

SKH-BoA-005  
Date: 7 May 2014



## Basis of Assessment (BoA)-005



## Semi-manufactured BAMBOO for EXTERIOR and INTERIOR APPLICATIONS



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Basis of Assessment BoA-005

For SEMI-MANUFACTURED BAMBOO for EXTERIOR and INTERIOR APPLICATIONS

version 2 dd. 7 May 2014

supersedes version 1 dd. 24 February 2014

Publisher:

Certification body SKH

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## **1. INTRODUCTION**

### **1.1 Subject**

The admission requirements for semi-manufactured bamboo in exterior and interior applications for an SKH Quality Declaration are described in this Basis of Assessment (BoA).

SKH lays down supplementary requirements in addition to the requirements specified in this BoA, as laid down in the product certification regulations of the SKH.

The test methods and/or assessment methods are explicitly stated or designated by a reference to an appendix, standard or other assigned document.

### **1.2 Area of application**

The Basis of Assessment describes the requirements applicable to the manufacture, control and performance of bamboo material. Semi-manufactured bamboo is covered by the SKH Quality Declaration.

The semi-manufactured product can have different compositions, with bamboo strips and/or bamboo strands as one of the (main) components. The performance requirements laid down in this BoA relate to the performance as a raw material for various end products in exterior and interior applications (different use classes in accordance with EN 335).

When the semi-manufactured bamboo meets (part of) the performance requirements laid down in this BoA for use in end products, the manufacturer of the end product or final product produced from the semi-manufactured bamboo must demonstrate that the end product or final product meets the requirements laid down in the standards and/or assessment directives (AD) concerned.

Bamboo is used as a raw material in various types of semi-manufactured products. Two main groups can be distinguished: 'laminated bamboo' and 'composite bamboo'. Combinations of both are also possible. Also sheet materials composed predominantly of bamboo may be included in this BoA. This includes products similar to OSB, MDF, chipboards, plywood, strand-woven mat boards, etc.

This BoA only covers materials in which bamboo was clearly processed. The bamboo stem itself, as hollow stem/pole, is not covered by the BoA.

In the interest of readability, this BoA uses the word bamboo, which means a composite semi-manufactured product with bamboo as the raw material.

## **2. TERMS AND DEFINITIONS**

**Bamboo strip:** element of bamboo cut from a bamboo stem, of which the outer layer (green part) and the inner layer (hollow part) have been removed.

**Laminated bamboo:** laminated element, composed of bamboo strips, with rectangular shape and flat sides.

**Bamboo strand:** element made of a bamboo strip roughened in longitudinal direction.

**Composite bamboo: strand-woven bamboo or compressed bamboo:** element of bamboo strands that are pressed/compressed under pressure and glued to a beam or panel.

**Bamboo veneer:** thin bamboo sheet with a thickness of 2.5 mm or less.

**Bamboo Plywood:** panel consisting of an assembly of layers glued together with the direction of the grain in adjacent layers usually at right angles. Or panels consisting of bamboo veneers in combination with a wood based core.

**Woven bamboo mat:** mat obtained by weaving thin bamboo strips.

**Semi-manufactured product, semi-finished products:** products of which another product is manufactured after further processing.

**Bamboo weave board.** Panels consisting of a core of thin bamboo strips usually not glued together and with the grain in adjacent layers usually at right angles. The top layers of the panel consist of a layer composed of a mat of woven thin strips of bamboo

## **3. PROCEDURE FOR OBTAINING ADMISSION**

### **3.1 Start**

The applicant of the quality declaration states whether he delivers bamboo material in accordance with the specifications stated in chapters 4 and 5. The applicant will deliver the information necessary for drawing up the quality declaration, including:

- The composition of the bamboo product.
- Description of the production process, the type of product.
- The area of application for which the material is considered suitable.
- He indicates which statements are to be included in the quality declaration and delivers the evidence for these statements.

### **3.2 Admission inspection**

SKH assesses whether the statements to be included in the quality declaration comply with the provisions of chapters 4 and 5. A written report of the initial inspection is prepared, on the basis of which the quality declaration will be granted, with or without certain requirements.

### **3.3 Assessment of the quality system of the applicant**

SKH investigates whether the applicant's quality system is consistent with chapter 8.

### **3.4 Issue of the admission**

The SKH quality declaration will be issued in accordance with the product certification regulations of SKH when the initial inspection specified in chapter 8.3 and the assessment of the quality system of the applicant specified in chapter 9 have been successfully concluded.

### **3.5 External quality control**

Once the SKH quality declaration has been issued, the inspections as described in chapters 9.4 and 11 are conducted by SKH.

## 4. GENERAL PRODUCT REQUIREMENTS

This chapter describes the general requirements that all bamboo products must meet or for which information needs to be provided.

### 4.1 Characterisation of the material

The following characteristics must have been determined.

- The origin (country and regional growth area if possible);
- The trade name of the material;
- The method of composition of the bamboo.

### 4.2 Performance requirements: Density

The variation in density should be limited to the average density +/- 10% .

Determination method

The density is determined in accordance with ISO 3131 or equivalent at an equilibrium moisture content corresponding to 65% ( $\pm 5\%$ ) RH, at a temperature of 20 °C.

Admission inspection

It will be checked whether the density of the material complies with the performance requirements.

Quality declaration

The quality declaration states the density of the materials used.

### 4.3 Performance requirements: Moisture content

The equilibrium moisture content of the bamboo material may have a maximum variation of +/- 2% relative to the equilibrium moisture content specified in the certificate and depending on the application. The climate conditions corresponding to the different applications are included in the Table below. When applying the bamboo, the moisture content must be equal to the specified equilibrium moisture content +/-2%

**Table 1. Climate conditions corresponding to the different applications.**

|               | Climate (at 20°C) used for determining the equilibrium moisture content |                                      |
|---------------|---|--------------------------------------|
|               | Interior  | Exterior<br>(incl. covered exterior) |
| Window frames | 50%   | 65%                                  |
| Doors         | 50%   | 65%                                  |
| Cladding      | 50%   | 80%                                  |
| Glazing beads | 50%   | 65%                                  |



Determination method

The moisture content is determined by means of the drying oven method in accordance with EN 13183-1 or with a wood moisture meter based on electrical resistance reading using a calibration curve for the bamboo product.

Remark: In case of composite bamboo, a longer drying time should be taken into account when using the drying oven method due to the slow release of moisture from the material.

Initial inspection

It will be verified whether the equilibrium moisture content complies with the performance requirements.

Quality declaration

The quality declaration states the moisture content of the materials used and the conditions under which this was determined.

#### **4.4 Performance requirements: Formaldehyde – emission**

The formaldehyde content must comply with class E1 in accordance with Appendix C of EN 14915, Appendix B of EN 13986 or Appendix A of EN 14342 (2008).

Determination method

The formaldehyde emission is determined by means of the small chamber method in accordance with EN 717-2.

Admission inspection

It will be verified whether the stated formaldehyde emission class, determined in accordance with EN 717-2, is correct.

Quality declaration

The declaration states the formaldehyde emission class.

#### **4.5 Performance requirements: Pentachlorophenol (if applicable)**

When the bamboo used is treated with pentachlorophenol (PCP), the PCP concentration in the semi-manufactured bamboo product should be below 5 ppm (5.0 mg/kg). If the semi manufactured bamboo contains raw materials that contain PCP, the semi manufactured bamboo should be tested.

Determination method

The amount of PCP should be determined in accordance with CEN\TR 14823.

Admission inspection

If it is suspected that the bamboo has been treated with PCP it should be tested whether the pentachlorophenol content meets the requirements.

Quality declaration

If the bamboo has been treated with PCP, the pentachlorophenol content will be stated in the quality declaration.

## 5. PRODUCT REQUIREMENTS PER USE CLASS AND MATERIAL

Tables 2 and 3 state the requirements for the different types of semi-manufactured products for non-load-bearing applications. Table 2 contains the requirements that apply to composite bamboo, table 3 those of laminated bamboo and table 4 of bamboo sheet materials other than laminated bamboo.

Depending on the use class (EN 335), it must be examined whether the bamboo material meets the performance requirements as shown in table 2, 3, or 4. The method of determination is indicated in the second column in tables 2 and 3. For Use Class 5, at least the requirements of Use Class 4 must be met. Depending on the application, additional requirements may be set.

Although bamboo cannot be used as raw material for 'wood based panels', and therefore cannot be called OSB, 'plywood', etc., these names are still used in table 4. The properties of the bamboo panels or board material are determined in the same manner as that of its 'wooden' counterpart.

Compliance with the requirements must be demonstrated by an independent laboratory. The quality declaration states the different performance requirements. Requirements that may be optional can be included in the quality declaration if they are tested.

