BS EN 15534-1:2014

BSI Standards Publication

Composites made from cellulose-based materials and thermoplastics (usually called wood-polymer composites (WPC) or natural fibre composites (NFC))

Part 1: Test methods for characterisation of compounds and products

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National foreword

This British Standard is the UK implementation of EN 15534-1:2014. It supersedes DD CEN/TS 15534-1:2007 which is withdrawn.

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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Compliance with a British Standard cannot confer immunity from legal obligations.

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English Version

Composites made from cellulose-based materials and thermoplastics (usually called wood-polymer composites (WPC) or natural fibre composites (NFC)) - Part 1: Test methods for characterisation of compounds and products

Composites à base de matières cellulosiques et de thermoplastiques (communément appelés composites bois-polymères (WPC) ou composites fibres d'origine naturelle (NFC)) - Partie 1: Méthodes d'essai pour la caractérisation des compositions et des produits

Verbundwerkstoffe aus cellulosehaltigen Materialien und Thermoplasten (üblicherweise Holz-Polymer-Werkstoffe (WPC) oder Naturfaserverbundwerkstoffe (NFC) genannt) - Teil 1: Prüfverfahren zur Beschreibung von Compounds und Erzeugnissen

This European Standard was approved by CEN on 9 November 2013.

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Foreword

This document (EN 15534-1:2014) 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of an identical text or by endorsement, at the latest by July 2014, and conflicting national standards shall be withdrawn at the latest by July 2014.

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.

This document supersedes CEN/TS 15534-1:2007.

The significant changes that have been made since the previous edition are the following:

— change of the status from Technical Specification to European Standard;

— complete technical review of the test methods.

EN 15534 consists of the following parts:

— EN 15534-1, *Composites made from cellulose-based materials and thermoplastics (usually called wood-polymer composites (WPC) or natural fibre composites (NFC)) — Part 1: Test methods for characterization of compounds and products*

— prEN 15534-2, *Composites made from cellulose-based materials and thermoplastics (usually called wood-polymer composites (WPC) or natural fibre composites (NFC)) — Part 2: Characterization of compounds*[1)]

— EN 15534-4, *Composites made from cellulose-based materials and thermoplastics (usually called wood-polymer composites (WPC) or natural fibre composites (NFC)) — Part 4: Specifications for decking profiles and tiles*

— EN 15534-5, *Composites made from cellulose-based materials and thermoplastics (usually called wood-polymer composites (WPC) or natural fibre composites (NFC)) — Part 5: Specifications for cladding profiles and tiles*

— prEN 15534-6, *Composites made from cellulose-based materials and thermoplastics (usually called wood-polymer composites (WPC) or natural fibre composites (NFC)) — Part 6: Specifications for fencing profiles and systems*[1)]

— prEN 15534-7, *Composites made from cellulose-based materials and thermoplastics (usually called wood-polymer composites (WPC) or natural fibre composites (NFC)) — Part 7: Specifications for general purpose profiles in external applications*[1)]

According to the CEN-CENELEC Internal Regulations, the national standards organizations 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) In preparation.

Introduction

The denomination “wood-polymer composites”, WPC, is usually used to designate materials or products consisting of one or more natural fibres or flours and one or a mixture of polymer(s). Natural fibres and flours come from different plant sources (e.g. wood, hemp, flax, sisal, coconut, cotton, kenaf, jute, abaca, banana leaf fibres, bamboo, rice, wheat straw or other fibrous material) and different polymers, virgin or recycled, are used. Currently, the most commonly used polymers are poly(vinyl chloride) (PVC), polypropylene (PP) and polyethylene (PE).

WPC materials can be processed by different techniques, as extrusion for profiles, calendering for films and sheets, injection moulding or compression moulding. The contents of natural fibres and polymers depend on the application and the processing techniques.

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

For the moment, the main applications of WPC products are decking, cladding, panelling and fencing and furniture.

1 Scope

This European Standard specifies test methods for the determination of properties of composites made from cellulose-based materials and thermoplastics, usually called wood-polymer composites (WPC) or natural fibre composites (NFC).

NOTE For editorial reasons, in EN 15534 the abbreviation “WPC” is used for “composites made from cellulose-based materials and thermoplastics”.

This part of EN 15534 is applicable to cellular or non-cellular compounds and products, made from cellulose-based materials and thermoplastics, intended to be or being processed through plastics processing techniques, without threshold for the cellulose-based material content.

All the properties listed in this part of EN 15534 are not necessarily assessed for a given application. Test parameters and requirements of the test methods for a given application are specified in the relevant part of EN 15534.

Profiles for the management of electrical power cables, communication cables and power track systems used for the distribution of electrical power, profiles for windows or doors and profiles for guttering are not covered by EN 15534[2)].

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 84:1997, *Wood preservatives - Accelerated ageing of treated wood prior to biological testing - Leaching procedure*

EN 117:2012, *Wood preservatives - Determination of toxic values against Reticulitermes species (European termites) (Laboratory method)*

EN 152:2011, *Wood preservatives - Determination of the protective effectiveness of a preservative treatment against blue stain in wood in service - Laboratory method*

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

EN 321:2001, *Wood-based panels - Determination of moisture resistance under cyclic test conditions*

EN 322:1993, *Wood-based panels - Determination of moisture content*

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 927-3, *Paints and varnishes - Coating materials and coating systems for exterior wood - Part 3: Natural weathering test*

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2) Profiles that are excluded are in the scopes of standards prepared by CEN/TC 33, CENELEC/TC 213 or CEN/TC 128.

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*

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

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*

EN 16472, *Plastics - Method for accelerated photoageing using medium pressure mercury vapour lamps*

EN 20105-A02, *Textiles - Tests for colour fastness - Part A02: Grey scale for assessing change in colour (ISO 105-A02)*

CEN/TS 15676, *Wood flooring - Slip resistance - Pendulum test*

EN ISO 75-1, *Plastics - Determination of temperature of deflection under load - Part 1: General test method (ISO 75-1)*

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

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

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

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

EN ISO 472:2013, *Plastics - Vocabulary (ISO 472:2013)*

EN ISO 527-2, *Plastics - Determination of tensile properties - Part 2: Test conditions for moulding and extrusion plastics (ISO 527-2)*

EN ISO 877-2, *Plastics - Methods of exposure to solar radiation - Part 2: Direct weathering and exposure behind window glass (ISO 877-2)*

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

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

EN ISO 2813, *Paints and varnishes - Determination of specular gloss of non-metallic paint films at 20°, 60° and 85° (ISO 2813)*

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

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)*

EN ISO 4892-2:2013, *Plastics - Methods of exposure to laboratory light sources - Part 2: Xenon-arc lamps (ISO 4892-2:2013)*

EN ISO 9227, *Corrosion tests in artificial atmospheres - Salt spray tests (ISO 9227)*

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)*

EN ISO 11507:2007, *Paints and varnishes - Exposure of coatings to artificial weathering - Exposure to fluorescent UV lamps and water (ISO 11507:2007)*

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

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*

ASTM D3273–00(2005), *Standard Test Method for resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber*

CIE[3)] Publication 51, *A method for assessing the quality of daylight simulators for colorimetry*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 472:2013 and the following apply.

3.1
wood-polymer composite
WPC
or
natural fibre composite
NFC
material or product made thereof being the result of the combination of one or several cellulose-based material(s) with one or several thermoplastics, intended to be or being processed through plastic processing techniques

3) Commission internationale de l'éclairage, Central Bureau, Kegelgasse 27, A-1030, Vienna, Austria.

3.2
compound
clearly defined homogenized mixture of a base polymer and cellulose-based material with additives, i.e. pigments, stabilisers and others, at a dosage level necessary for the processing and the intended use of the final product

3.3
cellular material
material the density of which is reduced by creating numerous small cavities (cells), during the processing, interconnecting or not, dispersed throughout the mass

3.4
batch
clearly identified collection of units, manufactured consecutively or continuously under the same conditions, using material or compound conforming to the same specification

Note 1 to entry: The production batch is defined and identified by the unit manufacturer: e.g. the change of the raw material preparation, the hot-cool-mixing, the shift in extruding process or the production line are considered as a new production batch.

4 Test specimens

The dimensions of test specimens shall be specified in the relevant test method.

The test specimens shall be selected according to the test method specifications.

For hollow 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 of test specimens

5.1 General

Depending on the potential application of the WPC products or on the requirements regarding the product testing, different approaches for conditioning are defined.

5.2 Reference conditioning

Reference conditioning is used for tests which request a high reproducibility (i.e. for comparative testing).

Unless other conditions resulting from the actual application of the WPC compounds/products, specimens shall be conditioned in the standard atmosphere 23/50, according to EN ISO 291 [(23 ± 2) °C, (50 ± 10) % RH] until a constant mass is reached.

The atmosphere 20/65 (20 °C, 65 % RH) may also be used. In that case, these conditions shall be declared in the test report.

Constant mass is considered to be reached when the results of two successive weighing operations, carried out at an interval of 24 h, do not differ by more than 0,1 % (arithmetic mean value) determined on the basis of the mass of the cellulosic material present in the WPC material. If the content of cellulosic material is not known, it shall be determined using a suitable method.

If the tested material contains a matrix polymer which itself absorbs water (e.g. starch), the mass of the respective matrix polymer shall be added to the mass of the cellulosic material.

If the time until constant mass is reached is considered excessively long, the change in mass of the specimens shall be monitored and recorded over a period of 96 h by taking at least four measurements. Tests are conducted after conditioning for at least 96 h and the moisture content at the time of testing shall be determined according to 6.3 and stated. The content of cellulosic material of the WPC material shall be stated.

For each test method, the moisture content of one additional test specimen shall be determined according to 6.3 before testing and shall be declared in the test report.

NOTE It is most probable that the moisture equilibrium of the material is not reached but the product is assumed to be suitable for testing.

5.3 Conditioning for factory production control and testing under other conditions

For the purpose of factory production control and testing under other conditions, the conditioning shall be carried out according to the specifications defined by the manufacturer. The conditioning parameters and tolerances shall be documented.

5.4 Conditioning for tests performed by third-parties

In the case where the tests are performed in a test laboratory of a third party, the tests should be started from the fourth week and not later than the sixth week after the production date of the specimens. The specimens shall be stored under conditions specified in 5.2, except during the transport.

6 Physical properties

6.1 Appearance (applicable to products)

The surfaces of the specimens shall illuminated by a source that complies with the CIE standard illuminant D65 (see CIE Publication No. 51) with an illumination of at least 600 lx. The light is incident upon the surfaces at an angle of approximately 45°, and the direction of viewing is approximately along the perpendicular to the plane of the surfaces.

6.2 Density

The density of WPC materials shall be determined according to either EN ISO 1183-1 [Method A (immersion method), or Method C (titration method)] or EN ISO 1183-3.

For solid profiles, the density of WPC materials may also be determined according to EN 323 [1].

6.3 Moisture content

The moisture content of WPC materials shall be determined according to EN 322:1993 with the following change in 5.2.

The constant mass shall be considered to be reached when the results of two successive weighing operations, carried out at an interval of seven days, do not differ by more than 0,5 % (arithmetic mean value) determined on the basis of the mass of the cellulosic material present in the WPC material.

The moisture content of WPC materials may be determined by other method(s), provided that a correlation has been established between the results obtained with this method and those obtained with EN 322, as modified above.

6.4 Slipperiness

6.4.1 General

The slipperiness of products shall be determined according to 6.4.2 (pendulum test), 6.4.3 (inclination plan test) or 6.4.4 (measurement of the dynamic coefficient of friction).

The method specified in 6.4.4 may be applied only to products which surfaces are dry in use.

6.4.2 Pendulum test

The slip resistance value shall be determined according to CEN/TS 15676.

6.4.3 Inclination plan test

6.4.3.1 General

This method is based on EN 13451-1:2011, Annex E [2].

6.4.3.2 Principle

A person carrying out the test (test person) moves in an upright position forward and backwards on the surface subjected to the test. The surface is wetted with water containing a wetting agent. The inclination of the test rig is increased starting from the horizontal position until an angle has been reached at which the testing person feels insecure.

6.4.3.3 Testing person

The testing person is a grown-up person with bare feet, whose feet shall have been wetted for at least 10 min prior to the start of the test. The person shall be protected against a fall by a safety device, which shall allow an unrestricted movement on the surface under test.

To acquaint the test persons with the test method, they should be trained on surfaces whose anti-slip properties have been previously determined in accordance with this method.

6.4.3.4 Test rig

A flat plate measuring 600 mm in width and 2 000 mm in length, with an adjustable angle of inclination from 0° to 45° shall be used as testing equipment; one short side shall be hinged to the floor and a clinometers with divisions of 1° shall be fitted on a side of the rig, showing the angle of inclination of the plate in relation to the horizontal plane.

For the safety of the test person, handrails shall be fitted to both longitudinal sides of the rig.

6.4.3.5 Test liquid

The test liquid shall be an aqueous solution of a neutral wetting agent in a concentration of 1 g/l. Water may be supplied by the municipal drinking water system.

6.4.3.6 Test specimen

The test specimen is a surface of at least 1 000 mm in length and 500 mm in width. Components of irregular shape shall be placed on aside the other, as nearby as possible, to cover the test surface of 1 000 mm x 500 mm.

The number of test specimens shall be as specified in the reference standard.

6.4.3.7 Test method

The test specimen is mounted and centred on the flat plate of the test rig. During the whole test, the test specimen shall be continuously and regularly wetted with a least 5 l/min of the test liquid.

If the fugues develop mainly in a specific direction, the specimen shall be tested in this direction and at a 90° angle.

