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**Reinforcement fibres — Woven fabrics
— Requirements and specifications**

Fibres de renfort — Tissus — Exigences et spécifications

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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 document 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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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 61, *Plastics*, Subcommittee SC 13, *Composites and reinforcement fibres*.

This third edition cancels and replaces the second edition (ISO 2113:1996), which has been technically revised. It also incorporates the Technical Corrigendum ISO 2113:1996/Cor 1:2003.

The main changes are as follows:

- [Clause 2](#) has been updated with new references added and others deleted;
- some editorial changes have been made.

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.

Introduction

A specification is intended to "specify" the standardized object by providing verifiable requirements, and its necessary elements include "requirements" and "verification methods". It should enumerate as completely as possible the points that should be considered at the time of drafting the specification.

The specification, therefore, can be used as the basis for procurement and trade, the basis for judging the conformity of products, processes or services, and the benchmark for self-declaration and certification.

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Reinforcement fibres — Woven fabrics — Requirements and specifications

1 Scope

This document provides characteristics and requirements to create specifications of fabrics woven from yarns (including single yarns, multiple-wound yarns, plied yarns, cabled yarns and rovings) made from textile glass, carbon or aramid and generally used for plastics reinforcements.

This document does not cover all requirements for some specialized applications.

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 291, *Plastics — Standard atmospheres for conditioning and testing*

ISO 1887, *Textile glass — Determination of combustible-matter content*

ISO 2078, *Textile glass — Yarns — Designation*

ISO 2797, *Textile glass — Rovings — Basis for a specification*

ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 3374, *Reinforcement products — Mats and fabrics — Determination of mass per unit area*

ISO 3598, *Textile glass — Yarns — Basis for a specification*

ISO 3951-1, *Sampling procedures for inspection by variables — Part 1: Specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection for a single quality characteristic and a single AQL*

ISO 4602, *Reinforcements — Woven fabrics — Determination of number of yarns per unit length of warp and weft*

ISO 4603, *Textile glass — Woven fabrics — Determination of thickness*

ISO 4604, *Reinforcement fabrics — Determination of conventional flexural stiffness — Fixed-angle flexometer method*

ISO 4606, *Textile glass — Woven fabric — Determination of tensile breaking force and elongation at break by the strip method*

ISO 5025, *Reinforcement products — Woven fabrics — Determination of width and length*

ISO 10548, *Carbon fibre — Determination of size content*

ISO 13002, *Carbon fibre — Designation system for filament yarns*

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

woven fabric

reinforcement-fibre fabric made by interlacing at least two sets of threads perpendicularly to each other, or at some other specified angle, such interlacing being carried out by weaving on weaving machine

3.2

warp

yarns lying in the lengthwise direction of the fabric in 0° direction

3.3

weft

yarns running from selvedge to selvedge, generally at right angles to the *warp* (3.2) in 90° direction

3.4

type of weave

designation of the method of interlacing *warp* (3.2) and *weft* (3.3) to give a regular, repeating pattern of weaving

EXAMPLE Plain, satin, twill.

3.5

construction

number of yarns per centimetre length in the *warp* (3.2) and *weft* (3.3) directions

Note 1 to entry: The term is also used with reference to the *type of weave* (3.4).

3.6

tracer yarn

yarn of either different colour or different composition, or both from the reinforcement yarns, which is included in the fabric for product identification or to aid fabric alignment during moulding

4 Types — Technical description of woven reinforcement fabrics

The technical description of a woven reinforcement fabric requires a definition of the following points:

- a) the designation of the yarns in the warp direction;
- b) the designation of the yarns in the weft direction;
- c) the construction of the fabric:
 - 1) type of weave,
 - 2) weave ratio,
 - 3) number of yarns per centimetre in warp and weft;
- d) the type of either treatment or size content, or both if applicable;
- e) the mass per unit area;
- f) the thickness, if applicable.

As the full description is unwieldy, woven reinforcement fabric manufacturers normally give a code number to their fabrics to simplify ordering and stocking. The full description of the woven fabric shall, however, be given in the manufacturers catalogue against its code number.

Though this technical description is not necessary for the designation of fabrics, it may be used as a guide to the establishment of descriptions in the reinforcement fabric catalogues, thereby ensuring a strong basis for identification of fabrics.

The designation of textile yarns shall be in accordance with ISO 2078. The designation of carbon fibres shall be in accordance with ISO 13002.

5 Sampling and number of test specimens

Each delivery of a given type of fabric shall be sampled in accordance with ISO 2859-1 and ISO 3951-1.