**Table 2: Minimum performance requirements of composite bamboo**

| Property                 | Chapter | N / O** | Unit  | Performance requirements/property to be determined* |                                      |                   |                            |
|--------------------------|---------|---------|---|---|--------------------------------------|-------------------|----------------------------|
|                          |         |         |   | UC 1,<br>dry interior                               | UC 2,<br>humid int.,<br>covered ext. | UC 3,<br>Exterior | UC 4,<br>ground<br>contact |
| Bonding quality          | 5.1     | N       | [N/mm <sup>2</sup> ]                          | > 3   | > 3                                  | > 3               | > 3                        |
| Swelling                 | 5.2     | N       | [%]   | -   | ≤ 15%                                | ≤ 7.5%            | ≤ 7.5%                     |
| Strength<br>Beam         | 5.5     | N       | [N/mm <sup>2</sup> ]<br>[kN/mm <sup>2</sup> ] | ≥ 40<br>≥ 8   | ≥ 40<br>≥ 8                          | ≥ 40<br>≥ 8       | ≥ 40<br>≥ 8                |
| Strength<br>panel        | 5.4     | N       | [N/mm <sup>2</sup> ]<br>[kN/mm <sup>2</sup> ] | ≥ 30<br>≥ 5   | ≥ 30<br>≥ 5                          | ≥ 30<br>≥ 5       | ≥ 30<br>≥ 5                |
| Biological<br>Durability | 5.6     | N       | class   | -   | 1, 2, 3 or 4                         | 1 or 2            | 1                          |
|                          | 5.7     | N       | class   | -   | -                                    | -                 | 1                          |
|                          | 5.8     | O       | class   | -   | 0 or 2                               | 0 or 1            | -                          |
| Constructive<br>strength | 5.10    | O       |   | X   | X                                    | X                 | X                          |
| Paintability             | 5.9     | O       |   | X   | X                                    | X                 | -                          |

\*) X = property to be determined;

\*\*) N = Normative, O = Optional

Table 3: Minimum performance requirements of laminated bamboo

| Property                 | Chapter | N / O** | Unit  | Performance requirements/property to be determined* |                                      |                   |                            |
|--------------------------|---------|---------|---|---|--------------------------------------|-------------------|----------------------------|
|                          |         |         |   | UC 1,<br>dry interior                               | UC 2,<br>humid int.,<br>covered ext. | UC 3,<br>Exterior | UC 4,<br>ground<br>contact |
| Bonding quality          | 5.3     | N       | [N/mm <sup>2</sup> ]                          | Tables 6 and<br>7                                   | Tables 6 and<br>7                    | Tables 6 and<br>7 | Tables 6 and<br>7          |
| Strength<br>Beam         | 5.5     | N       | [N/mm <sup>2</sup> ]<br>[kN/mm <sup>2</sup> ] | ≥ 40<br>≥ 8   | ≥ 40<br>≥ 8                          | ≥ 40<br>≥ 8       | ≥ 40<br>≥ 8                |
| Strength<br>panel        | 5.4     | N       | [N/mm <sup>2</sup> ]<br>[kN/mm <sup>2</sup> ] | ≥ 25<br>≥ 4   | ≥ 25<br>≥ 4                          | ≥ 25<br>≥ 4       | ≥ 25<br>≥ 4                |
| Biological<br>Durability | 5.6     | N       | class   | -   | 1, 2, 3 or 4                         | 1 or 2            | 1                          |
|                          | 5.7     | N       | class   | -   | -                                    | -                 | 1                          |
|                          | 5.8     | O       | class   | -   | 0 or 2                               | 0 or 1            | -                          |
| Constructive<br>strength | 5.10    | O       |   | X   | X                                    | X                 | X                          |
| Paintability             | 5.9     | O       |   | X   | X                                    | X                 | -                          |

\*) X = property to be determined;

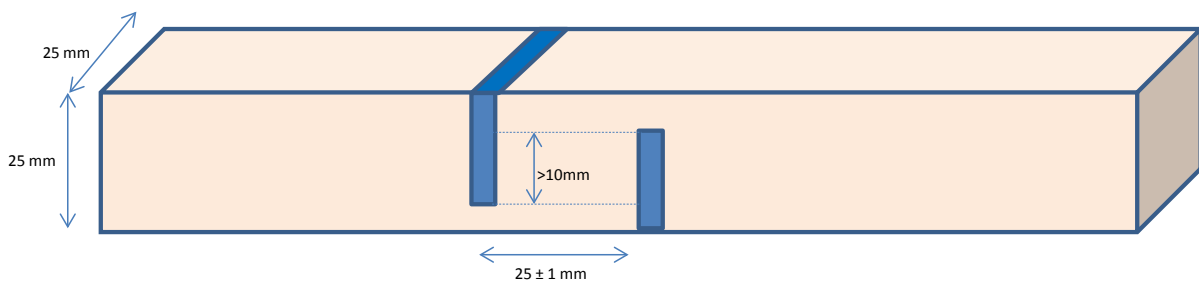
\*\*) N = Normative, O = Optional

Table 4: Properties to be determined of bamboo sheet material other than laminated bamboo

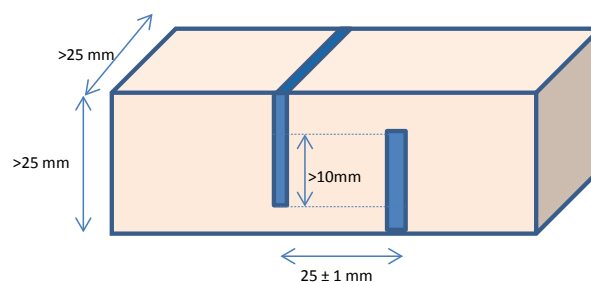
| Type of product | Requirements analogous to | Properties to be determined, if applicable.   |                    |
|-----------------|---------------------------|---|--------------------|
|                 |                           | Requirements depend on the intended use class |                    |
|                 |                           | Description                                   | Standard           |
| MDF             | EN 622                    | Mechanical properties                         | EN 310             |
|                 |                           | Swelling                                      | EN 317             |
|                 |                           | Internal bond                                 | EN 319             |
|                 |                           | Internal bond after boiling test              | EN 1087-1 + EN 319 |
|                 |                           | Internal bond after cyclic test               | EN 321 + EN 310    |
|                 |                           | Swelling after cyclic test                    | EN 321 + EN 317    |
| Chipboard       | EN 312                    | Mechanical properties                         | EN 310             |
|                 |                           | Swelling                                      | EN 317             |
|                 |                           | Internal bond                                 | EN 319             |
|                 |                           | Internal bond after boiling test              | EN 1087-1 + EN 319 |
|                 |                           | Internal bond after cyclic test               | EN 321 + EN 310    |
|                 |                           | Swelling after cyclic test                    | EN 321 + EN 317    |
| OSB             | EN 300                    | Mechanical properties                         | EN 310             |
|                 |                           | Swelling                                      | EN 317             |
|                 |                           | Internal bond                                 | EN 319             |
|                 |                           | Internal bond after boiling test              | EN 1087-1 + EN 319 |
|                 |                           | Internal bond after cyclic test               | EN 321 + EN 310    |
|                 |                           | Bending strength after cyclic test            | EN 321 + EN 310    |
| Plywood         | EN 636                    | Bonding quality                               | EN 314-2           |
| Woven sheet     | EN 636                    | Bonding quality                               | EN 314-2           |

### 5.1 Explanation on the determination method for the quality of glued joints of composite bamboo

The bonding quality of composite bamboo is determined as shear strength after a pre-treatment suitable for the area of application. The shear strength is determined analogously to the method as defined in EN 314. This means that a test piece of 25 x 25 mm in size is sawn as shown in figures 1 or 2. The overlap between the saw cuts should be at least 10 mm, and the distance between the saw cuts 25 ± 1 mm. The dimensions of the test pieces, the width and the distance between the saw cuts, will be determined after conditioning at 65% RH, at 20 °C for at least 72 hours. After the pre-treatment as described in Table 4, the shear strength under tension is determined on the wet test pieces. Sampling takes place in accordance with section 5.2 (swelling). In accordance with the swelling, the shear strength can be dependent on the orientation in the beam, the direction of pressing or perpendicular thereto. The bonding quality must be determined in both directions. The average shear strength of the bonding quality in the direction of pressing is determined independently from the shear strength perpendicular to the direction of pressing. Both average values of the shear strength must meet the requirements of table 2.



**Figure 1: Schematic representation of the determination of the shear strength under tension in composite bamboo**



**Figure 2: Schematic representation of the determination of the shear strength under pressure in composite bamboo**

For production control, it is possible to test the test pieces under pressure rather than under tension, as described above. To this end, the dimensions of the test pieces should be adjusted. The length of the test pieces is shorter, (no more than 3 times the width of the test piece) in order to prevent 'buckling' of the test pieces. The width and thickness can be adjusted. The distance between the saw cuts is maintained at 25 mm, and the overlap of the cuts continues to be > 10 mm. It is important to ensure that the crosscut sides of the test piece are absolutely parallel.