The test person moves half the length of a step forwards and backwards in an upright position, looking down to the test specimen surface, in a downstream direction. At the same time, the inclination of the test rig is increased by about 1° per second, starting from a horizontal position. The angle of inclination causing the test person to feel insecure shall be established through repeated changes of the inclination of the rig around the critical value.

6.4.3.8 Evaluation

The test results are expressed according to three rating classes:

— Class A: 12°: the items with a test result from 12° to 17°;

— Class B: 18°: the items with a test result from 18° to 23°;

— Class C: 24°: the items with a test result from 24° upwards.

6.4.3.9 Test report

The test report shall include the following information:

a) a reference to this subclause of EN 15534-1;

b) all the information necessary for identification of the product tested;

c) the angle of inclination and rating group.

6.4.4 Dynamic coefficient of friction

The dynamic coefficient of friction on the surfaces of the product shall be determined according to EN 13893.

6.5 Linear mass (applicable to profiles)

6.5.1 Apparatus

6.5.1.1 **Balance**, with an accuracy of 0,1 g.

6.5.1.2 **Rule or measuring tape**, with an accuracy of 0,5 mm.

6.5.2 Test specimens

The length of the test specimen, measured between two cross sections cut perpendicularly to the main axis of the profile, shall be such that its mass is at least 50 g.

The number of test specimens shall be as specified in the reference standard.

6.5.3 Procedure

Condition the test specimens before measuring according to 5.2, or, for the purpose of factory production control, according to 5.3.

Measure the length, L, of the test specimen, in metres, to 1 mm.

Measure the mass, M, of the test specimen, in grams, to 0,2 g.

6.5.4 Calculation and expression of results

Calculate the linear mass of the test specimen, P, by using Formula (1):

$$P = \frac{M}{L} \tag{1}$$

where

P is the value of the linear mass of the test specimen, expressed in grams per metre;

M is the mass of the test specimen, expressed in grams;

L is the length of the test specimen, expressed in metres.

6.6 Dimensional characteristics

6.6.1 Conditioning

Condition the test specimens before measuring according to 5.2 or, for the purpose of factory production control, according to 5.3.

6.6.2 Thickness, width and length (applicable to profiles, only)

The measurements of the thickness and width of a test specimen shall be carried out manually with an accuracy of 0,05 mm and the measurement of the length, with an accuracy of 1 mm.

The number of test specimens shall be as specified in the reference standard.

6.6.3 Deviation from straightness (applicable to profiles, only)

The test shall be carried out on the whole cross-section of the profile. The length of the test specimen shall be (1 000 ± 5) mm.

The number of test specimens shall be as specified in the reference standard.

The test specimen shall be tested in flatwise and edgewise positions.

Place the test specimen with its concave side on a flat surface.

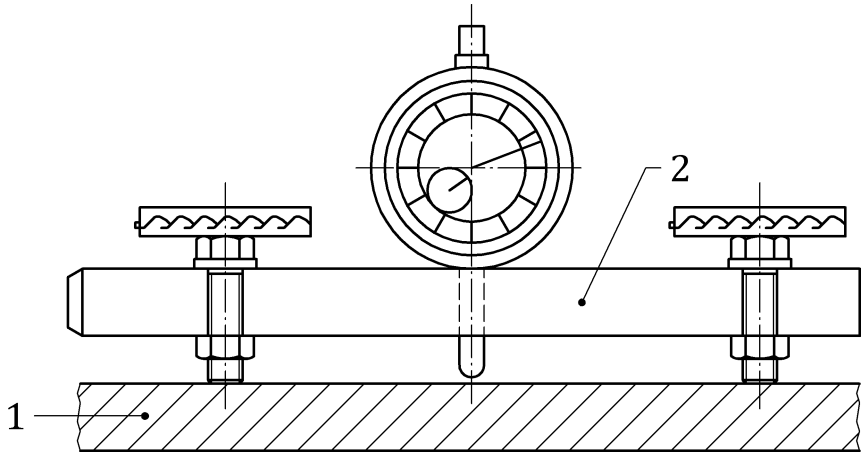
Measure the gap(s) between the test specimen and the flat surface with an appropriate measuring device.

Record the maximum value of the gap.

6.6.4 Cupping

Measure the cupping (flatness deviation across the width) of the test specimen by using a bow gauge placed at the position of greatest deformation.

Use a bow gauge, the length of which is at minimum the width of the test specimen, graduated to allow a reading to 0,1 mm (see Figure 1).



Key

1 test specimen

2 bow gauge

Figure 1 — Bow gauge for measuring cupping

Place the test specimen concave side up without restraint on a flat horizontal surface.

Place the bow gauge so that the three points (two fixed and one movable) are lightly touching the surface of the test specimen in the area of greatest deformation, and measure the flatness deviation (shown on the dial gauge) to the nearest 0,1 mm.

The two fixed points shall be at 5 mm apart from the edges of the flat surface of the test specimen.

The measured point shall correspond to the maximum bow.

The measuring tip of the bow gauge shall have a diameter between 10 mm to 16 mm.

The maximum flatness deviation measured using the bow gauge shall be recorded.

The number of test specimens shall be as specified in the reference standard.

7 Mechanical properties

7.1 Impact resistance

7.1.1 Impact resistance (applicable to compounds)

The Charpy impact strength of compound shall be determined according to EN ISO 179-1 by using Method ISO 179-1/1fU.

7.1.2 Falling mass impact resistance (applicable to products)

7.1.2.1 Decking profiles and tiles

7.1.2.1.1 Principle

Test specimens cut from a profile are subjected to a blow from a mass falling from a known height onto the exposed surface at midway between the supports, at a specified temperature.

After testing, the test specimens are examined visually to detect any presence of surface cracks and to measure the residual indentation.

7.1.2.1.2 Test method and test parameters

The resistance to impact shall be determined according to EN 477.

The mass of the striker, M_s with a smooth hemispherical striking surface of (25 ± 0,5) mm radius and the falling height, H, of the striker from the top surface of the test specimen shall be as specified in the reference standard.

The two rounded off steel supports of the apparatus shall be (200 ± 1) mm apart.

7.1.2.1.3 Test specimens

The test specimens shall be (300 ± 1) mm long the actual width and thickness of the profile.

The number of test specimens shall be specified in the reference standard.

If the profile may be used on both faces, the two faces of the test specimens shall be tested. If not, only the useable face of the test specimen shall be tested.

7.1.2.1.4 Conditioning

Condition the test specimens according to 5.2.

7.1.2.1.5 Procedure

Submit each specimen to the following test at (23 ± 2) °C or (20 ± 2) °C:

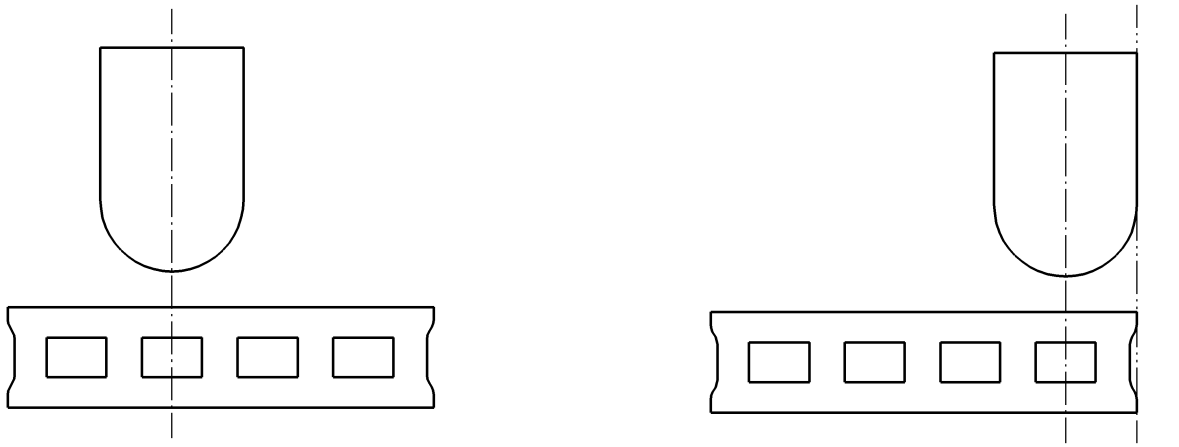
— set down the specimen on the supports with the extrusion direction of the test specimen perpendicular to the two rounded steel supports and the determined impact point positioned vertically to the striker;

— set up the falling height at the specified value in the reference standard;

— release the striker.

The impact position of the striker shall correspond to the weakest area of the test specimen. For hollow profiles, it is normally on the line located at midway between two ribs. See Figure 2 a).

Each longitudinal edge of the test specimen shall be tested. The impact position shall be determined in such a way that the circumference of the striker shall be flush with the outer edge of the specimen surface (useable face). See Figure 2 b).



a) Falling impact on the profile surface **b) Falling impact on a longitudinal edge**

Figure 2 — Falling impact testing on hollow profile

Where the impact energy may be transmitted between adjacent profiles (e.g. profiles with tongue and groove profiles), two test specimens shall be connected, as defined by the manufacturer. The impact shall be carried out with the striker set up symmetrically to the joint.

When illuminated according to 6.1, inspect the impact area of each test specimen by means of a magnifying glass (e.g. factor 10).

The longest perceptible surface crack is measured to an accuracy of 0,5 mm (linear distance between end points of the crack).

The maximum depth of the residual indentation is measured with a suitable measuring instrument (e.g. a vernier calliper) to an accuracy of 0,1 mm. The measurements shall be carried out at the earliest 5 min after the impact.

7.1.2.2 Profile cladding

7.1.2.2.1 Non-cellular material profiles

7.1.2.2.1.1 Principle

A test specimen cut from a profile is subjected to a blow from a mass falling from a known height onto the exposed surface at midway between the supports, at a specified temperature.

After testing, the test specimens are examined visually to detect any presence of failures.

The energy levels are classified according to the results of a series of impact tests with a striker of specified mass.

7.1.2.2.1.2 Apparatus

The impact resistance test shall be carried out with an impact testing machine, as described in EN 477:1995, Clause 4, incorporating the following equipment:

a) a main frame, rigidly fixed in the vertical position;

b) guide rails or a guiding tube, rigidly fixed to the main frame to guide the striker and release it to fall vertically and freely;

c) rigid specimen support, comprising two rounded off steel supports (100 ± 1) mm apart, rigidly fixed to a solid foundation or to a table having a mass of more than 50 kg;

d) release mechanism such that the striker can fall from a height which can be adjusted up to 1 500 mm, as measured from the top surface of the specimen;

e) striker, with a smooth hemispherical striking surface of (25 ± 0,5) mm radius. The total mass of the striker shall be adjustable with relevant additional masses to the following masses: (100 ± 1) g, (200 ± 1) g, (300 ± 2) g, (400 ± 2) g, (500 ± 2) g, (600 ± 5) g, (1 000 ± 5) g, (1 500 ± 5) g, (2 000 ± 5) g or (*m* x 100 ± 5) g where *m* is an integer.

7.1.2.2.1.3 Test specimens

Cut 10 specimens, (200 ± 10) mm long, from profiles selected at random from three different batches or one batch in case of factory production control.

In the case of profiles with webs, choose the impact point approximately at the midpoint between the supporting webs on the surface of the profile normally exposed, if applicable.

If the geometry of the profile does not allow the impact point to be determined clearly, the impact point and the method of installation of the specimen shall be recorded.

If the exposed and unexposed faces of the profile are identical, mark each face and submit 10 specimens to the impact resistance test on the exposed face.

7.1.2.2.1.4 Conditioning

The specimens shall be conditioned according to 5.2 or, for the purpose of factory production control, according to 5.3.

7.1.2.2.1.5 Procedure

Submit each specimen to the following test at (23 ± 2) °C:

— set down the specimen on the supports with the extrusion direction of the test specimen perpendicular to the two rounded steel supports and the determined impact point positioned vertically to the striker;

— set up the falling height at (1 000 ± 5) mm from the top surface of the specimen;

— release the striker.

Examine the specimen and record the result as “Passed” or “Failed”. Failure occurs when the impacted surface of the specimen splits or cracks. An unbroken dent of the impacted surface does not constitute failure.

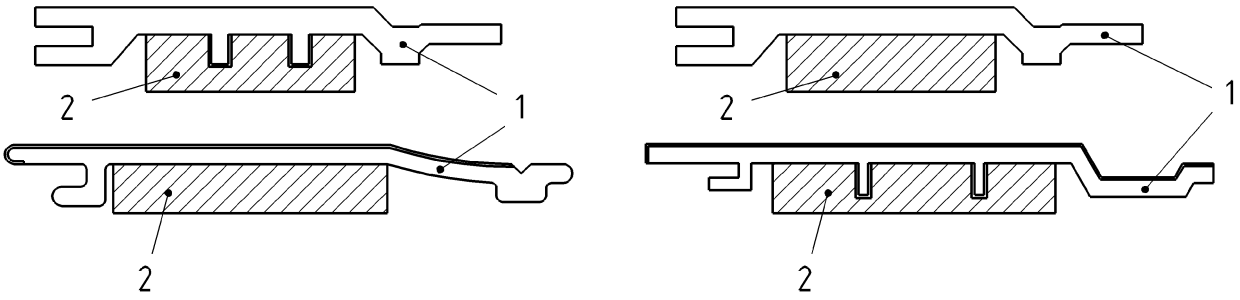
In case of a profile with a top layer/coating (laminated foil, lacquer-coating, co-extruded layer), delamination of the top layer shall also be considered as a failure.

