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Methods of accelerated cyclic corrosion
tests for surface treated steel sheet

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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry, through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by The Japan Iron and Steel Federation (JISF)/Japan Construction Material & Housing Equipment Industries Federation (J-CHIF) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS G 0594:2004** is replaced with this Standard.

This **JIS** document is protected by the Copyright Law.

It should be noted that being in conformance with this Standard may come under the use of the patent rights held by the following:

Type of test	Patent number	Title of invention	Date of registration
D	4218280	Method for evaluating corrosion resistance of steel plates for home appliances and steel plates for electrical and electronic parts for home appliances	21 November 2008

The relevant holders of the above-mentioned patent rights have indicated an intention of granting license to anyone under the nondiscriminatory and reasonable conditions, except to the other relevant holders of the patent rights related to this Standard who will not grant their licenses under the same conditions.

It should be noted that following this Standard does not always refer to granting a free license.

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The “patent rights” as mentioned here include patent right, application for a patent after opening to the public or utility model right.

Methods of accelerated cyclic corrosion tests for surface treated steel sheet

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 16151** : 2005, Edition 1, and **ISO 16539** : 2013, Edition 1, with some modifications of the technical contents. This Standard lays down the details of Methods B, C and D of accelerated cyclic corrosion tests. Method A of **ISO 16151** is specified in 8.2 of **JIS H 8502**.

The vertical lines on both sides and dotted underlines indicate changes from the corresponding International Standards. A list of modifications with the explanations is given in Annex JB. Annex JA contains unique contents to **JIS** that are not given in the corresponding International Standards.

1 Scope

This Standard specifies three types of accelerated cyclic corrosion tests ¹⁾ for zinc-coated steel sheets and other surface treated steel sheets intended for use in corrosion environment containing salt particles carried afloat from the sea.

Warning Persons carrying out tests based on this Standard should be familiar with normal laboratory practice. This Standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this Standard to establish appropriate safety and health practices.

NOTE The International Standards corresponding to this Standard and the symbol of degree of correspondence are as follows.

ISO 16151 : 2005 *Corrosion of metals and alloys — Accelerated cyclic tests with exposure to acidified salt spray, “dry” and “wet” conditions*

ISO 16539 : 2013 *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 (Overall evaluation : MOD)*

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

Note ¹⁾ Acidified salt spray cyclic test (see 3.3.1), neutral salt spray cyclic test (see 3.3.2), and salt deposition cyclic test (see 3.3.3).

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. For standards with the year indication, only the editions of the indicated year shall be applied and the revisions (including amend-

ments) made thereafter shall not be applied. For those without the indication of the year, the most recent editions (including amendments) shall be applied.

JIS K 8150 *Sodium chloride (Reagent)*

JIS K 8541 *Nitric acid (Reagent)*

JIS K 8951 *Sulfuric acid (Reagent)*

JIS Z 0103 *Glossary of terms used in rust and corrosion preventive technology*

JIS Z 2371 *Methods of salt spray testing*

ISO 11130 : 2010 *Corrosion of metals and alloys — Alternate immersion test in salt solution*

3 Terms and definitions

For the purpose of this Standard, the following terms and definitions, and those given in **JIS Z 0103** apply.

3.1

acid rain

rain having a pH of 5.6 or under

3.2

sea salt particles

particles of sea water mist generated by breaking of wave crests at the edge of and/or on the sea and then carried aloft by the wind

3.3

accelerated cyclic corrosion test

test to accelerate corrosion of steel sheet specimens through exposure to repeated cycles of salt mist (salt deposition), dry, and wet conditions

3.3.1

acidified salt spray cyclic test

test comprised of repeated cycles of acidified salt mist, dry and wet conditions (hereafter referred to as Method B)

NOTE Method B simulates corrosion of a steel sheet occurring in atmospheric environment having airborne sea salt particles and acid rain.

3.3.2

neutral salt spray cyclic test

test comprised of repeated cycles of neutral salt mist, dry and wet conditions (hereafter referred to as Method C)

NOTE Method C simulates corrosion of a steel sheet occurring in atmospheric environment having airborne sea salt particles and observed with a lim-

ited influence of acid rain.

3.3.3

salt deposition cyclic test

test comprised of repeated cycles of deposition of a given amount of salt, dry and wet conditions (hereafter referred to as Method D)

NOTE Method D simulates corrosion of a steel sheet occurring in atmospheric environment having a given amount of airborne sea salt particles. This method controls the amount of salt deposition and therefore can reproduce various environments with differing amounts of sea salt.