Table 5: Pre-treatment of test pieces for the determination of the swelling of the composite bamboo, and the quality of the glued joints of composite bamboo and laminated bamboo.

| Use class          | Pre-treatment procedure  |  |
|--------------------|--|--|
|                    | Pre-treatment  | Cooling off before the test                        |
| UC1 Interior       | Immersion in water at 20 ±3 °C for 24 hours  |  |
| UC2 Humid interior | Immersion in boiling in water for 6 hours  | Immersion in water at 20 ±3 °C for at least 1 hour |
| UC3 Exterior       | Immersion in boiling in water for 4 hours,<br>16 – 20 hours drying in an oven at 60 ± 3 °C,<br>Immersion in boiling in water for 4 hours | Immersion in water at 20 ±3 °C for at least 1 hour |
| UC4 Ground contact |  |  |
| UC5 Sea water      |  |  |

## 5.2 Explanation on the determination method for the swelling of composite bamboo

The swelling of panels and board material is determined in accordance with EN 317 after a pre-treatment as specified in Table 4. The dimensions of the test pieces must be 50 x 50 mm x the thickness of the sheet. After conditioning at 65% RH, 20 °C for at least 72 hours, the thickness of the test piece is determined at the centre of the surface. After the pre-treatment as described in Table 4, the thickness is determined once more and the swelling is calculated using the formulas below.

For determination of the swelling of beams, test pieces are cut of 25 x 25 mm in width and thickness. The length depends on the dimensions used for testing the bonding quality, as both properties, swelling and bonding quality, can be determined using the same test pieces.

After conditioning at 65% RH, 20 °C for at least 72 hours, the thickness and width of the test pieces are determined. Indicate the location of the measurement. After the pre-treatment as described in table 4, the dimensions are determined once more and the swelling is calculated using these formulas:

$$S_{swel,t} = \frac{d_{t1} - d_{t0}}{d_{t0}} \quad \text{and} \quad S_{swel,w} = \frac{d_{w1} - d_{w0}}{d_{w0}}$$

In which

$S_{swel,t}$ : thickness swelling of the bamboo. This value is expressed as a percentage.

$S_{swel,w}$ : width swelling of the bamboo. This value is expressed as a percentage.

$d_{t1}$ : thickness of the bamboo after the pre-treatment.

$d_{t0}$ : thickness of the bamboo after conditioning, prior to the test

$d_{w1}$ : width of the bamboo after the pre-treatment.

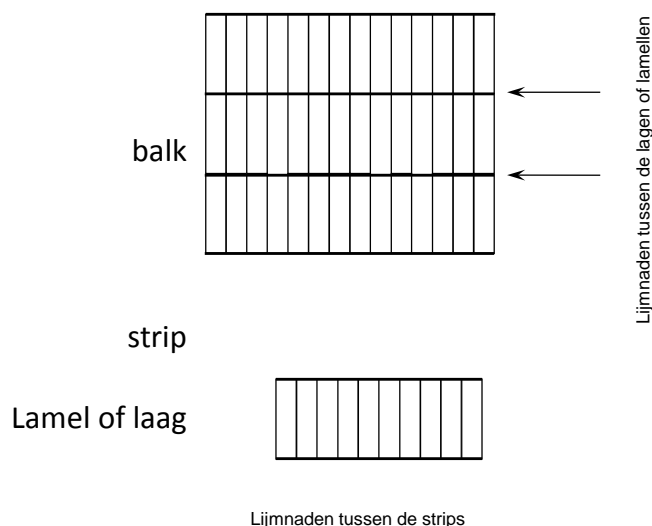
$d_{w0}$ : width of the bamboo after conditioning, prior to the test

The maximum swelling, either in width or in thickness, must comply with the requirement specified in Table 1.

For both panels or board material and beams that at least 15 test pieces from at least 3 different production batches must be tested.

### 5.3 Explanation on the determination method for the bonding quality of laminated bamboo:

Laminated bamboo is characterised by glue lines between the individual strips, and, if several layers composed of strips are glued together, by glue lines between these layers. (see Figure 2)



**Figure 2: Schematic representation of the glued joints between the strips and between the layers**

The bonding quality of the glue lines between the lamellae is demonstrated in accordance with EN 13354 or EN 14279 if this is necessary due to the dimensions of the material to be tested. In both cases, the shear strength is determined under pressure after a pre-treatment suitable for the application (see table 5). The requirements the glue lines must meet are in accordance with EN 13354 and are included in table 6. Per glue line 10 test pieces will be tested.

The bonding quality of the glue lines between the strips in the lamellae is tested in accordance with EN 14279, whereby the lamellae are cut from each other. The requirements of the pre-treatment are defined in EN 314-1 and are listed in table 5. The requirements the shear strength of glue lines must meet are in accordance with EN 314-2 and are included in table 7. At least 30 test pieces from at least 5 lamellae must be tested.

If the quality of the glued joint has been demonstrated for one type of sheet or beam, it also applies to sheets or beams with fewer layers/lamellae as long as the type of glue and gluing process conditions are the same.

**Table 6: Quality requirements for the glue lines between the lamellae in laminated bamboo**

| Average shear strength $f_v$<br>[N/mm <sup>2</sup> ] | Mean apparent wood failure $\omega$<br>[%] |
|--|--|
| $0.4 \leq f_v < 0.8$                                 | $\omega \geq 40\%$                         |
| $0.8 \leq f_v < 1.2$                                 | $\omega \geq 20\%$                         |
| $1.2 \leq f_v$                                       | No requirements                            |

**Table 7: Quality requirements applicable to the glue lines of the bamboo strips in the lamellae in laminated bamboo:**

| Average shear strength $f_v$<br>[N/mm <sup>2</sup> ] | Mean apparent wood<br>failure $\omega$<br>[%] |
|--|---|
| $0.2 \leq f_v < 0.4$                                 | $\omega \geq 80\%$                            |
| $0.4 \leq f_v < 0.6$                                 | $\omega \geq 60\%$                            |
| $0.6 \leq f_v < 1.0$                                 | $\omega \geq 40\%$                            |
| $1.0 \leq f_v$                                       | No requirements                               |

#### **5.4 Explanation on the determination of the strength of composite or laminated bamboo supplied as panels.**

The bending strength and stiffness of panels and board materials, composite or laminated bamboo, is tested once in a three-point bending test in accordance with EN 310 to demonstrate that the material represents a minimum strength at the corresponding density.

For non-structural panels, the strength of the panel is determined from a minimum of 15 test pieces in the longitudinal direction of the top veneers or top layers, and 15 test pieces perpendicular to the grain of the top veneers or top layers. The test pieces must be taken from at least 3 sheets. The average value must comply with the minimal values specified in tables 2 and 3.

For panels for structural applications, the Type Determination (Initial Type Testing, ITT) follows the instructions in EN 326-2.

#### **5.5 Explanation on the determination of the strength of beams for non-load-bearing applications**

For the strength of beams, either composite or laminated, the instructions of EN 408 must be followed. For beams used for non-structural applications, at least 15 test pieces are tested once in a four-point bending test in accordance with the alternative method (chapter 6) of EN 384 to demonstrate that the material represents a minimum strength at the corresponding density.

The test pieces must be taken from at least 3 beams. The test pieces must have a cross-sectional dimension of at least 40 x 40 mm. The average value must at least comply with the values specified in tables 2 and 3. For beams used for structural applications, see chapter 5.10 of this AD.

#### **5.6 Explanation on the determination method of the durability**

The application of bamboo in UC2 to UC5 is subject to durability requirements. These requirements are stated at the different applications. The durability is the resistance to fungal attack the material possesses after production; however, the durability can also be increased by applying a suitable preservative. In this case, proper treatment of the bamboo must be demonstrated.

##### **Determination method**

The durability shall be determined in accordance with EN 350-1 and test method EN 113 with the following modification. Prior to the implementation of EN 113, a leaching test is carried out in accordance with EN 84. In deviation from and supplementary to EN 350-1, the following fungi are prescribed: *Coniophora puteana*, *Gloeophyllum trabeum* and *Coriolus versicolor*. The fungi *Poria*

*placenta* and *Donkoioporia expansa* can be included optionally. Since bamboo is not a wood species, Beech is used as a reference for the white-rot fungi *Coriolus* and *Donkioporia* and Pine sapwood as a reference for the brown-rot fungi *Coniophora*, *Gloeophyllum* and *Poria*.

For the determination on the durability, beams, planks or panels are used that come from at least 3 production batches or deliveries. If it concerns composite bamboo, 45 beams or planks are tested, for laminated bamboo material, 30 beams or planks are tested with 45 or 30 test pieces respectively (one of each beam) for each fungus.

Classification is based on the results of the species of fungus causing the greatest mass loss of the test specimens.

## **5.7 Explanation on the determination of the durability for ground contact**

For products intended for ground contact (use Class 4), the durability of the material is not only determined in accordance with EN 113 as described in chapter 5.6, but also with a field test in accordance with EN 252.

The approval of bamboo products intended for ground contact requires long-term ground contact data, determined in accordance with EN 252 on 1 or preferably more, test sites. If no long-term test results (more than 5 years) are available, a provisional approval may be granted based on the results of ENV 807. A provisional approval can only be granted if the field tests have actually been deployed and intermediate results have been reported.

The field test in accordance with EN 252 must be performed on at least 15 test pieces/stakes or 10 test pieces/stakes per trial field, from 3 different deliveries. Untreated pine sapwood and preserved pine stakes are included as a reference, as well as stakes of at least one type of wood, which is expected to fall within durability class 1 or 2.

### **5.7.1 Explanation on the determination of the durability for ground contact: laboratory test**

The laboratory test for degradation by soft rot fungi in accordance with ENV 807 is carried out using two harvest periods. The first 'harvest' is taken when the pine sapwood reference test pieces have reached a weight loss of > 20%, the second 'harvest' is taken after double the exposure time of the first 'harvest'. The duration of the test depends on the virulence of the ground in which the test pieces are placed. If the first sample is taken after 12 weeks, the second sample will be taken after 24 weeks. If the first sample is taken after 20 weeks, the second sample will be taken after 40 weeks.

