BS EN 16245-3:2013

BSI Standards Publication

Fibre-reinforced plastic composites — Declaration of raw material characteristics

Part 3: Specific requirements for fibre

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National foreword

This British Standard is the UK implementation of EN 16245-3:2013.

The UK national committee are of the opinion that in all parts of EN 16245 the use of the terms "guaranteed minimum value" and "guaranteed maximum value" is not appropriate within a voluntary based standard. Furthermore, the absolute "minimum value" and "maximum value" cannot be determined practicably, so that "statistical minimum value" (defined in EN 16245-1) and "statistical maximum value" (calculated in a similar manner using maximal values) are preferred.

The UK participation in its preparation was entrusted to Technical Committee PRI/42, Fibre reinforced thermosetting plastics and prepregs.

A list of organizations represented on this committee can be obtained on request to its secretary.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (EN 16245-3:2013) has been prepared by Technical Committee CEN/TC 249 “Plastics”, the secretariat of which is held by NBN.

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of an identical text or by endorsement, at the latest by November 2013, and conflicting national standards shall be withdrawn at the latest by November 2013.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

EN 16245 consists of the following parts, under the general title *Fibre-reinforced plastic composites — Declaration of raw material characteristics*:

— *Part 1: General requirements*

— *Part 2: Specific requirements for resin, curing systems, additives and modifiers*

— *Part 3: Specific requirements for fibre* (the present document)

— *Part 4: Specific requirements for fabrics*

— *Part 5: Specific requirements for core materials*

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard specifies the minimum information to be declared for fibre material to be used for the manufacturing of composites products.

These specific declaration requirements are given in addition to the general requirements given in EN 16245-1.

This document includes requirements for the Certificate of Analysis (CoA). The purpose of the CoA is to verify that material properties and quality conforms to the declared values.

This part of the standard is applicable to carbon and glass fibre material.

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.

EN 16245-1:2013, *Fibre-reinforced plastics composites — Declaration of raw material characteristics — Part 1: General requirements*

EN ISO 291, *Plastics — Standard atmospheres for conditioning and testing (ISO 291)*

EN ISO 1889, *Reinforcement yarns — Determination of linear density (ISO 1889)*

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

EN ISO 3344, *Reinforcement products — Determination of moisture content (ISO 3344)*

EN ISO 9163, *Textile glass — Rovings — Manufacture of test specimens and determination of tensile strength of impregnated rovings (ISO 9163)*

EN ISO 10548:2003, *Carbon fibre — Determination of size content (ISO 10548:2002)*

EN ISO 10618, *Carbon fibre — Determination of tensile properties of resin-impregnated yarn (ISO 10618)*

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

ISO 1888, *Textile glass — Staple fibres or filaments — Determination of average diameter*

ISO 10119:2002, *Carbon fibre — Determination of density*

ISO 15100, *Plastics — Reinforcement fibres — Chopped strands — Determination of bulk density*

ASTM D150-11, *Standard Test Methods for AC Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulation*

ASTM D578-05, *Standard Specification for Glass Fiber Strands*

ASTM D2970-04, *Standard Test Method for Testing Tire Cords, Tire Cord Fabrics, and Industrial Yarns Made From Glass Filaments*

3 Terms and definitions

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

3.1
carbon fibre
fibre produced by the pyrolysis of organic precursor fibres such as rayon, polyacrylonitrile (PAN), and pitch in an inert atmosphere

Note 1 to entry: The term is often used interchangeably with graphite, however carbon fibres and graphite fibres differ in the temperature at which the fibres are made and heat-treated, and the amount of carbon produced. Carbon fibres typically are carbonised at about 1 300 °C and assay at 93 % to 95 % carbon, while graphite fibres are graphitised at 1 900 °C to 3 000 °C and assay at more than 99 % elemental carbon.

3.2
glass fibre
fibre made under highly controlled conditions from molten minerals and other inorganic materials where the resulting silica content normally is above 50 %

3.3
fibre
unit of matter characterised by a high ratio of length to thickness or diameter

3.4
filament
variety of fibres characterised by extreme length, such that there are normally no filament ends within a part except at geometric discontinuities

Note 1 to entry: Fibre and filament are often interchanged.

Note 2 to entry: Filaments can be formed into roving or yarn with low twist.

3.5
twist
number of turns per unit length about the axis, in a yarn or other textile strand

3.6
sizing agent/coupling agent
chemical substance applied to filaments/fibres for protection, processability and influence on mechanical and chemical properties

3.7
fibre strand
bundle of filaments

3.8
yarn
twisted strands

Note 1 to entry: For carbon fibre, yarn can be used on filament bundle with 0 twist.

3.9
roving
number of strands, tows or ends collected into a parallel bundle with little or no twist

4 Content of a declaration

A declaration for the fibre material shall consist of information according to EN 16245-1:2013, Clause 5 and Clause 5 of this standard.

5 Specific declaration requirements

5.1 General

The specific requirements for fibre are given below.

