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**General requirements for
atmospheric exposure testing**

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Foreword

This translation has been made based on the original Japanese Industrial Standard 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 Weathering Test Center (JWTC)/ Japanese Standards Association (JSA) 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 Z 2381** :2001 is replaced with this Standard.

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General requirements for atmospheric exposure testing

Introduction

This Japanese Industrial Standard was established in 1979 and has gone through three revisions up to the present. The last revision was made in 2001, and the revision at this time is to respond to the advances in technology.

No corresponding International Standard has been established at this point.

1 Scope

This Standard specifies general requirements for atmospheric exposure testing method of industrial materials and industrial products (hereafter referred to as materials and/or products) in the open-air atmosphere and the sheltered atmosphere.

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.

2 Normative references

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

JIS B 7753 *Light-exposure and light-and-water-exposure apparatus (Open-flame carbon-arc type)*

JIS B 7952 *Continuous analyzer for sulfur dioxide in ambient air*

JIS B 7953 *Continuous analyzers for oxides of nitrogen in ambient air*

JIS B 7957 *Continuous analyzers for ozone and oxidants in ambient air*

JIS K 0108 *Methods for determination of hydrogen sulfide in flue gas*

JIS K 7363 *Plastics—Instrumental determination of radiant exposure in weathering tests—General guidance and basic test method*

JIS R 3202 *Float glass and polished plate glass*

JIS Z 2382 *Determination of pollution for evaluation of corrosivity of atmospheres*

JIS Z 8401 *Guide to the rounding of numbers*

3 Terms and definitions

For the purposes of this Standard, the following terms and definitions apply.

3.1 atmospheric exposure test

test to examine the temporal changes in the chemical and physical properties and the performance of materials and/or products by exposure in the open-air atmosphere and the sheltered atmosphere (hereafter referred to as exposure test)

3.2 open-air atmosphere

atmosphere fully subject to the environmental factors in the open-air natural environment

3.3 sheltered atmosphere

atmosphere which is protected from some environmental factors in the natural environment

3.4 test specimens

materials and/or products used in the exposure test

There are test specimens for exposure test, for measurement of initial value, for storage and for reference.

3.5 exposure test site

site to conduct the exposure test on test specimens

3.6 exposure test apparatus

apparatus to expose the test specimens, consisting of the exposure stand, test specimen holding frame, etc.

3.7 exposure test period

period to conduct the exposure test on test specimens continuously

3.8 test box

container which houses test specimens or attaches them onto its upper surface, to be used for exposure of the test specimens

3.9 environmental factor

generic term for meteorological factors and air pollution factors at the exposure test site

3.10 meteorological factor

factor such as temperature, humidity, solar radiant exposure, amount of precipitation, wind direction, wind velocity and the like, which are measured in the meteorological observation

3.11 air pollution factor

factor which affects exposure test, such as sea salt particles, sulfur oxides, nitrogen oxides, hydrogen sulfide, etc. generated naturally or artificially

3.12 sea salt particle

particle comprising the seawater mist generated when the wave crest breaks around the edge of the surf and/or on the sea, which has been delivered by wind

The size of a sea salt particle is approximately 0.01 μm to 20 μm .

3.13 evaluation test

test to evaluate the degrees of changes in the chemical and physical properties and of the temporal change in performance of test specimens

4 Classification and explanation of exposure tests

Table 1 shows the classification and explanation of exposure tests.

Table 1 Classification and explanation of exposure tests

Classification	Explanation
Direct exposure test	Expose the test specimens directly in the atmosphere in the natural state such as sunshine, rain, snow and wind.
Glass-filtered exposure test	Expose the test specimens attached in the test box covered with plate glass to the solar-radiation transmitted through the plate glass. Also referred to as under-glass exposure test.
Sheltered exposure test	Expose the test specimens set under/in a shelter or indoor, avoiding direct effects of factors such as sunshine, rain, snow and wind.
Black box exposure test	Expose the test specimens attached to the upper surface of metallic test box whole insides and outsides of which are black-plated.

5 Exposure test planning

In order to obtain various kinds of information regarding the test specimens by the exposure test, it is preferable to make and consider the testing plan including the purposes of test, evaluation items, testing environments, test sites, types of test and test periods prior to testing. Annex A shows an example of the testing plan and the items to be considered from the planning through to the completion of the test.

6 Test specimens

6.1 Types of test specimens

The test specimens are classified according to the purpose or the condition of the exposure test.

6.1.1 Test specimens for exposure test

The test specimens for exposure test shall be as follows.