The test is performed on at least 30 test pieces per 'harvest' from 30 beams from at least 3 deliveries. Paired test pieces must be used for the first and second 'harvest'. The results of the first sample are decisive for classification in a durability class, while the results of the second sample will be used for verification purposes. If 'erosion' causes a weight loss in the test pieces in the second 'harvest' is greater than expected based on the first sample, the material will be classified in a durability class on the basis of the results of the second 'harvest'.

## **5.8 Explanation on the determination of the susceptibility to surface mould fungi**

If it is the intention to use the semi-manufactured bamboo product unfinished in an exterior environment, it must be demonstrated that the susceptibility to surface mould fungi is limited. In the absence of test methods for testing the susceptibility of timber and wood-based products to surface moulds other than blue stain, EN-ISO 846 tests B and B' must be performed. In this test, a mixture of 5 surface moulds is used (table 8)



Evaluation takes place after 4 weeks of exposure based on a visual inspection with the naked eye and/or with a microscope with 40 - 50x magnification. There are 6 distinct classes (table 9).

**Table 8: Fungi for the testing of the susceptibility of bamboo to surface mould fungi**

| Code       | Name                           | Alternative name                               |
|------------|--------------------------------|--|
| ATCC 6275  | <i>Aspergillus niger</i>       |  |
| CMI 114933 | <i>Penicillium funiculosum</i> | (=CBS 631.66 <i>Penicillium pinophilum</i> )   |
| ATCC 18502 | <i>Paecilomyces variotii</i>   | (=CBS 284.48 <i>Paecilomyces divaricatus</i> ) |
| ATCC 9645  | <i>Gliocladium virens</i>      | (=CBS 430.54 <i>Trichoderma virens</i> )       |
| ATCC 6205  | <i>Chaetomium globosum</i>     |  |

**Table 9: Assessment classes surface mould fungi**

| Growth intensity | Description  |
|------------------|--|
| 0                | No growth apparent under the microscope                                      |
| 1                | No growth visible to the naked eye, but clearly visible under the microscope |
| 2                | Growth visible to the naked eye covering up to 25% of the test surface       |
| 3                | Growth visible to the naked eye covering up to 50% of the test surface       |
| 4                | Significant growth, covering more than 50% of the test surface               |
| 5                | Heavy growth, covering the entire test surface                               |

### 5.9 Explanation on the determination of the paintability (optional).

When the bamboo, either laminated or composite, is intended to be applied with a film-forming coating, it must be demonstrated that the bamboo can be coated. It is possible to prescribe a certain coating or to indicate a general coating.

The protocol for demonstrating the paintability is included in Appendix 2.

### 5.10 Explanation on the determination of the strength properties for load-bearing applications (optional)

The use of bamboo in load-bearing structures is subject to the provisions of the Euro code. These are the calculation rules for building structures. The Euro code is divided into several parts:

EN 1990 (including national annex); Euro code – Basis of structural design.

EN 1991 (including national annex); Euro code 1: Actions on structures.

EN 1995 (including national annex); Euro code 5: Design of timber structures

Classifying bamboo into strength classes based on wood, as defined in EN 338 for solid wood and EN 1194 for plywood, is not possible. It is, however, possible to calculate structures based on strength properties. The strength properties are determined in accordance with EN 408, based on 40 beams from at least 3 production batches or deliveries. The maximum cross-section of the beams is tested.

As long as the manufacturing process does not change these values may be used for a 5-year period provided it is demonstrated that the properties do not change. After three years, the bending strength must again be determined in accordance with EN 408. Testing the properties on a limited scale means that 1 beam from each delivery will be tested in accordance with the dimensions prescribed in EN 408, or that 5 test pieces with minimum dimensions of 40 x 40 mm x 1 m from each delivery will be tested in accordance with the alternative method (chapter 6) of EN 384. The resulting bending strength and modulus of elasticity must at least comply with the characteristic value of the originally tested batch.

## **6. PROCESSING INSTRUCTIONS**

Processing instructions should be included in the delivery of the semi-manufactured bamboo or these should be available (on the website of the supplier). It should at least include the following topics:

- Measures to be taken during transport and storage as well as measures to protect the bamboo during the processing and handling phases
- Area of application: it must be indicated for which Use Class, ranging from UC1 to UC5, the semi-manufactured bamboo is suitable
- Processing of the material: It must be possible to process the bamboo material. If the bamboo negatively affects the life of the cutting tool, or if different processing methods must be applied, this should be reported in the processing instructions.
- Fasteners, if these are subject to certain requirements
- Other points of interest for the correct processing and handling of the product that may result in a stable end product. Including coating

## **7. BAMBOO IN APPLICATIONS (informative)**

This Assessment Directive applies to semi-manufactured bamboo. In certain cases, additional regulations apply to the material in order to demonstrate that the bamboo material is suitable for end products, or of which it should be demonstrated that these products can be manufactured from the bamboo. It is specified in Table 7 which requirements and regulations the semi-manufactured bamboo must meet in order to be used for the corresponding application. This list is only indicative. For applications that are not listed here, SKH will decide what additional requirements are necessary. In some cases, reference is made to European standards, which are designed specifically for solid wood or composite wood products. Under this assessment directive, bamboo products may also be considered suitable for the application, provided that they comply with the requirements. For a number of applications, fire properties of the material must be known. Chapters 7.1 and 7.2 list the requirements that generally apply to bamboo.

### **7.1 Performance requirements: Behaviour in the event of fire (informative)**

The requirements applicable to bamboo with respect to fire (contribution to fire propagation, contribution to smoke development or fire resistance) depend on its use. The relevant requirements established by national laws must be followed.

### **7.2 Requirements for bamboo products (informative)**

It is specified in table 10 which requirements a bamboo product must meet in order to be approved. In a number of cases, the above-mentioned document applies to wood products, and not directly to bamboo. These standards and documents are still listed here since they provide insight into the properties that are important to the corresponding application or end use. For façade cladding and frame timber, the requirements to be met for the use of bamboo are worked out in appendices 3 and 4 respectively.

**Table 10: Bamboo in end use applications. Properties and documents containing requirements for relevant (wooden) products.**

| End use  | Use class UC | Documents  | Additional requirements  |
|--|--------------|------------|--|
| Façade cladding  | 3            |            | See Appendix 3   |
| Decks and deck parts                                   | 3            |            | See Appendix 5.  |
| Indoor floors<br>Non-load-bearing floors and parquet   | 1, 2         | EN 14342   | Flammability<br>Breaking strength of self-supporting floors EN 1533*<br>Slipperiness in accordance with CEN/TS 15676*<br>Thermal conductivity in accordance with EN 12664* |
|  |              | EN 1534    | Brinell hardness* minimum 10 N/mm <sup>2</sup>   |
| Sheet material for furniture and interior construction | 1, 2         |            | No additional requirements other than those contained in chapter 5   |
| Glued load-bearing timber structures                   | 1, 2, 3      | AD 1701-01 | Complete   |
| Interior frames and doors                              | 2            | AD 2211    | Complete   |
|  |              | AD 0819    | Complete   |
| Façade joinery<br>Doors, windows and frames            | 3            |            | See Appendix 4.  |
| Finger joints  | 1, 2, 3      | AD 1704-2  | Non-load-bearing structures, if applicable   |
| Laminating   | 1, 2, 3      | AD 2902    | Non-load-bearing applications, if applicable   |

\*) If this property is declared.

## **8. REQUIREMENTS REGARDING THE INSPECTION OF SEMI-MANUFACTURED BAMBOO**

### **8.1 General**

The holder of the SKH quality declaration must have an administrative system that allows for tracing the origin of the semi-manufactured bamboo. The organisation shall maintain complete and up-to-date records covering all applicable requirements of this assessment directive.

The organisation shall keep and retain records that demonstrate that the semi-manufactured bamboo produced and sold with an SKH quality declaration comply at all times with the incoming quantities.

It applies to the incoming and outgoing goods that the records show invoice references and that the amounts (m<sup>1</sup>, m<sup>2</sup>, m<sup>3</sup>, or, for example, based on weight) are registered, as long as they can be compared to each other. The information to identify types and quantities of products to the supplier should also be present. In other words, stock records or a delivery chain administration (CoC) should be kept.

The holder of the SKH quality declaration should ensure that the semi-manufactured bamboo product with a quality declaration is clearly identified and kept separate from semi-manufactured bamboo products without a quality declaration.

### **8.2 Registration**

All relevant information regarding the bamboo products (including moisture content, density, adhesive share and other additional information) shall, to the extent possible, be delivered in writing by the manufacturer and recorded by the holder of the quality declaration by means of a registration. This information must be available during inspections and sampling by SKH.

### **8.3 Admission inspection composite bamboo and laminated bamboo, (Type Testing, ITT)**

Sampling of the test pieces for the admission inspection is supervised by SKH in accordance with chapter 5 of this AD. The properties assigned in chapter 5 and any additional properties the importer would like to declare optionally for this material must be determined according to the instructions in chapter 5.