All declaration requirements, i.e. the general information according to EN 16245-1 and the specific declaration requirements according to this part (i.e. EN 16245-3), and application dependant requirements as agreed between manufacturer/supplier and customer, shall be declared by the supplier as information to the customer. The following also apply:

— if the property given has reference to a test standard or test method, this test standard or test method shall be used;

— the values given shall be in accordance with the test standard given;

— if the test environment is not clearly stated in the specific test standard, the standard atmosphere conditioning and testing shall be carried out in accordance with EN ISO 291;

— the manufacturer shall be responsible for the performance and results of all tests required for the declaration.

5.2 Properties of carbon fibre

The specific declaration requirements for carbon fibre are listed below. The declaration including tolerances shall be given in accordance with the test standards stated in Table 1.

Deviations from the referred standards shall be clearly stated and explained.

The following specific declaration requirements a) to n) apply for all carbon fibre independent of application:

a) fibre identification (name/number/code used by the manufacturer for identification purposes);

b) fibre density [g/cm^3];

NOTE 1 Defines the density of the roving/yarn without sizing agent.

c) linear density [g/km (= tex)];

NOTE 2 Defines the linear density of the roving/yarn without sizing agent. Given as supply batch value and bobbin/roll value.

d) filament count (f);

e) filament diameter [μm];

f) size identification code, surface preparation and chemical basis of the sizing:

1) Defines the size applied to the fibre with respect to type and product identification.

2) The size identification shall refer to a revision number or date of modification if number/code is the same for different versions of the size formulation.

3) Identification of other type of preparation.

g) size content [wt%];

NOTE 3 Defines the average amount of size applied to fibre.

h) fibre twist [t/m]:

1) Defines the amount of twist. The twist refers to the twist after the roving/yarn has been taken off the bobbin/roll according to advised method. The associated take off method shall be mentioned, e.g. roll off or pull out from centre.

i) strand length (not applicable if continuous) [mm];

j) tensile strength [MPa]:

1) The standard and method applied shall be declared.

k) tensile modulus [GPa]:

1) The standard and method applied shall be declared.

l) tensile strain at break [%]:

1) The standard and method applied shall be declared.

m) packing/storing condition;

NOTE 4 Specifies the temperature and humidity at packaging premises and when stored.

n) bobbin/spool characteristic (i.e. spool dimensions, mass).

The Certificate of Analysis (CoA) verifies that the selected properties for the CoA for the delivered carbon fibre material comply with the declared values, in accordance with the methods specified in Table 1. The CoA shall be given in accordance with EN 16245-1:2013, Clause 6.

Table 1 — Material declaration of carbon fibre properties/conditions relevant for CoA

Ref. no 5.2	Property	Nominal value	Minimum and/or maximum value	Unit	Test method
b)	Density	Mean value	Minimum and maximum values	g/cm^3	ISO 10119:2002, Method A: – Liquid displacement method.
c)	Linear density	Mean value	Minimum and maximum values	g/km = tex	EN ISO 1889
d)	Filament count	Mean value	Minimum and maximum values	f	
e)	Filament diameter	Mean value	Minimum and maximum values	µm	
g)	Size content — non-cured sizing — partly cured and cured sizing	Mean value	Minimum and maximum values	wt%	EN ISO 10548:2003, Method A – Solvent method Method B – Acid method
h)	Twist (excluding chopped strand)	Mean value Direction of twist (S or Z) shall be given	Minimum and maximum values	t/m	EN ISO1890
i)	Strand length (excluding continuous fibre)	Mean value	Minimum and maximum values	mm	
j)	Tensile strength	Mean value	Minimum value	MPa	EN ISO 10618 (or test methods based on JIS R 7601 [1]) using test rate 5 mm/min to 30 mm/min
k)	Tensile modulus	Mean value	Minimum value	GPa	EN ISO 10618 (or test methods based on JIS R 7601 [1]) using test rate 5 mm/min to 30 mm/min
l)	Tensile strain at break	Mean value	Minimum value	%	EN ISO 10618 (or test methods based on JIS R 7601 [1]) using test rate 5 mm/min to 30 mm/min

5.3 Properties of glass fibre

The specific declaration requirements for glass fibre are listed below. The declaration including tolerances shall be given in accordance with the test standards stated in Table 2 and Table 3.

The following specific declaration requirements a) to p) apply for all glass fibre independent of application:

a) fibre identification (name/number/code used by the manufacturer for identification purposes);

b) chemical composition of glass (see example given in Table 4);

c) density [kg/m^3];

d) linear density [g/km] (= tex);

NOTE 1 Defines the linear density of the roving/yarn without sizing.

e) filament diameter [µm];

f) size type and identification:

1) Defines generically the size applied to the fibre. See Table 5 for required information.

2) The size identification shall refer to a revision number or date of modification if number/code is the same for different versions of the size formulation.

g) size content [wt%];

h) twist [t/m]:

1) Defines the amount of twist.

