

# SVENSK STANDARD

## SS-EN ISO 16151:2018



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**Korrosion hos metaller och legeringar – Accelererad cyklisk provning innefattande exponering i surgjord saltdimma, torr och fuktig atmosfär (ISO 16151:2018)**

**Corrosion of metals and alloys – Accelerated cyclic test with exposure to acidified salt spray, dry and wet conditions (ISO 16151:2018)**

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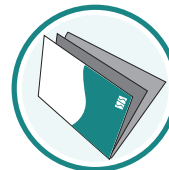
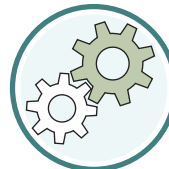
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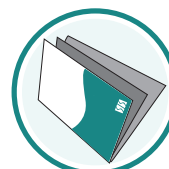
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Europastandarden EN ISO 16151:2018 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av EN ISO 16151:2018.

Denna standard ersätter SS-EN ISO 16151:2008, utgåva 1

The European Standard EN ISO 16151:2018 has the status of a Swedish Standard. This document contains the official version of EN ISO 16151:2018.

This standard supersedes the SS-EN ISO 16151:2008, edition 1

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Denna standard är framtagen av kommittén för Korrosion och korrosionsprovning av metaller i atmosfär, SIS/TK

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EUROPEAN STANDARD

EN ISO 16151

NORME EUROPÉENNE

EUROPÄISCHE NORM

July 2018

ICS 77.060

Supersedes EN ISO 16151:2008

English Version

Corrosion of metals and alloys - Accelerated cyclic test with exposure to acidified salt spray, dry and wet conditions (ISO 16151:2018)

Corrosion des métaux et alliages - Essais cycliques accélérés avec exposition au brouillard salin acidifié, en conditions «sèches» et en conditions «humides» (ISO 16151:2018)

Korrosion von Metallen und Legierungen - Schnellprüfungen unter zyklisch wechselnder Beanspruchung mit saurem Salzsprühnebel, "trockenen" und "feuchten" Bedingungen (ISO 16151:2018)

This European Standard was approved by CEN on 30 May 2018.

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## European foreword

This document (EN ISO 16151:2018) has been prepared by Technical Committee ISO/TC 156 "Corrosion of metals and alloys" in collaboration with 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 January 2019, and conflicting national standards shall be withdrawn at the latest by January 2019.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 16151:2008.

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### Endorsement notice

The text of ISO 16151:2018 has been approved by CEN as EN ISO 16151:2018 without any modification.

## Introduction

Corrosion of metallic materials, with or without corrosion protection, is influenced by many environmental factors, the importance of which may vary with the type of metallic material 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 the most important factors, which enhance the corrosion of metallic materials.

The accelerated corrosion-test methods described in this document are designed to simulate and enhance the environmental influence on a metallic material to outdoor climates, where exposure to acid rain and to salt-contaminated conditions occur and may promote corrosion. It has been prepared by reference to technical papers and reports (see the Bibliography).

The test methods involve cyclic exposure of test specimens to a mist of acidified-salt solution, to drying conditions, and to periods of high humidity. However, the methods are mainly intended for comparative testing and 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 they may be used. Nevertheless, the methods provide valuable information on the relative performance of materials exposed to salt and/or acid rain environments similar to those employed in the test.



# Corrosion of metals and alloys — Accelerated cyclic test with exposure to acidified salt spray, dry and wet conditions

**WARNING — This document may involve hazardous materials, operations and equipment. It does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this document to establish appropriate safety and health practices.**

## 1 Scope

This document specifies two accelerated corrosion-test procedures, Methods A and B, for the comparative evaluation of metallic materials with or without permanent corrosion protection or temporary corrosion protection in outdoor salt and/or acid rain environments. It also specifies the apparatus used. The two tests involve cyclic exposure of the specimens to acidified salt spray, “dry” and “wet” conditions.

The particular advantages of the two tests over conventional accelerated tests, such as the neutral salt spray (NSS) test as specified in ISO 9227 lie in their better ability to reproduce the corrosion that occurs in outdoor salt and/or acid rain environments. They are also useful for evaluating cosmetic corrosion.

Method A is applicable to

- metals and their alloys,
- metallic coatings (cathodic),
- anodic oxide coatings, and
- organic coatings on metallic materials.

Method B is applicable to

- steel coated with anodic coatings, and
- steel coated with anodic coatings covered with conversion coatings.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 1514, *Paints and varnishes — Standard panels for testing*

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

ISO 4623-2:2016, *Paints and varnishes — Determination of resistance to filiform corrosion — Part 2: Aluminium substrates*

ISO 8044, *Corrosion of metals and alloys — Basic terms and definitions*

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

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8044 and the following apply.