For the verification of visual properties, each roll selected as part of the sample shall be examined along its whole length except where otherwise specified.

For the physical properties, the method and the number of test specimens taken from each laboratory sample shall be as specified for each test method.

6 Conditioning

The specification shall supply the information required for the proper conditioning of the elementary units (rolls of fabric). In the absence of specific instructions for the fabric under consideration, it shall include a reference to ISO 291.

When required, specific conditioning instructions for the laboratory samples or test specimens shall be as given in each test method.

7 Characteristics and test methods

7.1 General

Woven reinforcement fabrics shall be of uniform structure. Depending on the type and end use, the supplier shall specify some or all of the characteristics listed in 7.2.

For each parameter specified, reference shall be made to the product specification for the specified value(s) and the allowable tolerances on such value(s).

The yarn used shall be in accordance with ISO 2797, ISO 3598 or other relevant specifications.

A roll of material shall be assumed to be in one piece, unless otherwise stated.

7.2 Characteristics to be specified

7.2.1 Construction characteristics

The construction of the reinforcement fabric shall be specified by:

- a) the type of yarn used in the warp and weft directions;
- b) the linear density, in tex, of the warp and weft yarns; for carbon fibre, it may be specified by the number of monofilaments;
- c) the type of weave: the main types of weave are illustrated in [Figure 1](#);
- d) the number of yarns in the warp and the weft per centimetre width, determined in accordance with ISO 4602, expressing the results to one decimal place.

