

## **Fibre-reinforced plastic composites — Declaration of raw material characteristics — Part 5: Additional requirements for core materials**

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## Foreword

This document (prEN xxx-5:2010) has been prepared by Technical Committee CEN/TC 249 “Plastics”, the secretariat of which is held by NBN.

This document is a working document.

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

- Part 1: *General requirements*
- Part 2: *Additional requirements for resin, curing systems, additives and modifiers*
- Part 3: *Additional requirements for fibres*
- Part 4: *Additional requirements for fabrics*
- Part 5: *Additional requirements for core materials* (this part)

## 1 Scope

This part of the standard specifies the minimum information to be declared for core materials to be used for the manufacturing of composites products.

These specific declaration requirements are in addition to the general requirements given in part 1 of this standard (i.e. prEN xxx-1).

The declaration 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 rigid foam and balsa core material.

## 2 Normative references

The following referenced documents are indispensable for the application 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.

EN xxxx-1:20xx, Fibre-reinforced plastics composites — *Declaration of raw material characteristics — Part 1: General requirements*

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

EN ISO 844, *Rigid cellular plastics — Determination of compression properties* (ISO 844:2007)

EN ISO 845, *Cellular plastics and rubbers — Determination of apparent (bulk) density* (ISO 845:2006)

ISO 1922, *Rigid cellular plastics — Determination of shear strength*

ASTM C297, *Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions*

ASTM C 273, *Standard Test Method for Shear Properties of Sandwich Core Materials*

ASTM C 365 *Standard Test Method for Flatwise Compressive Properties of Sandwich Cores*

ASTM D4444, *Standard Test Method for Laboratory Standardization and Calibration of Hand-Held Moisture Meters*

## 3 Terms and definitions

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

### 3.1

#### **core material**

the central component of a sandwich construction to which the sandwich faces or skins are attached.

### 3.2

#### **balsa core material**

rigid balsa sheets cut in end-grain configuration to assure good compressive properties normal to the plane.

### 3.3

#### **foam core material**

various different polymer materials that are foamed in order to reduce their specific weight.

## 4 Content of a declaration

A declaration for the core material shall consist of information given in part 1 and part 5 (this part) of this standard, i.e. EN xxx-1 and EN xxx-5.

## 5 Additional declaration requirements

### 5.1 General

The additional requirements for core are given below.

All declaration requirements, i.e. requirements in EN xxx-1 and this part (i.e. EN xxx-5), and application dependant requirements as agreed between manufacturer/supplier and customer, shall be declared by the manufacturer as information to the customer, and the following 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;
- the tolerances shall be given. If the tolerances are stated in the test standard these apply, if not these shall be specified;
- the clarification of the terms nominal, minimum and maximum test values is given in Annex A;
- 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;
- the material property declaration shall account for any density variation. Minimum and mean values shall be given considering the range of density specified in 5.2. Mean values are average expected values at average density. Min value is expected minimum value at the lower end of the density range.
- the material and fixture shall be acclimated at the test temperature for a period sufficient to ensure even temperature throughout the specimen and fixture. If the test standard does not specifically mention how the test at elevated/decreased temperature shall be performed, the test shall be performed in a temperature controlled chamber. The temperature in the specimen shall not deviate more than  $\pm 2^{\circ}\text{C}$  from the nominal test temperature.

### 5.2 Properties of foam core material

The additional declaration requirements for core material are listed below. The requirements shall be given in accordance with the test standards stated in Table 1 and including the tolerances.

The following additional declaration requirements a) to p) apply for all foam core material independent on application:

- a) Identification (name/number/code used by the manufacturer for identification purposes);
- b) Density [ $\text{kg}/\text{m}^3$ ];
- c) Shear strength [MPa] – average and minimum value;

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- d) Shear modulus [MPa] – average and minimum value;
- e) Shear elongation (ultimate) [%] – average and minimum value;  
NOTE Based on stress-strain curves obtained.
- f) Compression strength (out of plane) [MPa] – average and minimum value;
- g) Compression modulus (out of plane) [MPa] - average and minimum value;
- h) Tensile strength (out of plane) [MPa] – average and minimum value;
- i) Tensile modulus (out of plane) [MPa] - average and minimum value;
- j) Thickness [mm]
  - 1) The thickness is defined as the nominal thickness of the sheet.
  - 2) The thickness shall be measured 50 mm from the corner with equal distance to the edges.
  - 3) Tolerances shall be given as maximum difference of highest and lowest measured value (regardless of the location) to the nominal value (may be given as % of the nominal value).
- k) In-plane length and width dimensions [mm x mm];
  - 1) The nominal length and width of the sheet/panel shall be given.
  - 2) The tolerances shall be given as:
    - i) Maximum deviation from the nominal length:  $\pm$  [mm].
    - ii) Maximum deviation from the nominal width:  $\pm$  [mm].
    - iii) Difference between the lengths of the two diagonals.
  - 3) When core sheet/panel is based on core blocks, the block dimension shall be given.
- l) Maximum continuous operating temperature [°C];
  - 1) Maximum temperature at which the unloaded material can be exposed without degradation of the strength and modulus properties by more than 10 % over 3 months (measured at room temperature)
- m) Heat resistance [°C];
  - 1) Heat resistance is defined as the temperature at which the average strengths and modulus both in shear and compression have decreased by 20% relative to the average values obtained at the standard test temperature according to the relevant test standard.
  - 2) All four temperatures (strength related and modulus related for shear and compression) shall be given.

