
**Z vlakni ojačeni kompozitni polimerni materiali - Navajanje karakteristik surovin -
2. del: Posebne zahteve za smole, sisteme strjevanja, dodatke in modifikatorje**

Fibre-reinforced plastic composites - Declaration of raw material characteristics - Part 2:
Specific requirements for resin, curing systems, additives and modifiers

Faserverstärkte Verbundwerkstoffe - Angabe von Werkstoffeigenschaften - Teil 2:
Spezifische Anforderungen an Harz, Aushärtungssysteme, Zusatzstoffe und Modifizierer

Composites plastiques renforcés de fibres - Déclaration des caractéristiques des
matières premières - Partie 2: Exigences particulières pour les résines, les systèmes de
polymérisation, les additifs et les modificateurs

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This European Standard was approved by CEN on 21 March 2013.

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Foreword

This document (EN 16245-2:2013) 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of an identical text or by endorsement, at the latest by November 2013, and conflicting national standards shall be withdrawn at the latest by November 2013.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* (the present document)
- *Part 3: Specific requirements for fibre*
- *Part 4: Specific requirements for fabrics*
- *Part 5: Specific requirements for core materials*

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EN 16245-2:2013 (E)**1 Scope**

This European Standard specifies the minimum information to be declared for resins, curing systems, additives and modifiers to be used for the manufacturing of composites products.

These specific declaration requirements are 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.

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 plastic composites — *Declaration of raw material characteristics — Part 1: General requirements*

EN 59, *Glass reinforced plastics — Measurement of hardness by means of a Barcol impressor*

EN ISO 62, *Plastics — Determination of water absorption (ISO 62)*

EN ISO 75-2:2013, *Plastics — Determination of temperature of deflection under load — Part 2: Plastics and ebonite (ISO/FDIS 75-2:2012)*

EN ISO 178:2010, *Plastics — Determination of flexural properties (ISO 178:2010)*

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

EN ISO 527 (all parts), *Plastics — Determination of tensile properties (ISO 527)*

EN ISO 584, *Plastics — Unsaturated polyester resins — Determination of reactivity at 80 °C (conventional method) (ISO 584)*

EN ISO 787-5, *General methods of test for pigments and extenders — Part 5: Determination of oil absorption value (ISO 787-5)*

EN ISO 1183 (all parts), *Plastics — Methods for determining the density of non-cellular plastics (ISO 1183)*

EN ISO 2114, *Plastics (polyester resins) and paints and varnishes (binders) — Determination of partial acid value and total acid value (ISO 2114)*

EN ISO 2555, *Plastics — Resins in the liquid state or as emulsions or dispersions — Determination of apparent viscosity by the Brookfield Test method (ISO 2555)*

EN ISO 2592, *Determination of flash and fire points — Cleveland open cup method (ISO 2592)*

EN ISO 2719, *Determination of flash point — Pensky-Martens closed cup method (ISO 2719)*

EN ISO 2811 (all parts), *Paints and varnishes — Determination of density (ISO 2811)*

EN ISO 2884 (all parts), *Paints and varnishes — Determination of viscosity using rotary viscometers (ISO 2884)*

