



SLOVENSKI STANDARD
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Korozijsko preskušanje v umetnih atmosferah – Korozijski preskusi v slani komori

Corrosion tests in artificial atmospheres -- Salt spray tests

Essais de corrosion en atmosphères artificielles -- Essais aux brouillards salins

Ta slovenski standard je istoveten z: ISO 9227:1990

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INTERNATIONAL STANDARD

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Corrosion tests in artificial atmospheres — Salt spray tests

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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.

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 9227 was prepared by Technical Committee ISO/TC 156, *Corrosion of metals and alloys*.

It cancels and replaces International Standards ISO 3768:1976, ISO 3769:1976 and ISO 3770:1976.

Annexes A and B of this International Standard are for information only.

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Introduction

There is seldom a direct relation between resistance to the action of salt spray and resistance to corrosion in other media, because several factors influencing the progress of corrosion, such as the formation of protective films, vary greatly with the conditions encountered. Therefore, the test results should not be regarded as a direct guide to the corrosion resistance of the tested metallic materials in all environments where these materials may be used. Also, the performance of different materials during the test should not be taken as a direct guide to the corrosion resistance of these materials in service.

Nevertheless, the method described gives a means of checking that the comparative quality of a metallic material, with or without corrosion protection, is maintained.

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Corrosion tests in artificial atmospheres — Salt spray tests

1 Scope

This International Standard specifies the apparatus, the reagents and the procedure to be used in conducting the neutral salt spray (NSS), acetic acid salt spray (AASS) and copper-accelerated acetic acid salt spray (CASS) tests for assessment of the corrosion resistance of metallic materials with or without permanent corrosion protection or temporary corrosion protection.

It also describes the method employed to evaluate the corrosivity of the test cabinet environment.

It does not specify the dimensions of test specimens, the exposure period to be used for a particular product, or the interpretation of results. Such details are provided in the appropriate product specifications.

The salt spray tests are particularly useful for detecting discontinuities such as pores and other defects in certain metallic, anodic oxide and conversion coatings.

The neutral salt spray test applies to

- metals and their alloys;
- certain metallic coatings (anodic and cathodic)¹⁾;
- certain conversion coatings¹⁾;
- certain anodic oxide coatings¹⁾;
- organic coatings on metallic materials.

The acetic acid salt spray test is especially useful for testing decorative coatings of copper + nickel +

chromium or nickel + chromium. It has also been found suitable for testing anodic oxide coatings on aluminium.

The copper-accelerated acetic acid salt spray test is useful for testing decorative coatings of copper + nickel + chromium or nickel + chromium; it has also been found suitable for testing anodic coatings on aluminium.²⁾

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 1462:1973, *Metallic coatings — Coatings other than those anodic to the basis metal — Accelerated corrosion tests — Method for the evaluation of the results.*

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

ISO 4540:1980, *Metallic coatings — Coatings cathodic to the substrate — Rating of electroplated test specimens subjected to corrosion tests.*

ISO 6372-1:1989, *Nickel and nickel alloys — Terms and definitions — Part 1: Materials.*

1) See annex B.

2) Attention is drawn to the fact that no satisfactory basis for comparison can be derived from this test with regard to the respective quality of nickel + chromium coatings and copper + nickel + chromium coatings, because the reagent used contains a copper ion which promotes corrosion in the presence of nickel but is without influence on copper.

3 Test solutions

3.1 Preparation of the sodium chloride solution

Dissolve a sufficient mass of sodium chloride in distilled or deionized water with a conductivity not higher than $20 \mu\text{S}/\text{cm}$ at $25 \text{ }^\circ\text{C} \pm 2 \text{ }^\circ\text{C}$ to produce a concentration of $50 \text{ g/l} \pm 5 \text{ g/l}$. The sodium chloride concentration of the sprayed solution collected shall be $50 \text{ g/l} \pm 5 \text{ g/l}$. The specific gravity range for a $50 \text{ g/l} \pm 5 \text{ g/l}$ solution is 1,0255 to 1,0400 at $25 \text{ }^\circ\text{C}$.

