
Lesno-polimerni kompoziti (WPV) - 1. del: Preskusne metode za karakterizacijo WPC materialov in proizvodov

Wood-plastics composites (WPC) - Part 1: Test methods for characterisation of WPC materials and products

Holz-Polymer-Werkstoffe (WPC) - Teil 1: Prüfverfahren für die Beschreibung von WPC-Werkstoffen und -Erzeugnissen

Composites bois-plastiques (WPC) - Partie 1 : Méthodes d'essai pour la caractérisation des matériaux WPC et des produits en WPC

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This Technical Specification (CEN/TS) was approved by CEN on 29 December 2006 for provisional application.

The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

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Foreword

This document (CEN/TS 15534-1:2007) has been prepared by Technical Committee CEN/TC 249 “Plastics”, the secretariat of which is held by NBN.

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.

CEN/TS 15534 consists of the following parts, under the general title *Wood-plastics composites (WPC)*:

- *Part 1: Test methods for characterisation of WPC materials and products*
- *Part 2: Characterisation of WPC materials*
- *Part 3: Characterisation of WPC products.*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this Technical Specification: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

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Introduction

The denomination “wood-plastics composites”, WPC, is usually used to designate materials or products made of one or more natural fibres or flours and a polymer or a mixture of polymers. Natural fibres and flours come from different vegetable sources (e.g. wood, hemp, sisal, jute, kenaf, rice) and all kind of polymers (virgin or recycled) can be used but currently the most common ones are poly(vinyl chloride) PVC, polypropylene (PP) and polyethylene (PE).

WPC materials can be considered neither as filled plastics nor as a special kind of wood. They should be considered as a different material having their own characteristics.

The main applications of WPC products are at present decking, siding, cladding, panelling and fencing furniture. WPC materials can be processed by different techniques, as extruding for profiles and pipes, calendering for films and sheets or injection moulding. The contents of natural fibres and polymers depend on the application and the processing techniques.

As the market of WPC materials and products is currently growing in Europe, there is a lack of harmonisation for the test methods needed to characterise WPC materials and products and for the specifications they should comply with. Up to now, each branch of industry has its own practice and used its own test methods. In this context, a European Technical Specification seemed to be the best choice to increase the experience and knowledge in order to guarantee that quality products in this new market. The status of Technical Specification has also been chosen because the WPC materials and products and their characteristics are not sufficiently known for the time being.

It consists of the following parts:

- Part 1: to identify the test methods and their relevant parameters and test conditions to be used for the determination of the characteristics of WPC materials and products;
- Part 2: to identify the required and optional properties of WPC materials;
- Part 3: to identify the required and optional properties of WPC products.

This Technical Specification may be transformed into a European Standard after several years when the state of the art will be better known and stabilized.

1 Scope

This Technical Specification specifies test methods and their relevant parameters and test conditions to be used in determining selected properties of wood-plastics composites, usually called WPC, materials and products. It is applicable to cellular or non-cellular WPC materials processed through plastics processing techniques, as defined in Clause 3.

The properties have been selected from the test methods usually used in the plastics and wood fields.

These test methods are primarily intended to be used for the characterisation of WPC materials (see CEN/TS 15534-2 ^[1]) and WPC products (see CEN/TS 15534-3 ^[2]).

NOTE This document may be revised when other parts of CEN/TS 15534 are being amended or added.

The purpose of this document is to provide test methods to assess a wide range of performance characteristics for WPC materials and products. But, all the characteristics listed in this part of CEN/TS 15534 are not necessarily to be assessed for a given application.

This Technical Specification takes into account the current state of the art and is intended to be used by WPC material suppliers and converters. No limitation has been introduced for the content of cellulosic materials.

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 117:2005, *Wood preservatives — Determination of toxic values against Reticulitermes species (European termites) (laboratory method)*

EN 310, *Wood based panels — Determination of modulus of elasticity in bending and of bending strength*

EN 317, *Particleboards and fibreboards — Determination of swelling in thickness after immersion in water*

EN 318, *Wood-based panels — Determination of dimensional changes associated with changes in relative humidity*

EN 321, *Wood based panels — Determination of moisture resistance under cyclic test conditions*

EN 477:1995, *Unplasticized polyvinylchloride (PVC-U) profiles for the fabrication of windows and doors — Determination of the resistance to impact of main profiles by falling mass*

