EUROPEAN ASSESSMENT DOCUMENT

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STRUCTURAL COMPOSITE LUMBER PRODUCT: LAMINATED STRAND LUMBER (LSL)

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This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation (EU) No 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

Contents

1 SCOPE OF THE EAD

1.1 Description of the construction product

This EAD is applicable to structural composite lumber products called Laminated Strand Lumber (LSL). Laminated Strand Lumber is a composite of wood strand elements with wood fibers primarily oriented along the length of the member. The least dimension of the strands shall not exceed 2.54 mm and the average length shall be a minimum of 150 times the least dimension. Laminated Strand Lumber is produced at a moisture content range of 6-10 %.

The Laminated Strand Lumber may be treated with flame/fire retardants and/or biocides. Laminated Strand Lumber manufactured with recycled wood strand elements are not considered in this document.

The product is not covered by a harmonised European standard (hEN): The standard EN 13986[1] Wood-based panels for use in construction - Characteristics, evaluation of conformity and marking, does not cover the LSL boards. The standard EN 14374 does not cover the LSL boards as the scope is for LVL, materials composed of wood veneers, not wood strand.

Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement and repair of the product as he considers necessary.

It is assumed that the product will be installed according to the manufacturer's instructions or (in absence of such instructions) according to the usual practice of the building professionals.

Relevant manufacturer's stipulations having influence on the performance of the product covered by this European Assessment Document shall be considered for the determination of the performance and detailed in the ETA (e.g. kind and type of adhesive).

1.2 Information on the intended use(s) of the construction product

1.2.1 Intended use(s)

Laminated Strand Lumber (LSL) is intended to be used for one- or two-dimensional structural building applications including short and intermediate span beam and panels, lintels, purlins, studs, ceiling joists, sills, stair stringers and rim boards and as component of the other structural elements.

The present EAD does not cover exterior use of LSL and considers only indoor applications in dry service conditions, i.e. Service Classes 1 and 2 according to EN 1995-1-1. The products evaluated shall be employed in hazard classes 1 and 2 only, as defined in EN 335.

1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of the Laminated Strand Lumber (LSL) for the intended use of 50 years when installed in the works (provided that the LSL is subject to appropriate installation. These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product, the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works[2].

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1 All undated references to standards or to EAD's in this chapter are to be understood as references to the dated versions listed in clause 4.

2 The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than referred to above.

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

1.3 Specific terms used in this EAD (if necessary in addition to the definitions in CPR, Art 2)

Unless otherwise stated, the terms used in EN 1995-1 apply.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 1 shows how the performance of Laminated Strand Lumber (LSL) is assessed in relation to the essential characteristics.

Table 1 **Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics**

No	Essential characteristic	Assessment method	Type of expression of product performance *(level, class, description)*
Basic Works Requirement 1: Mechanical resistance and stability			
1	Bending strength parallel to grain: edgewise bending	2.2.1	*Level*
2	Bending strength parallel to grain: flatwise bending	2.2.2	*Level*
3	Tensile strength parallel to grain	2.2.3	*Level*
4	Tensile strength perpendicular to grain	2.2.4	*Level*
5	Compressive strength parallel to grain	2.2.5	*Level*
6	Compressive strength perpendicular to grain: edgewise compression	2.2.6	*Level*
7	Compressive strength perpendicular to grain: flatwise compression	2.2.7	*Level*
8	Shear strength parallel to grain: edgewise shear	2.2.8	*Level*
9	Shear strength parallel to grain: flatwise shear	2.2.9	*Level*
10	Modulus of elasticity parallel to grain: edgewise	2.2.10	*Level*
11	Modulus of elasticity parallel to grain: flatwise	2.2.11	*Level*
12	Modulus of elasticity perpendicular to grain	2.2.12	*Level*
13	Shear modulus: edgewise bending	2.2.13	*Level*
14	Shear modulus: flatwise bending	2.2.14	*Level*
15	Density	2.2.15	*Level*
16	Durability against biological attack	2.2.16	*Class*

No	Essential characteristic	Assessment method	Type of expression of product performance *(level, class, description)*
Basic Works Requirement 2: Safety in case of fire			
17	Reaction to fire	2.2.17	Class
18	Charring rate	2.2.18	Level
Basic Works Requirement 3: Hygiene, health and the environment			
19	Content, emission and/or release of dangerous substances	*2.2.*19	Level, description or class

2.2 Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product

This chapter is intended to provide instructions for TABs. Therefore, the use of wordings such as “shall be stated in the ETA” or “it has to be given in the ETA” shall be understood only as such instructions for TABs on how results of assessments shall be presented in the ETA. Such wordings do not impose any obligations for the manufacturer and the TAB shall not carry out the assessment of the performance in relation to a given essential characteristic when the manufacturer does not wish to declare this performance in the Declaration of Performance.

2.2.1 Bending strength parallel to grain: edgewise bending

The bending strength of the LSL shall be determined according to EN 14374 Clause 4.4.2, using the assessment method specified in EN 408 Clause 19 with l = 18 h ±3 h as described in EN 408 Figure 17.

The test samples shall be conditioned according to EN 408 Clause 8 under (20 ± 2) ºC and (65 ± 5) % RH conditions.

The moisture content of the LSL products shall be stated in the ETA according to EN 322.

The minimum number of samples shall be 30.

The calculation of the characteristic values from test results shall be carried out according to EN 14358, assuming a log-normal distribution Coefficient k_s is obtained from EN 14358 Table 1.