- Test body** The products (also the parts) used for the exposure test.
- Test piece** Test specimen made by machining a material so as to meet the purpose of exposure test or made by cutting out a part of a test body, which represents material or product.

When cutting off the test pieces from the product, consider the service condition. Also, consider the thickness, residual stress, exposure test surface and the like so as to represent the product and indicate the cutting portion and cutting method. The test specimens having an anisotropy caused by machining, etc. shall be tested in both longitudinal and lateral directions.

6.1.2 Test specimen for measurement of initial value

The test specimens prepared in the same way and at the same time as those for exposure test, to measure the initial values of chemical and physical properties and the performance before the exposure test.

6.1.3 Test specimen for storage

The test specimens for storage shall be as follows.

- a) The test specimens prepared in the same way and at the same time as those for exposure test, to be stored without exposure for the purposes of comparison and contrast with the exposed test specimens.
- b) Keep the test specimens for storage appropriately in a desiccator, in a cool and dark place, etc. where the chemical and physical properties of the test specimens do not change easily.

6.1.4 Reference test specimen

The reference test specimens shall be as follows.

- a) The test specimens exposed together with the test specimens for exposure test so that their test results are compared relatively.
- b) The reference test specimens whose tendency of change in chemical and physical properties caused by the exposure test are known are preferable.
- c) When the requirements are not specified in the product standard, etc., the reference test specimens shall be as agreed between the purchaser and the supplier.

NOTE 1 The reference test specimens are also referred to as the reference materials (**JIS K 7219-1**) or the control test specimens (**JIS K 6266**).

NOTE 2 As the reference test specimens of metallic materials, any of carbon steels, atmospheric corrosion resisting steels, copper, zinc, aluminium alloy or stainless steels specified in **JIS Z 2383** are available. However, the methods to use the test specimens specified in **JIS Z 2383** differ from those specified in this Standard.

NOTE 3 With regard to the reference test specimens of rubber materials, use any one of the weathering reference materials (SBR, EPDM, CR and NR) specified in Annex A of **JIS K 6266** as the control test specimen.

6.2 Shapes and dimensions of test specimens

The shapes and dimensions of test specimens for exposure test shall be suitable for the purpose of the exposure test. Annex B shows examples of the forms and dimensions of test specimens for exposure test.

6.3 Number of test specimens

The number of test specimens for exposure test shall be sufficient to evaluate the changes with time in the chemical and physical properties correctly. When the test result variability is specifically taken into consideration, three or more test specimens should be used.

6.4 Marking of test specimens

6.4.1 Marking items

The marking items for the identification of test specimens shall be follows.

- a) The items shall contain the type of test specimen, exposure test site, test condition, etc. and it shall be simply indicated using symbols, numbers, etc.
- b) Slitting to the edge of test specimens, drilled holes, etc. may be used as the marking.

6.4.2 Position of marking

The position of marking shall be as follows.

- a) Mark in the position where the exposure test and its evaluation are not disturbed, such as end part and back face of the test specimen.
- b) When impossible to mark directly to test specimens, the marking at the exposure stand, the test specimen holding frame, etc. to which the test specimens are attached may be allowed.

6.4.3 Marking method

The marking method shall be as follows.

- a) Mark by the method not having the chemical and physical effects on the test specimens. The marking shall be legible and durable over the whole period of exposure.
- b) The area affected by marking shall be minimized.
- c) The layout or the like which provides the exposure test situation such as the symbol of test specimen and the position of test specimen on the exposure stand should be prepared beforehand.

6.5 Pretreatment of test specimen for exposure test

For the purpose of decreasing the fluctuation in exposure test results and improving the reproducibility, perform the pretreatment such as washing, protection of the end and back faces, as necessary.

If the requirements are specified in the product standard, etc. they take precedence.

7 Exposure test site

7.1 Environment of exposure test site

The exposure test is significantly affected by the meteorological and air pollution factors, both of which are environmental factors of the exposure test site. It is desirable to clarify the environment section of the exposure test site in order to analyze the results of the exposure test with sufficient accuracy.

Annex C shows the sections of exposure environments.

NOTE : In Japan, there are the climate sections based on the local climatic features, and the air pollution sections based on the level of air pollution caused by sulfur oxides. Establish the sea salt sections by considering the influence on corrosion by the emission amount of sea salt particles for the evaluation of corrosivity of metallic materials, etc.

7.2 Requirements for exposure test sites

The requirements for exposure test sites shall be as follows.

