

---

---

**Fibre-reinforced polymer (FRP)  
reinforcement of concrete — Test  
methods —**

**Part 1:  
FRP bars and grids**

*Polymère renforcé par des fibres (PRF) pour l'armature du béton —  
Méthodes d'essai —*

*Partie 1: Barres et grilles en PRF*



This document is a preview generated by EBS



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2015

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.org](mailto:copyright@iso.org)  
Web [www.iso.org](http://www.iso.org)

Published in Switzerland

# Contents

Page

<b>Foreword</b>	<b>v</b>
<b>1 Scope</b>	<b>1</b>
<b>2 Normative references</b>	<b>1</b>
<b>3 Terms, definitions, and symbols</b>	<b>1</b>
3.1 Terms and definitions	1
3.2 Symbols	5
<b>4 General provision concerning test pieces</b>	<b>6</b>
<b>5 Test method for cross-sectional properties</b>	<b>6</b>
5.1 Test pieces	6
5.2 Test method	6
5.3 Calculations	7
5.4 Test report	8
<b>6 Test method for tensile properties</b>	<b>8</b>
6.1 Test pieces	8
6.2 Test equipment	9
6.3 Test method	9
6.4 Calculations	9
6.5 Test report	11
<b>7 Test method for bond strength by pull-out testing</b>	<b>13</b>
7.1 Test pieces	13
7.2 Testing machine and devices	15
7.3 Test method	16
7.4 Calculations	17
7.5 Test report	17
<b>8 Test method for performance of anchorages and couplers</b>	<b>18</b>
8.1 Test method for performance of anchorages	18
8.2 Test method for performance of couplers	19
8.3 Test report	19
<b>9 Test method for long-term relaxation</b>	<b>20</b>
9.1 Test pieces	20
9.2 Testing frame and devices	21
9.3 Test temperature	21
9.4 Test method	22
9.5 Calculations	22
9.6 Test report	23
<b>10 Test method for tensile fatigue</b>	<b>23</b>
10.1 Test pieces	23
10.2 Testing machine and devices	23
10.3 Test temperature	24
10.4 Test method	24
10.5 Calculations	25
10.6 Test report	25
<b>11 Test method for alkali resistance</b>	<b>25</b>
11.1 Test pieces	25
11.2 Immersion in alkaline solution	26
11.3 External appearance and mass change	26
11.4 Tensile test	27
11.5 Calculations	27
11.6 Test report	28
<b>12 Test method for creep failure</b>	<b>29</b>

12.1	Test pieces.....	29
12.2	Testing frame and devices.....	29
12.3	Test temperature.....	29
12.4	Tensile capacity.....	29
12.5	Test method.....	29
12.6	Calculations.....	30
12.7	Test report.....	30
<b>13</b>	<b>Test method for transverse shear strength.....</b>	<b>31</b>
13.1	Test pieces.....	31
13.2	Testing machine and devices.....	31
13.3	Test temperature.....	32
13.4	Test method.....	33
13.5	Calculations.....	33
13.6	Test report.....	33
<b>14</b>	<b>Test method for flexural tensile properties.....</b>	<b>34</b>
14.1	Test pieces.....	34
14.2	Testing unit and devices.....	34
14.3	Test method.....	35
14.4	Calculations.....	35
14.5	Test report.....	35
<b>15</b>	<b>Test method for the coefficient of longitudinal thermal expansion by thermo-mechanical analysis.....</b>	<b>36</b>
15.1	Test pieces.....	36
15.2	Testing device.....	37
15.3	Test method.....	37
15.4	Calculations.....	38
15.5	Test report.....	38

## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/TC 71, *Concrete, reinforced concrete and pre-stressed concrete*, Subcommittee SC 6, *Non-traditional reinforcing materials for concrete structures*.

This second edition cancels and replaces the first edition (ISO 10406-1:2008), which has been technically revised.

ISO 10406 consists of the following parts, under the general title *Fibre-reinforced polymer (FRP) reinforcement of concrete — Test methods*:

- *Part 1: FRP bars and grids*
- *Part 2: FRP sheets*



# Fibre-reinforced polymer (FRP) reinforcement of concrete — Test methods —

## Part 1: FRP bars and grids

### 1 Scope

This part of ISO 10406 specifies test methods applicable to fibre-reinforced polymer (FRP) bars and grids as reinforcements or pre-stressing tendons in concrete.

### 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 291:2008, *Plastics — Standard atmospheres for conditioning and testing*

ISO 3611, *Geometrical product specifications (GPS) — Dimensional measuring equipment: Micrometers for external measurements — Design and metrological characteristics*

ISO 4788, *Laboratory glassware — Graduated measuring cylinders*

ISO 7500-1, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system*

ISO 13385-1, *Geometrical product specifications (GPS) — Dimensional measuring equipment — Part 1: Callipers; Design and metrological characteristics*

### 3 Terms, definitions, and symbols

#### 3.1 Terms and definitions

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

##### 3.1.1

##### **alkalinity**

condition of having or containing hydroxyl (OH-) ions; containing alkaline substances

Note 1 to entry: In concrete, the initial alkaline environment has a pH above 13.

##### 3.1.2

##### **anchorage reinforcement**

lattice or spiral reinforcing steel or FRP connected with the anchorage and arranged behind it

##### 3.1.3

##### **anchoring section**

end part of a test piece where an anchorage is fitted to transmit loads from the testing machine to the test section