

# **JSCE-K 511-2007**

## **Test methods for weathering resistance of concrete surface coating materials**

**JSCE-K 511-2007****Test methods for weathering resistance of concrete surface coating materials****1. Scope**

This JSCE standard describes the procedure for the determination of weather resistance of surface coating materials used for repair of concrete structures.

Note (1): The weathering test methods include an accelerated weathering test as a main test, and an outdoor exposure test, if necessary.

Note (2): Concrete structures, such as water and sewerage facilities and water tanks which surfaces are always washed by water, are excluded from this standard.

**2. Normative References**

This standard incorporates by dated or undated references, provisions from other publications. These normative references are cited at appropriate places in this text and the publications are listed hereafter.

- JIS B 7753      Light-exposure and light-and-water-exposure apparatus  
                  (Open-flame sunshine carbon-arc type)
- JIS B 7754      Light-exposure and light-and-water-exposure apparatus (xenon-arc lamp type)
- JIS K 5600-1-7    Testing methods for paints -- part 1: general rule  
                  -- section 7: determination of film thickness
- JIS K 5600-2-6    Testing methods for paints -- part 2: characteristics and stability of paints  
                  -- section 6: pot life
- JIS K 5600-4-5    Testing methods for paints -- part 4: visual characteristics of film  
                  -- section 5: colorimetry (measurement)
- JIS K 5600-4-6    Testing methods for paints -- part 4: visual characteristics of film  
                  -- section 6: colorimetry (calculation of colour differences)
- JIS K 5600-4-7    Testing methods for paints -- part 4: visual characteristics of film  
                  -- section 7: specular gloss
- JIS K 5600-7-7    Testing methods for paints -- part 7: long-period performance of film  
                  -- section 7: accelerated weathering (exposure to filtered xenon-arc radiation)

JIS K 5600-8-1	Testing methods for paints -- part 8: evaluation of degradation of paint coatings -- section 1: general principles and rating schemes
JIS K 5600-8-2	Testing methods for paints -- part 8: evaluation of degradation of paint coatings -- section 2: designation of degree of blistering
JIS K 5600-8-4	Testing methods for paints -- part 8: evaluation of degradation of paint coatings -- section 4: designation of degree of cracking
JIS K 5600-8-5	Testing methods for paints -- part 8: evaluation of degradation of paint coatings -- section 5: designation of degree of flaking
JIS K 5600-8-6	Testing methods for paints -- part 8: evaluation of degradation of paint coatings -- section 6: rating of degree of chalking
JIS K 6266	Testing methods of weatherability for rubber, vulcanized or thermoplastic
JIS R 5201	Physical testing methods for cement
JIS R 6252	Abrasive papers
JIS Z 8703	Standard atmospheric conditions for testing

### 3. Definition

For the purposes of this standard, the following definition is applied.

**Surface coating materials:** Synthetic resin and polymer modified cement coating materials which are coated on concrete surfaces for repair of concrete structures. Surface coating materials are generally consisted of surface preparation material (primer), leveling material (putty), main and finish coating materials.

Note (3): The surface preparation material is used to improve the adhesion of concrete and leveling material, and to prevent the penetration of main coating material into the base concrete. This material is also called “primer”.

Note (4): The leveling material is used to fill in air voids of concrete surface and to prepare the smooth surfaces for coating. This is also called “putty”.

Note (5): The main coating material forms film or coating that stops the penetration of water, oxygen and carbon dioxide into concrete through its surface or cracks in order to prevent the deterioration of concrete or steel bar in concrete. This coating material is also called “second coating”.

Note (6): The finishing material is coated to give colors and luster to a finished face, and to improve the

weather resistance and water proofing of surface. The term “top coating material” is also used.

#### 4. Preparation of Specimens

##### 4.1 Experimental base plates

Experimental base plates, referred to "base plates" hereafter, are prepared as follows:

- a) The base plates, based on JIS R 5201 10.4 (Preparation of specimen), made of mortar with a water cement ratio of 50% and a sand cement ratio of 3, are cast in steel mould of 70 x 70 x 20 mm in size.
- b) The plate with mould is stored at a temperature of  $20\pm 2$  and a relative humidity of 80% for 24 hours. Then, the mould is removed and the base plate is cured in water at  $20\pm 2$  for 6 days. And the base plate is stored at a temperature of  $23\pm 2$  and a relative humidity of  $50\pm 5\%$  for 7 days or more.
- c) The bottom surface of base plate is thoroughly polished using abrasive paper #150 which is provided in JIS R 6252.

##### 4.2 Types of tests

The types of tests, the item number of applying tests and the number of specimens are given in Table-1.

Table 1 Types of specimens

Type of tests	Section	Number of outdoor exposure test specimens	Number of original specimens
Accelerated weathering test	5.1 ~ 5.2	3	1
Outdoor exposure test	5.3 ~ 5.4	3	1

Note (7): Original specimens are used for comparison with outdoor exposure specimens. After being prepared, they are kept in a dark room at normal humidity and temperature (1) until the end of exposure to be compared with outdoor exposed specimen.

Comment (1): The normal humidity and temperature are, as provided in JIS Z 8703 (Standard Atmospheric Conditions for Testing), Class 15 temperature of  $20\pm 15$  and Class 20

humidity of  $65\pm 20\%$ , respectively.