7.1.2.2.2 Cellular material profiles

For cellular material profiles, the test method specified in 7.1.2.2.1 applies with the following changes:

a) the test specimen shall be completely supported by a flat wooden plate (e.g. plywood of a minimum 32 mm thickness) adjusted to the geometry of the profile to support it completely when tested. Possible

voids between the back side of the profile and the support plate can be filled up with a soft material such as cellular rubber filler. Figure 3 gives examples of profiles and corresponding plates:



Key

1 profile

2 wooden plate

Figure 3 — Examples of profiles and corresponding plates

b) the distance between the two rounded off steel supports (7.1.2.2.1.2) shall be (200 ± 1) mm;

c) the test specimens shall be (300 ± 10) mm long.

7.1.3 Extreme temperatures

For profiles intended to be used in areas with low or high extreme temperatures, additional requirements regarding the impact resistance may be added in the national foreword.

7.2 Tensile properties (applicable to compounds)

The tensile properties shall be determined according to EN ISO 527-2, by using specimens Type 1A or 1B.

The type of specimens shall be declared.

7.3 Flexural properties

7.3.1 Flexural properties (applicable to compounds)

The flexural properties shall be determined according to EN ISO 178.

7.3.2 Flexural properties (applicable to non-load bearing products)

For products intended to be used for non-load bearing applications, the cross section of which are rectangular (profiles), the flexural properties shall be determined according to Annex A. The test shall be carried out on the full cross section of the profiles.

7.4 Creep behaviour (applicable to finished products for non-load bearing applications)

7.4.1 Known span in use

7.4.1.1 Principle

A specimen is submitted to a three-point bending test under a constant load in a defined atmosphere. The deflection under a defined load and the residual deflection 24 h after removal of the load are measured.

7.4.1.2 Apparatus

An apparatus, as described in A.2, shall be used.

The distance between the supports shall be defined by the manufacturer and shall be equal to the nominal installation distance of the support structure of the profiles.

7.4.1.3 Test specimens

The length of the test specimen shall be equal to the distance between the supports, as defined in 7.4.1.2, plus 100 mm.

The number of test specimens shall be as specified in the reference standard.

7.4.1.4 Atmosphere for conditioning and testing

The age of the test specimens shall be at least 24 h with a maximum of two weeks.

The test specimens shall be conditioned according to 5.2.

The test shall be performed in the atmosphere 23/50 [(23 ± 2) °C, (50 ± 10) % RH]. As an alternative, it may be performed in the atmosphere 50/50 [(50 ± 2) °C, (50 ± 10) % RH].

7.4.1.5 Procedure

The specimens shall not be fixed on the supports.

The load to be applied on the specimens shall be equal to 1 000 N when testing in the atmosphere 23/50 or 850 N when testing in the atmosphere 50/50.

The load shall be applied on the test specimen midway between the supports after conditioning during 1 h in its test set up.

The test duration shall be 504 h (3 weeks) when testing in the atmosphere 23/50 or 168 h when testing in the atmosphere 50/50.

Measure and record the deflections a_i, in millimetres, of each test specimen at midspan to an accuracy of 0,1 mm:

a) before applying the load, a_1;

b) 1 min after the load is applied, a_2;

c) at the end of loading (before the removal of the load), a_3;

d) 24 h after the removal of the load, a_4.

Calculate the deflection, Δs, by using Formula (2):

$$\Delta_s = a_3 - a_2 \quad (2)$$

where

Δ_s is the deflection, expressed in millimetres;

a_3 is the deflection at the end of loading before the removal of the load, expressed in millimetres;

a_2 is the deflection 1 min after the load is applied, expressed in millimetres.

Calculate the residual deflection, Δs_r, by using Formula (3):

$$\Delta_{sr} = a_4 - a_1 \quad (3)$$

where

Δ_{sr} is the residual deflection, expressed in millimetres;

a_4 is the deflection 24 h after the removal of the load, expressed in millimetres;

a_1 is the deflection before applying the load, expressed in millimetres.

7.4.2 Unknown span in use

The test method specified in 7.4.1 shall be applied with the following changes:

a) the span shall be 20 times the thickness of the test specimen;

b) the stress to be applied shall be 25 % of the of the maximum load F_{max} determined according to A.5.2;

c) the test duration shall be 168 h.

Calculate the creep factor by using Formula (4):

$$C_f = \frac{a_3 - a_2}{a_2 - a_1} \quad (4)$$

where

C_f is the creep factor of the test specimen, expressed as a dimensionless ratio;

a_1 is the deflection before applying the load, expressed in millimetres;

a_2 is the deflection 1 min after the load is applied, expressed in millimetres;

a_3 is the deflection at the end of loading before the removal of the load, expressed in millimetres.

Calculate the creep recovery by using Formula (5):

$$E_{rc} = 100 \times \frac{a_3 - a_5}{a_3 - a_1} \quad (5)$$

where

E_{rc} is the creep recovery of the test specimen, expressed as a percentage;

a_3 is the deflection at the end of loading (before the removal of the load), in millimetres;

a_5 is the deflection after the removal of the load, expressed in millimetres;

a_1 is the deflection before applying the load, expressed in millimetres.

7.5 Resistance to indentation

7.5.1 Principle

The resistance to indentation is determined by applying a loaded indenter to the face of the test specimen. The difference of depths of the indentations under a preload and an additional load is used to evaluate the Brinell hardness of the test specimen. After the loading, the unloaded specimen is left to recover and the depth of the residual indentation is used to evaluate the rate of elastic recovery.

NOTE This method is based on the principle of EN 1534:2010 [3].

7.5.2 Apparatus

7.5.2.1 Indenter, i.e. a hardened steel spherical body with diameter of (10 ± 0,01) mm.

7.5.2.2 Measurement rig, i.e. a device capable of measuring the depth of the residual indentation on the face of the test specimen to an accuracy of ± 0,1 mm.

7.5.2.3 Loading head, i.e. a device with a load cell accurate to ± 2 % of the maximum applied loads, moving perpendicular to a flat rigid table.

The load and the rate of head movement of the loading head shall be adjustable within specified limits.

7.5.2.4 Rigid steel support.

7.5.3 Test specimens

The test specimens shall be prepared by sawing, milling or sanding (grade 120 or grade 240) and their minimum finished dimensions shall be 50 mm x 50 mm x 4 mm thick. The surface of the test specimens shall be smooth.

If needed, in the case of hollow profiles the superposition of two walls is permitted. The ratio of the thickness of the test specimen to the maximum indentation to shall be at minimum 4 to prevent the cleavage of the test specimen.

The number of test specimens shall be as specified in the reference standard.

7.5.4 Test method

7.5.4.1 Accuracy

All the measurements shall be made to the limits of accuracy specified for the instruments as defined in 7.5.2.2.

7.5.4.2 Application of preload and load

The test specimen shall be free of any material that may interfere with the results. Set the test specimen on the table of the loading head. Lower the indenter to the surface of the test specimen. Apply a preload of 20 N. Continue to apply the force increasing at such rate that the additional load of 2 000 N is reached after (30 ± 10) s.

Maintain the force at this value for (25 ± 5) s. Withdraw the indenter completely.

Throughout the test, the machinery shall be vibration and shock free, to ensure that the sample is rigidly held.

7.5.4.3 Measurement of residual indentation

After withdrawal of the indenter, wait (let recover) for at least 24 h. Measure the depth of the residual indentation, one per test specimen.

7.5.4.4 Expression of results

7.5.4.4.1 Brinell hardness

The hardness Brinell (*HB*) is calculated to two significant figures, according to Formula (6):

$$HB = \frac{F}{\pi \times D \times I} \tag{6}$$

where

HB is the Brinell hardness, in N/mm^2 or MPa.

F is the load (2 000 N), in newtons;

D is the diameter of the indenter, in millimetres;

I is the depth of the indentation under 2 000 N load, in millimetres.

7.5.4.4.2 Rate of elastic recovery

The rate of elastic recovery is calculated to two significant figures, according to Formula (7):

$$Rec = 100 \times \left(1 - \frac{I_r}{I}\right) \tag{7}$$

where

Rec is the rate of elastic recovery, expressed a percentage;

I_r is the residual depth of the indentation after 24 h, in millimetres;

I is the depth of the indentation under 2 000 N load, in millimetres.

7.6 Nail and screw withdrawal

The withdrawal capacity of nails, screws and staples inserted into products shall be determined according to EN 13446.

The dimensions of the test pieces shall be consistent with the actual installation.

The number of test specimens shall be as specified in the reference standard.

7.7 Pull through resistance

The resistance of products to the head pull through of timber fasteners shall be determined according to EN 1383.

The dimensions of the test pieces shall be consistent with the actual installation.

The number of test specimens shall be as specified in the reference standard.

8 Durability

8.1 Resistance to artificial weathering

8.1.1 Test methods for artificial weathering

For products for external use, artificial weathering shall be performed by exposure to xenon-lamps according to EN ISO 4892-2:2013, Cycle 1, or to fluorescent UV-A 340 lamps according to EN 927-6, or to medium pressure mercury lamps according to EN 16472 provided that a correlation between the test results obtained with these light sources and these obtained after an natural exposure.

For products for internal use, artificial weathering shall be performed by exposure to xenon-lamps according to EN ISO 4892-2:2013, Cycle 2, or to fluorescent UV-A 351 lamps specified in EN ISO 11507:2007, using the principles of EN 927-6, or to medium pressure mercury lamps according to EN 16472 provided that a correlation between the test results obtained with these light sources and these obtained after an natural exposure.

Only the exposed side(s) of the products shall be exposed to artificial weathering.

8.1.2 Methods for assessing of the resistance to artificial weathering

Depending on the application, the assessment of the resistance to artificial weathering shall be based on one or several of the following characteristics:

— the difference of colour expressed according to the grey scale described in EN 20105-A02 or the difference of colour, ΔL^*, Δa^*, Δb^*, ΔE^* determined according to ISO 7724-1, ISO 7724-2 and ISO 7724-3;

— appearance criteria, defined by the manufacturer;

— the degree of chalking according to 10.1, if relevant;

— the change of gloss according to 10.2, if relevant; and/or

— the peel strength resistance according to 10.3, if relevant.

8.2 Resistance to natural ageing (external use)

8.2.1 Test methods for natural ageing

The direct exposure of products to solar radiation shall be carried out according to EN ISO 877-2, Method A or EN 927-3.

Only the exposed side(s) of the products shall be exposed to solar radiation.

For the assessment of solar irradiation conditions, it is recommended to refer to the WMO N° 8, 2008, *Guide to Meteorological Instruments and Methods of Observation*, Seventh edition [4].

NOTE For example, a natural exposure during one year in the south of France is corresponding to a total solar radiant exposure of 6,6 GJ/m^2 and an average temperature of 15,5 °C.

In addition to the total solar radiant exposure and the average temperature of the place of exposure, the relative humidly should be taken into consideration.

8.2.2 Methods for assessing the resistance to natural ageing

Depending on the application, the assessment of the resistance to natural ageing shall be based on one or several of the following characteristics:

— the difference of colour expressed according to the grey scale described in EN 20105-A02 or the difference of colour, ΔL^*, Δa^*, Δb^*, ΔE^* determined according to ISO 7724-1, ISO 7724-2 and ISO 7724-3;

— appearance criteria, defined by the manufacturer;

— the change of the modulus of elasticity in bending (A.6.1) and bending strength (A.6.2) according to 7.3.2, if relevant;

— the resistance to falling mass impact according to 7.1.2, if relevant;

— the slip resistance according to 6.4, if relevant;

— the degree of chalking according to 10.1, if relevant;

— the change of gloss according to 10.2, if relevant; and/or

— the peel strength resistance according to 10.3, if relevant.

8.3 Moisture resistance

8.3.1 Swelling and water absorption

8.3.1.1 General

The swelling of compounds/products shall be determined according to EN 317 with the following changes:

a) The measurement of the dimensions in thickness, width and length of the specimens shall be carried out according to 8.3.1.2, 24 h, 2 days, 4 days, 7 days, 14 days and 28 days after the total immersion into water at a temperature of (20 ± 2) °C.

b) The water absorption of the compounds/product shall be calculated by differential weighing of the test specimens for each time period.

c) For the determination of swelling of compounds, the dimensions of the test specimens shall comply with EN ISO 178:2010, 6.1.2.

d) For the determination of swelling of products, the dimensions of the test specimens shall be 100 mm long and the actual width and thickness of the products.

The number of test specimens shall be as specified in the reference standard.

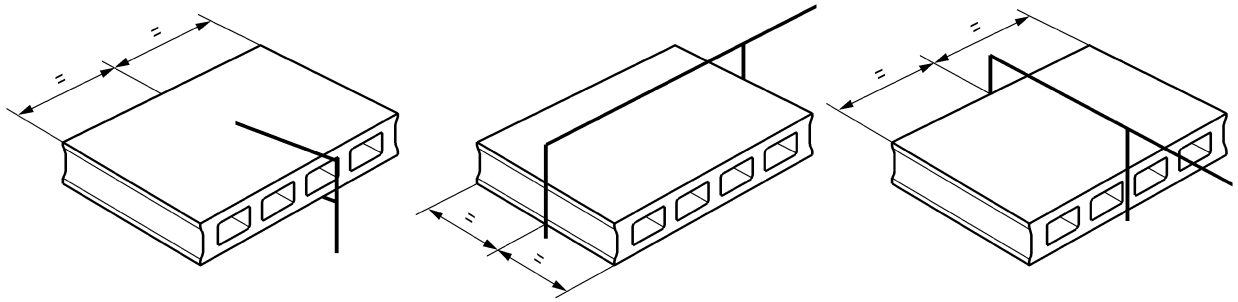
8.3.1.2 Measurement of dimensions

In case of profiles, the measurements of the dimensions (thickness, width and length) of a test specimen shall be carried out by means of a vernier calliper according to the method as shown in Figures 4 and 5.

