BRITISH STANDARD

BS EN
13002-2:1999

# Carbon fibre yarns —

## Part 2: Test methods and general specifications

The European Standard EN 13002-2:1999 has the status of a British Standard

ICS 59.100.20

# National foreword

This British Standard is the English language version of EN 13002-2:1999.

The UK participation in its preparation was entrusted to Technical Committee PRI/42, Fibre reinforced thermosetting plastics and prepregs, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

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**Summary of pages**

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**EUROPEAN STANDARD** **EN 13002-2**
**NORME EUROPÉENNE**
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ICS 59.100.20

**English version**

# Carbon fibre yarns — Part 2: Test methods and general specifications

Fils de carbone — Partie 2: Méthodes d'essais et spécifications générales

Kohlenstoffilamentgarne — Teil 2: Prüfverfahren und allgemeine Festlegungen

This European Standard was approved by CEN on 4 March 1999.

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**CEN**

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart, 36 B-1050 Brussels



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# Foreword

This European Standard has been prepared by Technical Committee CEN/TC 249, Plastics, the Secretariat of which is held by IBN**.**

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 1999, and conflicting national standards shall be withdrawn at the latest by October 1999.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

This standard is one part of EN 13002 which is structured as follows:

— *Carbon fibre yarns — Part 1: Designation.*

— *Carbon fibre yarns — Part 2: Test methods and general specifications.*

— *Carbon fibre yarns — Part 3: Technical specifications.*

## 1 Scope

This standard is applicable to high-performance, high modulus carbon fibre filament yarns as defined in material standards. The carbon fibre filament yarns are used for manufacturing semi-finished products and for reinforcing metallic, plastic and ceramic parts. Polyacrylonitrile, pitch or viscose filament yarns are used as precursor which are transformed into carbon fibre filament yarns by controlled pyrolysis.

## 2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

prEN ISO 10618, *Carbon fibre — Determination of tensile properties by resin-impregnated yarns* (ISO/DIS 10618:1994).

EN ISO 1886, *Reinforcement fibres — Sampling plans applicable to received batches* (ISO 1886:1990).

EN ISO 1889, *Reinforcement yarns — Determination of the linear density* (ISO 1889:1997).

EN ISO 1890, *Reinforcement yarns — Determination of twist* (ISO 1890:1997).

EN ISO 10548, *Carbon fibre — Determination of size content* (ISO 10548:1994).

ISO 472, *Plastics — Vocabulary*.

ISO 472:1988/AM5:1996, *Plastics — Vocabulary — Amendment 5: Terms relating to carbon*.

ISO 2859-1, *Sampling procedure for inspection by attributes — Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection*.

ISO 10119, *Carbon fibre — Determination of density*.

## 3 Definitions

For the purposes of this European Standard, the definitions given in ISO 472, ISO 472:1988/AM5:1996 and the following definitions apply.

**3.1**
**qualification testing**
evaluation of one or several successive lots of a given product to demonstrate that the product meets the requirements of the applicable specification

**3.2**
**acceptance testing**
evaluation of a received lot of a given product to demonstrate that the lot fulfils the requirements of the applicable specification

## 4 Yarn characteristics

### 4.1 Physical properties

According to the relevant material standards for carbon fibre filament yarns.

### 4.2 Visual properties

The carbon fibre filament yarns shall be free from oil, grease and other contaminants as well as from partial tow breakage and fluffy debris on the surface of or within the bobbin.

### 4.3 Other properties

#### 4.3.1 *Splices*

Distinction shall be made between blown splices and bonded splices. Type and number shall be agreed between the yarn manufacturer and the customer.

## 5 Quality inspection

The tests to be performed on a lot (or batch) of carbon yarn will be different depending on whether they are for a reception lot or a production lot.

One production lot is obtained by a fabrication campaign of limited duration in time on the basis, for example, of one given amount of raw material.

One reception lot, as received by a customer, can be made from one part or the whole of one production lot. It can also originate from several production lots in accordance with EN ISO 1886.

### 5.1 Sampling and criteria for acceptance

The evaluation at reception of a lot of carbon yarn is based on the sampling that is described in the standards EN ISO 1886 and ISO 2859-1 and on the acceptable quality level (AQL) of 1,5 % for the physical properties and 2,5 % for the visual properties.

Depending on the circumstances, the control for the evaluation of a lot may be either with a “normal” inspection level (for the qualification of a product or in the case of problems), or with a “reduced” inspection level, when a minimum of three successive controls have given an acceptable result. The control should return to the “normal” level if the result on a reduced inspection level is negative. In the context of this standard, sampling by ATTRIBUTES is proposed. It is also possible to use control by variables.

Tables 1 and 2 show the procedure for inspection by attributes with the normal test plan (see Table 1) and the reduced test plan (see Table 2).

