated wood. Exceptionally, if it is necessary to suspend the test panels, the material used shall be synthetic fibre, cotton thread or another inert insulating material, but on no account metallic material. The test panels may be located at different levels in the cabinet but they shall be positioned so that the solution cannot drip from panels or holders at one level on to other panels below.

6.6 If the equipment has been used for a spray test, or for any other purpose, with a solution differing from that specified for this test, it shall be thoroughly cleaned before use.

6.7 Calibration of the equipment shall be carried out as specified in annex C.

7 Sampling

Take a representative sample of the product to be tested (or of each product in the case of a multi-coat system), as described in ISO 1512.

Examine and prepare the sample for testing, as described in ISO 1513.

8 Test panels

8.1 Material and dimensions

Unless otherwise specified or agreed, the test panels shall be of burnished steel complying with ISO 1514, and of approximate dimensions 150 mm x 100 mm x 1 mm.

²⁾ 1 kPa = 1 kN/m² (= 0,01 bar)

8.2 Preparation and coating of panels

Unless otherwise specified, prepare each test panel in accordance with ISO 1514 and then coat it 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.

8.3 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 a temperature of (23 ± 2) °C and a relative humidity of (50 ± 5) % 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.

8.4 Thickness of coating

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

8.5 Preparation of scratches

All scratches shall be at least 25 mm from each other and from any edge of the test panel.

If specified, make a straight scratch or scribed mark through the coating to the substrate.

To apply the scratch, use a scratch instrument with a hard tip. The scratch shall have either parallel sides or an upwards-broadening cross-section which shows a width of 0,3 mm to 1,0 mm of the metallic substrate, unless otherwise agreed.

One or two scratches may be applied. The scratch(es) shall be parallel to the longer edge of the test panel, unless otherwise agreed.

Cutting the scratch with a knife is not allowed.

For aluminium panels, two scratches shall be made which are perpendicular to, but do not intersect, each other. One scratch shall be parallel to the rolling direction and the other at right angles.

NOTE 5 If zinc- or zinc-alloy-coated steel is used as a test panel the intention is that the scratch should be to the zinc coating, and not further, to the steel, unless otherwise agreed.

9 Method of exposure of test panels

9.1 Place the panels in the cabinet such that they are not in the direct line of travel of spray from a spray nozzle.

9.2 Each test surface shall be placed in the cabinet facing upwards at an angle of between 15° and 25° to the vertical.

NOTE 6 The angle at which each panel is exposed in the cabinet is very important.

By agreement between the interested parties, it is sometimes necessary to expose painted components of different shapes. When such tests are conducted, it is of particular importance to expose the shaped components in their normal attitude in use. Within this restriction the component shall be placed so as to minimize the disruption of flow. Furthermore, other test panels and components cannot be tested at the same time if the shape of the painted component interferes with the general direction of flow.

The degree of film breakdown at different angles of orientation may vary, and due consideration shall be given to this in the interpretation of the results.

9.3 Arrange the panels so that they do not come into contact with one another or with the cabinet and so that the surfaces to be tested are exposed to the spray only where it is settling freely.

10 Operating conditions

10.1 The measured temperature inside the spray cabinet shall be (35 ± 2) °C.

10.2 The average rate of collection of spray solution, measured over a minimum period of 24 h, shall be 1 ml/h to 2,5 ml/h for a horizontal spray-collecting device of area 80 cm².

This solution collected shall have a sodium chloride concentration of (50 ± 10) g/l and a pH of 6,5 to 7,2 (see 5.2).

10.3 Test solution which has been sprayed shall not be re-used.

11 Procedure

Carry out the determination in duplicate, unless otherwise agreed.

11.1 Set up the apparatus and adjust it to meet the conditions specified in clause 10.

11.2 Arrange the test panels in the cabinet as described in clause 9.

11.3 Close the cabinet and start the flow of the test solution through the spray nozzle(s). Continuously spray throughout the prescribed test period, except for a short daily interruption (see clause 12) to inspect, re-arrange or remove test panels, to check and replenish the solution in the reservoir and to check that the conditions specified in clause 10 are still being met.

12 Examination of test panels

Make periodic examinations of the panels, taking care not to damage the surfaces under test. The panels shall be assessed as quickly as possible and the cabinet shall be turned off for no more than 30 min in any 24 h. Do not allow the panels to dry.

Whenever possible, the examination shall be made at the same time of day.

At the end of the specified test period, remove the panels from the apparatus and rinse with clean, warm water to remove residues of test solution from the surface. Immediately dry the panel and examine the test surfaces for signs of deterioration, for example blistering, rusting or creep of corrosion from the scratch(es), in accordance with ISO 4628, parts 1 to 5 [see annex A, item g)].

If required, keep the panels in the standard conditions defined in ISO 3270 for the specified period and then re-examine the test surfaces for deterioration.

If it is required to examine the substrate for signs of attack, remove the coating by the specified method.

13 Precision

No relevant precision data are currently available.

ISO/TC 35 intends to obtain precision data for all relevant standards, including ISO 7253. When precision data are available these will be incorporated in the standard.

