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(JCI)

Test method for alkali resistance of fiber
reinforced polymer (FRP) bars and grids
for reinforcement of concrete

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Contents

Page

Introduction	1
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Test pieces	2
4.1 Preparation of test pieces	2
4.2 Treatment of ends of test pieces	2
4.3 Length of test pieces	2
4.4 Handling of test pieces	2
4.5 Number of test pieces	2
5 Alkaline solution for immersion of test pieces	3
5.1 Type of alkaline solution	3
5.2 Preparation of alkaline solution	3
6 Test method	3
6.1 Immersion of test pieces in alkaline solution	3
6.2 Observation of external appearance	4
6.3 Tensile test	4
7 Test results	4
7.1 Calculation of rate of mass loss	4
7.2 Calculation of tensile capacity retention rate	4
8 Test report	5
Annex JA (informative) Comparison table between JIS and corresponding International Standard	7
Annex JB (informative) Comparison table between previous and current editions of this Standard on technically significant revisions	10

Foreword

This Japanese Industrial Standard has been revised by the Minister of Land, Infrastructure, Transport and Tourism through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Concrete Institute (JCI) 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 A 1193** : 2005), which has been technically revised.

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Test method for alkali resistance of fiber reinforced polymer (FRP) bars and grids for reinforcement of concrete

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 10406-1** : 2015, Edition 2, with some modifications of the technical contents.

The dotted underlines indicate changes from the corresponding International Standard. A list of modifications with the explanations is given in Annex JA. The comparison table between previous and current editions of this Standard on technically significant revisions is given in Annex JB.

1 Scope

This Standard specifies test methods for alkali resistance of fiber reinforced polymer (FRP) bars and grids used as a substitute for reinforcing bars and steel for reinforcements in concrete.

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

ISO 10406-1 : 2015 *Fibre-reinforced polymer (FRP) reinforcement of concrete — Test methods — Part 1 : FRP bars and grids* (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

Part or all of the provisions of the following standards, 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 A 1192 *Test method for tensile properties of fiber reinforced polymer (FRP) bars and grids for reinforcement of concrete*

JIS K 8574 *Potassium hydroxide (Reagent)*

JIS K 8575 *Calcium hydroxide (Reagent)*

JIS K 8576 *Sodium hydroxide (Reagent)*

JIS Z 8401 *Rounding of numbers*

JIS Z 8802 *Methods for determination of pH of aqueous solutions*

3 Terms and definitions

For the purpose of this Standard, the terms and definitions given in JIS A 1192 ap-

ply.

4 Test pieces

4.1 Preparation of test pieces

Unless otherwise agreed, test pieces shall be taken from the bar or grid in the “as-delivered” condition. In cases where test pieces are taken from a coil or drum, they shall be straightened prior to any test by a simple bending operation with a minimum amount of plastic deformation. For the determination of the mechanical properties in the tensile, bond, and anchorage tests, the test piece may be artificially aged (after straightening, if applicable) depending on the performance requirements of the product. When a test piece is “aged”, the conditions of the ageing treatment shall be stated in the test report.

Test pieces shall be cut to a predetermined length so that the material properties of the test section does not change. For FRP grids, test pieces can be prepared by cutting away the part excluding test direction. In this case, the part in the orthogonal direction should be cut away leaving at least a 2 mm projection of the crossbars.

4.2 Treatment of ends of test pieces

In order to prevent the infiltration of the solution via the ends of the test pieces during immersion in alkaline solution, coat both ends of the test pieces with e.g. epoxy resin.

4.3 Length of test pieces

The length of test pieces shall be taken to be the sum of the length of the test section and the anchoring section. The length of the test section of test pieces shall be taken to be as follows.

- a) For bars, the length shall be not less than 100 mm and not less than 40 times the nominal diameter.

Nominal diameters shall be obtained in accordance with Annex JA of JIS A 1192.

- b) For stranded bars, the length shall be in accordance with the provision in a) and not less than 2 times the strand pitch.
- c) For grids, the length shall be in accordance with the provision in a) and shall include not less than three cross-points.

4.4 Handling of test pieces

Store the test pieces and protect against deformation, heating, and exposure to ultraviolet light, which can cause changes to the material properties of the test section during sampling and preparation of test pieces.

4.5 Number of test pieces

The number of test pieces shall be at least 5 each of test pieces immersed in alkaline solution and test pieces not immersed in alkaline solution. In the event that a test piece fails at, or slips out of, the anchoring section, an additional test shall be carried

out on a separate test piece taken from the same lot as the failed test piece.

5 Alkaline solution for immersion of test pieces

5.1 Type of alkaline solution

Alkaline solution for immersion of test pieces shall be as follows.

- a) Solution A : alkaline solution which has the same composition as the pore solution found in the concrete
- b) Solution B : sodium hydroxide aqueous solution given in 5.2 b)

5.2 Preparation method of alkaline solution

The alkaline solution shall be prepared as follows.

- a) Solution A shall be prepared by mixing the following aqueous solutions 1) to 3) to pH 13 or higher.

The distilled water used for the aqueous solution may be water of a quality equal to or better than that of the distilled water.

- 1) Aqueous solution in which 14 g of potassium hydroxide specified in JIS K 8574 is dissolved in 1 000 ml of distilled water
- 2) Aqueous solution in which 2 g of calcium hydroxide specified in JIS K 8575 is dissolved in 1 000 ml of distilled water
- 3) Aqueous solution in which 10 g of sodium hydroxide specified in JIS K 8576 is dissolved in 1 000 ml of distilled water
- b) Solution B shall be prepared by dissolving 100 g of sodium hydroxide specified in JIS K 8576 in 1 000 ml of distilled water.

Attention should be paid to the preparation of the alkaline solution because heat is produced in the preparation process.

6 Test method

6.1 Immersion of test pieces in alkaline solution

Immersion of test pieces in alkaline solution shall be as follows.

- a) Take part of alkaline solution, cool to ordinary temperature, and measure the pH in accordance with JIS Z 8802.
- b) Immerse the test piece in alkaline solution. Place the test piece at a position 3 cm or more above the bottom of an immersion container and 3 cm or less below the liquid level, and allow it to stand stably and horizontally. The test pieces shall be placed at intervals of 3 cm or more.

The temperature of alkaline solution shall be kept at $60\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ during the immersion of the test piece. The moisture shall not be evaporated and the carbon dioxide in air shall not be absorbed during the immersion. If the test piece is immersed for a long period, pH shall be measured and recorded periodically. When