- n) Maximum process temperature [ $^{\circ}\text{C}$ ];
  - 1) The maximum temperature during processing, i.e. the highest allowable temperature during a curing cycle for the sandwich.
  - 2) Give at least one set of values for temperature, pressure and time for such a process.
- o) Marking;
  - 1) Each sheet shall be marked with its product identification (including nominal density).
  - 2) Each sheet shall be marked with its batch number.
- p) Core treatment/modification/assembly;
  - 1) When a material is added to the surface of the core (coating/impregnation), the type and weight per square meter shall be given including tolerances [ $\text{kg}/\text{m}^2$ ].
  - 2) When core is machined, the type of process shall be stated, i.e. surface sanding, milling, contouring, etc.
  - 3) When core sheet is delivered with a carrier textile/Scrim, the type and specification of the carrier textile/Scrim shall be given
  - 4) When core blocks are bonded together to form a rigid plate/sheet, the bonding system type must be specified

### 5.3 Properties of balsa core material

The additional declaration requirements for balsa core material are listed below. The requirements shall be given in accordance with the test standards stated in Table 2 and including the tolerances.

The following additional declaration requirements a) to o) apply for all balsa core material independent on application:

- a) Identification (name/number/code used by the manufacturer for identification purposes);
- b) Density [ $\text{kg}/\text{m}^3$ ];
  - 1) The average, maximum and minimum values shall be given.
  - 2) The density shall be measured prior to any application of surface treatment (impregnation).
  - 3) The density shall be measured when the humidity in the sheet is as stated in clause m)
- c) Shear strength [MPa] - average and minimum value;
- d) Shear modulus [MPa] – average and minimum value;
- e) Shear elongation (Ultimate) [%] – average and minimum value;
- f) Compression strength (out of plane) [MPa] – average and minimum value;
- g) Compression modulus (out of plane) [MPa] - average and minimum value;
- h) Tensile strength (out of plane) [MPa] – average and minimum value;
- i) Tensile modulus (out of plane) [MPa ] - average and minimum value;

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- j) Thickness [mm]
  - 1) The thickness is defined as the nominal thickness of the sheet.
  - 2) The thickness shall be measured 50 mm from the corner with equal distance to the edges.
  - 3) Tolerances shall be given as maximum difference of highest and lowest measured value (regardless of the location) to the nominal value (may be given as % of the nominal value).
- k) In-plane length and width dimensions [mm x mm]
  - 1) The nominal length and width of the sheet/panel shall be given.
  - 2) The tolerances shall be given as:
    - i) Maximum deviation from the nominal length:  $\pm$  [mm].
    - ii) Maximum deviation from the nominal width:  $\pm$  [mm].
    - iii) Difference between the lengths of the two diagonals.
  - 3) When core sheet/panel is based on core blocks, the block dimension shall be given.
- l) Maximum continuous operating temperature [ $^{\circ}$ C];
  - 1) Maximum temperature at which the unloaded material can be exposed without degradation of the relevant material properties by more than 10% over 3 months (measured at room temperature)
- m) Humidity of the sheet [%];
  - 1) The maximum sheet humidity shall be given. This value is calculated as an average of measurements of at least the sheet's four corners and its centre using a moisture meter.
  - 2) Balsa core shall be packed in water proof bags.
- n) Core treatment/modification/assembly;
  - 1) When a material is added to the surface of the core (coating/impregnation), the type and weight per square meter shall be given including tolerances [ $\text{kg}/\text{m}^2$ ].
  - 2) When core is machined the type of process shall be stated, i.e. surface sanding, milling, contoured, etc.
  - 3) Core sheet delivered with a carrier textile/Scrim, the type and specification of the carrier textile/Scrim shall be given
  - 4) When core blocks are bonded together to form a rigid plate/sheet, the bonding system type shall be specified
- o) Marking;
  - 1) Each sheet shall be marked with its product identification (including nominal density).
  - 2) Each sheet shall be marked with its batch number.

## **6 Content of certificate of analysis (CoA)**

### **6.1 General**

Certificate of analysis (CoA) shall be delivered on request. The certificate shall verify that the delivered batch is within the agreed number of declared values. The relevant test methods used to obtain batch data shall be the same as used for the declaration.

Each sheet of the CoA shall be clearly marked with identification and batch number.

### **6.2 CoA for foam core**

The certificate of analysis for foam core, with reference to relevant items given in 5.2., is given in Table 1 for the application independent foam core properties.