The sodium chloride shall contain less than 0,001 % (*m/m*) of copper and less than 0,001 % (*m/m*) of nickel as determined by atomic absorption spectrophotometry or another analytical method of similar sensitivity. It shall not contain more than 0,1 % (*m/m*) of sodium iodide or more than 0,5 % (*m/m*) of total impurities calculated for dry salt.

NOTE 1 If the pH of the prepared solution, measured at $25 \text{ }^\circ\text{C} \pm 2 \text{ }^\circ\text{C}$, is outside the range 6,0 to 7,0, investigate the presence of undesirable impurities in the salt and/or the water.

3.2 pH adjustment

Adjust the pH of the salt solution to the desired value on the basis of the pH of the sprayed solution collected.

3.2.1 NSS test

Adjust the pH of the salt solution (3.1) so that the pH of the sprayed solution collected within the test cabinet (4.1) is between 6,5 to 7,2. Check the pH using electrometric measurement at $25 \text{ }^\circ\text{C} \pm 2 \text{ }^\circ\text{C}$, or, in routine checks, with a short-range pH paper which can be read in increments of 0,3 pH units or less. Make any necessary correction by adding hydrochloric acid or sodium hydroxide solution of analytical grade.

Possible changes in pH may result from loss of carbon dioxide from the 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 $35 \text{ }^\circ\text{C}$ before it is placed in the apparatus, or by making the solution from freshly boiled water.

3.2.2 AASS test

Add a sufficient amount of glacial acetic acid to the salt solution (3.1) to ensure that the pH of samples of sprayed solution collected in the test cabinet (4.1) is between 3,1 and 3,3. If the pH of the solution as initially prepared is 3,0 to 3,1, the pH of the

sprayed solution is likely to be within the specified limits. Check the pH using electrometric measurement at $25 \text{ }^\circ\text{C} \pm 2 \text{ }^\circ\text{C}$, or, in routine checks, with a short-range pH paper which can be read in increments of 0,1 pH units or less. Make any necessary correction by adding glacial acetic acid or sodium hydroxide of analytical grade.

3.2.3 CASS test

Dissolve a sufficient mass of copper(II) chloride dihydrate ($\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$) in the salt solution (3.1) to produce a concentration of $0,26 \text{ g/l} \pm 0,02 \text{ g/l}$ [equivalent to $(0,205 \pm 0,015) \text{ g}$ of CuCl_2 per litre].

Adjust the pH using the procedures described in 3.2.2.

3.3 Filtration

If necessary, filter the solution before placing it in the reservoir of the apparatus, to remove any solid matter which might block the apertures of the spraying device.

4 Apparatus

All components in contact with the spray or the test solution shall be made of, or lined with, materials resistant to corrosion by the sprayed solution and which do not influence the corrosivity of the sprayed test solutions. The apparatus shall include the following components.

4.1 Spray cabinet

The cabinet shall have a capacity of not less than $0,2 \text{ m}^3$ and preferably of not less than $0,4 \text{ m}^3$ since, with smaller volumes, difficulties were experienced in ensuring the even distribution of spray. For large-capacity cabinets, it is necessary to ensure that the conditions of homogeneity and distribution of the spray are met. The upper parts of the cabinet shall be designed so that drops of sprayed solution formed on its surface do not fall on the specimens being tested.

The size and shape of the cabinet shall be such that the collection rate of solution in the cabinet is within the limits specified in 8.2.

NOTE 2 A schematic diagram of one possible design of spray cabinet is shown in annex A.

4.2 Heater and temperature control

An appropriate system maintains the cabinet and its contents at the specified temperature (see 8.1). The temperature shall be measured at least 100 mm from the walls.