3.4

synthetic ocean water

solution prepared to simulate composition and concentration of ocean water (see Annex JA)

3.5

mixed salt

mixture of mineral salts contained in synthetic ocean water

3.6

spray solution

in the tests according to Methods B and C, test solution sprayed in mist by the spraying device

3.7

transition period

time taken for temperature and relative humidity to reach the specified values once the test conditions have been changed

3.8

corrosion test specimen

test specimen used for accelerated cyclic corrosion test

3.9

dummy specimen

small-sized specimen used to fill the space in the exposure cabinet when the exposure cabinet is not full of corrosion test specimens

The material used for dummy specimens shall not influence corrosion of the corrosion test specimens.

NOTE Dummy specimens are usually made of plastics, glass, or other chemically inert materials.

3.10

preliminary test specimen

specimen used to confirm the deposited amount of mixed salt prior to the test

NOTE This specimen is usually made of a material with similar composition to the corrosion test specimen.

3.11

wet/dry cycles

test to expose corrosion test specimens to repeated cycles of dry and wet conditions (see 4.3.6)

3.12

weekly cycle

test cycle, performed over a period of seven days, that exposes corrosion test specimens to a continuous series of procedures consisting of deposition of mixed salt, dry/wet cycles, rinse treatment, deposition of mixed salt, dry/wet cycles, and rinse treatment (see Figure 2)

4 Accelerated corrosion test method

4.1 Acidified salt spray cyclic test (Method B)

4.1.1 Water and test solution

The water and test solution used shall be as follows.

- a) **Water** Deionized or distilled water, preferably having an electric conductivity of 20 $\mu\text{S}/\text{cm}$ or smaller at $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$.
- b) **Synthetic ocean water**, prepared according to Annex JA.
- c) **Test solution for Method B (acidified-salt solution)**, prepared according to the following.

- 1) **Preparation of acidic solution** Pour an appropriate volume of water in a container made of glass etc., dissolve in it 16.2 g of nitric acid (reagent grade) specified in JIS K 8541 and 42.5 g of sulfuric acid specified in JIS K 8951, and dilute with water to a total volume of 1 L.

The total volume may be other than 1 L, in which case the concentrations of nitric acid and sulfuric acid shall be controlled to the same as in the case of 1 L.

NOTE The molar ratio (nitric acid/sulfuric acid) of this solution is about 0.4.

- 2) **Preparation of test solution** Dilute the synthetic ocean water [b] with water [a] by 1 : 6, and adjust the pH at $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ to within 2.5 ± 0.1 . For adjusting pH, use the acidic solution [c) 1)].
- 3) **Draining of test solution** The test solution used for Method B test shall be treated appropriately before being discharged into the drainage system. Discharging the test solution directly into the outside environment is not permissible.

4.1.2 Test apparatus

The test apparatus used shall be as follows. An example of apparatus configuration is shown in Figure A.1. The apparatus should be made of corrosion resistant materials.

- a) **Exposure cabinet**, having a minimum capacity of 0.4 m³. The upper part of the cabinet shall be designed so that drops of sprayed solution formed on its surface do not fall on the test specimens being tested. The exposure cabinet shall be provided with a spraying device, collecting devices and test specimen supports. The test specimen supports shall be made of glass, plastics or other chemically inert material.
- b) **Humidity and temperature control**, provided with a structure and a system to maintain the exposure cabinet and its contents within the specified temperature and humidity limits. The temperature shall be measured at a position at least 100 mm from the walls of the cabinet.
- c) **Spraying device**, for spraying the specified amount of test solution, consisting of a supply of clean air of controlled pressure and humidity, a reservoir containing the test solution to be sprayed, and one or more atomizer. The compressed air supplied to the atomizers shall be passed through a filter to remove all traces of oil or solid matter. The atomizers shall be made of glass, plastics or other chemically inert material.

NOTE The compressed air shall normally be at a pressure of 98 kPa.

- d) **Air saturator**, structured to humidify the air by passing it through a saturation tower containing hot water at a temperature several degrees Celsius higher than that of the exposure cabinet in order to prevent evaporation of water from the sprayed droplets.
- e) **Collecting devices** At least two suitable collecting devices, consisting of clean funnels with a collecting area of approximately 80 cm², made of plastics, glass or other chemically inert material, with the stems inserted into graduated cylinders or other similar container shall be placed at different distances from the spraying device to ensure even distribution of the spray. The collecting devices shall be placed with their upper ends being approximately flush with the lower ends of the corrosion test specimens, and in such a way that they collect only the sprayed solution, and not the liquid falling from corrosion test specimens or from parts of the exposure cabinet.
- f) **Air dryer**, capable of supplying dried air of the specified humidity in the exposure cabinet during “dry” periods.
- g) **Exhaust system**, designed not to release the test solution from inside the exposure cabinet to the outside of the building.

4.1.3 Corrosion test specimens

4.1.3.1 Number and dimensions of corrosion test specimens

The number and dimensions of corrosion test specimens shall be agreed between the