- a) Select the exposure test sites so that the testing area will normally be exposed to the full effects of the relevant weather. Also select the place where fluctuation between years in the amount of air pollution factors is small.
- b) Avoid the topographical characteristics, ground objects such as buildings, and plants which significantly affect the environmental conditions of sunshine, precipitation and air flow in all the directions of east, west and equator of the exposure test site with the elevation angle 20 degrees or over and 45 degrees or over in the opposite direction of equator. However, this does not apply if the exposure test is to be particularly conducted in special environments such as urban areas, factory areas, volcano/hot spring zones, rivers, coastal areas and the like.
- c) The exposure test site shall be the place where the exposed test specimens can be observed periodically and where the environmental factors specified in clause **10** can be measured and recorded.
- d) Place the exposure test apparatus on the well-drained ground where grass (such as lawn), gravel, concrete, artificial lawn or the like is paved.

In order to avoid the reflection of solar radiation, water submerge, dust blow, etc., a well-drained grass ground (such as lawn) is desirable. The presence of low-growing shrubs and other plants immediately below and around the exposure test apparatus may affect the temperature and humidity distribution, therefore these should be controlled to a maximum height of 0.2 m.

- e) If chemicals are used to control plant growth in the vicinity of the exposure test apparatus, they may contact with any of the test specimens; therefore, the use of them should be avoided.
- f) Provide adequate security such as fencing against theft, damage, of the test specimens, the exposure test apparatus, etc. at the exposure test site. Also, care shall be taken so that the fence surrounding the exposure test site, etc. does not affect the exposure test.

8 Exposure test apparatus

The exposure test apparatus shall be as follows.

- a) The exposure test apparatus shall consist of the exposure stand, test box, test specimen holding frame, test specimen attaching device, etc. and shall be of solid structure suitable for the exposure test.
- b) The component materials of the exposure test apparatus shall have strength and durability to endure a rainstorm, snow-drift and the maximum load when the test specimens are fully attached to the whole face of the exposure stand.
- c) The component materials of the exposure test apparatus shall be the metallic materials such as stainless steels, aluminium alloys, precoated steels which are corrosion-resistant and have no effect on the change with time in the chemical and physical properties and the performance of the test specimens, and inactive materials such as wood and ceramics to which an antiseptic treatment is properly applied.

- d) The exposure test apparatus shall be installed adequately and solidly so as not to be affected by storm, snow-drift, frost heave, etc.
- e) The exposure stand, test box, test specimen holding frame and their attaching devices shall have the construction suitable for the type and purpose of exposure test, the type, shape and dimensions of test specimens and exposure test conditions.
- f) When the contamination due to corrosion products is likely to have an effect on the test specimens for exposure test, the members such as exposure stand, test box, test specimen holding frame, metallic fittings, the members of sheltering structure, the devices and accessories for applying stress or strain shall be performed with adequate protection treatments such as rust prevention treatments and antiseptic treatments.
- g) The attaching mechanism of test specimens shall be so that it does not disturb the free deformation of test specimens and the test specimens do not fall. The attaching and detaching of test specimens shall be executed easily and safely.
- h) The exposure test apparatus shall have the construction capable of settling and holding the specified azimuth and the angle of the surface of the test specimen.
- i) The distance from the ground on which the exposure test apparatus is set up to the lowest end part of the test specimens for exposure test shall be 0.5 m or over unless the distance from the ground is specified in the material or product standard of the exposed test specimen. When conducting the exposure test with the test specimen being in direct contact with or close to the ground assuming the service condition of the specimen to be exposed, the distance from the ground to the bottom of the specimen may not necessarily satisfy the above-mentioned requirements.

NOTE : For the distance from the ground to the lowest end part of the test specimens for exposure test, it is recommended to refer to the following examples of provisions of **JISs** and **ISOs**.

- 0.5 m or over: **JIS H 0521**, **JIS H 8502**, **JIS K 7219-2**, **ISO 8565**, etc.
- 0.45 m or over: **ISO 2810**

9 Exposure testing method

9.1 Azimuth and angle of exposure test surface

The azimuth and angle of exposure test surface shall be as follows.

- a) For direct exposure test, glass-filtered exposure test and black box exposure test, make the surface of test specimens face the equator. The test specimens shall be exposed at the inclination of 0°, 20°, 30°, 45°, 60° or 90° to the horizontal plane unless specified in other product standard, etc.
- b) In the case of the sheltered exposure test, the angle of the test surface to be exposed shall be in between 0° and 90° from the horizontal plane, unless otherwise specified in other product standard, etc., or as agreed between the purchaser and the supplier.