### **8.4 Admission inspection of board material other than composite bamboo and laminated bamboo, (Type Testing, ITT)**

Sampling of the test pieces for the admission inspection must be carried out in accordance with EN 326-2.

The properties assigned in chapter 5 and any additional properties the importer would like to declare optionally for this material must be determined.

To this end, one series of 20 pieces or 2 series of 13 pieces will be tested for the properties specified. For the declaration of the variable properties, 12 samples will be tested.

An exception is made for durability (resistance to biological attack). The number of samples that will be tested is specified in chapter 5.2 (in accordance with EN 326).

The samples must be taken from at least 3 deliveries. Sampling is carried out in consultation with SKH.

### **8.5 Uniformity of the production process, import inspection (IQC)**

The holder of the quality declaration must demonstrate that the uniformity of the production process remains constant. For the quality control required to ensure this uniformity, the following properties must be determined for each delivery by testing at least five panels, parts or beams per product per container.

Composite bamboo:

- Swelling after pre-treatment in accordance with EN 314: for use class 1, 2, 3 or 4;
- Moisture absorption;
- Bonding Quality ;
- Density;
- Moisture content (electrical resistance, capacitive or drying oven method);
- Dimensional tolerances in accordance with EN 315 for panels and EN 336 for beams.

Laminated bamboo:

- Bonding Quality
- Density;
- Moisture content (electrical resistance, capacitive or drying oven method);
- Dimensional tolerances in accordance with EN 315 for sheets and EN 336 for beams.

The average value should at least meet the requirement as set out in chapter 5, or as declared by the importer. The test pieces of each delivery must be stored for inspection by SKH.

For material intended for load-bearing applications, the characteristic value must meet the value declared by the importer. For beams, the characteristic value is determined in accordance with EN 384 based on the values obtained in accordance with EN 408. The characteristic value of board material or panels is determined in accordance with EN 326-2 based on the values obtained with EN 310.

If it becomes apparent over time that the quality of the semi-manufactured bamboo is consistent, SKH may decide that the frequency of import inspections can be adjusted.

Once it is or becomes known that changes were made to the production process, the holder of the SKH quality declaration is required to inform SKH thereof. If SKH is of the opinion that the process has been modified to such an extent that changes in the properties of the product can be expected, these properties will need to be determined and recorded again.

## 9. REQUIREMENTS REGARDING THE QUALITY SYSTEM (of the importer, IQC)

### 9.1 General

In the following sections requirements have been formulated to which the quality system of the holder of the SKH quality declaration, as referred to in section 1.2, must comply. For the semi-manufactured bamboo produced in the context of this quality declaration, chapters 4, 5 and 7 must be included in this quality system.

### 9.2 Responsibility

The importer/manufacturer is responsible for the internal quality control (incoming and outgoing inspection and maintaining the properties) of the semi-manufactured bamboo.

#### 9.2.1 Reporting changes

Any changes in the quality system, such as changes in procedures, the internal quality control scheme, production methods, etc., shall be reported in advance to the certification body in writing.

### 9.3 Manager of the quality system

Within the organisational structure, an official must be appointed who is charged with the implementation and management (keeping up-to-date) of the quality system. This notwithstanding the other duties and responsibilities of this official.

### 9.4 Quality system

#### 9.4.1 Document management

The written procedures for inspection and testing must be assessed and approved for suitability and effectiveness by authorised persons in the company before they are issued. Document management must ensure that only valid documents are available for inspection and testing. The documents must be in Dutch or English, or prepared in such a way that they are accessible to SKH.

This can be achieved by, for example, introducing a quality system in accordance with ISO 9001.

#### 9.4.2 Inspection and testing

##### 9.4.2.1 Internal quality control

The manufacturer shall implement internal quality control; the following minimum components shall be included in this and laid down in writing:

- Inspection of the raw materials upon arrival, characterisation of the material (semi-manufactured bamboo);
- Workplace instructions;
- Inspection of the outgoing deliveries;
- Inspection of measuring equipment;
- Complaint registration.

##### *Non-conformities in products*

Semi-manufactured products or parts of products that are found during the production process not to comply with the requirements must be clearly recognisable as such. One should also have at its disposal a procedure for the handling of these products, a registration and an identifiable (separate) storage. If necessary, corrective measures must be taken.

#### **9.4.2.2 Registration**

Records must be kept of the inspections and tests as described in the IQC scheme. Registered data must be kept for at least 10 years.

The manufacturer shall keep a suitable and accessible registration of the inspections and tests carried out and the registration shall be kept up-to-date, so that it can be used to show that the requirements specified have been fulfilled. Where necessary, statistical techniques shall be applied to the test results.

Exception to the retention period of records are the test samples from the incoming inspection. These have a minimum retention period of 1 year.

Based on inspections, SKH may decide to increase or decrease the retention period.

(In case of a shortened retention period, the data of the deliveries since the inspection should always be available.)

#### **9.4.2.3 Calibration**

Inspection, measuring equipment and test equipment must be calibrated at least once a year. Records must be kept of this.

Calibration can be performed internally (calibrated reference measuring equipment) or externally (calibration company).

#### **9.4.2.4 Supplies**

The goods received must be inspected according to the quality system.

Records must be kept of the inspections.

#### **9.4.2.5 Laboratory**

There must be a separate, properly equipped area for carrying out laboratory activities. All the prescribed measuring and testing equipment must be present. When an external laboratory is used, this must have been approved by the certification body.

It is preferred if the external laboratory is accredited in accordance with EN-ISO/IEC 17025.

The samples used for inspection and testing are clearly identified. Any testing sequence must be clearly recognisable.

Depending on the products to be made or imported, and on the extent this applies to mandatory inspections to be carried out for the products, the manufacturer/importer of the semi-manufactured bamboo covered by this quality declaration should have the following equipment:

- Moisture meter (electrical resistance or capacitive), with an accuracy of  $\pm 2\%$ ;
- Thermostatic bath (or other means for immersing samples in boiling water);
- Drying oven (at least 100 °C), with an accuracy of  $\pm 2$  ° C;
- Scales and/or balance with an accuracy of  $\pm 0.01$  g;
- Calliper with an accuracy of  $\pm 0.01$  mm;
- Stopwatch with an accuracy of  $\pm 1$  second;
- Thermometers, including a calibrated thermometer with an accuracy of  $\pm 0.5$  °C;
- Tensile strength tester;
- Press.



#### **9.4.2.6 *Non-conformities in products***

Semi-manufactured products or parts of products that are found during the production process not to comply with the requirements must be clearly recognisable as such. One should also have the disposal of a procedure for the handling of these products, a registration and an identifiable (separate) storage. If necessary, corrective measures must be taken.

#### **9.4.3 Handling complaints**

The holder of the SKH quality declaration must be able to demonstrate the presence of a complaints procedure and registration for the semi-manufactured product to which the quality declaration applies and its use in practice.

A statement must be made regarding every complaint, describing how the complaint was analysed and dealt with and any appropriate corrective measures subsequently taken.

## **10. MARKING**

Each bundle or package must be marked with the SKH quality mark.

If desired, each element may be marked on the longitudinal or cross-cut ends.

The layout of this marking is as follows:

- Logo SKH Quality Declaration
- A batch number or traceable delivery
- SKH Quality Declaration Number
- Use class in accordance with EN 335
- Suitable application (optional)

## **11. REQUIREMENTS TO BE MADE OF EXTERNAL INSPECTION**

### **11.1 General**

External quality control is specified by SKH in accordance with the Regulations of SKH.

### **11.2 Admission inspection**

During the initial admission inspection, SKH checks whether the company in question complies with the requirements stated in this assessment directive. A report is prepared on the admission inspection, based on which the SKH Quality Declaration will be issued.

### **11.3 Annual inspection**

SKH will check, without prior notice, whether the technical specification as described in 8.4 and set out in the SKH Quality Declaration has been continuously satisfied, and whether the manufacturer's internal quality control system meets the requirements laid down in chapter 10.

For each container/delivery it is checked whether the requirements of 8.4 are met and if the records are complete. The preserved, stored test pieces will also be inspected.

SKH inspects the internal quality system twice per year, during one of which samples are taken that will then be tested by an independent testing institute from compliance with the requirements of 8.3.

The samples for external inspection may be taken from either the tested IQC samples, the present stock or from deliveries at a customer.

A written report is compiled of these inspections.

The aforementioned frequency of inspections can be adjusted on the recommendation of the Board of Experts.