- EN ISO 3251, *Paints, varnishes and plastics — Determination of non-volatile-matter content (ISO 3251)*
- EN ISO 3521, *Plastics — Unsaturated polyester and epoxy resins — Determination of overall volume shrinkage (ISO 3521)*
- EN ISO 3838, *Crude petroleum and liquid or solid petroleum products — Determination of density or relative density — Capillary-stoppered pyknometer and graduated bicapillary pyknometer methods (ISO 3838)*
- EN ISO 4629, *Binders for paints and varnishes — Determination of hydroxyl value — Titrimetric method (ISO 4629)*
- EN ISO 4630 (all parts), *Clear liquids — Estimation of colour by the Gardner colour scale (ISO 4630)*
- EN ISO 15512, *Plastics — Determination of water content (ISO 15512)*
- ISO 760, *Determination of water — Karl Fischer method (General method)*
- ISO 3105, *Glass capillary kinematic viscometers — Specifications and operating instructions*
- ISO 5661, *Petroleum Products — Hydrocarbon liquids — Determination of refractive index*
- ISO 14848, *Plastics — Unsaturated-polyester resins — Determination of reactivity at 130 degrees C*
- ASTM D1135-86, *Standard Test Methods for Chemical Analysis of Blue Pigments*
- ASTM D2196-10, *Standard Test Methods for Rheological Properties of Non-Newtonian Materials by Rotational (Brookfield type) Viscometer*
- ASTM D3278-96, *Standard Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus*
- ASTM D4835-08, *Standard Specification for Propylene Glycol Monomethyl Ether Acetate*
- ASTM D6420-99, *Standard Test Method for Determination of Gaseous Organic Compounds by Direct Interface Gas Chromatography-Mass Spectrometry*
- ASTM E298-08, *Standard Test Methods for Assay of Organic Peroxides*
- ASTM E1473-09, *Standard Test Methods for Chemical Analysis of Nickel, Cobalt, and High-Temperature Alloys*
- UOP523, *Glycol and Carom Solvent Distribution in Mixtures by GC*
- DIN 16945:1989, *Testing of resins, hardeners and accelerators, and catalyzed resins*

EN 16245-2:2013 (E)**3 Terms and definitions**

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

3.1 accelerator
promoter
substance used in small proportion to increase the reaction rate of a chemical system (reactants, plus other additives)

[SOURCE: EN ISO 472:2013, 2.1]

3.2 additive
modifier
substance added to a resin to improve or modify one or more properties (i.e. UV stability, surface tensions, air release etc.)

3.3 Barcol hardness
hardness value obtained by measuring the resistance to penetration of a sharp, spring-loaded steel point with an instrument called the Barcol Impressor

Note 1 to entry: The value can be used as an indicative measure of the degree of cure of a thermosetting resin.

3.4 cure
process of chemically converting an unsaturated polymeric composition into a more stable three-dimensional network by cross-linking

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3.5 curing system
initiator, promoter, accelerator and inhibitor, all related to the chemical reaction of the resin

3.6 flash point
lowest temperature at which a combustible liquid will give off a flammable vapour that will burn momentarily by ignition near the surface of the liquid or within the vessel used

3.7 gel time
interval of time, in connection with the use of synthetic thermosetting resins, extending from the introduction of an initiator and a catalyst into a liquid resin system until the interval of gel formation/solidification

3.8 inhibitor
substance used in small proportion to suppress a chemical reaction

[SOURCE: EN ISO 472:2013, 2.488]

3.9 initiator
substance, used in small proportion, that starts a chemical reaction, for example, by providing free radicals

[SOURCE: EN ISO 472:2013, 2.490]

3.10**monomer**

relatively simple substance, usually containing carbon and of low molecular mass, which can react to form a polymer by combination with itself or with other similar molecules or substances

Note 1 to entry: To be distinguished from the term reactive monomer, which within the context of unsaturated polyester/vinyl ester is defined as a substance with unsaturated groups which can undergo cross-linking reactions with the unsaturated polymers through the curing reaction.

3.11**resin**

<thermosetting materials> the uncured liquid material that is used as matrices to bind together the reinforcement materials in a fibre-reinforced composite product

3.12**styrene**

colourless liquid produced from the catalytic dehydrogenation of ethylbenzene which is easily polymerized by exposure to light, heat or a peroxide initiator

Note 1 to entry: The main reactive monomer used in unsaturated polyester/vinyl ester materials.

3.13**unsaturated polyester**

thermosetting resins of polyester molecules, dissolved in a reactive monomer (e.g. styrene) capable of copolymerisation with the polyester molecules

Note 1 to entry: The polyester molecules are condensation products of polyols (e.g. ethylene glycol, dipropylene glycol, glycerol) and saturated/unsaturated difunctional carboxylic acids/anhydrides (e.g. terephthalic acid, phthalic anhydride, fumaric acid, maleic anhydride) and/or cyclic unsaturated hydrocarbons (e.g. dicyclopentadiene).

Note 2 to entry: At least one of the acids/anhydrides is unsaturated (usually maleic anhydride/fumaric acid is used).