4.3 Spraying device

The device for spraying the salt solution comprises a supply of clean air, of controlled pressure and humidity, a reservoir to contain the solution to be sprayed, and one or more atomizers.

The compressed air supplied to the atomizers shall be passed through a filter to remove all traces of oil or solid matter and shall be at an absolute pressure of 70 kPa³⁾ to 170 kPa.

NOTE 3 Atomizing nozzles may have a "critical pressure" at which an abnormal increase in the corrosiveness of the salt spray occurs. If the "critical pressure" of a nozzle has not been established with certainty, control of fluctuations in the air pressure within $\pm 0,7 \text{ kN/m}^2$ ($\pm 0,1 \text{ psi}$), by installation of a suitable pressure regulator valve minimizes the possibility that the nozzle will be operated at its "critical pressure".

In order to prevent evaporation of water from the sprayed droplets, the air shall be humidified before entering the atomizer, by passage through a saturation tower containing hot water at a temperature several degrees Celsius higher than that of the cabinet. The appropriate temperature depends on the pressure used and on the type of atomizer nozzle and shall be adjusted so that the rate of collection of spray in the cabinet and the concentration of the collected spray are kept within the specified limits (see 8.2). The level of the water must be maintained automatically to ensure adequate humidification.

The atomizers shall be made of inert material, for example glass or plastics materials. Baffles may be used to prevent direct impact of spray on the test specimens and the use of adjustable baffles is helpful in obtaining uniform distribution of the spray within the cabinet. The level of the salt solution in the salt reservoir shall be maintained automatically to ensure uniform spray delivery throughout the test.

4.4 Collecting devices

At least two suitable collecting devices shall be available, consisting of funnels made of glass or other chemically inert material, with the stems inserted into graduated cylinders or other similar containers. Funnels with a diameter of 100 mm have a collecting area of approximately 80 cm². The collecting devices shall be placed in the zone of the cabinet where the test specimens are placed, one close to an inlet of spray and one remote from an inlet. They shall be placed so that only spray, and not liquid falling from specimens or from parts of the cabinet, is collected.

3) $1 \text{ kPa} \approx 1 \text{ kN/m}^2 \approx 0,01 \text{ atm}$

4) "Practically faultness" means free from pores, slights, marks, scratches, and any light coloration.

4.5 Re-use

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

The equipment shall then be operated for a minimum period of 24 h and the pH of the collected solution measured to ensure that pH is correct throughout the entire spraying period, before any specimens are placed in the chamber.

5 Method of evaluation of the corrosivity of the chamber

To check the reproducibility of the test results for one piece apparatus or for similar items of apparatus in different laboratories, it is necessary to verify the apparatus at regular intervals as described in 5.1.1 to 5.1.3.

5.1 NSS test

5.1.1 Reference specimens

To verify the apparatus, use four reference specimens $1 \text{ mm} \pm 0,2 \text{ mm}$ thick and $50 \text{ mm} \times 80 \text{ mm}$, of CR4 grade steel according to ISO 3574, with a practically faultless surface⁴⁾, and a mat finish (arithmetic mean deviation of the profile $R_a = 1,3 \mu\text{m} \pm 0,4 \mu\text{m}$). Cut these reference specimens from cold-rolled plates or strips.

Clean the reference specimens carefully immediately before testing. Besides the specifications given in 6.2 and 6.3, cleaning shall eliminate all traces of dirt, oil or other foreign matter capable of influencing the test results.

Use one of the following methods:

- Clean the reference specimens by vapour degreasing with a chlorinated hydrocarbon. Use three successive treatments of 1 min each, with an interval of at least 1 min between successive treatments.
- Thoroughly clean the reference specimens with an appropriate organic solvent (hydrocarbon, with a boiling point between 60 °C and 120 °C) using a clean soft brush or an ultrasonic cleaning device. Carry out the cleaning in a vessel full of solvent. After cleaning, rinse the reference specimens with fresh solvent, then dry them.