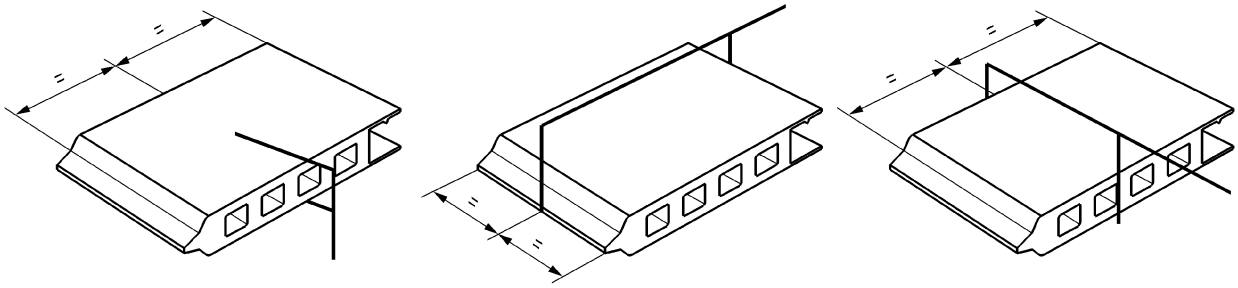
The measuring points shall be fixed centrally with respect to the axis of symmetry of the profile, independent of whether there is a rib or a hollow chamber below the measuring point.

The measurement of the thickness shall be carried out on the cross section of the profile. The measuring instrument shall be applied at a distance of $10\ ^{0}_{-1}$ mm from the end of the profile and shall be supported over a length of at least 10 mm (Figure 5).

In case of surface with grooves, the measuring apparatus shall be positioned with an angle to overlap the grooves.



a) Symmetrical profile



b) Asymmetrical profile

Figure 4 — Measuring points for the determination of dimensions

Dimensions in millimetres

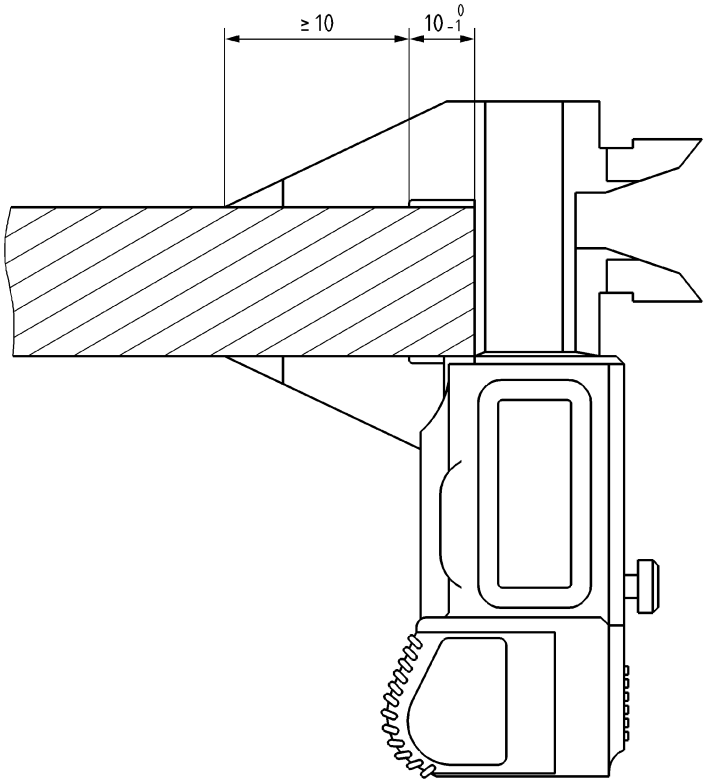


Figure 5 — Detail regarding measurement of profile thickness

8.3.2 Moisture resistance under cyclic conditions

The moisture resistance of products under cyclic conditions shall be determined according to EN 321 with the following changes:

a) In EN 321:2001, 6.1.2.1 for the first cycle:

   1) The immersion period in water bath at (20 ± 1) °C shall be (28 ± 1) days. The measurement of the mass of the test specimens shall be carried out one day, two days, four days, seven days, 14 days and 28 days after the total immersion into water.

   2) The freezing period shall be (24 ± 1) h.

   3) The drying period shall be (72 ± 1) h.

b) In EN 321:2001, 6.1.2.2 and 6.1.2.3 for the second and third cycles:

   1) The immersion period in water bath at (20 ± 1) °C shall be (72 ± 1) h.

   2) The freezing period shall be (24 ± 1) h.

   3) The drying period shall be (72 ± 1) h.

c) In EN 321:2001, 6.1.3, remove the test pieces from the drying cabinet and condition them according to 5.2 for 72 h.

The test specimens shall be defined in the reference standard.

The number of test specimens shall be as specified in the reference standard.

The modulus of elasticity in bending (A.6.1) and the bending strength (A.6.2) shall be determined according to 7.3.2 before and after the cyclic treatment.

The decrease of the bending strength and the modulus of elasticity in bending shall be expressed as a percentage of the initial value.

8.3.3 Moisture resistance – Boiling test

8.3.3.1 Principle

Test specimens are immersed in boiling water. After removal from the water, the water intake is determined.

8.3.3.2 Test specimens

The thickness and width of the test specimens before testing shall be the actual dimensions of the profile. The length of the test specimens (parallel to the direction of production) shall be (100 ± 2) mm.

The number of test specimens shall be as specified in the reference standard.

The test specimens shall be tested at least 24 h and at latest 2 weeks after production. During this time period, the test specimens shall be stored a temperature of (23 ± 2) °C and a relative humidity of (50 ± 10) % RH.

8.3.3.3 Procedure

The test specimens are immersed in water after reaching the boiling point. The reduction of water temperature by adding the test specimens shall not last longer than 10 min.

The test specimens are immersed in boiling water during 5 h ± 10 min.

After 5 h storage in boiling water, the test specimens are immediately immersed in cold water at (20 ± 2) °C during 15 min.

For each test, fresh water shall be used.

Then, the test specimens are removed from water, excess water is taken off (e.g. by blowing off) and stored at a temperature of (23 ± 2) °C and a relative humidity of (50 ± 10) % RH.

Within 120 min after the removal of the test specimens from water, the water uptake of the test specimens expressed as a percentage of the initial mass of the test specimen shall be determined.

8.4 Resistance against termites

The resistance of WPC materials against termite attack shall be determined according to EN 117 with the changes as given in Table 1.

Subclauses 5.2.4, 5.3.3, 5.3.5, 5.3.6, 5.3.8, 5.3.9, 5.3.10, and 8.1 and Clause 6 of EN 117:2012 are not relevant.

The test shall be evaluated by expressing the amount of compound consumed as percentage of the initial mass, and reporting the score given in a visual assessment which describes the nibbling marks.

NOTE It is assumed that the determination of the resistance against termites of the compounds is not necessary if the cellulosic material content is less than or equal to 60 % and optional if it is greater than 60 %. In any case, the request of the determination of the resistance against termites is dependent on local/national regulations.

Table 1 — Changes in EN 117:2012

Subclause of EN 117:2012	**Change**
7.3	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 ± 0,5) mm x (50 ± 0,5) mm x (4 ± 0,2) mm. The test specimens shall originate from at least three production samples prepared from three different batches of compounds/products. The type of processing shall be mentioned in the test report. For the untreated control specimens (see 7.5) the given requirements for the wood quality are valid, but use the test specimens with the same dimensions as WPC test specimens.
7.4	The dimensions of the test specimens shall be as defined above (7.3).
7.5	For the test specimens subject to attack by *Reticulitermes*, use at least three test specimens for each type of WPC material tested. “c)” is not applicable.
Clause 9	Report the results of the visual examination for each test specimen. Also, record the survival rate of the workers and the presence, if any, of soldiers and/or nymphs at the end of test.
Clause 10	Adapt the test report according to the changes as given in this table.

8.5 Resistance against biological agents

8.5.1 Pre-treatment

For the microbial or fungi tests according to 8.5.2, 8.5.3 and 8.5.6, a pre-treatment in order to increase moisture content of the WPC material shall be performed. The pre-treatment procedure shall be carried out according to EN 84. The test specimens are ready in wet condition (EN 84:1997, 6.1.2), without drying (EN 84:1997, 6.2).

8.5.2 Resistance against basidiomycetes

8.5.2.1 General

The resistance of WPC materials against an attack by wood-destroying basidiomycetes shall be determined according to ENV 12038 including the changes given in Table 2. All calculations shall be based on the whole WPC material, not only on the wood content.

The pre-treatment procedure of the WPC specimens, as described in 8.5.1, shall be applied.

NOTE At present there is no sufficient database to provide a valid classification system. A new system will be developed in the future when more data is available.

Table 2 — Changes in ENV 12038:2002

Subclause of ENV 12038	**Change**
5.1.1.1 and 5.1.1.2	*Pleurotus ostreatus* is not obligatory. *Coniophora puteana*, *Gloeophyllum trabeum* and *Coriolus versicolor* are obligatory.
5.1.2.4	Not relevant.
6.1	Specimens may be produced by any process (such as injection moulding, extrusion or compression moulding). Results are valid for sample process type only. Preferably, the specimens come from at least three batches.
6.2	The dimensions of the specimens shall comply with EN ISO 178:2010, 6.1.2 (80 mm × 10 mm × 4 mm). If the specimens are prepared by extrusion, the largest specimen dimension shall correspond to the extrusion direction. The specimen surface shall not be removed after manufacturing.
7.1	Use six specimens as test specimens (7.1.1), six specimens as water content specimens (7.1.2) and six specimens as water uptake control specimens (7.1.3).
7.3	Not relevant.
8.1	Pre-treatment is according to 8.5.1 is not relevant.
8.2.1	Conditioning in climate for all specimens is not relevant. Prolong the drying time (oven drying at 103 °C) of the moisture control blocks to at least 72 h and determine the oven dry weight (m_1) as described in ENV 12038. NOTE Depending on the type of WPC material used, the equilibrium moisture content will be achieved only within several weeks to several months. Therefore in many cases the weight changes over time will be very small (< 0,05 g/24 h), as it is not satisfactory to wait several months until the samples have reached the equilibrium moisture content.
8.3	Sterilize also the specimens foreseen to determine the water uptake (see ENV 12038:2002, 7.1.3). NOTE Gamma radiation can strongly affect the structure of polymers. Check carefully if the polymer of the WPC material tested is suited for gamma radiation.
8.6.2	Place two test specimens (7.1.1) in each culture vessel. If specimens have different surfaces, place the side in contact with the fungal mycelium which is expected to be more sensitive to fungal growth. This will be the case for, e.g. extruded specimens with grooves.
8.6.4	Store the moisture control specimens as described, but expose the specimens to determine the water uptake (see ENV 12038:2002, 7.1.3) in sterile culture vessels containing agar/nutrient. Place two specimens (7.1.3) in each culture vessel.
8.8.2	Treat specimens to determine the water uptake (7.1.3) in the same way as test specimens (7.1.1). Prolong the time of the oven drying at 103 °C to at least 72 h. All specimens, which are not contaminated by organisms other than the test fungi, are valid independent of moisture content.
Clause 10	Not relevant.
Clause 11	Adapt the report accordingly. The production process of specimens shall be mentioned. Include mass loss, moisture content after pre-treatment, and after incubation and moisture content of specimens to determine water uptake (7.1.3). The report shall include results from mechanical testing as well (8.5.2.2).

8.5.2.2 Mechanical properties

Fungal degradation may decrease mechanical properties of WPC materials. To evaluate the impact of fungal attack on WPC materials, the flexural strength and the modulus of elasticity in flexure shall be evaluated according to EN ISO 178 immediately before drying, on the following specimens:

a) specimens without any treatment;

b) moisture control specimens (ENV 12038:2002, 7.1.2);

c) specimens to determine the water uptake (ENV 12038:2002, 7.1.3).

The exposed face of the test specimens shall be tested in tension.

Calculate the relative loss of the flexural strength by using Formulae (9) to (11).

$$\sigma_{fm} = 100 \times \frac{\sigma_i - \sigma_m}{\sigma_i} \quad (9)$$

$$\sigma_{fd} = 100 \times \frac{\sigma_i - \sigma_d}{\sigma_i} \quad (10)$$

$$\sigma_{ff} = \sigma_{fd} - \sigma_{fm} \quad (11)$$

where

σ_i is the initial flexural strength of the specimen, expressed in megapascals;

σ_m is the moisture dependent flexural strength of the specimen, expressed in megapascals;

σ_d is the degradation dependent flexural strength, expressed in megapascals;

σ_{fm} is the loss of the flexural strength of the specimen, caused by moisture, expressed in megapascals;

σ_{ff} is the loss of the flexural strength of the specimen, caused by fungi, expressed in megapascals;

σ_{fd} is the loss of the flexural strength of the specimen, caused by the degradation procedure, expressed in megapascals.

