
**Fibre reinforced polymer (FRP)
reinforcement for concrete
structures —**

**Part 2:
Specifications of CFRP strips**

*Polymère renforcé par des fibres (PRF) pour l'armature du béton —
Partie 2: Spécifications des bandes en PRFC*

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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).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 71, *Concrete, reinforced concrete and pre-stressed concrete*, Subcommittee SC 6, *Non-traditional reinforcing materials for concrete structures*.

A list of all parts in the ISO 18319 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Fibre reinforced polymer (FRP) reinforcement for concrete structures —

Part 2: Specifications of CFRP strips

1 Scope

This document specifies requirements for unidirectional carbon fibre-reinforced polymer (CFRP) strips as external-bonded reinforcements on the concrete substrate. This document is applicable for the CFRP strips that:

- consist of carbon fibre and thermoset resin;
- are manufactured by pultrusion method;
- have a carbon fibre fraction over 60 % by volume; and
- have a thickness within 3 mm.

This document specifies the methodologies to express the mechanical properties as characteristic values, appearance and dimensions, and sampling test.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 10406-3, *Fibre-reinforced polymer (FRP) reinforcement of concrete — Test methods — Part 3: CFRP strips*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

straightness

lateral warped deformation perpendicular to the longitudinal axis of strip

3.2

initial inspection

inspection carried out by the manufacturer of the product for the initial production from the relevant production apparatus, and the cases of change in the production method, product design and raw materials to be used

3.3 periodic inspection

inspection carried out by the manufacturer of the product on every production lot

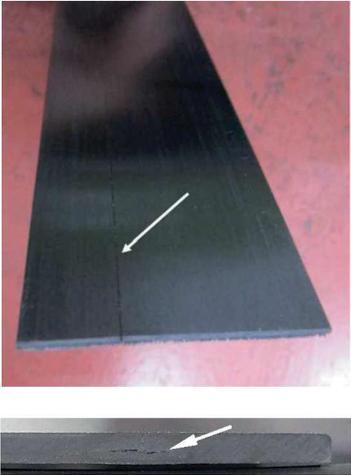
4 Appearance, dimensions, and straightness

4.1 Appearance

CFRP strips shall not have defects such as crack (mechanical defect), whitening (incomplete curing), blistering (mechanical defect), etc.

NOTE Examples of defects are shown in [Table 1](#).

Table 1 — Examples of defects

External/Internal crack	Whitening	Blistering
		

4.2 Dimensions

4.2.1 Nominal width, thickness, cross sectional area and length

The nominal width, nominal thickness, nominal cross-sectional area and nominal length of CFRP strips shall be agreed between interested parties.

4.2.2 Tolerance for width, thickness and cross-sectional area

The tolerances for width, thickness and cross-sectional area in the sampling test specified in [Clause 6](#) shall be in accordance with [Table 2](#).

Table 2 — Tolerance of cross-sectional dimensions

Item	Tolerance
Width	No less than nominal width
Thickness	±10 % of the nominal thickness
Cross-sectional area	No less than nominal cross-sectional area

4.2.3 Tolerance for length

The tolerance for length in the sampling test specified in [Clause 6](#) shall be in accordance with [Table 3](#).

Table 3 — Tolerance of length

Nominal length, l	Tolerance
$l \geq 30$ m	+1,0 m, -0 m
$30 \text{ m} > l \geq 10$ m	+0,5 m, -0 m
$10 \text{ m} > l \geq 5$ m	+0,1 m, -0 m
$l < 5$ m	+0,01 m, -0 m

4.3 Straightness

Tolerance of straightness in sampling test specified in [Clause 6](#) shall not be larger than 0,5 mm.

5 Mechanical properties

5.1 General

The mechanical properties of CFRP strips shall be expressed by the characteristic values of tensile strength, Young's modulus, and ultimate strain.

NOTE This requirement is to be met by the manufacturer of the product. The properties for design are calculated from the characteristic values, as prescribed in an appropriate design code which is in accordance with ISO 14484.

5.2 Characteristic value of tensile strength and Young's modulus

The characteristic value of tensile strength and characteristic value of Young's modulus of CFRP strips shall be agreed between interested parties.