Table 1 — CoA properties for application independent foam core

Ref. no 5.2	Property	Declared value with tolerances (% or range)	CoA Test result	Unit	Test method	CoA Content <sup>a</sup>
b)	Density			[kg/m <sup>3</sup> ]	EN ISO 845	O
c)	Shear strength			[MPa]	ISO 1922 also for -20 °C and +80 °C	O
d)	Shear modulus			[MPa]	ISO 1922 also for -20 °C and +80 °C	O
e)	Shear elongation			[%]	ISO 1922 also for -20 °C and +80 °C	O
f)	Compression strength			[MPa]	ISO 844 also for -20 °C and +80 °C	O
g)	Compression modulus			[MPa]	ISO 844 also for -20 °C and +80 °C	O
h)	Tensile strength			[MPa]	ASTM C297 also for -20 °C and +80 °C	O
i)	Tensile modulus			[MPa]	ASTM C297 also for -20 °C and +80 °C	O
j)	Thickness			[mm]		O
k)	In-plane dimensions			[mm]		O
l)	Maximum continuous operating temperature			[°C]		O
m)	Heat resistance			[°C]		O
n)	Maximum processing temperature			[°C] [MPa] [min.]		O
p)	Core treatment/modification/ assembly			[kg/m <sup>2</sup> ]		

<sup>a</sup> ● - Compulsory  
O - Optional

### 6.3 CoA for balsa core

The certificate of analysis for foam core, with reference to relevant items given in 5.3., is given in Table 2 for the application independent foam core properties.

Table 2 — CoA properties for application independent balsa core

Ref. no 5.3	Property	Declared value with tolerances (% or range)	CoA Test result	Unit	Test method	CoA Content <sup>a</sup>
b)	Density			[kg/m <sup>3</sup> ]	EN ISO 845	O
c)	Shear strength			[MPa]	ASTM C 273	O
d)	Shear modulus			[MPa]	ASTM C 273	O
e)	Shear elongation			[%]	ASTM C 273	O
f)	Compression strength			[MPa]	ASTM 365	O
g)	Compression modulus			[MPa]	ASTM 365	O
h)	Tensile strength			[MPa]	ASTM C297	O
i)	Tensile modulus			[MPa]	ASTM C297	O
j)	Thickness			[mm]		O
k)	In-plane dimensions			[mm]		O
l)	Maximum continuous operating temperature			[°C]		O
m)	Humidity of the sheet			[%]	ASTM D4444	O
n)	Core treatment/modification/ assembly			[kg/m <sup>2</sup> ]		O
<sup>a</sup> ● - Compulsory O - Optional						

## **Annex A** (informative)

### **Clarification of nominal, maximum and minimum test values**

#### **A.1 General**

The requested properties as given in this part of the standard EN xxx (i.e. EN xxxx-y), are given as nominal values with upper and lower limits, maximum values and/or minimum values. The purpose of this annex is to clarify the nomenclature and the associated values.

#### **A.2 Clarification of nominal value**

Nominal value means that the properties of the material will have a mean value equal to the declared value. The mean value is based on all measured values of all batches of the manufacturer. The material delivered to the customer is normally only a fraction of the totally produced material. This may result in that the actual value on the property of the delivered material has a mean value lower or higher than the declared value. However, the mean value of the property of the delivered material shall not be outside the declared tolerance limits in order to be delivered according to the declared properties. These tolerances include inaccuracy in the measurement itself.

#### **A.3 Clarification of minimum and maximum value**

Minimum value and maximum value means the mean value minus (-) and plus (+) two standard deviations, respectively.

The minimum and maximum value is based on all measured values of all batches of the manufacturer. The delivered materials have a 97,6 % probability of being within the minimum and maximum values, thus having 2,4 % probability of being outside the minimum and maximum value. This implies that part of or all of the delivered material may belong to the fraction which is outside the minimum and maximum values. In order to avoid this, an agreement between the manufacturer and customer stating that no material shall have properties above or below the declared minimum and maximum values, i.e. guaranteed minimum or maximum values.

#### **A.4 Guaranteed minimum and maximum value**

Guaranteed minimum and maximum value mean that no delivered material has properties below or above these values. When destructive testing is needed the mean value of the tested material (within the same batch) shall be within the declared minimum and maximum value for that particular test if guaranteed values have been agreed. In case a guaranteed value is not agreed, a sample test may have any value and still be within the specified range.

## **A.5 Extent of testing**

The extent of testing involved for a CoA has to be agreed between the supplier and the customer. For a resin material it is normal to obtain the properties from the batch. For core and fibre material, several of the tests are destructive tests and have to be performed on undelivered material.

For core plates, destructive testing for mechanical properties can be performed in the lower range of density, while non destructive tests, (dimensions and density) may be performed on every plate or a selection.

The extent of testing of fibre material is similar as for core material, where typical values are obtained from one or more bobbins or an agreed selection.