Calculate the relative loss of modulus of elasticity by using Formulae (12) to (14).

$$E_{fm} = 100 \times \frac{E_i - E_m}{E_i} \quad (12)$$

$$E_{fd} = 100 \times \frac{E_i - E_d}{E_i} \quad (13)$$

$$E_{ff} = E_{fd} - E_{fm} \quad (14)$$

where

E_i is the initial modulus of elasticity in flexure of the specimen, expressed in megapascals;

E_m is the moisture dependent modulus of elasticity in flexure of the specimen, expressed in

megapascals;

E_d is the degradation dependent modulus of elasticity in flexure of the specimen, expressed in megapascals;

E_{fm} is the loss of the modulus of elasticity in flexure of the specimen, caused by moisture, expressed in megapascals;

E_{ff} is the loss of the modulus of elasticity of elasticity in flexure of the specimen, caused by fungi, expressed in megapascals;

E_{fd} is the loss of the modulus of elasticity of elasticity in flexure of the specimen, caused by the degradation procedure, expressed in megapascals.

8.5.3 Resistance against soft rotting micro-fungi

8.5.3.1 General

The resistance of WPC materials against an attack by soft rotting micro-fungi shall be determined according to CEN/TS 15083-2 with the changes given in Table 3. All calculations shall be based on the whole WPC material, not only on the wood content.

The pre-treatment procedure of the WPC specimens, as described in 8.5.1, shall be applied.

NOTE At present there is no sufficient database to provide a valid classification system. A new system will be developed in the future when more data is available.

8.5.3.2 Mechanical properties

Fungal degradation may decrease mechanical properties of WPC materials. To evaluate the impact of fungal attack on WPC materials, the flexural strength and the modulus of elasticity in flexure shall be evaluated according to EN ISO 178 immediately before drying, on the following specimens:

a) specimens without any treatment;

b) moisture control specimens e_2 (CEN/TS 15083-2:2005, 6.5);

c) specimens to determine the degradation e_1 (CEN/TS 15083-2:2005, 6.5).

The exposed face of the test specimens shall be tested in tension.

Calculate the relative loss of the flexural strength by using Formulae (9) to (11).

Calculate the relative loss of modulus of elasticity by using Formulae (12) to (14).

Table 3 — Changes in CEN/TS 15083–2:2005

Subclause of CEN/TS 15083–2	**Change**
5.1.2.3 and 5.1.2.4	The dimensions of reference timber test specimens shall be 10 mm x 4 mm in cross-section and 80 mm long.
6.1 to 6.3	Not relevant.
6.4	The specimens may be manufactured by any process (such as injection moulding, extrusion or compression moulding). Results are valid for the specimen process type only. The dimensions of specimens shall comply with EN ISO 178, 6.1.2 (80 mm × 10 mm × 4 mm), 6.1.2. If the specimens are prepared by extrusion, the largest specimen dimension shall correspond to the extrusion direction. The specimen surface shall not be removed after manufacturing.
6.5	The specimens are prepared from more than one batch, preferably.
7.1.2	Pre-treat the test specimens, e_1 and e_2, as described in 8.5.1. Dry the test specimens e_2 at 103 °C as described, but increase the drying time for at least 72 h.
7.2	7.2 is not relevant. Measure the flexural strength, σ_m, and the modulus of elasticity in flexure, E_m, as described in subclause 8.5.2.2.
7.5	7.5.1 and 7.5.2 are not relevant. Test is finished after 24 weeks. If 20 % loss in mass of the reference timber test specimens has not been achieved after the 24 weeks exposure, the test is not valid.
7.6	Follow the procedure given in 7.6.1. Measure the flexural strength, σ_d, and the modulus of elasticity in flexure, E_d, as described in 8.5.2.2. Prolong the drying time for at least 72 h.
7.6.3 and 7.6.4	WPC material may have atypical behaviour regarding soft rot. This test is valid if the reference test specimens exhibit soft rot degradation and the mass loss of the reference test specimens is equal or greater than 20 %.
Clause 8	Not relevant.
Clause 9	Adapt the report accordingly. Mention the manufacturing process of specimens. Include the mass loss and the moisture content and the results of mechanical testing.

8.5.4 Resistance against discolouring micro-fungi according to ASTM D 3273

The resistance against discolouring mould-fungi shall be determined according to ASTM D3273-00(2005) including the changes as given in Table 4.

Specimens are submitted to an accelerated test in a humid chamber. The specimens are exposed indirectly by hanging them.

The pre-treatment procedure of the WPC specimens, as described in 8.5.1, shall be applied.

Table 4 — Changes in ASTM D3273–00(2005)

Subclause of ASTM D3273	**Change**
Clause 4	Use a container from inert plastics (polyethylene or polystyrene) or glass with a cover. Openings shall allow the monitoring of the climate conditions within the container. The temperature of (26 ± 2) °C within the container shall be realized by keeping in a climate room or by direct heating. The relative humidity shall be $96\ ^{+2}_{-1}$ % and shall be realized by water within the container on the bottom. The minimum sizes of the container shall be approximately 350 mm x 300 mm x 400 mm. The described chamber in the ASTM D3273–00 may be used in consideration of the above-named climate conditions.
5.1	A common pot soil for seedlings with a pH-value between 5.5 and 7.6 is an appropriated substrate for mould fungi. The pot soil shall be sterilized to eliminate any influences of undesired organisms and to provide uniform test conditions.
5.2	Use the following species: — *Aureobasidium pullulans*, strain DSM 3497; — *Penicillium pinophilum* (former name: *Penicillium funiculosum*), strain DSM 1944; — *Aspergillus niger*, strain DSM 1957; — *Chaetomium globosum*, strain DSM 1962; — *Cladosporium herbarum*, strain DSM 63422.
5.3	The test specimens have the dimensions of (100 ± 0,5) mm x (70 ± 0,5) mm (length x width). The thickness is depending on the product; it can be the original thickness of the product, or, specimens are cut only from the outer face of the decking. The test surface shall be representative of the surface in practice, i.e. it shall not to be removed. The reference material shall be *Scots pine* (*Pinus sylvestris L.*). The dimensions of the specimens are (110 ± 0,5) mm x (40 ± 0,5) mm x (10 ± 0,5) mm. Specimens as described in EN 152:2011 are appropriate. The reference specimens shall be free of defects like knots, excessive resins or other abnormalities and their surfaces shall be planed. A hole with a diameter of about 5 mm is to realise near the narrow side on each specimen for the attachment.
7.1	The specimens shall be sterilized by autoclaving (15 min, 121 °C, 1 bar). Other sterilization procedures may be arranged according to the products characteristics (e.g. heat stability). Prepare five replicates of the test specimens and reference specimens.
7.2	Arrange the five replicates each in five separate containers. Each container shall contain one reference specimen. The references shall develop a 3 to 4 mould growth rating within four weeks. If this growth is not obtained in some containers, the results for all specimens in that container have to be neglected.
7.3	Rate the specimens each week for four weeks. The original surface shall be rated only. The rating scheme given in Table 5 shall be used. The observation shall be done by means of a reflecting microscope at 20-fold magnification.
8.1	Report the results after four weeks of the exposure giving the mean as integral number and the range of five specimens. It shall be specified whether the mould covering/discolouration is visible by the naked eyes or by microscope only. The report shall include information to the production process, specimen size, pre-treatment, the used test strains and each variation of this method.

Table 5 — Rating scheme

Rating number	Criteria	Interpretation
0	No covering/discoloration visible	Resistant to mould infestation
1	Few traces of fungi visible only by microscope	
2	Covering/discoloration on maximum 25 % of the total surface area	Moderately susceptible to mould infestation
3	Covering/discoloration on > 25 up to 50 % of the total surface area	Susceptible to mould infestation
4	Covering/discoloration on more than 50 % of the total surface area	

8.5.5 Resistance against discolouring micro-fungi according to ISO 16869

8.5.5.1 General

The efficacy of a fungicide in a WPC material shall be determined according to ISO 16869.

WPC specimens are exposed to a spore suspension of mould fungi in a nutrient agar system.

This test is obligatory when the efficacy of a biocide against mould fungi shall be proved.

The pre-treatment procedure of the WPC specimens, as described in 8.5.1, shall be applied.

8.5.5.2 Test procedure

A nutrient agar is inoculated with a mix of mould spores: add 100 µl mixed suspension of 5×10^5 up to 1×10^6 spores/ml to 20 ml agar. The specimens are put on the solid nutrient agar with the test side upgrade. The infestation/discoloration of the moulds is observed over 21 days of incubation. The efficacy is assessed by observation by microscope (20-fold magnification) of the presence of mould growth on top of the specimens and by determination of the inhibition zone around the specimens. A specimen of the same type of WPC material without biocide (so called “blanco”) shall also be included in the test to determine the improvement in durability caused by the fungicide.

Use at least three test pieces of 20 mm × 20 mm. The specimen surface shall not be removed after manufacturing.

The rating scheme given in Table 6 shall be used.

Table 6 — Rating scheme

Rating number	Criteria	Interpretation
0	No covering/discoloration visible	Resistant to mould infestation
0*	Inhibition zone free from mould around the specimen	
1	Few traces of fungi visible only by microscope	
2	Covering/discoloration considerably weaker than on the control specimens without fungicide	Partially protected to mould infestation
3	Covering/discoloration equal or considerably stronger than on the control specimens without fungicide	Not protected to mould infestation/susceptible to mould infestation

8.5.6 Resistance against discolouring algae

The resistance against discolouring algae shall be determined according to EN 15458:2007 with the changes as given in Table 7.

A WPC specimen is the exposure to a defined mixture of algae known to damage or discolour exterior surfaces and facades. The specimens are applied to a nutrient salt agar and the growth of the algae on the sample surface is observed over a defined time period of incubation. The test shall be conducted in duplicate on specimens which surfaces are approximately 8 cm^2 to 18 cm^2.

The effectiveness is assessed by the observation of the presence of algae growth on top surface of the specimens as well as by the determination of the inhibition zone around the specimens.

In case of testing a WPC material containing an algaecide, a specimen of the same type of WPC material without biocide (so called “blank”) shall be included in the test to determine the improvement in durability caused by the biocide.

Table 7 — Changes in EN 15458:2007

Subclause of EN 15458	**Change**
6.2	The samples may be manufactured by any process (such as injection moulding, extrusion or compression moulding). Results are valid for the samples process type only.
6.4	After conditioning, at least three test specimens are made from the samples. The dimensions of specimens shall be 20 mm × 20 mm × 4 mm. The specimen surface shall not be removed after manufacturing. The test specimens shall be sterilised by autoclaving (15 min at 121 °C, 1 bar). Other sterilisation procedures may be used depending on the products characteristics (e.g. heat stability). Prepare three replicates of the test specimens and three reference specimens.
7.7	The rating scheme given in Table 8 shall be used.

Table 8 — Rating scheme

Rating number	**Criteria**	**Interpretation**
0	Free of any growth on the surface	Resistant to algae infestation
0*	Free of growth with inhibition zone around the specimen	
1	Surface marginally or up to 10 % overgrown by algae	
2	Surface overgrown between 10 % and 30 %	Partially protected to algae infestation
3	Surface overgrown between 30 % and 50 %	Not protected to algae infestation/susceptible to algae infestation
4	Surface overgrown between 50 % and 100 %	

8.6 Resistance to salt spray

The resistance to salt spray shall be determined according to EN ISO 9227 by using the neutral salt spray (NSS) test.

Depending on the application, the assessment of the resistance to salt spray shall be based on one or several of the following characteristics:

— the difference of colour expressed according to the grey scale described in EN 20105-A02 or the difference of colour, ΔL^*, Δa^*, Δb^*, ΔE^* determined according to ISO 7724-1, ISO 7724-2 and ISO 7724-3;

— appearance criteria, defined by the manufacturer.

9 Thermal properties

9.1 Heat deflection temperature (HDT)

The temperature of deflection under load (flexural stress under three-point loading) of WPC materials shall be determined according to EN ISO 75-1 and EN ISO 75-2, Method A, using a flexural stress of 1,80 MPa in the flatwise position.

9.2 Linear thermal expansion

The coefficient of linear thermal expansion of compounds shall be determined according to ISO 11359-2 using a temperature range for the measurements of −20 °C to 80 °C.

9.3 Heat reversion

The heat reversion at 100 °C of products/profiles shall be determined according to EN 479.

9.4 Heat build-up (applicable to products)

9.4.1 Principle

The purpose of this method is to predict the increase in temperature above that of ambient air temperature due to the amount of energy absorbed by a specimen from the sun, relatively to a black reference. It is applicable to specimens taken from profiles.

A specimen cut from a profile is heated under an infrared reflective heat lamp in specified conditions. The rise in temperature measured on the exposed surface of the specimen is compared to the one measured under the same conditions on a black control specimen of similar shape. The predicted maximum heat build-up is calculated by multiplying an experimental reference temperature rise under real solar exposure by the ratio calculated according to this method.

NOTE This method gives a relative heat build-up compared to black control specimen under defined conditions and does not predict actual application temperature of the product in real situations.

9.4.2 Apparatus

9.4.2.1 Internally thermally insulated box, with the following approximate inner dimensions: length: 500 mm; width: 300 mm and height: 300 mm.

NOTE An insulating material, such as polystyrene with a λ = 0,030 W/(m.K), with a thickness of 5 mm is suitable.