EN 479, *Unplasticized polyvinylchloride (PVC-U) profiles for the fabrication of windows and doors — Determination of heat reversion*

EN 789:2004, *Timber structures — Test methods — Determination of mechanical properties of wood based panels*

EN 927-6, *Paints and varnishes — Coating materials and coating systems for exterior wood — Part 6: Exposure of wood coatings to artificial weathering using fluorescent UV lamps and water*

ENV 1156, *Wood-based panels — Determination of duration of load and creep factors*

EN 1383, *Timber structures — Test methods — Pull through resistance of timber fasteners*

EN 1534, *Wood and parquet flooring — Determination of resistance to indentation (Brinell) — Test method*

ENV 12038:2002, *Durability of wood and wood-based products — Wood-based panels — Method of test for determining the resistance against wood-destroying basidiomycetes*

EN 13446, *Wood-based panels — Determination of withdrawal capacity of fasteners*

EN 13823, *Reaction to fire tests for building products — Building products excluding floorings exposed to the thermal attack by a single burning item*

EN 13893, *Resilient, laminate and textile floor coverings — Measurement of dynamic coefficient of friction on dry floor surfaces*

CEN/TS 15083-2:2005, *Durability of wood and wood-based products — Determination of the natural durability of solid wood against wood-destroying fungi, test methods — Part 2: Soft rotting micro-fungi*

prEN 15458, *Paints and varnishes — Laboratory method for testing the efficacy of film preservatives in a coating against algae*

EN 20105-A03, *Textiles — Tests for colour fastness — Part A03: Grey scale for assessing staining (ISO 105-A03:1993)*

EN ISO 75-1, *Plastics — Determination of temperature of deflection under load — Part 1: General testing conditions (ISO 75-1:2004)*

EN ISO 75-2, *Plastics — Determination of temperature of deflection under load — Part 2: Plastics, ebonite and long-fibre-reinforced composites (ISO 75-2:2004)*

EN ISO 178, *Plastics — Determination of flexural properties (ISO 178:2001)*

EN ISO 179-1, *Plastics — Determination of Charpy impact properties — Part 1: Non-instrumented impact test (ISO 179-1:2000)*

EN ISO 291, *Plastics — Standard atmospheres for conditioning and testing (ISO 291:2005)*

EN ISO 472:2001, *Plastics — Vocabulary (ISO 472:1999)*

EN ISO 527-1, *Plastics — Determination of tensile properties — Part 1: General principles (ISO 527-1:1993 including Corr 1:1994)*

EN ISO 527-2, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics (ISO 527-2:1993 including Corr 1:1994)*

EN ISO 877, *Plastics — Methods for exposure to direct weathering, to weathering using glass-filtered daylight, and to intensified weathering by daylight using Fresnel mirrors (ISO 877:1994)*

EN ISO 899-2, *Plastics — Determination of creep behaviour — Part 2: Flexural creep by three-point loading (ISO 899-2:2003)*

EN ISO 1183-1, *Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pycnometer method and titration method (ISO 1183-1:2004)*

EN ISO 1183-3, *Plastics — Methods for determining the density of non-cellular plastics — Part 3: Gas pycnometer method (ISO 1183-3:1999)*

EN ISO 2813, *Paints and varnishes -- Determination of specular gloss of non-metallic paint films at 20°, 60° and 85° (ISO 2813:1994, including Technical Corrigendum 1:1997)*

EN ISO 4589-2, *Plastics — Determination of burning behaviour by oxygen index — Part 2: Ambient-temperature test (ISO 4589-2:1996)*

EN ISO 4628-6, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 6: Assessment of degree of chalking by tape method (ISO 4628-6:2006)*

EN ISO 4892-1, *Plastics — Methods of exposure to laboratory light sources — Part 1: General guidance (ISO 4892-1:1999)*

EN ISO 4892-2, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps (ISO 4892-2:2006)*

EN ISO 6603-2, *Plastics — Determination of puncture impact behaviour of rigid plastics — Part 2: Instrumented puncture test (ISO 6603-2:2000)*

EN ISO 9142:2003, *Adhesives — Guide to the selection of standard laboratory ageing conditions for testing bonded joints (ISO 9142:2003)*

EN ISO 9239-1, *Reaction to fire tests for floorings — Part 1: Determination of the burning behaviour using a radiant heat source (ISO 9239-1:2002)*