## Literature

- ASTM D143; Standard Test Methods for Small Clear Specimens of Timber
- AD 0801; Wooden façade elements
- AD 0803; Wooden exterior doors
- AD 0814; Film forming coatings for application on timber
- AD 0817; Film-forming midcoat and topcoat systems on timber
- AD 0819; Joining techniques in wooden façade elements
- AD 1701; Glued load-bearing building structures
- AD 1704-1; Fingerjointed timber for load bearing applications
- AD 1704-2; Fingerjointed timber for non-load bearing applications
- AD 0819; Joining techniques in wooden façade elements
- AD 2211; Inner doors and frames
- AD 2339; Adhesives for non-load bearing applications
- AD 2902; Optimized timber for non-load-bearing applications
- AD 4103; Wooden and wood-based façade cladding systems
- AD 9923; Wooden scaffolding boards
- CEN/TR 14823:2003 en; Durability of wood and wood-based products – Quantitative determination of pentachlorophenol in wood - Gas chromatographic method
- CEN/TS 15083-2:2005 en - Durability of wood and wood-based products – Determination of the natural durability of solid wood against wood-damaging fungi - Part 2: Soft rot fungus
- EN 84:1997 en; Wood preservatives - Accelerated ageing of treated wood prior to biological testing - Leaching method
- EN 113:1996 en; Wood preservatives - Test method for determining the preventive effectiveness against wood-damaging basidiomycetes - Determination of toxic threshold values
- EN 252:1991; Wood preservatives - Determining the relative protective effect upon contact with the ground - Field research method
- EN 300:2006 en; Oriented Strand Boards (OSB) - Terms and definitions, classification and specifications
- EN 310:1993 en; Wood-based panels - Determination of modulus of elasticity in bending and of the bending strength
- EN 314-1:2005 en; Plywood - Bonding quality - Part 1: Test methods
- EN 314-2:1993 en; Plywood - Bonding quality - Part 2: Requirements
- EN 315:2000 en; Plywood - Tolerances for dimensions
- EN 317:1993 en; Chipboard and fibreboard - Determination of the increase in thickness due to swelling after immersion in water
- EN 318:2002 en; Wood-based panels - Determination of the changes in the dimensions in relation to changes in relative humidity
- EN 319:1993 en; Chipboard and fibreboard - Determination of tensile strength perpendicular to the plane of the plate
- EN 326-2:2010 en; Sheet material - Sampling, cutting and inspection - Part 2: Initial type testing and factory production control
- EN 335:2013 en; Durability of wood and wood-based products - Use classes: Definitions, application to solid wood and wood-based panels
- EN 336:2013 en; Structural timber - Sizes, permitted deviations
- EN 338:2009 Structural timber - Strength classes
- EN 350-1:1994 en; Durability of wood and wood-based products – Natural durability of solid wood - Part 1: Guide to the principles of testing and classification of the natural durability of wood
- EN 384: 2010; Timber structures - Determination of characteristic values of mechanical properties and density
- EN 385:2001 Finger-jointed structural timber - Performance requirements and minimum production requirements
- EN 408: 2010; Timber structures - Structural timber and glued laminated timber - Determination of some physical and mechanical properties.

- EN 717-1:2004 en; Wood-based sheet material - Determination of formaldehyde emission - Part 1: Formaldehyde emission by the chamber method
- EN 717-2:1995; Wood-based sheet material - Determination of formaldehyde emission - Part 2: Formaldehyde emission by the gas analysis method
- EN-ISO 846. Plastics - Evaluation of the behaviour of micro-organisms (ISO 846:1997).
- EN 942 Timber in joinery - General requirements
- EN 1087-1:1995 en; Chipboard - Determination of moisture resistance - Part 1: Boil test
- EN 1194:1999 Timber structures - Glued laminated timber - Strength classes and determination of characteristic values
- EN 1990+A1+A1/C2:2011 Euro code – Basis of structural design (including A1:2006 and C2:2010)
- EN 1991-1-1+C1:2011 Euro code 1: Actions on structures - Part 1-1: General loads – Densities, self-weight and imposed loads for buildings (including C1:2009)
- EN 1995-1-1+C1+A1:2011 Euro code 5: Design timber structures – Part 1-1: General – Common rules and rules for buildings (including C1:2006 and A1:2008)
- EN 1533:2010 en; Wood flooring - Determination of bending strength under static load - Test methods
- EN 1534:2010 en; Wood flooring and parquet - Determination of resistance to indentation (Brinell) - Test method
- NEN 6762 Dowel type fasteners for use in load-bearing structures
- EN 13329:2006+A1:2008 en; Laminate floor coverings - Elements with a surface layer based on amino plastic thermosetting resins - Specifications, requirements and test methods
- EN 13354:2008 en; Solid wood panels (SWP) - Bonding quality - Test method
- EN 13471:2001 en; Thermal insulating products for building equipment and industrial installations - Determination of the coefficient of thermal expansion
- EN 13501-1:2007+A1:2009 en; Fire classification of construction products and building elements – Part 1: Classification using data from results of fire tests Buildings Decree 2012 standard
- ENV 13986:2010 en; Wood-based sheet material for use in construction - Characteristics, evaluation of conformity and marking
- EN 14279:2005+A1:2009 en; Laminated Veneer Lumber (LVL) - Definitions, classification and specifications
- EN 14342:2005+A1:2008 en; Wood flooring - Characteristics, evaluation of conformity and marking
- EN 14354:2004 en; Wood-based panels - Wood veneer floor covering
- EN 14915:2006 en; Solid wood panelling and cladding - Characteristics, evaluation of conformity and marking
- NPR-CEN/TS 15676:2008 en; Wood flooring - Slip resistance - Pendulum test
- NVN-ENV 807:2001 en; Wood preservatives - Determination of the effectiveness against soft rot fungi and other soil-inhabiting micro-organisms
- SKH Publication 05-01; Determination of the adhesion of paint on wood
- SKH Publication 06-02; Assessment of the quality of the sealing of a paint film on wood
- SKH publication 06-03; Protocol for the finishing of wooden façade elements and wooden exterior doors on the basis of performance requirements
- SKH Publication 08-02; Determination of the water permeability after critical drying and complete drying of undercoat and topcoat systems on wood
- SKH Publication 08-04 Date: 01-03-2010; Visual assessment of a door panel
- SKH Publication 10-01; Water uptake and freeze stability test
- SKH Publication 97-04; Assessment Directive 'Timber species for use in joinery; requirements and determination methods'
- SKH Publication 98-04; Conditions and internal controls for the industrial finishing of joinery with water-diluted paints
- SKH Publication 99-05; Approved timber to be used in wooden façade elements (window frames, windows and doors)
- WPC Q.A.; Quality and Testing Specifications for Production Control for Terrace Decking made from Wood-Polymer Composites; Version: 2011-05-05; Quality Association for Wood-based panels reg.assn

## **APPENDIX 1. Specimen of Quality Declaration**

SKH quality declaration

.....

Number: «number  
declaration»  
Issued: «date»  
Replaces: «Replaces»

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|                  |            |          |
|------------------|------------|----------|
| Producer         | Factory at | Importer |
| «Company name»   |            |          |
| «E-mail_address» |            |          |

Declaration by SKH

This quality declaration is based on AD @ '.....', issued by SKH.

SKH declares that there is legitimate confidence that the bamboo material manufactured by the producer, suitable only for ..... applications, continuously complies with the technical specifications laid down in this quality declaration, provided that it is marked with the SKH quality logo represented below in the manner indicated in this quality declaration.



On behalf of SKH      H.J.O. van Doorn, Director

Users of this quality declaration are advised to enquire at SKH whether this document is still valid.

This quality declaration consists of @ pages.

## APPENDIX 2. Protocol for the determination of the paintability using film-forming coating systems. (optional)

### B.2.1 General

For a number of end products, including windows, doors and frames, the bamboo must be finished with a film-forming coating system. The paintability of the semi-manufactured bamboo must be tested, based on three coating systems that have been certified in accordance with AD 0814 and AD 0817. The choice of the coating system is determined by the association conducting the tests, if necessary in consultation with the industry (coating and bamboo). To test the paintability, use is made of three normal opaque (primer) coating systems (colour RAL 9010), for bamboo materials without bleeding extractives or three insulating covering (primer) paint systems (colour RAL 9010), for bamboo materials which have been shown to contain water-soluble and extractable components. Tests with three transparent systems (in the most critical colour allowed) are optional.

### Assessment methodology

1. Assessment of bleeding or non-bleeding based on wetting with water (SKH Publication 05-01 § 7.4)
2. Application of coating systems and assessment of the closedness of the paint coat in accordance with SKH Publication 06-02.
3. Assessment of dry and wet adhesion after 7 days of drying in accordance with SKH Publication 05-01 (including discolouration due to wetting of the incised pattern). The determination method shall be at least equivalent to the test in accordance with ASTM D 3359.
4. Assessment of emitted components in accordance with section 5.2.7.3 of SKH Publication 05-01 (including adhesion rating)
5. Blister test in accordance with SKH Publication 97-04 section 5.2.7.3 (the determination method shall be at least equivalent to the determination in accordance with ISO 4628-2)
6. Water uptake and freeze stability test in accordance with SKH Publication 10-01

The paintability of bamboo is determined in accordance with the test methods described in sections 1 to 6. It is not always necessary to perform all tests in order to determine the paintability. The bleeding of the product, closedness of the paint coat, adhesion and the emission of extractives (sections B.2.3.1 to B.2.3.4) must always be assessed. Depending on the results of these tests and the water absorption behaviour, the following additional tests must be conducted:

- a) If water absorption is low, a closed paint coat in normal system build-up can be applied and there is no bleeding of volatile components, no additional tests are required.
- b) If water absorption is high or if an additional layer is required to get a closed paint coat, the blister test (test 5) must be performed additionally.
- c) If an additional layer is required to get a closed paint coat or in case of bleeding bamboo material, the Water uptake and freeze stability test (test 6) must be performed additionally.