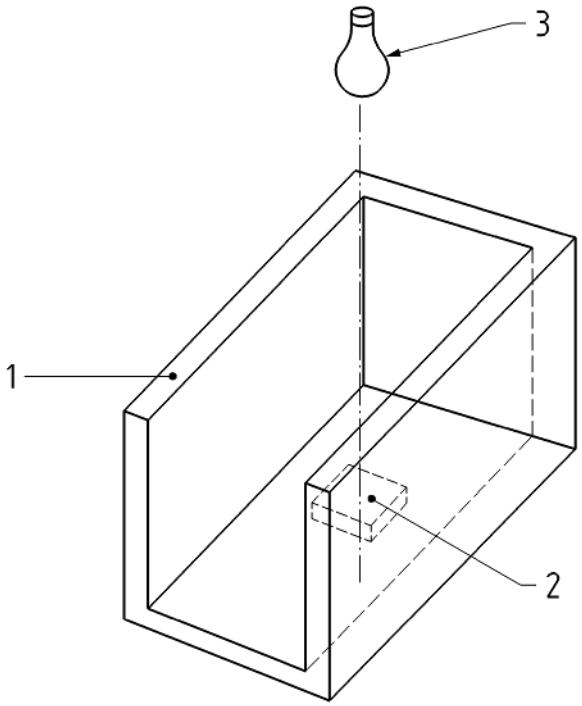
The box is opened on the top face and one small lateral face (see Figure 6). The box is equipped with any means allowing the vertical alignment of the test specimen with the heat lamp.

9.4.2.2 **White infrared heat lamp**, having a nominal power of approximately but not less than 250 W. The lamp is placed above the open box and the distance between the lowest part of the downward oriented heat lamp and the exposed side of the specimen shall be adjustable.

9.4.2.3 **IR-thermometer**, with an emission factor E = 0,95.

9.4.2.4 **Time measuring device.**

9.4.2.5 **Black-panel,** according to EN ISO 4892-1:2000, 5.2.2.2.



Key

1 insulated box
2 black control specimen/test specimen
3 heat lamp

Figure 6 — Test apparatus

9.4.3 Test specimens

Cut at least three test specimens from a profile, with the following approximate dimensions:

— length: 100 mm;

— width: actual width of the profile;

— thickness: actual thickness of the profile.

9.4.4 Procedure

9.4.4.1 Conduct the test at (23 ± 2) °C.

9.4.4.2 Place the black control specimen underneath the heat lamp so as to vertically align their respective centres.

In case of hollow profiles, close the open sides of the black control specimen to prevent ventilation during the measurement.

9.4.4.3 Record the temperature of the black control specimen, before starting the test. It shall be as close as possible to the ambient air temperature and shall not differ by more than 3 °C.

9.4.4.4 Switch on the lamp and adjust the distance between the lowest part of the downward oriented lamp and the exposed side of the black control specimen, so that the temperature rise of the black control specimen, measured by means of the IR-thermometer, is 50 °C for profiles for use in horizontal position (e.g. decking) and 41 °C for vertical position (e.g. cladding), respectively. The test duration shall be at least 10 min or more in case a constant equilibrium temperature is not observed.

9.4.4.5 Switch off the lamp and prepare the box for the next measurement carried out on the test specimen, notably lowering back the box temperature to the ambient air one.

9.4.4.6 Conduct the procedure (9.4.4.1 to 9.4.4.5) for each of test specimens. The surface temperature of the test specimen shall be measured by means of the IR-thermometer identically to this of the black control specimen.

9.4.4.7 Any further calculation shall be based on the average of three measurements, preferably on at least three different test specimens.

9.4.4.8 Two tests for the black control specimen shall be performed in the same conditions, one before and the other one at the end of a series of tests for the test specimens that shall not be more than nine measurements.

9.4.5 Expression of results

The temperature rise is given by Formula (15):

$$\Delta T_{\mathrm{exp}}(\mathrm{j}) = T_{\mathrm{M}} - T_{\mathrm{i}} \tag{15}$$

where

$\Delta T_{\mathrm{exp}}(j)$ is the temperature rise, in degrees Celsius, of the test specimen/black control specimen above the ambient air temperature in the laboratory under the heat lamp, with $j = s$ for the test specimen and $j = c$ for the black control specimen;

T_{M} is the surface temperature, in degrees Celsius, of the test specimen/black control specimen (measured for the test specimen, 73 °C for the black control specimen);

T_{i} is the ambient air temperature, in degrees Celsius, in the laboratory.

The predicted heat build-up is given by Formula (16):

$$\Delta T = \Delta T_{\mathrm{exp}}(s) \tag{16}$$

where

ΔT is the predicted heat build-up, in degrees Celsius, of the test specimen due to heating by the sun;

$\Delta T_{\mathrm{exp}}(s)$ is the temperature rise, in degrees Celsius, of the test specimen, as given by Formula (15).

9.4.6 Test report

The test report shall include the following information:

a) a reference to this subclause of EN 15534-1;

b) all information necessary for identification of the profile tested, including type (solid or hollow profile,), source, manufacturer's code number;

c) ambient air temperature;

d) average temperature rise above ambient air temperature for the black control specimen;

e) average time to reach the equilibrium temperature for the black control specimen;

f) average temperature rise above ambient air temperature for the specimen tested;

g) average time to reach the equilibrium temperature for the specimen tested;

h) predicted heat build-up of the profile for use in horizontal position;

i) predicted heat build-up of the profile for use vertical position;

j) identification of the laboratory or the operator;

k) date of testing.

9.5 Oxygen index (OI)

The oxygen index of WPC products shall be determined according to EN ISO 4589-2.

9.6 Reaction to fire

9.6.1 Single flame source test

The ignitability of WPC products by direct small flame impingement under zero impressed irradiance using specimens tested in a vertical orientation shall be determined according to EN ISO 11925-2.

9.6.2 Single burning item (SBI) test (applicable to cladding only)

9.6.2.1 General

The reaction to fire performance of products excluding floorings, when exposed to thermal attack by a single burning item (SBI) shall be determined according to EN 13823.

9.6.2.2 Mounting and fixing conditions

NOTE Mounting and fixing conditions are based on EN 13245–2:2008, Annex A [5].

To represent normal mounting and fixing conditions of profiles for wall and ceiling finishes, four types of mounting and fixing can be considered for the SBI test, as described in Table 9. The different mounting and fixing conditions are shown in Figure 7.

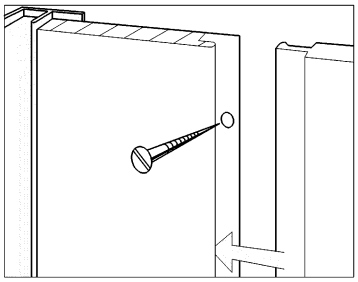
Table 9 — Mounting and fixing conditions in the SBI test

Method of fixing	Position	Type of fixing [a]	Code
Directly on the wall	Vertical	Mechanical fixing [b]	DVM
		Glued	DVG
	Other orientation	Mechanical fixing [b]	DHM
		Glued	DHG
On spacers with an air gap	Vertical	Mechanical fixing [b]	AVM
		Glued	AVG
	Other orientation	Mechanical fixing [b]	AHM
		Glued	AHG

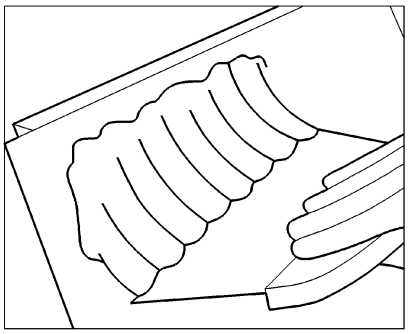
[a] The edges of specimens shall be closed to obtain an unventilated air gap.

[b] Fixing by screws, nails or other mechanical fixings, e.g. clips.

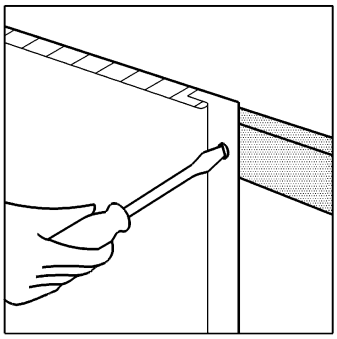
Any other method of fixing than those given above may be used but, in this case, the results apply only to that method.



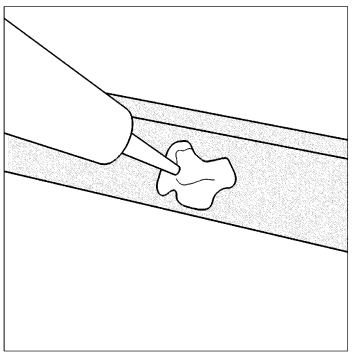
a) Directly on wall using screws



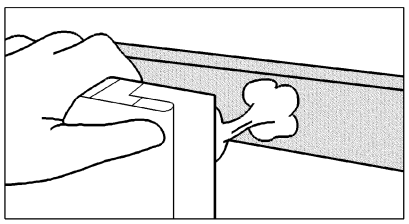
b) Directly on a wall using glue



c) On spacer using screws



d) Application of glue



e) Fixing of profile

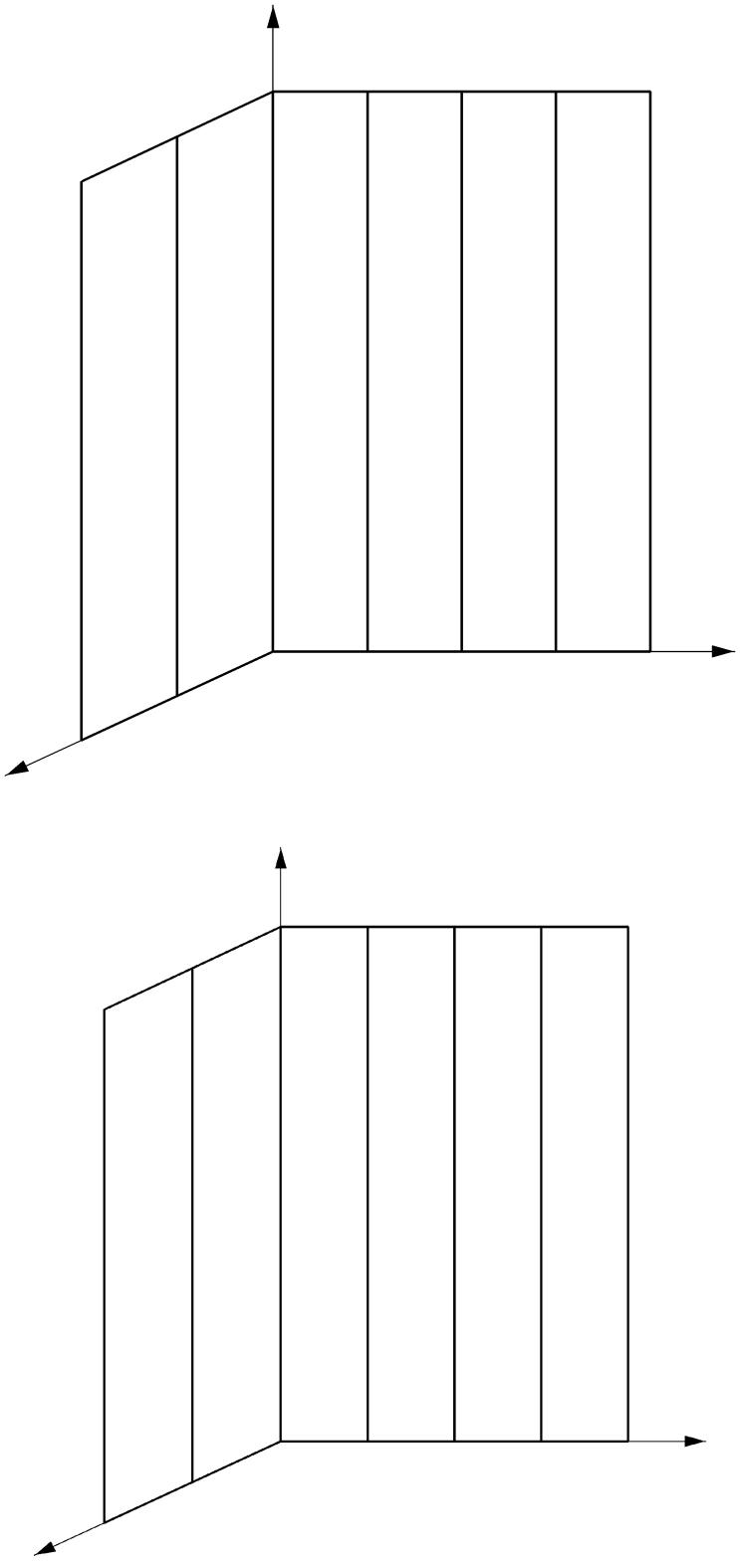
Figure 7 — Example of fixing

The parameters listed in Table 10 shall be selected and these need to be specified in the test report with the fire class.