Users of this standard should be aware that, because of the subjective nature of the assessment of the deterioration of the coating, precision will depend upon a number of factors. These include the evaluation method, the preparation of the test panels, the thickness of the coating, the drying and conditioning of the test panels and the preparation of the scratch(es).

However, the method has been found to be useful in comparing the salt spray resistance of different coatings. It is most useful in providing relative ratings for a series of coated panels exhibiting significant differences in salt spray resistance.

14 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 International Standard (ISO 7253);
- 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) above;
- e) the duration of the test;
- f) whether a scratch or scratches were made before exposure and, if so, their nature and position (see 8.5);
- g) whether the position of the panels was changed;
- h) the results of the test, in terms of the stated requirements;
- i) any deviation from the test procedure specified;
- j) 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.

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) Substrate material and surface preparation to be used (see 8.1 and 8.2).
- b) Method of application of the test coating to the substrate (see 8.2).
- c) Duration and conditions of drying (or stoving) and ageing (if applicable) of the test panel before testing (see 8.3).
- d) Thickness, in micrometres, of the dry coating and method of measurement in accordance with ISO 2808, and whether it is a single coating or a multi-coat system (see 8.4).
- e) Number and location of scratches to be made before exposure.
- f) Duration of the test (see clause 12).
- g) How inspection of the test coating is to be carried out and what characteristics are to be considered in evaluating its resistance properties (see clause 12).

Annex B

(normative)

Factors to be taken into account in the design and construction of salt spray cabinets greater than 2 m³ in volume (see 6.1)

- B.1** The number and positioning of spray nozzles and baffles required to produce an even spray distribution within the limits specified in 10.2.
- B.2** The number of collecting devices required to monitor the spray rate as required in 6.4.
- B.3** The heating, insulation and control equipment required to produce a uniform temperature within the cabinet at all positions where test panels are exposed.
- B.4** The design of the ceiling (for example a false ceiling) needed to prevent drops of solution falling on to the test panels as required in 6.1.

Annex C

(normative)

Calibration of the apparatus (see 6.7)

C.1 General

For quality assurance purposes (using e.g. the ISO 9000 series of International Standards) it is necessary to carry out a correlation assessment on all test equipment to establish that the response of a coating or coating system to the method of test detailed in this International Standard, when exposed in separate test runs but under identical conditions, results in a reproducible absence or degree of degradation.

In the case of very large or 'walk-in' cabinets, it is necessary to establish that any position within the exposure volume will give rise to an equivalent performance or degradation with similar test panels.

It is necessary for reproducibility to be assessed by the simultaneous exposure, for a specified time, of a number of reference panels prepared by one source, and for the operating parameters within this International Standard to be adjusted to obtain reproducibility.

C.2 Reference panels

C.2.1 The reference panels shall be of steel complying with grade CR4 of ISO 3574 and of approximate dimensions 150 mm × 75 mm, with a thickness of $(1 \pm 0,2)$ mm.

C.3 Preparation of reference panels

C.3.1 Prepare the reference panels by abrasion (burnishing) in accordance with ISO 1514.

C.3.2 Immediately before testing, carefully clean the reference panels with an appropriate organic solvent, using a soft brush or an ultrasonic cleaning device. Carry out the cleaning in a vessel full of solvent. After cleaning, rinse the reference panels with fresh solvent and dry them.

NOTES

7 Hydrocarbon solvent with a boiling point range of 60 °C to 120 °C is suitable.

8 Other cleaning methods may be used by agreement between interested parties, provided the results are comparable.

C.3.3 Weigh the reference panels to within 1 mg.

C.3.4 Protect the backs of the reference panels with self-adhesive waterproof foil.

C.4 Procedure

C.4.1 Place at least six reference panels facing upwards in the panel racks (see 6.5) at an angle of $(20 \pm 5)^\circ$ to the vertical, within the cabinet, arranged so that distribution effects can be determined.

NOTE 9 - Larger cabinets may require a greater number of reference panels.

C.4.2 Expose the reference panels for 96 h, without interruptions totalling more than 30 min.

C.4.3 At the end of the exposure period, remove the protective backing, remove the loosely adhering corrosion products with a stiff nylon brush or pad, and wash the exposed face under running water. Remove chemically the

remaining corrosion products by one of the following methods, taking care not to allow the chemical used to act on the panels for any longer than necessary (see note 10):

- a) Immerse the panels in a 50 % (V/V) solution of concentrated hydrochloric acid ($\rho = 1,18$ g/ml) in water, inhibited by 3,5 g of hexamethylene tetramine per litre of solution.
- b) Immerse the panels in a 20 % (V/V) solution of concentrated hydrochloric acid ($\rho = 1,18$ g/ml) in water, inhibited by 1 ml of propargyl alcohol per litre of solution.

NOTE 10 It has been found in practice that these methods take about 15 min.

C.4.4 After the corrosion products have been removed, thoroughly rinse the panels in running water, wash with acetone, and dry.

C.4.5 Reweigh the reference panels and calculate the loss in mass, in grams per square metre of exposed area.

The apparatus shall be deemed satisfactory if the mean loss in mass of the reference panels is (130 ± 20) g/m² and no individual panel has a mass loss greater or less than 25 g/m² from the mean or from a value agreed by the interested parties.

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