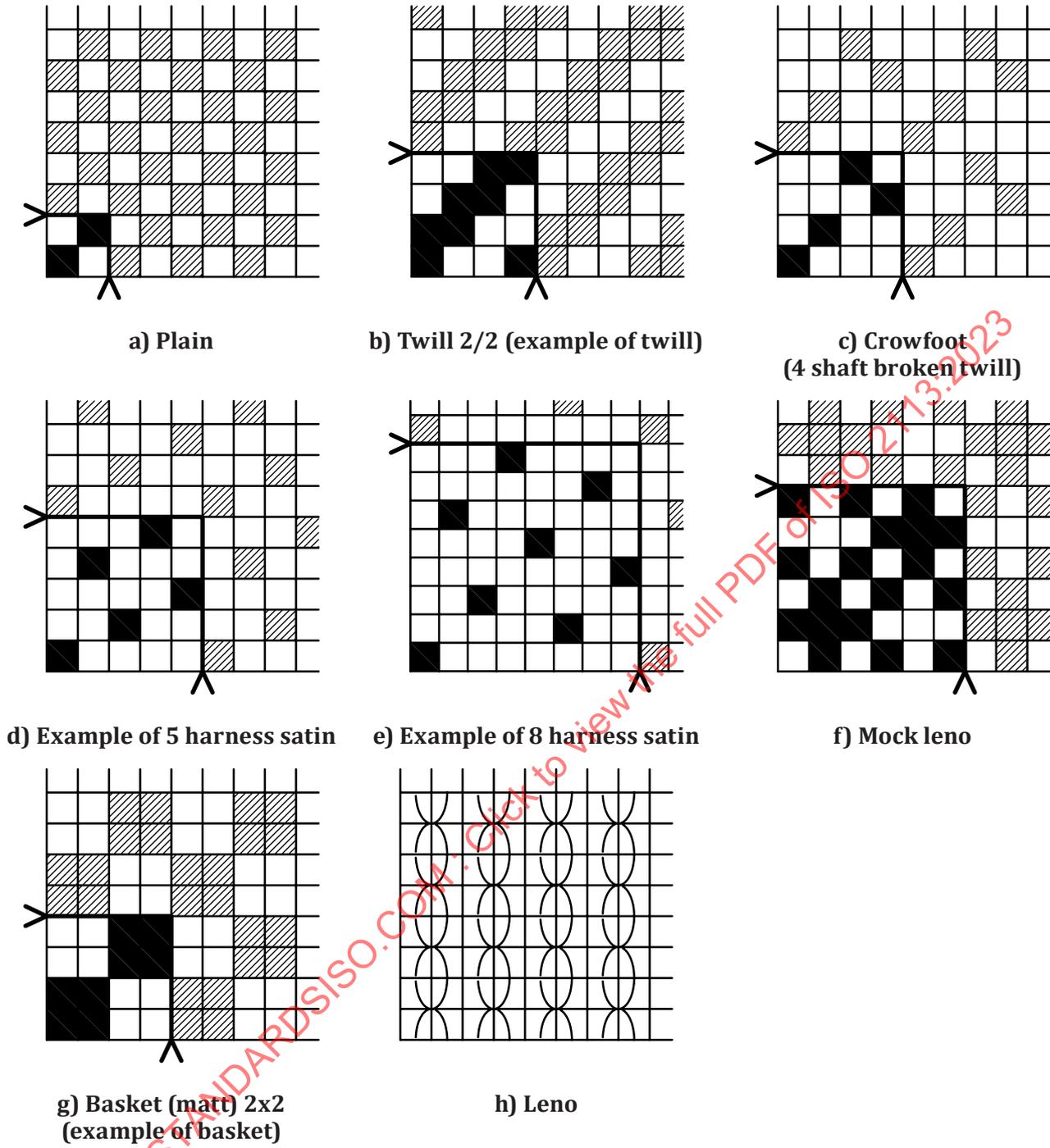


Figure 1 — Examples of test specimen supports

7.2.2 Physical characteristics of fabric

7.2.2.1 Mass per unit area

The mass per unit area of the fabric as received shall be determined in accordance with ISO 3374 and indicated in grams per square metre. The measured value shall lie within $\pm 5\%$ of the specified value, unless stated otherwise in the product specification (see 7.1).

7.2.2.2 Width and length

The width and length shall be subject to agreement between the interested parties. The width shall be indicated in centimetres and the length in metres.

The method specified in ISO 5025 shall be used to measure:

- a) the width;
- b) the length, measured during manufacture or by unrolling the fabric.

The overall width, i.e. including the fringes, may also be measured, subject to agreement between the interested parties.

7.2.2.3 Thickness

The thickness shall be determined in accordance with ISO 4603 and expressed in millimetres. The measured thickness shall lie within $\pm 15\%$ of the specified thickness value, unless stated otherwise in the product specification (see 7.1).

7.2.3 Surface treatment

7.2.3.1 General

Fabrics may be produced with different types of surface treatment depending on the type of yarn and the resin compatibility required. The following properties shall be specified to ensure the resin compatibility.

7.2.3.2 Type of surface treatment of fibre

- a) textile size;
- b) plastic size;
- c) cleaned and finished;
- d) oxidized;
- e) Corona-treated;
- f) any other treatment.

7.2.3.3 Amount of size and/or finish

The amount of size and finish on the fabric shall be determined in accordance with:

- ISO 1887 for glass-fibre fabrics;
- ISO 10548 for carbon-fibre fabrics.

For fabrics manufactured from other reinforcement yarns or mixed fibres, the specification shall provide suitable instructions. The results shall be expressed as a percentage by mass of the dried fabric, to the nearest $\pm 0,1\%$.

7.2.4 Tracer yarn

If the fabric contains a tracer yarn, the following shall be identified:

- a) type;
- b) linear density;

- c) warp spacing;
- d) weft spacing.

7.2.5 Mechanical characteristics

7.2.5.1 Tensile strength and elongation at break

The tensile strength and elongation at break of the reinforcement fabric shall be determined in accordance with ISO 4606 in both the warp and the weft directions. The results shall be expressed in newtons to the nearest 1 % for the tensile strength and as a percentage to two decimal places for the elongation.

7.2.5.2 Stiffness

The stiffness of the reinforcement fabric shall be determined in accordance with the fixed-angle flexometer method specified in ISO 4604. The stiffness shall be determined in both the warp and the weft directions. The results shall be expressed in millinewton metres.

7.3 Defects

7.3.1 General

Any or all of the following defects may be excluded by agreement between the interested parties.

7.3.2 Warp defects

- a) Ends out: a gap caused by a missing warp yarn.
- b) Misreed (wrong denting): a place in the fabric where one or more ends are not properly placed in the reeds.
- c) Tight end: a single end woven under excessive tension.
- d) Slack end: an end woven under insufficient tension.
- e) Slack selvage.
- f) Tight selvage.
- g) Fuzzy ends/fuzz balls.
- h) Streaks: short lengths of yarn of different colour.

7.3.3 Weft defects

- a) Broken pick: a pick missing across part of the width.
- b) Weft with differing tex values.
- c) Heavy mark: a band or bar running in the weft direction across the full width of the fabric or part of it and containing picks of larger linear density than normally used in the fabric or containing more than the normal number of picks.
- d) Light mark: opposite of heavy mark.
- e) Jerked-in (or lashed-in) weft or trailer: an extra thread dragged into the shot with the regular pick and extending only a part of the way across the fabric.