### B.2.2 Requirements for the paintability of the bamboo

The outcome of the tests described in sections 1 to 6 will be converted into the paintability of the bamboo as follows.

1. All the tested systems have been assessed as satisfactory.

The bamboo material is released for general paintability. The company processing the bamboo is

required to test the tolerance of the bamboo to a specific coating in accordance with the instructions in SKH Publication 98-04 before processing the selected coating system and to repeat this with the frequency described therein.

2. Not all the tested systems have been assessed as satisfactory.

The bamboo material is released for paintable under certain conditions. The paint supplier has the obligation to substantiate its paint advice by performing independent adhesion tests on the relevant material. The company applying the coating is required to test the tolerance of the material in accordance with the instructions in SKH Publication 98-04 before processing the selected coating system and to repeat this with the frequency described therein.

3. None of the tested systems have been assessed as satisfactory.

In this case the bamboo material is not suitable to be released for general paintability.

COMMENT: The company applying the coating is required to demonstrate the paintability in accordance with the paintability test described in this publication before processing with a selected coating system.

### **B.2.3 Description of the test methods**

#### **B.2.3.1 Assessment of bleeding or non-bleeding based on wetting with water**

The assessment must be conducted to one standard opaque coating system on 15 samples, preferably from 3 production batches or deliveries. When applying the certified standard opaque primer or undercoat system in accordance with AD 0814 or AD 0817, all test pieces, with a minimum size of 12 x 70 x 300 mm, will be provided with two (primer) coats, applied by airless spray or a different application method according to the processing instructions of the supplier.

After application the finished samples are conditioned for 7 days at 65% ± 5% RH and 20 ± 2 °C.

After conditioning, incisions will be made in the finish of the test pieces in accordance with SKH Publication 05-01 § 7.4. and it is covered with wet filter paper for 1 hour. After 1 hour the discolouration outside the incised pattern is assessed.

#### **Requirements for the bleeding of the bamboo material**

Bamboo is considered non-bleeding when no discolouration is visible outside the incised pattern at a magnification of 10x. If the bamboo bleeds (there is discolouration outside the incised pattern), a switch must be made to 3 insulating paint systems for the articles of section 2.3.2 and beyond

#### **B.2.3.2 Application of paint systems and assessment of the sealing of the paint coat**

The sealing of the paint coat is tested for each coating system on 15 test pieces with a minimum size of 12 x 70 x 300 mm. When applying an opaque system, all test pieces will be provided with two (primer) coats of a certified primer or undercoat system in accordance with AD 0814 or AD 0817, applied by airless spray or a different application method according to the processing instructions of the supplier.

When applying a transparent undercoat system, all test pieces will be provided with a certified transparent undercoat system in accordance with AD 0817, applied by airless spray or a different application method according to the processing instructions of the supplier. After application the coated samples are conditioned for 7 days at 65% ± 5% RH and 20 ± 2 °C. the closedness of the paint coat will be assessed in accordance with SKH Publication 06-02.

#### **Requirements for the sealing of the paint coat.**

In accordance with SKH Publication 06-02, the paint coat should be closed. If this is not the case, an additional layer up to a layer thickness of at least 140 µm total dry paint coat is applied. If it is still not possible to obtain a closed paint coat, the bamboo material will not be released for use in joinery.

### B.2.3.3 Assessment of the dry and wet adhesion after 7 days of drying

The wet adhesion is tested for each coating system on 15 test pieces. The dry adhesion is tested for each finishing system on 3 test pieces, unless the variation in wet adhesion requires a larger number. The minimum size of the test pieces is 12 x 70 x 300 mm. The application of the paint coat and conditioning should take place as described in paragraph 2 of this Protocol. Determination of the wet and dry adhesion of the coating must be performed in accordance with SKH Publication 05-01.

#### Requirement for the wet and dry adhesion

The average of the measurements of wet and dry adhesion must meet maximum Class 1 and at least 13 of the 15 samples must meet Class 0 or 1 in accordance with SKH Publication 05-01.

### B.2.3.4 Assessment of the emission of components (IR radiation)

The emission of volatile components is determined for each coating system on 15 test pieces with a minimum size of 12 x 70 x 150 mm. The application of the paint coat and conditioning should take place as described in paragraph 2 of this Protocol. After conditioning, the surface of the test pieces is irradiated with an infrared lamp for 8 hours in such a way that a one-sided surface temperature of 70 °C is reached. After this, the samples are visually assessed on the emission of components (e.g. resin), cracking, blistering and flaking. The test is concluded with an assessment of the adhesion of the paint.

#### Requirements for the emission of components and the adhesion

The requirements the paint coat must comply to after irradiation of the surface are shown in the table below.

**Table 10: Requirements for the emission of components**

| Property                        | Method                | Requirement  |
|---------------------------------|-----------------------|--|
| Emission of volatile components | -                     | Not allowed  |
| Cracking                        | NEN-ISO 4628-4        | Maximum 1S1  |
| Blistering                      | NEN-ISO 4628-2        | 0  |
| Flaking                         | NEN-ISO 4628-5        | 0  |
| Adhesion                        | SKH Publication 05-01 | The average of the measurements must meet maximum Class 1 and at least 13 of the 15 samples must meet Class 0 or 1 |

### B.2.3.5. Blister test

One sided moisture load of the bamboo may cause any water-soluble components or unreacted adhesive components in the material to migrate to one of the surfaces in an accelerated manner. The possible consequences, such as blistering, detachment or discolouration, are studied.

The blistering is determined on 10 test pieces per coating system. The test pieces with dimensions of 12 x 70 x 150 mm must be coated on three sides. Both cross cut sides are sealed with an appropriate agent (SKH Publication 08-02). The test pieces are placed in the blister box with the non-finished side to the interior. The water temperature in the blister box is set to 40 ± 1 °C. The blister box must be



placed in an environment of  $50 \pm 5\%$  RH and  $23 \pm 2$  °C. The test will take 10 days. The samples are weighed before and after the test. After the test, the samples are visually assessed for blistering, discolouration and flaking. The test is concluded with an assessment of the adhesion of the coating.

#### **Requirements for the blister test**

The requirements for the blister test are shown in the table below.

**Table 11: Requirements for the blister test**

| <b>Property</b> | <b>Method</b>         | <b>Requirement</b>   |
|-----------------|-----------------------|--|
| Blistering      | NEN-ISO 4628-2        | 0  |
| Flaking         | NEN-ISO 4628-5        | 0  |
| Discolouration  | -                     | no visible discolouration  |
| Adhesion        | SKH Publication 05-01 | The average of the measurements must meet maximum Class 1 and at least 13 of the 15 samples must meet Class 0 or 1 (wet and dry) |

#### **B.2.3.6 Water uptake and freeze stability test**

The Water uptake and freeze stability test must be performed on test pieces with dimensions of 12 x 70 x 150 mm in accordance with SKH Publication 10-01 taking into account the following deviations (simplified procedure):

1. The test pieces must be conditioned during 1 week
2. 10 test pieces will be tested in RAL 9010 per paint system
3. The test pieces are weighed before the initial water absorption, before the fourth water absorption and after completion of the last step.
4. The test pieces will only be assessed visually for cracking, blistering and flaking after the last step. The test is concluded with an assessment of the adhesion of the paint.

#### **Requirements for the Water uptake and freeze stability test**

The requirements the paint coat must meet after the Water uptake and freeze stability test are described in section 4.1.5 of AD 0817.

### **APPENDIX 3. Bamboo in Façade cladding (optional)**

Reference is initially made to façade cladding in exterior applications, Use Class UC 3.

In addition to the requirements set to bamboo material in this AD for use class 3, the requirements set out in AD 4103, Wooden and wood-based façade cladding systems, must be met.

If it can be demonstrated that certain requirements of the AD do not apply to the bamboo product (for instance that is proven to be possible to use bamboo façade cladding with film-forming coating systems), this can be included in the certificate.

## APPENDIX 4. Bamboo in joinery (optional)

### B.4.1. Principle

To determine whether semi-manufactured bamboo is suitable for joinery, it must be established in coordination with the certification body which properties of the material should be tested. This protocol is produced to give an overview of the properties of the semi-manufactured bamboo that need to be determined for it to be used in joinery in accordance with AD 0801 and AD 0803.

### B.4.2. Starting points

For the application of frames, windows and doors in accordance with AD 0801 and AD 0803, the following properties must be determined:

#### B.4.2.1 Starting material, quality of the semi-manufactured bamboo

The quality of the bamboo depends not only on the process, but also on the quality of the starting material. The density, bonding quality and swelling determine the quality of the starting material. The requirements the starting material must meet are set out in chapter 5. Thereby, the requirements for Use Class 3 (UC3) must be met.

#### B.4.2.2 Durability, resistance to fungal attack

The durability of the semi-manufactured bamboo is determined in accordance with the description in chapter 5.6.

#### Requirements for the durability

For use in frames, windows and doors, the durability of the bamboo material must be class 1 or 2. Semi-manufactured bamboo falling in durability class 3 may be used in frames, windows and doors provided the water absorption is low (see water absorption requirements).

