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**Accelerated cyclic corrosion tests
with dry and wet conditions at
constant absolute humidity for
stainless steels**

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Foreword

This Japanese Industrial Standard has been established by the Minister of Economy, Trade and Industry, through deliberations at the Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law.

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Accelerated cyclic corrosion tests with dry and wet conditions at constant absolute humidity for stainless steels

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 16539:2013**, Edition 1, with some modifications of the technical contents to reflect the local needs and situations in Japan.

The vertical lines on both sides and dotted underlines indicate changes from the corresponding International Standard. A list of modifications with the explanations is given in Annex JB.

1 Scope

This Standard specifies the accelerated corrosion test procedures for the evaluation of corrosion behaviour of stainless steels in atmospheric environments. It also specifies the apparatus used. The tests involve salt deposition and dry/wet conditions at a constant absolute humidity¹⁾.

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

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* (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⁾ Absolute humidity is expressed by the mass (g) of vapour contained per air volume of 1 m³.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this Standard. The most recent edition of the standard (including amendments) indicated below shall be applied.

JIS G 0595 *Rating method of rust and stain of atmospheric corrosion for stainless steels*

3 Test solution

3.1 Mixed salt solution

For the tests specified in this Standard, commercial synthetic ocean water, or the substitute ocean water specified in Annex JA or the mixed salt solution specified in 3.2 below shall be used.

3.2 Preparation of mixed salt solution

The composition of this mixed salt solution is the same as that of the substitute ocean water given in Annex JA. Preparation shall be in accordance with this subclause and Annex JA.

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 $25^\circ\text{C} \pm 2^\circ\text{C}$, to produce a mixed salt solution with a concentration of $36.0 \text{ g/L} \pm 3.6 \text{ g/L}$. All reagents used shall be of guaranteed grade.

Table 1 Reagents and their concentrations of a mixed salt solution

Unit: g/L	
Reagents	Concentration
NaCl	24.53
MgCl ₂	5.20
Na ₂ SO ₄	4.09
CaCl ₂	1.16
KCl	0.695
NaHCO ₃	0.201
KBr	0.101
H ₃ BO ₃	0.027
SrCl ₂	0.025
NaF	0.003

WARNING Handling of SrCl₂ and NaF can be hazardous and shall be restricted to use by skilled test operators or conducted under their control.

To adjust the pH of the solution, $5.0 \text{ g} \pm 0.5 \text{ g}$ of NaOH shall be dissolved in distilled or deionized 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 ± 0.1 at $25^\circ\text{C} \pm 2^\circ\text{C}$.

3.3 Preparation of test solution

The test solution shall be used as the mixed salt solution or shall be diluted by 1:5 and 1:25 to obtain the mixed salt solution with a concentration of $36.0 \text{ g/L} \pm 3.6 \text{ g/L}$, $7.20 \text{ g/L} \pm 0.72 \text{ g/L}$ and $1.44 \text{ g/L} \pm 0.144 \text{ g/L}$.

When not specified, the concentration shall be agreed by the interested parties.

4 Apparatus

4.1 Anti-corrosiveness of components All components in contact with the test solution shall be made of, or lined with, materials resistant to corrosion by the test solution and which do not influence the corrosivity of the atomized test solution. The apparatus shall include the components described in 4.2 to 4.4 in the following.

4.2 Exposure cabinet It is essential that temperature and humidity in exposure cabinet are controlled constantly.

4.3 Salt deposition device The atomizer shall be made of corrosion resistant materials, e.g. glass, plastic, or titanium. The atomized test solution shall be deposited homogeneously on specimens. The amount of deposited test solution shall be controlled so that the specified amount of salt is on the specimen.

The diameter of the atomized test solution should be small enough to achieve homogenized size of droplets deposited on the specimen.

The amount of deposited test solution can be controlled in the following manners:

- a) by controlling the test period with a continuous atomization;
- b) by controlling the amount of test solution, the atomized pressure, and the moving speed of the atomizer. The compressed air supplied to the atomizer shall be passed through a filter to remove all trace of oil or solid matter;
- c) in the case of manual spraying, by controlling the number of sprayings of the sprayer whose flow rate has been properly adjusted.

4.4 Temperature and humidity control device The device shall be capable of detecting and controlling the temperature and humidity around specimens. In the transition period of temperature and humidity, the device shall be capable of controlling the dry bulb temperature linear to target value and test period. The device shall be capable of controlling the humidity by keeping the absolute humidity constant to dry bulb temperature.

4.5 Types of apparatus The following are three types of apparatus that satisfy the requirements specified in 4.2 to 4.4.

- a) **Two-cabinet type (automatic procedures)** Specimens move between salt deposition cabinet and exposure cabinet. The atomizer moves front to back and side to side, making it possible to change the amount of salt deposition on each specimen. Then, the specimens are moved to the exposure cabinet and wet/dry cycles and rinse treatment are conducted automatically (see Annex A).
- b) **One-cabinet type (automatic procedures)** Specimens are settled in one cabinet. The atomizer is set, and wet/dry cycles and rinse treatment are conducted automatically (see Annex B).
- c) **One-cabinet type (manual procedures)** After salt deposition (4.3) by hand, the test specimens shall be settled in the cabinet for wet/dry cycles. Then, the test specimens shall be taken out from the cabinet and rinse treatment conducted. After the salt deposition, the test specimens shall be settled up in the cabinet as quickly as possible (see Annex C).

5 Test specimens

5.1 Type, number and dimensions

The type (type symbol, surface finish, etc.) and number of test specimens shall be selected according to the specification for the material or product being tested. When not so specified, these details shall be mutually agreed between the interested parties. Preferable test specimen dimensions are 50 mm × 50 mm.

5.2 Surface condition

All test specimens shall receive the following degreasing treatment prior to testing so that they have uniform surface condition before deposition of salt.

- a) Clean the specimen surface using a commercially available neutral detergent. Hold the edge of a specimen with hands wearing gloves, rub lightly the specimen surface with a cotton wool impregnated with drinking water and a small amount of neutral detergent.
- b) Immediately after this cleaning, wash both surfaces of the specimen carefully with drinking water. Neutral detergent contains components that corrode stainless steels, and shall be completely removed.
- c) Then, without drying the specimen surface, immediately pour distilled water or deionized water to wash off the drinking water.
- d) Blow a blast of air, which may be heated, or nitrogen gas at the specimen until the specimen surface is dry with no remaining water drop.
- e) Carry out ultrasonic cleaning in ethanol for one minute.
- f) Blow a blast of air, which may be heated, or nitrogen gas at the specimen until the specimen surface is dry with no remaining water drop.

6 Salt deposition measurement method

The test solution shall be applied to make salt deposition on the surface of the specimen. The average amount of salt deposition shall be measured by the mass change of the specimen before and after salt deposition process to the nearest 1 mg. These measurements shall be carried out as quickly as possible in order to prevent the specimen from drying.

7 Arrangement of test specimens

After the salt deposition on the test specimens, the test specimens shall be placed in the cabinet. The test specimens shall be arranged so that they do not come into contact with the cabinet. The specimens may be placed at different levels within the cabinet, as long as the droplet of the moisture does not drip from specimens or their supports at one level onto specimens placed below them.

8 Operating conditions and procedure

Using the temperature, relative humidity and operation time settings as given in Figure 1, the test shall be carried out according to the procedure laid out in Figure 1 and also according to the following. Operating conditions, including the apparatus settings of temperature, relative humidity and wet/dry times, shall be in accordance with Table 2.