### 4.3 Specimens

- a) Specimens are prepared as follows: The base plates and materials for base preparation, leveling, main and finish coatings are stored at a temperature of  $23\pm 2$  and a relative humidity of  $50\pm 5\%$  for 24 hours.
- b) The surface of the base plate is coated according to the specifications by the manufacturer, and is stored for 28 days at a temperature of  $23\pm 2$  and a relative humidity of  $50\pm 5\%$ . Also, all other five surfaces can be coated with same surface coating material in order to prevent the ingress of deleterious substances.

## 5. Test Methods

### 5.1 Accelerated weathering test

The “xenon-arc lamp” method is carried out by using the apparatus specified in JIS B 7754, and in conformity with JIS K 5600-7-7, **6.2**, “Method 1”, and **9.4**, “Cycle A”. Other operations should be in conformity with JIS K 5600-7-7. The “sunshine carbon-arc lamp” method is carried out by using the apparatus specified in JIS B 7753, and with operating condition specified as following Table 2. Other operations should be in conformity with JIS K 6266, **5**. The test duration of “light exposure” is determined based on the agreement between the orderer and the receiver.

Table 2 Test conditions

		Sunshine carbon arc lamp system
Types of glass filter		Type A specified in JIS B 7753, Table 2. Type I specified in JIS K 6266, Table 2.
Life time of glass filter		Not exceed 2,000 hours. Until remarkable color change or white impurity are emerged.
Black panel temperature		$63\pm 3$
Water spraying conditions	Spraying intervals	Lighting of 102 minutes, followed by 18 minutes of lighting with water spraying
	Lighting condition	Continuous lighting

## 5.2 Evaluation of accelerated weathering test

- a) After a specified time of lighting, the specimens are taken out from the apparatus. If the specimens are wetted, they are dried by shaking from the surfaces and be stored in a room for an hour. Then, by comparing with the original specimen, the changes of the weathering test specimens in the coat surfaces affected by the lighting is visually inspected according to JIS K 5600-8-1, JIS K 5600-8-2, JIS K 5600-8-4, 8-5, 8-6.
- b) The luster is measured in accordance with JIS K 5600-4-7, and color deterioration is measured in accordance with JIS K 5600-4-5, JIS K 5600-4-6.
- c) Fixing marks and a 10-mm rim of the coated surfaces should be excluded from this evaluation.

## 5.3 Outdoor exposure test

- a) The test is carried out as the procedure provided in JIS K 5600-7-6.
- b) For an exposure angle of  $\theta$  in the weathering test machine, 0 degree is recommended.

## 5.4 Evaluation of outdoor exposure test

- a) After a specified exposing duration, the specimens are removed from the exposure equipment. Then, by comparison with the original specimens, the changes in the coat surfaces affected by the exposure, such as chalking, heaving, cracking and peeling, are visually inspected.
- b) The luster is measured in accordance with JIS K 5600-4-7, and color difference is measured in accordance with JIS K 5600-4-5, JIS K 5600-4-6.
- c) Fixing marks and a 10-mm rim of the coated surfaces should be excluded from this evaluation.
- d) Preprocessing, such as cleaning, for the evaluation is carried out in accordance with the method provided by the manufacturer.

## 6. Report

### 6.1 Accelerated weathering test

- a) Types and coating specifications of the surface coating materials, based on Table 3.
- b) Types of accelerated weathering test machines, the operating conditions and test duration.
- c) Surface coating material's visual evaluations. If preprocessing such as cleaning is carried out, the method is also given.
- d) Luster and color differences of the surface coating materials. If preprocessing such as cleaning is

carried out, the method is also given.

- e) The testing organization.

## **6.2 Outdoor exposure test**

- a) Types and coating specifications of the surface coating materials, based on Table-3.
- b) The location of the test site.
- c) The exposure angle.
- d) The starting time and term of the test and observation.
- e) Weather observation data.
- f) Surface coating material's visual evaluations. If preprocessing such as cleaning is carried out, the method is also given.
- g) Luster and color differences of the surface coating materials. If preprocessing such as cleaning is carried out, the method is also given.
- h) Testing organization.

Table 3 Types of surface coating materials and coating specifications

Stage of procedure	Types of surface coating materials	Preparation of surface coating materials		Conditions for coating					
		Names of materials. Mixing ratio.	Types of dilution materials and dosage. (%)	Coating method	Quantity (kg/m <sup>3</sup> ) (2)	Working life (3)	Thickness of coating (μm) (4)		Coating intervals (5)
							Dry	Wet	
Pre-processing	Base preparation material (Primer)								
	Leveling material (Putty)								
Second coating material	Main coating material (6) (Second coating material) (Number of coating)								
Top coating	Finish coating material (Top coating material) (Number of coating)								

Comment (2): Quantity used before dilution

Comment (3): In accordance with the method provided in JIS K 5400 4.9 (Pot life)

Comment (4): Measured thickness of coat put onto a steel plate

Dry: In accordance with the method provided in JIS K 5400 3.5 (measurement of coating film thickness)

Wet: In accordance with the method provided in JIS K 5400 3.4 (measurement of coating layer thickness)

Comment (5): The period of time between a coatings and next coating when preparing specimens

Comment (6): When reinforcing materials such as glass fiber are used, their types are given.