## SS-EN ISO 16151:2018 (E)

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <http://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

### 3.1

#### **reference material**

material with known test performance

### 3.2

#### **reference specimen**

portion of the *reference material* (3.1) that is to be exposed with the intention to check the reproducibility and repeatability of the test results for the test cabinet in use

### 3.3

#### **test specimen**

specific portion of the samples upon which the testing is to be performed

### 3.4

#### **substitute specimen**

specimen made of inert materials (such as plastic or glass) used for the substitute of a *test specimen* (3.3)

## 4 Test solution

### 4.1 General

Instructions for the preparation and use of the solutions used in Methods A and B are given in 4.2 and 4.3.

### 4.2 Method A

#### 4.2.1 Neutral sodium chloride solution

A sufficient mass of sodium chloride shall be dissolved 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  $50 \text{ g}/\text{l} \pm 5 \text{ g}/\text{l}$ . The specific gravity range for a  $50 \text{ g}/\text{l} \pm 5 \text{ g}/\text{l}$  solution shall be 1,029 to 1,036 at  $25 \text{ }^\circ\text{C}$ .

The sodium chloride shall not contain a mass fraction of the heavy metals of copper (Cu), nickel (Ni) and lead (Pb) in total more than 0,005 %. It shall not contain a mass fraction of sodium iodide more than 0,1 % and a mass fraction of total impurities more than 0,5 %, calculated for dry salt.

NOTE Sodium chloride with anti-caking agents can act as corrosion inhibitors or accelerators. A useful sodium chloride salt grade is a grade named Ph. Eur/USP or JIS, ACS.

#### 4.2.2 Preparation of the acidified-salt solution

The pH of the solution shall be adjusted to a value of  $3,5 \pm 0,1$  at  $25 \text{ }^\circ\text{C} \pm 2 \text{ }^\circ\text{C}$ , by adding the following reagents to 10 l of the prepared neutral sodium chloride solution in 4.2.1 as follows:

- 12 ml of nitric acid ( $\text{HNO}_3$ ,  $\rho = 1,42 \text{ g}/\text{ml}$ );
- 17,3 ml of sulfuric acid ( $\text{H}_2\text{SO}_4$ ,  $\rho = 1,84 \text{ g}/\text{ml}$ );
- a sufficient quantity of 10 % mass fraction of sodium hydroxide (NaOH) solution, to adjust the pH of the solution to  $3,5 \pm 0,1$  (about 300 ml will be required).

## 4.3 Method B

### 4.3.1 Preparation of the mixed salt solution

The reagent shown in [Table 1](#) shall be dissolved 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 stock solution with a concentration of  $36,0 \text{ g}/\text{l} \pm 3,6 \text{ g}/\text{l}$ . It shall be diluted by 1:6 to produce a mixed salt solution with a concentration of  $6,0 \text{ g}/\text{l} \pm 0,6 \text{ g}/\text{l}$ .

**Table 1 — Composition and concentration of a stock solution for a mixed salt solution**

| Reagent                         | Concentration<br>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 skilled chemists or conducted under their control.

NOTE The composition of the stock solution is the same as typical synthetic ocean water shown in ISO 11130.

### 4.3.2 Preparation of the acidic solution

To prepare the acidic solution, 16,2 g of concentrated nitric acid (HNO<sub>3</sub>,  $\rho = 1,40 \text{ g}/\text{ml}$ , with a mass fraction of HNO<sub>3</sub> equal to 0,65) and 42,5 g of sulfuric acid (H<sub>2</sub>SO<sub>4</sub>,  $\rho = 1,84 \text{ g}/\text{ml}$ , with a mass fraction of H<sub>2</sub>SO<sub>4</sub> equal to 0,96) shall be dissolved in water and diluted to a total volume of 1 l to make 1 N acid solution with respect to nitric acid and sulfuric acid at an equivalent ratio of  $[\text{NO}_3^-]/[\text{SO}_4^{2-}]$  of 0,4.

### 4.3.3 Preparation of the acidified-salt solution

The prepared acidic solution from [4.3.2](#) shall be added to the mixed salt solution from [4.3.1](#) to adjust the pH to  $2,5 \pm 0,1$  at  $25 \text{ }^\circ\text{C} \pm 2 \text{ }^\circ\text{C}$ .

NOTE The relationship between the amount of mixed acidic solution from [4.3.2](#) and the pH of the acidified-salt solution is shown in [Annex A](#). This solution, with pH value near to 2,5, would have a no-buffering action.

## 5 Apparatus

### 5.1 Component protection.

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

The supports for the test specimen shall be constructed such that different substrate types do not influence each other. It shall also be constructed so that the supports themselves do not influence the test specimens.