

Corrosion of metals and alloys - Accelerated cyclic corrosion tests with exposure to synthetic ocean water salt-deposition process - "Dry" and "wet" conditions at constant absolute humidity (ISO 16539:2013)

## EESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

See Eesti standard EVS-EN ISO 16539:2022 sisaldab Euroopa standardi EN ISO 16539:2022 ingliskeelset teksti.	This Estonian standard EVS-EN ISO 16539:2022 consists of the English text of the European standard EN ISO 16539:2022.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation and Accreditation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 22.06.2022.	Date of Availability of the European standard is 22.06.2022.
Standard on kättesaadav Eesti Standardimis-ja Akrediteerimiskeskusest.	The standard is available from the Estonian Centre for Standardisation and Accreditation.

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English Version

**Corrosion of metals and alloys - Accelerated cyclic corrosion tests with exposure to synthetic ocean water salt-deposition process - "Dry" and "wet" conditions at constant absolute humidity (ISO 16539:2013)**

Corrosion des métaux et alliages - Essais de corrosion cyclique accélérée avec exposition à l'eau de mer synthétique par procédé de dépôt de sel - Conditions "sèches" et conditions "humides" à taux d'humidité absolue constant (ISO 16539:2013)

Korrosion von Metallen und Legierungen - Beschleunigte zyklische Korrosionsprüfungen unter Aussetzung von synthetischem Meerwassersalz im Absetzungsprozess - "Trockene" und "feuchte" Bedingungen, bei einer konstanten absoluten Feuchtigkeit (ISO 16539:2013)

This European Standard was approved by CEN on 20 June 2022.

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## European foreword

The text of ISO 16539:2013 has been prepared by Technical Committee ISO/TC 156 "Corrosion of metals and alloys" of the International Organization for Standardization (ISO) and has been taken over as EN ISO 16539:2022 by Technical Committee CEN/TC 262 "Metallic and other inorganic coatings, including for corrosion protection and corrosion testing of metals and alloys" the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2022, and conflicting national standards shall be withdrawn at the latest by December 2022.

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## Endorsement notice

The text of ISO 16539:2013 has been approved by CEN as EN ISO 16539:2022 without any modification.

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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 16539 was prepared by Technical Committee ISO/TC 156, *Corrosion of metals and alloys*.

## Introduction

Corrosion of metallic materials, with or without corrosion protection, is influenced by many environmental factors, the importance of which can vary with the type of metallic materials and with the type of environment. It is impossible, therefore, to design accelerated laboratory corrosion tests in such a way that all environmental factors influencing resistance to corrosion are taken into account. Laboratory tests are, therefore, designed to simulate the effects of most important factors, which enhance the corrosion of metallic materials.

The accelerated corrosion tests described in this International Standard are designed to simulate and enhance the environmental influence on a metallic material of exposure to outdoor climates, where exposure to salt-contaminated conditions occurs and can promote corrosion. It has been prepared by reference to technical papers and reports (see the Bibliography).

The particular advantages of two tests described in this International Standard over conventional accelerated tests, such as the neutral salt spray test (NSS) as specified in ISO 9227 and the wet (salt fog)/dry/humidity test as specified in ISO 14993, lies in their better ability to reproduce the corrosion that occurs in atmospheric environments which contain much sea salt.

Accelerated corrosion tests to simulate atmospheric corrosion in such environments are intended/expected to include the following requirements.

- a) Constant absolute humidity: It is generally observed that temperature and relative humidity change under a constant absolute humidity in outdoor environments. The water absorption of deposited salts is an important factor affecting atmospheric corrosion behaviour. The same relationship, constant absolute humidity, as an actual environment is intended/expected to exist for temperature and relative humidity during dry/wet cycles.
- b) Control of the amount of salt deposition: The amount of the salt deposition on test specimens is intended/expected to be changed according to the corrosivity of the atmosphere in which the tested metallic material can be used. A salt-containing test solution is intended/expected to be diluted or the spraying time is intended/expected to be adjusted to provide the same yearly average amount of the salt deposition as an actual environment.

Therefore, the tests described in this International Standard involve the salt deposition and cyclic dry/wet conditions under a constant absolute humidity.

The results obtained do not permit far-reaching conclusions on the corrosion resistance of the tested metallic material under the whole range of environmental conditions in which it can be used. Nevertheless, the tests provide valuable information on the relative performance of materials exposed to salt-contaminated environments similar to those used in the tests.