**Table 1 — Test plan — normal inspection according to ISO 2859-1 (level II)**

| Number of elementary units in batch | Sample size | Acceptance criteria | | Acceptance criteria | |
|---|---|---|---|---|---|
| | | AQL 1,5 % | | AQL 2,5 % | |
| *N* | $n_1$ | A | R | A | R |
| 2 to 8 | 2 | 0 | 1 | 0 | 1 |
| 9 to 15 | 3 | 0 | 1 | 0 | 1 |
| 16 to 25 | 5 | 0 | 1 | 0 | 1 |
| 26 to 50 | 8 | 0 | 1 | 0 | 1 |
| 51 to 90 | 13 | 0 | 1 | 1 | 2 |
| 91 to 150 | 20 | 1 | 2 | 1 | 2 |
| 151 to 280 | 32 | 1 | 2 | 2 | 3 |
| 281 to 500 | 50 | 2 | 3 | 3 | 4 |
| 501 to 1 200 | 80 | 3 | 4 | 5 | 6 |
| 1 201 to 3 000 | 125 | 5 | 6 | 7 | 8 |
| 3 201 to 10 000 | 200 | 7 | 8 | 10 | 11 |

A: Batch is acceptable if the number of non-conforming units is equal to or less than the number given.

R: Batch is unacceptable if the number of non-conforming units is equal to or greater than the number given.

For batches of more than 10 000 elementary units, sampling shall be the subject of an agreement between the yarn manufacturer and the customer.

**Table 2 — Test plan — reduced inspection according to ISO 2859-1 (level II)**

| Number of elementary units in batch | Sample size | Acceptance criteria | | Acceptance criteria | |
|---|---|---|---|---|---|
| | | AQL 1,5 % | | AQL 2,5 % | |
| *N* | $n_1$ | A | R | A | R |
| 2 to 25 | 2 | 0 | 1 | 0 | 1 |
| 26 to 50 | 3 | 0 | 1 | 0 | 1 |
| 51 to 90 | 5 | 0 | 1 | 0 | 2 |
| 91 to 150 | 8 | 0 | 2 | 0 | 2 |
| 151 to 280 | 13 | 0 | 2 | 1 | 3 |
| 281 to 500 | 20 | 1 | 3 | 1 | 4 |
| 501 to 1 200 | 32 | 1 | 4 | 2 | 5 |
| 1 201 to 3 000 | 50 | 2 | 5 | 3 | 6 |
| 3 201 to 10 000 | 80 | 3 | 6 | 5 | 8 |

A: Batch is acceptable if the number of non-conforming units is equal to or less than the number given.

R: Batch is unacceptable if the number of non-conforming units is equal to or greater than the number given.

For batches of more than 10 000 elementary units, sampling shall be the subject of an agreement between the yarn manufacturer and the customer.

### 5.2 Testing at manufacturer

The manufacturer has to make sure that the shipped product meets a given specification. Therefore he has to define a quality control system which will generally include process control (SPC) and testing of final and semi products with adequate test frequency.

On the basis of the knowledge of the process and implementation of SPC, possibly combined with the use of automated production equipment, the testing at manufacturer will generally be done using a reduced sampling compared to that used for the reception of lots, with a trend toward testing of process variables in place of testing on product itself.

### 5.3 Certificate

The supplier may, at the request of the customer, issue a certificate for any shipment.

This can be:

— a certificate of conformance, which is a document confirming that the material has been controlled and meets the requirements of the specification,

— a certificate of analysis, which, besides the statement above, also includes the test results for the applicable material.

**Table 3 — Tests**

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| **No.** | **Properties** | **Units** | **Test methods** |
| 1 | Density | $g/cm^3$ | ISO 10119 |
| 2 | Linear density | tex | EN ISO 1889 |
| 3 | Size content (quantitative) | % | EN ISO 10548 |
| 4 | Twist | — | EN ISO 1890 |
| 5 | Tensile strength | MPa | prEN ISO 10618 |
| 6 | Tensile modulus | MPa | prEN ISO 10618 |
| 7 | Elongation at break | % | |

## 6 Mode of delivery

### 6.1 Packaging

Unless otherwise explicitly specified, the carbon fibre filament yarns shall be sealed in plastic bags, adequately supported and protected to prevent damage during normal transit and storage.

### 6.2 Marking of packages

Carbon fibre filament yarns shall be marked in a clearly visible and legible way with at least the following information:

| | |
|---|---|
| on each bobbin: | trade designation |
| on the packed unit: | trade designation |
| | name of manufacturer, batch No. |
| | net weight |

## 7 Storage

Carbon fibre filament yarns, packed or unpacked, shall be stored in dry locations so as to prevent damage. The storage temperature shall be less than 50 °C. The relative humidity should be less than 85 %.

After delivery, the storage life shall be at least one year, counted from the date of delivery.

## Annex A
## Certificate of analysis (model) for carbon fibre filament yarns

Customer.....

Material specification .....

Trade designation of the product .....

Designation according to the European Standard.....

Name and address of manufacturer.....

Order No ..... Production batch No. or date .....

Quantity delivered ..... Date of delivery .....

**Table A.1**

| Properties | Units | Test methods | Required values | Measured values |
|---|---|---|---|---|
| Linear density | Tex | EN ISO 1889 | | |
| Size content | % | EN ISO 10548 | | |
| Tensile strength | $N/mm^2$ | prEN ISO 10618 | | |
| Tensile modulus | $N/mm^2$ | prEN ISO 10618 | | |

This is to certify that the properties of the carbon fibre filament yarns comply with the requirements of the material standard EN ….

.....

(signature of the inspector)

..... .....

(date and place) (stamp of company and department)

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