#### B.4.2.3. Dimensional stability

The dimensional stability of façade joinery is determined based on test pieces that are sawn at right angles to the longitudinal direction of the material and by conditioning them at different climate conditions until an equilibrium is reached. The test pieces are preferably 50 x 50 mm in size, but at least 20 x 20 mm with a length of 10 mm. The dimensions and the swelling are determined in two directions, the direction of production and perpendicular thereto. Since the direction of production is not always visible, we will speak of direction 1 and direction 2 here. A minimum of 15 test pieces will be used from 15 different planks or beams, preferably originating from 3 different deliveries or production batches.

The dimensional stability is determined over a range from 50% RH to 90% RH. Due to hysteresis effects, the test pieces will initially be conditioned at 30 - 35% RH, 20 °C, during at least 1 week. For the determination of the dimensions at 50% RH, the test pieces are conditioned at 50 ± 5% RH, 20 ± 2 °C. After reaching the equilibrium (maximum weight change 0.1% in 24 hours), the dimensions will be determined with a minimum accuracy 0.02 mm. The test pieces will then be conditioned at 90 ± 5% RH, 20 ± 2 °C until an equilibrium is reached. The dimensions will be determined once more with minimum accuracy 0.02 mm.

The swelling is calculated as follows:

$$S1_{50-90\%} = \frac{(D1_{90} - D1_{50})}{D1_{50}} \times 100\% \text{ and}$$

$$S2_{50-90\%} = \frac{(D2_{90} - D2_{50})}{D2_{50}} \times 100\%$$

In which

$S1_{50-90\%}$  swelling in direction 1 over a range of 50% to 90% RH [%]

$S2_{50-90\%}$  swelling in direction 2 over a range of 50% to 90% RH [%]

$D1_{50}$  dimensions in direction 1 at 50% RH [mm]

$D1_{90}$  dimensions in direction 1 at 90% RH [mm]

$D2_{50}$  dimensions in direction 2 at 50% RH [mm]

$D2_{90}$  dimensions in direction 2 at 90% RH [mm]

### Requirements for the swelling

Table 2 shows the requirements placed on the bamboo material timber for use in frames, windows and doors.

**Table 12: Requirements for the swelling of modified wood**

| Orientation                               | Requirement over a range of 50 to 90% RH           |
|---|--|
| Swelling direction 1                      | Average $\leq 4\%$ , standard deviation $\leq 1\%$ |
| Swelling direction 2                      | Average $\leq 4\%$ , standard deviation $\leq 1\%$ |
| swelling direction 2/swelling direction 1 | $\leq 2.3$   |
| swelling direction 1/swelling direction 2 | $\leq 2.3$   |

#### B.4.2.4. Equilibrium moisture content

The equilibrium moisture content must be determined on test pieces that have been conditioned in different climates until an equilibrium is reached. The test pieces are 50 x 50 mm in size, but at least 20 x 20 mm with a length of 10 mm. The production orientation plays no role in this case

A minimum of 15 test pieces will be used from 15 different planks or beams, preferably originating from 3 different deliveries or production batches (5 per batch). The equilibrium moisture content is determined at  $65\% \pm 5\%$  RH, 20 °C.

An equilibrium is reached at a maximum weight change of 0.1% in 24 hours. After conditioning, the test pieces are dried in an oven for 16 - 24 hours at  $103 \pm 2$  °C, and the weight is determined after cooling in a desiccator. The weight of the test pieces is determined with a minimum measuring accuracy of 0.02 gram.

The equilibrium moisture content is calculated as follows:

$$EMC_{i\%} = \frac{(m_i - m_{od})}{m_{od}} \times 100\%$$

In which

$EMC_{i\%}$  Equilibrium moisture content at a relative humidity of  $i\%$  RH [%]

$m_i$  weight after conditioning at  $i\%$  RH [g]

$m_{od}$  dry weight [g]

**Requirements for the equilibrium moisture content.**

The quality declaration should include the equilibrium moisture content of the semi-manufactured bamboo at a relative humidity of 65% and a temperature of 20 °C. The equilibrium moisture content is expressed as a percentage with a tolerance of ± 2%.

**B.4.2.5 Water absorption and release**

For the determination of the water absorption, 15 stakes of the dimensions 20 x 20 x 400 mm from 3 different production batches (5 per batch) are used per timber species or type of process. As a reference, 15 stakes of pine sapwood with the same dimensions are included.

The stakes are conditioned at 65 ± 5% RH, 20 ± 2 °C until the weight is constant. All stakes are weighed with an accuracy of 0.2 gram. Twelve stakes, four of each batch, are placed in a closed container with 5 – 10 mm of water. Three stakes, the fifth stake of each batch, are placed in the same container, but not in the water. Make sure the stakes are separated and do not touch each other. The weight of the stakes is determined after 1 hour and after 24 hours and then after 2, 3, 7, 14 and 21 days.

After the water absorption period, the release of moisture is determined. To this end, the stakes are placed in an environment of 65% ± 5% RH, 20 ± 2 °C and weighed after 1 hour and after 24 hours and then after 2, 3, 7 and 14 days.

The water absorption is determined by the absorption of the liquid water and by hygroscopicity due to the development of a high humidity in the closed vessel.

The water absorption and release are determined as follows:

$$W_i = (m_{wi} - m_{w0}) - (m_{di} - m_{d0})$$

In which:

- $W_i$  Water absorption and release at time  $i$  [g]
- $m_{wi}$  mass of water absorption stakes at time  $i$  [g]
- $m_{w0}$  mass of water intake absorption at time 0 [g]
- $m_{di}$  mass of water vapour absorption stakes at time  $i$  [g]
- $m_{d0}$  mass of water vapour absorption stakes at time 0 [g]

**Requirements for water absorption and desorption.**

Bamboo with a durability class 3 or 4 can be used in frames, windows and doors under the following conditions: a high water absorption in combination with low water release is not found. (see also the requirements for durability).

High water absorption in combination with low water release is attained when:

the maximum water absorption after 21 days  $\geq 0.4$  times the maximum water absorption of pine sapwood

the initial moisture content after 14 days of conditioning is not reached during the moisture desorption..

**B.4.2.6 Density**

The density must be determined on at least 45 parts, preferably coming from three different production batches. See chapter 4.2.

The density is included in the quality declaration

#### **B.4.2.7 Strength properties**

The bending strength and modulus of elasticity are determined by a four-point bending test in accordance with EN 408. At least 40 test pieces are tested with a minimum cross-section of 40 x 40 mm. The material preferably comes from 3 different deliveries, and the following properties must be determined in accordance with the alternative method (chapter 6) described in EN 384:

The typical (average) modulus of elasticity ( $E_{0,mean}$ ) in N/mm<sup>2</sup>.

The typical bending strength ( $f_{m,k}$ ) in N/mm<sup>2</sup>.

#### **Requirements for the strength properties**

The determined strength values apply to the tested material with the same quality regarding density, bonding quality and swelling (determined in accordance with chapter 5.3). For use in frames, the maximum span must be determined for mullions and transoms.

#### **B.4.2.8 Paintability**

See the description in Appendix 2.

#### **B.4.2.9 Gluability**

The gluability of the semi-manufactured bamboo must be demonstrated. Depending on the intended use, the following must be demonstrated:

- Frame joints; per glue system and/or joining product in accordance with AD 0819.
- Windows and doors; per glue system in accordance with section 4.1.4 (exterior façade joinery) of AD 2339.
- Finger joints; per glue system in accordance with section 4.1.3 (exterior façade joinery) of AD 2339.
- Laminating; per glue system in accordance with section 4.1.2 (exterior façade joinery) of AD 2339.

In addition to the requirements after ageing as described in AD 0819 and AD 2339, severe cracking in the bamboo after ageing is not allowed. Severe cracking shall be understood to mean: cracks of over 2 mm wide and 100 mm long.

If the tests are conducted on glued sample material manufactured by a manufacturer (for instance frame joints made by a joinery factory), the results are applicable only for the production process of the joinery factory.

#### **B.4.2.10 burglary resistance.**

The semi-manufactured bamboo may be used for burglary -resistant frames provided that the following requirements are met:

- The extraction resistance of the screws must at least be equivalent to that of pine or meranti. The equivalence of the extraction resistance must be determined in accordance with section 3.2 of SKH-AD 002.  
It is possible that the required extraction resistance can be reached only by using longer screws. This can be included in the processing instructions.
- The splitting strength in both the direction of pressing and perpendicular to the direction of pressing must be at least equivalent to that of pine. Testing of the splitting strength must be determined in accordance with ASTM D143.

If the semi-manufactured bamboo does not comply with the above requirements, the burglary resistance of the entire façade element must be tested.

## **APPENDIX 5. Bamboo decking and decking elements (optional)**

Bamboo decking and decking elements are primarily intended for exterior use, use class 3 or 4.

The following properties affect the performance of the deck parts:

- Strength
- Stiffness
- Durability
- Hardness
- Impact energy of the break
- Wear resistance
- Slipperiness
- Screw extraction resistance
- UV resistance

Currently, no requirements apply to the bamboo for use as decking or decking elements



## **Changes with regard to previous version(s)**

Changes with regard to version 1 dd. 24 February 2014.

*Inserted:*

*Table 1. Climate conditions corresponding to the different applications.*