EN ISO 11925-2, *Reaction to fire tests — Ignitability of building products subjected to direct impingement of flame — Part 2: Single-flame source test (ISO 11925-2:2002)*

ISO 7724-1, *Paints and varnishes — Colorimetry — Part 1: Principles*

ISO 7724-2, *Paints and varnishes — Colorimetry — Part 2: Colour measurement*

ISO 7724-3, *Paints and varnishes — Colorimetry — Part 3: Calculation of colour differences*

ISO 11359-2, *Plastics — Thermomechanical analysis (TMA) — Part 2: Determination of coefficient of linear thermal expansion and glass transition temperature*

ISO 16869, *Plastics — Assessment of the effectiveness of fungistatic compounds in plastics formulations*

ISO 16979:2003, *Wood-based panels — Determination of moisture content*

3 Terms and definitions

For the purposes of this document, the following terms and definitions given in EN ISO 472:2001 and the following apply.

3.1

wood-plastics composite, WPC

material or product made thereof being the result of the combination of one or several cellulosic materials with one or several thermoplastics and being or to be processed through plastic processing techniques

4 Test specimens

Unless otherwise specified in the relevant test method, the test specimens shall be prepared by sawing, milling or sanding (grade 120 or grade 240) on all surfaces and their finished dimensions shall be 50 mm x 50 mm x 4 mm.

For cellular WPC products, the thickness of the test specimens shall be the actual thickness of the samples from which they are prepared and shall be declared in the test report.

5 Conditioning

Unless otherwise specified in the relevant test method, the test specimens used for the determination of the material and product characteristics shall be conditioned during at least 24 h in the standard atmosphere 23/50 (23 °C, relative humidity 50 %) in accordance with EN ISO 291.

6 Physical properties

6.1 Density

The density of non-cellular WPC materials can be measured according to:

- EN ISO 1183-1: This part of EN ISO 1183 specifies three methods for the determination of the density of non-cellular plastics in the form of void-free moulded or extruded objects, as well as powders, flakes and granules.
 - Method A: immersion method for solid plastics (except for powders) in void-free form. This method consists of comparing the weight of the specimen in air and immersed in a liquid of specified density. The density of the specimen is calculated using the Archimède principle.
 - Method B: liquid pycnometer method, for particles, powders, flakes, granules or small pieces of finished parts. This method consists of comparing the weight of the pycnometer full of immersion liquid and the pycnometer full with specimen and immersion liquid. The density of the specimen is calculated using the Archimède principle.
 - Method C: titration method, for plastics in any void-free form. This method consists of mixing two miscible liquids of different density, one lighter, the other heavier than specimen and to estimate the density of the mixture where the specimen stays in suspension.
- EN ISO 1183-3: Gas pycnometer method. The volume of a specimen of known apparent mass is determined by measuring the change of gas volume within a pycnometer upon introducing the specimen. The volume change may be obtained either directly by means of a movable piston or indirectly by measuring the change of the pressure within the pycnometer and calculating the volume using

In order to avoid problems with liquid absorption by WPC materials, EN ISO 1183-3 is recommended.

Density for cellular WPC materials can be measured according to EN ISO 1183-3. This method consists of measuring the volume and the mass of the sample and calculating the mass per unit volume of the sample.

6.2 Moisture content

ISO 16979 describes a test method for determining the moisture content of wood-based panels by weighing the loss of mass of each test piece between its state at the time of sampling and its state after drying to constant mass at (103 ± 2) °C, and calculation of this loss of mass as a percentage of the mass of the test piece after drying.

Constant mass is considered to be reached when the results of two successive weighing operations, carried out at a minimum interval of 24 h, do not differ by more than 0,1 % of the mass of the test pieces.

NOTE ISO 16979:2003 is based on EN 322^[3].

6.3 Heat deflection temperature (HDT)

EN ISO 75-1 gives a general test method for the determination of the temperature of deflection under load (flexural stress under three-point loading) of plastics. In that method, a standard test specimen is subjected to three-point bending under a constant load to produce stresses in the specimen. The temperature is raised at a uniform rate, and the temperature at which the standard deflection occurs measured.

EN ISO 75-2 describes three methods using different test loads and two specimen positions, edgewise and flatwise as follows:

- Method A using a flexural stress of 1,80 MPa;
- Method B using a flexural stress of 0,45 MPa;
- Method C using a flexural stress of 8,00 MPa.