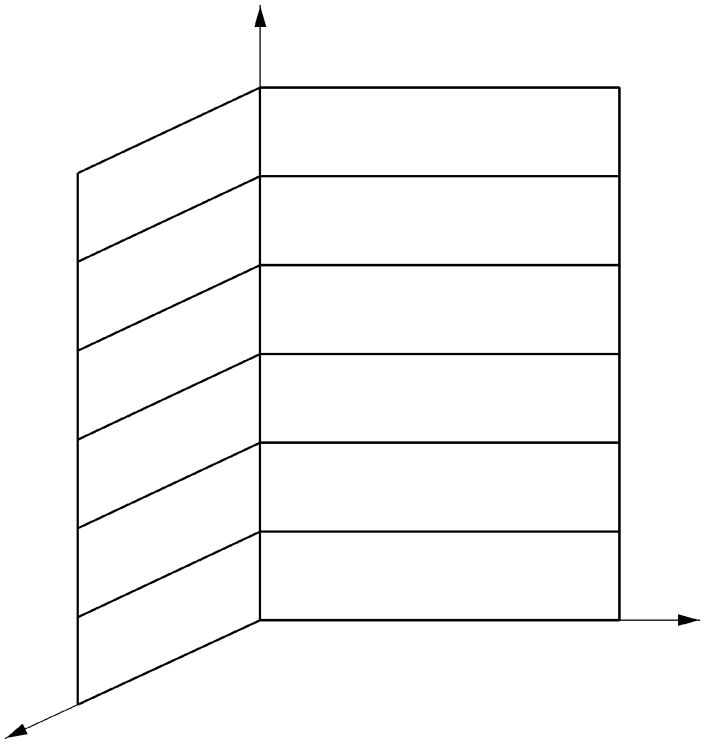
Table 10 — Parameters to be specified in SBI testing

Fixing	Parameters
On spacers	Spacer raw material (wood, WPC, …) Dimensions of the spacer sections (depth gives the air gap value) Distance between spacers and from spacers to the edge of the wall Type of fixing (screw, nail, glue, other mechanical fixings) If the profiles are glued on spacers, the type of glue Number and orientation of fixing points on spacers Perimeter (finishing profile or aluminium tape), if relevant Corner (finishing profile or other kind of finishing), if relevant Fixing of the finishing profiles
Directly on the SBI support wall with screws, nails, staples, glue	Type of fixing (screw, nail, glue, other mechanical fixings) Number and orientation of fixing points on the wall Perimeter (finishing profile or aluminium tape), if relevant Corner (finishing profile or other kind of finishing), if relevant Fixing of the finishing profiles If the profiles are glued, the type and the quantity of glue in grams per square metre

Figure 8 gives examples of the overall mounting of profile specimens in the SBI apparatus.



a) Profiles of width 250 mm in vertical position



b) Profiles of width 250 mm in horizontal position

Figure 8 — Example of SBI mounting

Following testing and classification, the results shall be shown as the reaction to fire class(es) followed by the mounting code(s) from Table 9, as shown below. When several mounting conditions result in the same class, each different mounting condition shall follow the class, whereas different classes shall be presented separately.

EXAMPLE 1

B-d0, s3/AVG/DVM for a profile in Class B-d0, s3 mounted vertically, glued on spacers or mechanically fixed directly to the wall.

EXAMPLE 2

C-d1, s2/DVG for a profile in Class C-d1, s2 mounted vertically, glued directly to the wall.

9.6.2.3 Direct application rules and related parameters

Table 11 gives the products parameters which have an influence on determining the reaction to fire performance of the product on its own not related to any end use, when tested according to EN ISO 11925-2 (small flame test) or to EN 13823 (single burning item test).

Table 11 — Product parameters when tested according to EN ISO 11925-2 or EN 13823

Product parameters	Influence on single-flame source/ SBI test results
Colour	No
Coating (lacquer-coating, laminated foil, co-extruded layer)	Yes

Composition (amount of inorganic fillers)	Yes
Mass per unit area	Yes

Table 12 gives the end-use parameters which have an influence on determining the reaction to fire performance of the product in its end-use application when tested according to EN 13823 (single burning item test).

Table 12 — End-use application parameters when tested according to EN 13823

End-use application parameter				Influence on SBI test results
Method of fixing	**Position**	**Type of fixing**	**Code**	
Directly on the wall	Vertical	Mechanical fixing [a]	DVM	Yes
		Glued	DVG	Yes
	Other orientation	Mechanical fixing [a]	DHM	Yes
		Glued	DHG	Yes
On spacers with an air gap	Vertical	Mechanical fixing [a]	AVM	Yes
		Glued	AVG	Yes
	Other orientation	Mechanical fixing [a]	AHM	Yes
		Glued	AHG	Yes
[a] Fixing by screws, nails or staples.				

9.6.2.4 Direct application rules

Table 13 gives direct applications rules for the product parameters.

Table 13 — Validity of the test results for the product parameters

Product parameter	Validity of the test results
Colour	The colour has no influence on the SBI or small flame test result.
Composition (amount of inorganic fillers)	For a family and a given amount of inorganic fillers, the result applies to any product with a higher amount of inorganic fillers.
Mass per unit area	For a family the maximum and the minimum mass per unit area of the profile shall be tested and the lowest classification shall be declared. [a]
Coating	No direct application rule exists.
[a] A range of products may be divided into more than one family.	

Table 14 and Table 15 give direct applications rules for the end-use application parameters.

Table 14 — Validity of the test results for profiles directly fixed on wall

End use application parameter		Influence on SBI test results
Position	**Type of fixing**	
Vertical	Mechanical fixing [a]	Rules I, II and III.
	Glued	Rules III and IV.
Other orientation	Mechanical fixing [a]	Rules I and II.

	Glued	Rule IV.
[a] Fixing by screws, nails or staples.		
Rule I: The test result (classification) with a distance between two consecutive fixings, d, is valid, without additional test, for the same type of WPC profiles mounted with a distance between two consecutive fixings less than d, all other mounting parameters being identical. Rule II: The results from any product with one type of mechanical fixing (i.e. screws) are applicable to the same product fixed with any other mechanical system (i.e. staples or nails), all other mounting parameters being identical. Rule III: The results from vertical orientation are applicable to the same product used in any other orientation. Rule IV: The results from any product tested with mechanical fixings are applicable to the same product glued.		

Table 15 — Validity of the test results for profiles directly fixed on spacers with an air gap

End use application parameter		Influence on SBI test results
Position	**Type of fixing**	
Vertical	Mechanical fixing [a]	Rules III, V, VI, VII and VIII.
	Glued	Rules III, IV, VI and VII.
Other orientation	Mechanical fixing [a]	Rules V, VI, VII and VIII.
	Glued	Rules IV, VI and VII.
[a] Fixing by screws, nails or staples.		
Rule III: The results from vertical orientation are applicable to the same product used in any other orientation. Rule IV: The results from any product tested with mechanical fixings are applicable to the same product glued. Rule V: The test result (classification) with a distance between two consecutive fixings, d, shall be valid, without test, for the same type of WPC profiles mounted with a distance between two consecutive fixings less than d, all other parameters and orientation being identical. Rule VI: The test result (classification) with an air gap, e, shall be valid, without test, for the same type of WPC profiles mounted with an air gap less than e or without air gap (directly on the wall), all other parameters and orientation being identical. Rule VII: The results on wood spacers are valid for the product on spacers of equal or higher reaction to fire class than that of the wood. Rule VIII: The results from any product with one type of mechanical fixing (i.e. screws) are applicable to the same product fixed with any mechanical system.		

9.6.3 Radiant heat source test (floorings)

The burning behaviour of products using a radiant heat source shall be assessed according to EN ISO 9239-1.

10 Other properties

10.1 Degree of chalking (applicable to coated products, only)

The degree of chalking of products shall be designated and rated according to EN ISO 4628-6.

10.2 Change of gloss

The specular gloss of products shall be determined according to EN ISO 2813. The 60° geometry is recommended.

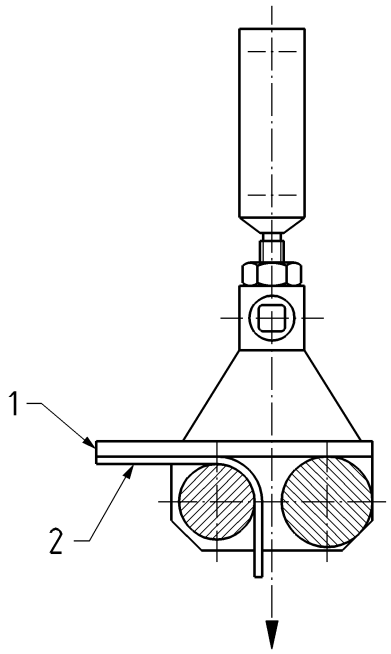
10.3 Peel strength (applicable to profiles with laminated foil)

10.3.1 Principle

A tear strip of the laminated foil of a profile is subjected to a longitudinal force, perpendicular to the profile surface, either at a constant-speed or under a constant-load.

10.3.2 Apparatus

Peel strength apparatus, capable of applying a load to a tear strip of a laminated test piece, either by static masses or by tension at a constant-speed using a tensile testing machine, as shown in Figure 9 or comparable.



Key

1 profile test piece
2 laminated foil

Figure 9 — Peel strength apparatus

10.3.3 Preparation of test pieces

Four test pieces either (20 ± 1) mm wide (for the constant-speed tensile test) or (25 ± 1) mm wide (for the constant-load tensile test) at least 100 mm long shall be cut from the sight surface of a profile with laminated foil. Notching along the cut edge shall be avoided.

The laminated foil (for clamping purposes) of approximately 50 mm long shall be separated from the substrate (profile) by a suitable procedure. The same result may be achieved during lamination by inserting a contact blocking material (e.g. polyethylene foil) between the profile and the laminated foil.

If only finished profiles with laminated foil are available, the test pieces shall be prepared as follows:

a) Cut the sight surface of the profile from the core over the entire width of the profile. Cut the separated sight surface into 200 mm long test pieces.

b) Place either a (200 ± 2) mm × (20 ± 1) mm metal template (for the constant-speed tensile test) or a (200 ± 2) mm × (25 ± 1) mm metal template (for the constant-load tensile test) lengthways on the sight surface of the test piece, midway between the sides.

c) Using a blade, cut through the laminated foil along the long sides of the template.

d) Mill away the back wall of the profile surface to a thickness of 0,5 mm along a line midway between the test piece short sides and transverse to its longitudinal axis. Be careful not to cut into the substrate too deep so as to avoid damaging the laminated foil. Then mill away (also to a thickness of 0,5 mm) the entire back wall of the test piece along the two lines cut in the laminated foil from one end of the test piece as far as the transverse line. Break off the material on either of the 100 mm × 20 mm (for the constant-speed tensile test) or 100 mm × 25 mm (for the constant-load tensile test) milled by gently bending the test piece.

10.3.4 Conditioning

Condition the test pieces for a minimum of 72 h after lamination, at (23 ± 5) °C.

The test pieces shall not be tested within 72 h after lamination.

10.3.5 Procedure

10.3.5.1 Constant-speed tensile test

Carry out testing at (23 ± 5) °C using the following procedure:

a) Set up the test piece (20 ± 1) mm wide in the peel strength apparatus and connect the laminated foil to the jaw such that the load is applied perpendicular to the main axis of the profile.

b) Extend the test piece by applying a rate of displacement of the driven grip of the test machine of (10 ± 1) mm/min.

If the foil breaks before peeling occurs, the tensile strength at break of the foil shall be reported.

The test results shall be expressed in newtons per millimetre.

For the determination of the peel strength after ageing, the constant-speed tensile test shall be used if it is used for testing non-aged profiles.

10.3.5.2 Constant-load tensile test

Carry out testing at (23 ± 5) °C using the following procedure:

a) Set up the test piece (25 ± 1) mm wide in the peel strength apparatus, supported by free running rollers and connect the laminated foil to the jaw such that the load is applied perpendicular to the main axis of the profile.

b) Apply smoothly during one minute to the test piece a constant load of (5 ± 0,01) kg (i.e. 2,0 N/mm), either by slowly releasing the load or by gradually applying the equivalent force by means of the tensile testing machine.

Measure the peeled length occurring between the foil and the profile either before the foil stretches and shears or when the constant load is applied.

The test shall be stopped at maximum 25 mm of peeling.

For the determination of the peel strength after ageing, the constant-load tensile test shall be used if it is used for testing non-aged profiles.

10.3.6 Test report

The test report shall include the following information:

a) reference to this subclause of EN 15534-1;

b) all details necessary for complete identification of the test pieces;

c) number of test pieces;

d) width of the test pieces, in millimetres;

e) test method used [constant-speed tensile test (10.3.5.1) or constant-load tensile test (10.3.5.2)];

f) type of separation of the laminated foil;

g) result of the constant-speed tensile test (10.3.5.1);

   1) individual peel strength values in newtons per millimetre;

   2) if the foil breaks, the tensile strength at break of the foil in newtons;

h) result of the constant-load tensile test (10.3.5.2):

   1) peeled length in millimetres;

i) any factors which may have affected the results, such as any incidents or any operating details not specified in this part of EN 15534;

j) date of the test.

Annex A
(normative)

Determination of the modulus of elasticity in bending and bending strength of profiles

A.1 Principle

The test specimen rests on two supports and is deflected by means of loading head between the supports. The test specimen is deflected at a constant rate at midspan until the maximum load is obtained (A.5.2) or until rupture occurs (A.5.3). During the procedure, the force applied to the test specimen and the resulting deflection at midpoint is measured.

NOTE 1 This method is based on EN 310:1993 [6].

The modulus of elasticity in bending is calculated by using the slope of the linear region of the load-deflection curve obtained in the test under standard conditions (see A.6.1).

NOTE 2 The value calculated is the apparent modulus of elasticity, not the true modulus of elasticity, because the test method includes shear as well as bending.

The bending strength is calculated by determining the ratio of the bending moment at the maximum load, obtained in the test under conditions defined by the manufacturer (see A.6.2) to the section moment of its full cross-section.

NOTE 3 In case of hollow profiles, the bending strength is the apparent bending strength, because the test method includes shear as well as bending and the applying bending force deforms the profile cross section which causes a significant change of the section moment.

A.2 Apparatus

A.2.1 Testing apparatus (Figure A.1), having the following essential components:

a) Two parallel, cylindrical, roller-bearing supports of length exceeding the width of the test specimen and of (15 ± 0,5) mm diameter. The distance between the supports shall be adjustable.

b) Cylindrical loading head, of the same length than the supports and of (30 ± 0,5) mm in diameter, placed parallel to the supports and equidistant from them.

c) Suitable instrument capable of measuring the deflection of the test specimen at midspan with an accuracy of 0,1 mm.

d) Suitable load measurement system capable of measuring the load applied to the test specimen with an accuracy of 1 % of the measured value.