5.3 Characteristic value of ultimate strain

The characteristic value of ultimate strain shall be determined by the characteristic value of tensile strength divided by the characteristic value of Young's modulus.

6 Sampling test

6.1 Dimensions

6.1.1 Width, thickness and cross-sectional area

The width of CFRP strips shall be measured with an interval of 10 m in length by a calliper, expressed with a precision of 0,1 mm rounded down to the first decimal place.

The thickness of CFRP strips shall be measured with an interval of 10 m in length by a calliper, expressed with a precision of 0,1 mm rounded down to the first decimal place.

The cross-sectional area of CFRP strips shall be determined by multiplying the width and the thickness, expressed with a precision of 0,1 mm² rounded down to the first decimal place.

6.1.2 Length

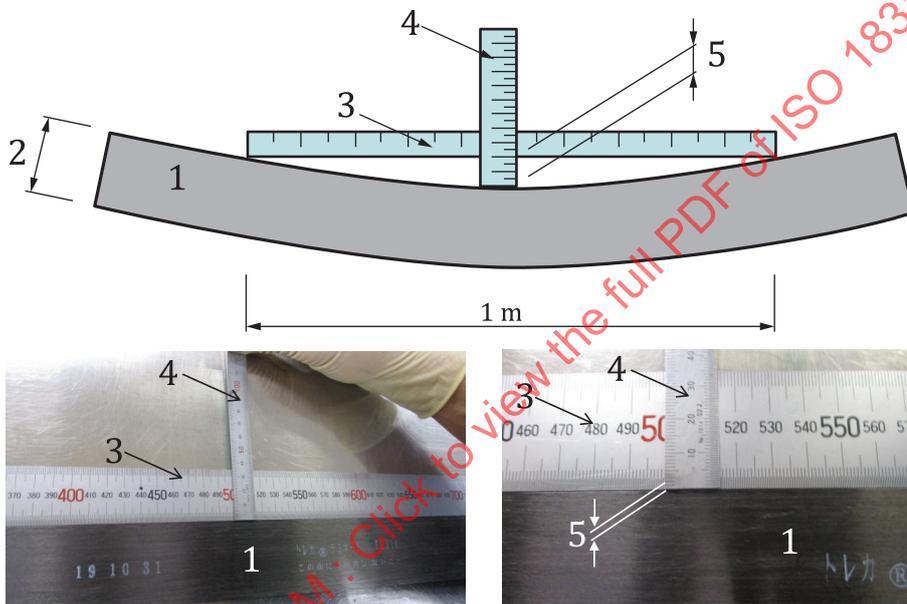
In case the nominal length is equal to or larger than 5 m, the length of CFRP strips shall be measured by a roller type length measuring device with rolling up the strip, expressed with a precision of 0,1 m rounded down to the first decimal place.

In case the nominal length is smaller than 5 m, the length of CFRP strips shall be measured by a metallic tape measure for the flattened strip, expressed with a precision of 0,01 m rounded down to the second decimal place.

6.1.3 Straightness

Straightness of CFRP strips shall be measured in accordance with following procedure.

- a) Place the flattened strip on a surface plate.
- b) A metallic scale with 1 m length (long scale) shall be disposed along the axis of the strip. Other metallic scale shall be placed perpendicularly at the central position of the long scale as shown in [Figure 1](#).
- c) The interstice between the strip and the long scale shall be measured with a precision of 0,1 mm rounded down to the first decimal place.



Key

- 1 CFRP strip
- 2 width of strip
- 3 metallic scale with 1 m length (long scale)
- 4 metallic scale
- 5 straightness

Figure 1 — Measurement of straightness

6.2 Tensile properties

6.2.1 Test method

The test method to determine tensile properties shall be conducted in accordance with ISO 10406-3. The number of test pieces shall be no fewer than 20, including two or more lots of products in case of the initial inspection. The number of test pieces shall be no fewer than five in case of the periodic inspection.

6.2.2 Tensile strength and Young's modulus

The characteristic value of tensile strength shall be determined by subtracting three times the standard deviation from the mean strength in the initial inspection.

The characteristic value of Young's modulus shall be determined by the mean value in the initial inspection.

In case of the periodic inspection, the average and minimum of tensile strength and the average of Young's modulus shall be reported.

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