6.4 Coefficient of friction

EN 13893 specifies the method for the determination of the dynamic coefficient of friction on dry floor surfaces.

Skates made of a specified material and having a specified form are loaded in order to give a specified force to the floor. The loaded skates are pulled parallel to the surface of the floor at a specified constant speed. The horizontal force required for the pulling is registered over a certain distance. The horizontal force is divided by the vertical force to calculate the dynamic coefficient of friction.

NOTE Works are in progress in CEN/TC 339 for the preparation of test methods for the determination of the slip resistance of pedestrian surfaces.

7 Mechanical properties

7.1 Impact resistance

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7.1.1 Flexural impact

EN ISO 179-1 specifies a method for determining the Charpy impact strength of plastics under defined conditions. A number of different types of methods are defined amongst which ISO 179-1/1fU is recommended for the purpose of this Technical Specification. Method ISO 179-1/1fU refers to a flat wise impacted unnotched specimen.

The method is used to investigate the behaviour of specified types of specimen under the impact conditions defined and for estimating the brittleness or toughness of specimens within the limitations inherent in the test conditions. It may also be used for the determination of comparative data from similar types of material.

The test specimen, supported near its ends as a horizontal beam, is impacted by a single blow of a striker, with the line of impact midway between the supports, and bent at a high, nominally constant, velocity.

7.1.2 Falling mass impact

EN 477 describes a test method for determining the resistance to impact of profiles, subjected to a blow from a known height on the sight surface at a point mid-way between two supporting webs at a given temperature.

EN 477 can be used to determine the resistance to impact of non-cellular WPC products. The energy level used and the test temperature shall be declared in the test report.

However, EN 477 is not applicable for determining the resistance to impact of profiles made of cellular materials. In this case the test method given in Annex A shall be used.

7.1.3 Puncture impact

EN ISO 6603-2 which specifies a method for the determination of puncture impact properties of rigid plastics in the form of flat specimens using instruments for measuring forces and deflection at a given temperature, can be used for WPC products. The test atmosphere conditions shall be declared.

7.2 Tensile properties

EN ISO 527-1 specifies the general principles for determining the tensile properties of plastics and plastic composites under defined conditions. The methods are used to investigate the tensile behaviour of the test specimens and for determining the tensile strength, tensile modulus and other aspects of the tensile stress/strain relationship. In these methods, the test specimen is extended along its major longitudinal axis at constant speed until the specimen fractures or until the stress (load) or the strain (elongation) reaches some predetermined value. The test conditions are specified in EN ISO 527-2.

The test specimen shall be dumb-bell-shaped 1B which is the shape preferred for machined specimens. Type 1A (directly-moulded multipurpose test specimens) is not recommended for WPC materials.

7.3 Flexural properties

7.3.1 Materials

EN ISO 178 specifies a test method for determining the flexural properties of rigid and semi-rigid plastics under specified conditions. It also applies to fibre-reinforced compounds with fibre lengths $\leq 7,5$ mm prior to processing. A standard test specimen is defined (80 mm x 10 mm x 4 mm), but parameters are included for alternative specimen sizes for use where appropriate. The test specimen, supported as a beam, is deflected at a constant rate ($2 \pm 0,5$) mm/min, at the midspan until the specimen fractures or until the deformation reaches some predetermined value.

7.3.2 Non-load bearing products

EN 310 specifies a method of determining the apparent modulus of elasticity in flat wise bending and bending strength of wood-based panels of nominal thickness equal to or greater than 3 mm. The test method consists of applying, at a given speed, a force by means of a loading edge in a transversal direction to the faces of the test specimen, which is placed on two supporting positions.

The test specimen is a full size product, then cut in rectangular shape to length for testing. The full length of the specimen is defined as being 20 times its thickness plus 50 mm.

NOTE If for technical reasons, the length as specified cannot be achieved, a specimen of a shorter length may be used.

The actual length of the specimen shall be declared in the test report.

The calculated value is the apparent modulus of elasticity, because of the shear forces induced in the specimen. The bending strength is the maximum stress calculated from the maximum force recorded during the bending procedure, at a constant rate of 10 mm/min.

7.3.3 Load bearing products

Clause 7 of EN 789:2004, which specifies a test method for determining bending properties of wood-based panels, can be applied to WPC products intended to be used in load bearing structures.