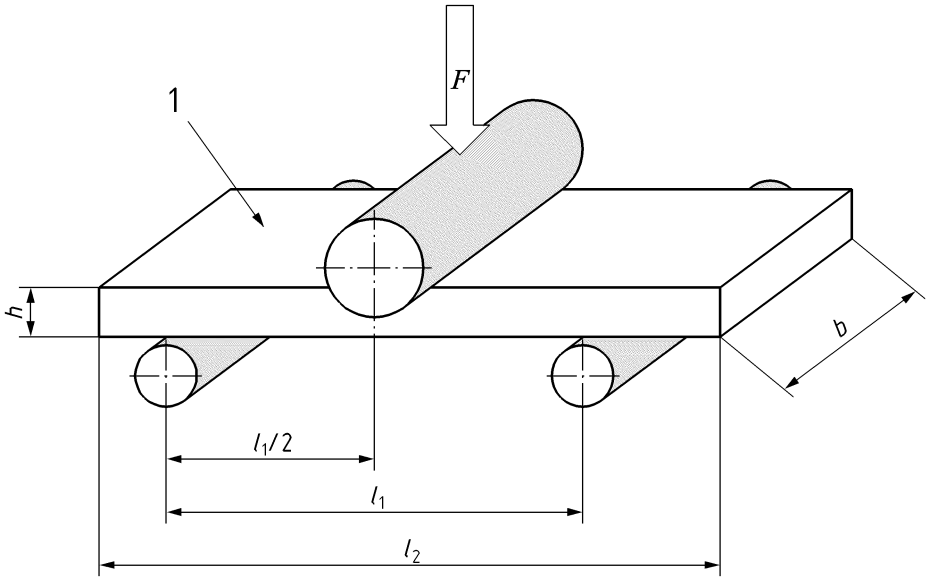
e) Air oven, thermostatically controlled such that it operates at the temperature as specified in A.4. The air oven shall be equipped with a thermostat capable of maintaining the specified temperature to a permissible deviation of ± 2 °C.

f) Cold room, thermostatically controlled such that it operates at the temperature as specified in A.4. The freezer shall be equipped with a thermostat capable of maintaining the specified temperature to a permissible deviation of ± 2 °C.

A.2.2 Measuring instruments

a) Micrometer with circular anvils of a diameter (16 ± 1) mm, capable to exert a force at the measurement faces of (4 ± 1) N, allowing a reading within 0,01 mm.

b) Vernier calliper with jaw width of at least 5 mm, graduated to allow a reading within 0,1 mm.



Key

1 test specimen
F load
h thickness of test specimen
b width of the test specimen
l_1 span
l_2 length of the test specimen

Figure A.1 — Position of the test specimen at start of the test

The contact of the test specimen with the supports and the cylindrical loading head shall be continuous. If necessary, appropriate spacers may be set between the test specimen and the roller-bearing supports and the cylindrical loading head. Additional details shall be given in the reference standard, where relevant.

A.3 Test specimens

The test specimens shall be cut rectangular to the longitudinal direction of the profiles. The cross section of the test specimens shall be the full cross section of the profiles from which they are cut.

For the test under standard conditions (A.5.2), the length of the test specimen l_2 shall be 20 times the nominal thickness *h* plus 100 mm.

For the test under conditions defined by the manufacturer (A.5.3), the length of the test specimen l_2 shall be the span defined by the manufacturer plus 100 mm.

The span defined by the manufacturer is equal to the distance between the axes of the supports.

The number of test specimens shall be as specified in the reference standard.

A.4 Atmosphere for conditioning and testing

The test specimens shall be conditioned according to Clause 5.

The test specimens shall be tested in the standard atmosphere 23/50, unless otherwise agreed upon the interested parties.

Optionally, the test specimens may be tested in one of the following atmospheres:

a) T_1 = −20 °C ± 2 °C, 50 % RH (cold climate).

Before testing at T_1, the specimens shall remain in the cold room) at T_1 for at least 2 h. The test shall be performed in the cold room or started within 1 min of being removed from the cold room.

b) T_2 = 50 °C ± 2 °C, 50 % RH (warm climate).

Before testing at T_2, the specimens shall remain in the air oven at T_2 for at least 2 h. The test shall be performed in the air oven) or started within 1 min of being removed from the air oven.

A.5 Procedure

A.5.1 Measure the thickness *h* of each test specimen at the mid-length.

For test specimens made from solid profiles with rectangular cross section, measure the width *b* of each test specimen at the mid-length.

A.5.2 For the test under standard conditions:

a) Adjust the distance between the centres of the supports (span) l_1, within 1 mm, to 20 times the thickness *h* of the test specimen. The distance shall be not less than 100 mm.

b) Measure the distance between the centres of the supports to the nearest 0,5 mm.

c) Place the test specimen flat on the supports, with its longitudinal axis at right angles to those of the supports with the centre point under the load (Figure A.1).

d) Apply the load at a constant rate of cross-head movement throughout the test.

The specimens shall be loaded at a constant strain rate of (1 ± 0,1) % per minute. Average time to failure for each test configuration shall be recorded. A constant rate of 1 % per minute is achieved by using a constant rate of the test cross head speed *v*, in millimetres per minute, given by Formula (A.1):

$$v = 0{,}00185 \times \frac{l_1^2}{h} = 0{,}00185 \times \frac{(20 \times h)^2}{h} = 0{,}74 \times h \qquad \text{(A.1)}$$

where

l_1 is the span, expressed in millimetres;

h is the thickness of the test specimen, expressed in millimetres.

e) Measure the deflection of the test specimen at midspan (below the loading head) to an accuracy of 0,1 mm and plot this value against the corresponding loads measured to an accuracy of 1 % of the measured value. If deflection is determined by incremental readings, at least six pairs of readings shall be used.

f) Record the maximum load F_{max} to an accuracy of 1 % of the measured value.

g) Test five test specimens with the exposable side upwards. If the profile may be used on both sides, the two sides of the test specimens shall be tested.

A.5.3 For the test under conditions defined by the manufacturer:

a) Adjust the distance between the centres of the supports (span) l_1, within 1 mm, to the span defined by the manufacturer.

Measure the distance between the centres of the supports to the nearest 0,5 mm.

If the deflection of the test specimen is such that the rupture does not occur, the span shall be reduced.

b) Place the test specimen flat on the supports, with its longitudinal axis at right angles to those of the supports with the centre point under the load (Figure A.1).

c) Apply a preload of 50 N. Then, apply a load, until the rupture, at a constant rate of cross-head movement throughout the test.

d) Measure the deflection of the test specimen at midspan (below the loading head) to an accuracy of 0,1 mm and plot this value against the corresponding loads measured to an accuracy of 1 % of the measured value. If deflection is determined by incremental readings, at least six pairs of readings shall be used.

e) Record the maximum load F'_{max} to an accuracy of 1 % of the measured value.

f) Test five test specimens with the exposable side upwards. If the profile may be used on both sides, the two sides of the test specimens shall be tested.

A.6 Expression of results

A.6.1 Modulus of elasticity in bending

A.6.1.1 Solid profiles with rectangular cross section

Calculate the modulus of elasticity in bending, E_m, in megapascals, for each test specimen, using Formula (A.2):

$$E_m = \frac{l_1^3 \cdot (F_2 - F_1)}{4 \cdot b \cdot h^3 \cdot (a_2 - a_1)} \quad \text{(A.2)}$$

where

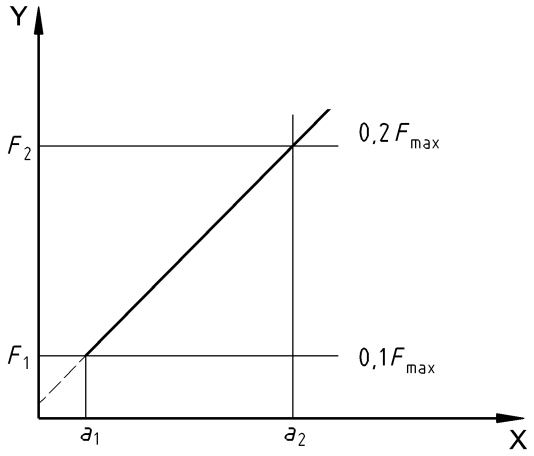
l_1 is the span, in millimetres;

$F_2 - F_1$ is the increment of load, in newtons, on the straight line portion of the load-deflection curve obtained in A.5.2 (Figure A.2). F_1 shall be approximately 10 % and F_2 shall be approximately 20 % of the maximum load F_{max};

b is the width, in millimetres, of the test specimen;

h is the thickness, in millimetres, of the test specimen;

$a_2 - a_1$ is the increment of deflection, in millimetres, at the mid-length of the test specimen (corresponding to $F_2 - F_1$).



Key

X deflection

Y load

Figure A.2 — Load-deflection curve within the range of elastic deformation

The modulus of elasticity in bending E_m for each test specimen shall be expressed to three significant figures.

Calculate the arithmetic mean of the test results, expressed to three significant figures.

A.6.1.2 Other shape of profiles

Calculate the modulus of elasticity in bending, E_m, in megapascals, for each test specimen, using Formula (A.3):

$$E_m = \frac{l_1^3 \cdot (F_2 - F_1)}{48 \cdot J_x \cdot (a_2 - a_1)} \quad \text{(A.3)}$$

where:

l_1 is the span, in millimetres;

$F_2 - F_1$ is the increment of load, in newtons, on the straight line portion of the load-deflection curve obtained in A.5.2 (Figure A.2). F_1 shall be approximately 10 % and F_2 shall be approximately 20 % of the maximum load F_{max};

J_x is the second moment of area, in mm^4, as specified by the manufacturer;

$a_2 - a_1$ is the increment of deflection, in millimetres, at the mid-length of the test specimen (corresponding to $F_2 - F_1$).

The modulus of elasticity in bending E_m for each test specimen shall be expressed to three significant figures.

Calculate the arithmetic mean of the test results, expressed to three significant figures.

A.6.2 Bending strength

A.6.2.1 Solid profiles with rectangular cross section

Calculate the bending strength σ_m, in megapascals, of each test specimen, using Formula (A.4.1) or (A.4.2), as relevant:

$$\sigma_m = \frac{3 \cdot F_{max} \cdot l_1}{2 \cdot b \cdot h^2} \quad \text{(A.4.1)}$$

$$\sigma_m = \frac{3 \cdot F'_{max} \cdot l_1}{2 \cdot b \cdot h^2} \quad \text{(A.4.2)}$$

where

F_{max} is the maximum load, in newtons, obtained in A.5.2;

F'_{max} is the maximum load, in newtons, obtained in A.5.3;

l_1 is the span, in millimetres;

b is the width, in millimetres, of the test specimen;

h is the thickness, in millimetres, of the test specimen.

The bending strength σ_m for each test specimen shall be expressed to two significant figures.

Calculate the arithmetic mean of the test results, expressed to two significant figures.

A.6.2.2 Other shape profiles

Calculate the bending strength σ_m, in megapascals, of each test specimen, using Formula (A.5.1) or (A.5.2), as relevant:

$$\sigma_m = \frac{M_B}{W_x} = \frac{F_{max} \cdot l_1}{4 \cdot W_x} \quad \text{(A.5.1)}$$

$$\sigma_m = \frac{M'_B}{W_x} = \frac{F'_{max} \cdot l_1}{4 \cdot W_x} \quad \text{(A.5.2)}$$

where

M_B is the bending moment, in newtons millimetres, at the maximum load F_{max}, obtained in A.5.2;

F_{max} is the maximum load, in newtons, obtained in A.5.2;

M'_B is the bending moment, in newtons millimetres, at the maximum load F'_{max}, obtained in A.5.3;

F'_{max} is the maximum load, in newtons, obtained in A.5.3;

l_1 is the span, in millimetres;

W_x is the section moment, as specified by the manufacturer.

For profiles with a symmetrical cross section, calculate W_x using Formula (A.6):

$$W_x = \frac{J_x}{\frac{h}{2}} \tag{A.6}$$

where

J_x is the moment of inertia, in mm^4, as specified by the manufacturer;

h is the thickness, in millimetres, of the test specimen.

This formula is not applicable for hollow profiles with unsymmetrical cross section. W_x is depending on the distance from the centre of the area. It may be determined according the parallel-axis theorem, e.g. with appropriate software.

The bending strength σ_m for each test specimen shall be expressed to two significant figures.

Calculate the arithmetic mean of the test results, expressed to two significant figures.

A.7 Test report

The test report shall include the following information:

a) reference to this part of EN 15534;

b) all the information necessary for identification of the profile tested, including type (solid or hollow profile), source, manufacturer's code number, form and previous history where these are known;

c) dimensions of the test specimens used for the determination of the modulus of elasticity in bending;

d) dimensions of the test specimens used for the determination of the bending strength;

e) span used for the determination of the modulus of elasticity in bending;

f) span used for the determination of the bending strength;

g) method of preparing the specimens;

h) conditioning and test conditions;

i) moisture content of the test specimens;

j) number of specimens tested;

k) test speed;

l) accuracy grading of the test machine;

m) values and arithmetic means values deflection at the mid-length of the test specimens;

n) moment of inertia and section moment of the profile, if applicable;

o) individual values and arithmetic means values for the modulus of elasticity in bending;

p) individual values and arithmetic means values for the maximum load and the bending strength;

q) mean values for the modulus of elasticity in bending and the bending strength.

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