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(JFCA/JSA)

**Fine ceramics (advanced ceramics,
advanced technical ceramics) — Test
method for self-cleaning performance of
photocatalytic materials — Part 1:
Measurement of water contact angle**

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In the event of any doubts arising as to the contents,
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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 Japan Fine Ceramics Association (JFCA)/Japanese Standards Association (JSA) with a draft being attached, based on the provision of Article 12, paragraph (1) of the Industrial Standardization Act applied mutatis mutandis pursuant to the provision of Article 16 of the said Act. This edition replaces the previous edition (**JIS R 1703-1** : 2007), which has been technically revised.

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JIR R 1703 series consists of the following 2 parts under the general title *Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for self-cleaning performance of photocatalytic materials* :

Part 1 : Measurement of water contact angle

Part 2 : Decomposition of wet methylene blue

Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for self-cleaning performance of photocatalytic materials — Part 1 : Measurement of water contact angle

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 27448** : 2009, Edition 1, with some modifications of the technical contents.

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 JA.

1 Scope

This Standard specifies the measurement method using water contact angle among the test methods for self-cleaning performance of photocatalytic materials, in which metal oxide semiconductors such as titanium dioxide are mainly used as photocatalysts.

This Standard does not apply to the permeable photocatalytic materials which absorb water and cannot retain water droplets, photocatalytic materials with uneven surfaces which hide waterdrops, photocatalytic materials with high water repellency, powdered and granular photocatalytic materials, and photocatalytic materials of visible light response type.

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

ISO 27448 : 2009 *Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for self-cleaning performance of semi-conducting photocatalytic materials — Measurement of water contact angle* (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**.

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 K 0557 *Water used for industrial water and wastewater analysis*

JIS K 7100 *Plastics — Standard atmospheres for conditioning and testing*

JIS K 9701 *Heptane (Reagent)*

JIS R 1709 *Fine ceramics (advanced ceramics, advanced technical ceramics) —
Light source for test of photocatalytic materials used under ultraviolet*

JIS R 3257 *Testing method of wettability of glass substrate*

JIS Z 8101-1 *Statistics — Vocabulary and symbols — Part 1 : General statistical
terms and terms used in probability*

NOTE Corresponding International Standard : ISO 3534-1 *Statistics — Vocabulary and symbols — Part 1 : General statistical terms and terms used in probability*

JIS Z 8401 *Rounding of numbers*

JIS Z 8703 *Standard atmospheric conditions for testing*

3 Terms and definitions

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

3.1

photocatalyst

substance that carries out one or more functions based on oxidization and reduction reactions under photoirradiation, including decomposition and removal of air and water contaminants, deodorization, and antibacterial, antifungal, antiviral, and self-cleaning actions, which is a type of functional fine ceramics

3.2

photocatalytic materials

building materials and other materials in which, or on which, the photocatalyst is added by coating, impregnation, mixing, or various film forming methods intended for using various functions of the photocatalyst

3.3

hydrophilicity

property in which the surface of the photocatalytic material shows a strong affinity for water

3.4

hydrophobicity

property in which the surface of the photocatalytic material shows a weak affinity for water

3.5

self-cleaning

function whereby a photocatalyst, attached to a surface like a building material, prevents fouling of the surface by utilizing at least one of the following: the phenomenon

where fouling substances attached to the surface are broken down by oxidation and reduction when irradiated with light, and/or the phenomenon where fouling is washed away when the surface is exposed to rain or rinsed with water, due to the hydrophilicity which manifests itself when irradiated with light at the same time

3.6

contact angle

when a tangent line is drawn from the contact point of the solid, liquid and vapour phases (normally air, hereafter referred to as air) along the curve of the liquid on the solid, the angle in the liquid side between the line and the solid surface is referred to as the contact angle

3.7

water contact angle

contact angle of water

3.8

initial contact angle

contact angle immediately before starting UV irradiation

3.9

contact angle after n h of UV irradiation

contact angle after applying UV irradiation for n h

3.10

final contact angle

contact angle at the highest water affiliation after UV irradiation at a constant intensity on a photocatalytic material

3.11

pretreatment of test piece

preparation of a test piece by irradiating it with UV and then applying organic substances such as oleic acid

3.12

dark condition

test condition with no light illumination by the light source or no incidence of external light

3.13

coefficient of variation

ratio of the standard deviation, as specified in **JIS Z 8101-1**, to the mathematical average of measured values

4 Symbols and unit

For the purposes of this Standard, the following symbols and unit apply.

θ_i : initial contact angle (°)

θ_n : contact angle after n h of UV irradiation (°)

$\bar{x}$: average of θ_n of the three consecutive points (°)

s : standard deviation of θ_n of the three consecutive points (°)

θ_f : final contact angle (°)

5 Principle

This Standard is for the development, comparison, quality assurance, characterization, reliability, and design data generation of photocatalytic materials. This Standard defines the test method, which provides a performance correlated with the contamination that occurred during the exposure test. The test method in this Standard is to evaluate the self-cleaning performance of a photocatalytic material by measuring water contact angle under ultraviolet light irradiation and obtaining the final contact angle of a test piece, among those factors that influence self-cleaning performance of flat-plate photocatalytic materials.

The organic substance is first applied to the surface of the photocatalytic materials, on the assumption of fouling in outdoor environments, and then irradiated by ultraviolet light. This allows the photocatalyst on the surface of the photocatalytic material to decompose the organic substance through oxidation and reduction actions. Consequently, the hydrophilicity of the photocatalytic material after decomposition of the organic substance is improved compared to the state at the time of attachment of the organic substance. When ultraviolet light irradiation is continued, the hydrophilicity of the photocatalytic materials reaches the final contact angle specific to such materials. Since the value of the final contact angle correlates with the self-cleaning performance of photocatalyst, self-cleaning performance of the photocatalytic materials can be evaluated by this test method.

6 Test apparatus

The test apparatus shall be as follows.

6.1 Black light blue fluorescent UV lamp, with a peak wavelength of 351 nm and blue glass for absorbing visible light, as specified in Clause 4 of JIS R 1709.

6.2 Ultraviolet irradiator, capable of providing uniform irradiation from the lamp specified in 6.1 to the test piece, intercepting the light from surroundings, and moving the position of the lamp or test piece so that the irradiation intensity is adjustable. When a lamp reflector is attached, it shall be made of a material that absorbs less ultraviolet radiation and is less deteriorated and shall be of the structure in which the irradiation intensity can be measured at the location of the test piece.

6.3 Ultraviolet light radiometer, as specified in Clause 5 of JIS R 1709.