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3.14**vinyl ester resins**

thermosetting resins of vinyl ester molecules, dissolved in a reactive monomer (e.g. styrene) capable of copolymerisation with the vinyl ester molecules

Note 1 to entry: The vinyl ester is a product of the esterification reaction of any epoxy resin (e.g. Novolac, Bisphenol A epoxy) with an unsaturated monocarboxylic acid (e.g. methacrylic acid).

3.15**viscosity**

measure of the resistance to flow due to internal friction when one layer of fluid is caused to move in relationship to another layer

Note 1 to entry: In the context of thermosetting resins for the FRP (Fibre-Reinforced Plastic) industry, viscosity is one of the important parameters that express the ability of a resin to flow in reinforcements and release entrapped air often formed during the application a production process.

3.16**water absorption**

moisture absorption

amount of water absorbed by a material under specified test conditions

Note 1 to entry: The conditions may be immersion in water or exposure to a humid atmosphere, in the latter case the process is also referred to as water vapour absorption.

[SOURCE: EN ISO 472:2013, 2.1246]

EN 16245-2:2013 (E)**4 Content of a declaration**

A declaration for the resin, curing system, additive and modifier 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 resins, curing systems, additives and modifiers 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 16245-2), 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 method standard or test method, this test method standard or test method shall be used;
- the values given shall be in accordance with the test method standard given;
- if the test environment is not clearly stated in the specific test method 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 declaration is for the delivered material and not for its constituents.

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5.2 Declaration for resin**5.2.1 Declaration for unsaturated polyester and vinyl ester resin****5.2.1.1 Properties of liquid resin as delivered to customer**

The specific declaration requirements for liquid resin are listed below. The declaration including tolerances shall be given in accordance with the test method standards stated in Table 1 and Table 2.

The following specific declaration requirements a) to f) apply for all liquid resins independent of application:

- a) identification (name/number/code used by the manufacturer for identification purposes);
- b) density [kg/m^3];
- c) viscosity [$\text{mPa}\cdot\text{s}$] (cP):
 - 1) The supplier will define and declare which standard is to be used.
- d) acid number [mg KOH/g];
- e) non-volatile content [$\text{wt.}\%$];

NOTE Defines the amount of solid content from which styrene content in the material can be calculated.

- f) flash point [$^{\circ}\text{C}$].

The following additional declaration requirements g) to l) apply for liquid resin for specific application:

- g) gel time [min] [s]: defines the gel time of the resin at a given temperature and for a given curing system. To be given as the arithmetic mean value of at least two tests that are both within 10 % of their mean value, including tolerances;
- h) reactivity [min or s] and [°C];
- i) maximum recommended laminating thickness [mm]:
- 1) Amount and type of initiator shall be given in connection to recommended laminate thickness applied wet in wet. Wet in wet is defined by impregnation of all layers through the thickness prior to curing.
- j) colour:
- 1) The supplier shall decide and declare the procedure to be used. Accepted standards are: ISO 2211 and EN ISO 4630. Acceptable standards for spectrophotometric methods are: ASTM D156-12, ASTM D263-05, ASTM D1045-08, ASTM D1209-05, ASTM D1500-12, EN 1557 and DIN 6162.
- k) water content [wt.%]:
- 1) The supplier shall decide and declare the procedure to be used together with Karl Fischer Titration.
- l) chemical thickening (i.e. valid for Sheet Moulding Compound resin (SMC resin)).

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

Table 1 — Material declaration of liquid resin properties relevant for CoA (independent of application)

Ref. no 5.2.1.1	Property	Nominal value	Minimum and/or maximum value	Unit	Test method
b)	Density	Mean value	Minimum and maximum value	kg/m ³	EN ISO 2811 (all parts)
c)	Viscosity, high shear Viscosity, low shear	Mean value	Minimum and maximum value	mPa·s cP	EN ISO 2884 (all parts) EN ISO 2555 ASTM D2196-10
d)	Acid number	Mean value	Maximum value	mg KOH/g	EN ISO 2114
e)	Non-volatile content	Mean value	Minimum and maximum value	%	EN ISO 3251
f)	Flash point	Mean value	Minimum and maximum value	°C	ASTM D3278-96 EN ISO 2592