The International Organization for Standardization (ISO) draws attention to the fact that it is claimed that compliance with this International Standard can involve the use of a patent concerning the tests given in [Clause 8](#), [Table 3](#), and [Figure 2](#).

ISO takes no position concerning the evidence, validity, and scope of this patent right.

The holder of this patent right has ensured the ISO that he/she is willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with ISO. Information can be obtained from:

JFE Steel Corporation

2-2-3, Uchisaiwaicho, Chiyoda-ku, Tokyo 100-0011, JAPAN

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# Corrosion of metals and alloys — Accelerated cyclic corrosion tests with exposure to synthetic ocean water salt-deposition process — “Dry” and “wet” conditions at constant absolute humidity

## 1 Scope

This International Standard specifies two accelerated corrosion test procedures, Methods A and B, for the evaluation of corrosion behaviour of surface-treated metals and their alloys with and without paint on them in atmospheric environments. It also specifies the apparatus used. The two tests involve salt deposition and dry/wet conditions at a constant absolute humidity.

Method A applies to:

metals and their alloys (including corrosion-resistance alloys)

Method B applies to:

metals and their alloys

metals and their alloys with coatings [including metallic coatings (anodic or cathodic), organic coatings, and conversion coatings]

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4628-1, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 1: General introduction and designation system*

ISO 4628-2, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 2: Assessment of degree of blistering*

ISO 4628-3, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 3: Assessment of degree of rusting*

ISO 4628-4, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 4: Assessment of degree of cracking*

ISO 4628-5, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 5: Assessment of degree of flaking*

ISO 8407, *Corrosion of metals and alloys — Removal of corrosion products from corrosion test specimens*

ISO 8993, *Anodizing of aluminium and its alloys — Rating system for the evaluation of pitting corrosion — Chart method*

ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO 10289, *Methods for corrosion testing of metallic and other inorganic coatings on metallic substrates — Rating of test specimens and manufactured articles subjected to corrosion tests*



ISO 11130, *Corrosion of metals and alloys — Alternate immersion test in salt solution*

ISO 14993, *Corrosion of metals and alloys — Accelerated testing involving cyclic exposure to salt mist, “dry” and “wet” conditions*

ISO 17872, *Paints and varnishes — Guidelines for the introduction of scribe marks through coatings on metallic panels for corrosion testing*

### 3 Test solution

#### 3.1 Preparation of the mixed salt solution

The mass of reagents shown in [Table 1](#) shall be dissolved in distilled water or deionized water, with a conductivity of not higher than 20  $\mu\text{S}/\text{cm}$  at  $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ , to produce a mixed salt solution with a concentration of  $36,0\text{ g/l} \pm 3,6\text{ g/l}$ .

The composition of the mixed salt solution is the same as typical synthetic ocean water shown in ISO 11130:2010, A.3 (test solution for simulating the corrosive effects of ocean water).

**Table 1 — Reagents and their concentrations of a mixed salt solution**

Reagents	Concentration (g/l)
NaCl	24,53
MgCl <sub>2</sub>	5,20
Na <sub>2</sub> SO <sub>4</sub>	4,09
CaCl <sub>2</sub>	1,16
KCl	0,695
NaHCO <sub>3</sub>	0,201
KBr	0,101
H <sub>3</sub> BO <sub>3</sub>	0,027
SrCl <sub>2</sub>	0,025
NaF	0,003
WARNING – Handling of SrCl <sub>2</sub> and NaF can be hazardous and shall be restricted to use by skilled chemists or conducted under their control.	

#### 3.2 pH adjustment

To adjust the pH of the solution,  $5,0\text{ g} \pm 0,5\text{ g}$  of NaOH shall be dissolved in water and diluted to total volume of 1 L to make 0,125 mol/l NaOH solution. It shall be added to the mixed salt solution to adjust the pH to  $8,2 \pm 0,1$  at  $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ .

#### 3.3 Preparation of the test solution

The test solution shall be used as the mixed salt solution or shall be diluted by 1:10 and 1:100 to the mixed salt solution with a concentration of  $36,0\text{ g/l} \pm 3,6\text{ g/l}$ ,  $3,60\text{ g/l} \pm 0,36\text{ g/l}$ , and  $0,360\text{ g/l} \pm 0,036\text{ g/l}$ . When not specified, the concentration shall be agreed by the interested parties.