2) The twist shall refer to the twist after the roving/yarn has been taken off the bobbin/roll according to advised method.

i) moisture content [wt%];

j) strand length (not applicable for continuous fibre) [mm];

k) tensile strength [MPa];

NOTE 2 Given as supply batch value or bobbin value for continuous fibre.

l) tensile modulus [GPa];

NOTE 3 Given as supply batch value or bobbin value for continuous fibre.

m) tensile strain at break [%];

NOTE 4 Given as supply batch value or bobbin value for continuous fibre.

n) thermal expansion (applicable if glass type is outside defined types according to ASTM D578) [1/°C];

o) catenary [cm];

NOTE 5 Defines the differences in length of the fibre strands in a bundle.

p) packing/storing condition (specifies the temperature and humidity at packaging premises);

q) bobbin /spool characteristic (i.e. spool dimensions, mass).

The following specific declaration requirements r) to s) apply for glass fibre for specific application:

r) dielectric constant:

1) Applicable if glass type is outside defined types according to ASTM D578.

2) To be given at 1 MHz and 10 GHz.

s) dissipation factor:

1) Applicable if glass type is outside defined types according to ASTM D578.

2) To be given at 1 MHz and 10 GHz.

The Certificate of Analysis (CoA) verifies that the selected properties for CoA for the delivered glass fibre material comply with the declared values, in accordance with the methods specified in Table 2 and Table 3. The CoA shall be given in accordance with EN 16245-1:2013, Clause 6.

Table 2 — Material declaration of glass fibre properties/conditions relevant for CoA (independent of application)

Ref. no 5.3	Property	Nominal value	Minimum and/or maximum value	Unit	Test method
b)	Chemical composition	Mean value	Minimum and maximum values	%	
c)	Density	Mean value	Minimum and maximum values	kg/m^3	ISO 15100
d)	Linear density (desized)	Mean value	Minimum and maximum values	g/km = tex	EN ISO 1889
e)	Filament diameter	Mean value	Minimum and maximum values	µm	ISO 1888
g)	Size content	Mean value	Minimum and maximum values	wt%	ISO 1887
h)	Twist	Mean value Direction of twist (S or Z) shall be given	Minimum and maximum values	t/m	EN ISO1890
i)	Moisture content	-	Maximum values	wt%	EN ISO 3344
j)	Strand length (excluding continuous fibres)	Mean value	Minimum and maximum values	mm	
k)	Tensile strength	Mean value	Minimum value	MPa	EN ISO 9163
l)	Tensile modulus	Mean value	Minimum value	GPa	EN ISO 9163
m)	Tensile strain at break	Mean value	Minimum value	%	EN ISO 9163
n)	Thermal expansion	Mean value	Minimum and maximum values	1/°C	ASTM D578-05
o)	Catenary	-	Minimum and maximum values	cm	ASTM D2970-04

Table 3 — Material declaration of glass fibre properties/conditions relevant for CoA (application specific)

Ref. no 5.3	Property	Nominal value	Minimum and/or maximum value	Unit	Test method
r)	Dielectric constant	Mean value	Minimum and maximum values		ASTM D150-11
s)	Dissipation factor	Mean value	Minimum and maximum values		ASTM D150-11

Table 4 — Example of chemical composition declaration for glass fibre

Constituent	Declared Content %	Actual Content[a] %
SiO_2	58 - 60	59,3
Al_2O_3	25 - 27	25,1
B_2O_3	0 - 0,2	0,05
CaO	8 - 10	8
MgO	4-7	5,1
ZnO		
BaO		
Li_2O		
Na_2O+K_2O	0 - 0,5	0,001
TiO_2		
ZrO_2		
Fe_2O_3	0 - 0,1	0,02
F_2	0 - 0,1	0,05
Other		

[a] Applicable if CoA.

Table 5 — Generic information to be given with respect to size

Size Identification			
Nomenclature	**Chemistry**	**Role**	**Evolutionary technology**
Film Formers	Epoxies, polyester, PVAc, EVAc, polyolefins, polyurethanes, etc.	Fibre protection, strand integrity, wetting and solubility	Improve thermal stability, low surfactant, controlled solubility, etc.
Lubricants	Imidazolines, tetraethylene amide, mineral oil/amide ester, polyethylene glycols, etc.	Strand integrity, surface friction, improved fibre forming	“Non-migrating” lubes Functionalised lubes
Emulsifiers	Fatty alcohol surfactants, Polyoxyethylene nonylphenyl ether, EO/PO condensate polyoxyethylene octylphenyl glycol ether, etc.	Render film former and lubes water compatible	Fugitive emulsifiers Functionalised emulsifiers
Coupling Agents	Silanes, titanates, zirconates	Resin/glass bonding	Improved thermal stability Bonding to new matrices
Other Additives:			
- Antistats	Metal halides, quat. ammonium, etc.	Increase conductivity	Less-hygroscopic species
- pH Control	Organic acids/bases	Control pH	Improved coupling stability
- Nucleating Agents	Yes/No pat. reference	Surface nucleation	Encourage transcrystalinity

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[1] JIS R 7601, *Testing methods for carbon fibers*

[2] EN ISO 2078, *Textile glass — Yarns — Designation* (ISO 2078)

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