The characteristic value at the 5%-percentile of bending strength, parallel to grain, in N/mm^2 shall be given in the ETA.

2.2.2 Bending strength parallel to grain: flatwise bending

The bending strength of the LSL shall be determined according to EN 14374 Clause 4.4.3 using the assessment method specified in EN 408 Clause 19 with l = 18 h ±3 h as described in EN 408 Figure 17.

The test samples shall be conditioned according to EN 408 Clause 8 under (20 ± 2) ºC and (65 ± 5) % RH conditions.

The moisture content of the LSL products shall be determinate in the ETA according to EN 322.

The minimum number of samples shall be 30.

The calculation of the characteristic values from test results shall be carried out according to EN 14358 assuming a log-normal distribution. Coefficient ks is obtained from EN 14358 Table 1.

The characteristic value at the 5%-percentile of bending strength, parallel to grain, in N/mm^2 shall be given in the ETA.

2.2.3 Tensile strength parallel to grain

The tensile strength of the LSL shall be determined according to EN 14374 Claude 4.4.4 using the assessment method specified in EN 408 Clause 13.

The test specimen shall be conditioned according to EN 408 Clause 8 under (20 ± 2) ºC and (65 ± 5) % RH conditions.

The moisture content of the LSL products shall be determinate in the ETA according to EN 322.

The minimum number of samples shall be 30.

The calculation of the characteristic values from test results shall be carried out according to EN 14358 assuming a log-normal distribution. Coefficient k_s is obtained from EN 14358 Table 1.

The characteristic value at the 5%-percentile of tensile strength, parallel to grain, in N/mm^2 shall be given in the ETA.

2.2.4 Tensile strength perpendicular to grain

The tensile strength of the LSL shall be determined according to EN 14374 Clause 4.4.5 using the assessment method specified in EN 408 Clause 16.

The test specimen shall be conditioned according to EN 408 Clause 8 under (20 ± 2) ºC and (65 ± 5) % RH conditions.

The moisture content of the LSL products shall be determinate in the ETA according to EN 322.

The minimum number of samples shall be 30.

The calculation of the characteristic values from test results shall be carried out according to EN 14358 assuming a log-normal distribution. Coefficient k_s is obtained from EN 14358 Table 1.

The characteristic value at the 5%-percentile of tensile strength, perpendicular to grain, in N/mm^2 shall be given in the ETA.

2.2.5 Compressive strength parallel to grain

The compressive strength of the LSL shall be determined according to EN 14374 Clause 4.4.6 using the assessment method specified in EN 408 Clause 15.

The test specimen shall be conditioned according to EN 408 Clause 8 under (20 ± 2) ºC and (65 ± 5) % RH conditions.

The moisture content of the LSL products shall be determinate in the ETA according to EN 322.

The minimum number of samples shall be 30.

The calculation of the characteristic values from test results shall be carried out according to EN 14358 assuming a log-normal distribution. Coefficient k_s is obtained from EN 14358 Table 1.

The characteristic value at the 5%-percentile of compressive strength, parallel to grain, in N/mm^2 shall be given in the ETA.

2.2.6 Compressive strength perpendicular to grain: edgewise compression

The compressive strength of the LSL shall be determined according to EN 14374 Clause 4.4.7 using the assessment method specified in EN 408 Clause 16.

The test specimen shall be conditioned according to EN 408 Clause 8 under (20 ± 2) ºC and (65 ± 5) % RH conditions.

The moisture content of the LSL products shall be determinate in the ETA according to EN 322.

The minimum number of samples shall be 30.

The calculation of the characteristic values from test results shall be carried out according to EN 14358 assuming a log-normal distribution. Coefficient k_s is obtained from EN 14358 Table 1.

The characteristic value at the 5%-percentile of compressive strength, perpendicular to grain, in N/mm^2 shall be given in the ETA.

2.2.7 Compressive strength perpendicular to grain: flatwise compression

The compressive strength of the LSL shall be determined according to EN 14374 Clause 4.4.7 using the assessment method specified in EN 408 Clause 16.

The test specimen shall be conditioned according to EN 408 Clause 8 under (20 ± 2) ºC and (65 ± 5) % RH conditions.

The moisture content of the LSL products shall be determinate in the ETA according to EN 322.

The minimum number of samples shall be 30.

The calculation of the characteristic values from test results shall be carried out according to EN 14358 assuming a log-normal distribution. Coefficient k_s is obtained from EN 14358 Table 1.

The characteristic value at the 5%-percentile of compressive strength, perpendicular to grain, in N/mm^2 shall be given in the ETA.

2.2.8 Shear strength parallel to grain: edgewise shear

The shear strength of the LSL shall be determined according to EN 14374 Clause 4.4.8 using the assessment method specified in EN 789 Clause 10.

The test specimen shall be conditioned according to EN 408 Clause 8 under (20 ± 2) ºC and (65 ± 5) % RH conditions.

The moisture content of the LSL products shall be determinate in the ETA according to EN 322.

The minimum number of samples shall be 30.

The calculation of the characteristic values from test results shall be carried out according to EN 14358 assuming a log-normal distribution. Coefficient k_s is obtained from EN 14358 Table 1.

The characteristic value at the 5%-percentile of shear strength, parallel to grain, in N/mm^2 shall be given in the ETA.

2.2.9 Shear strength parallel to grain: flatwise shear

The shear strength of the LSL shall be determined according to EN 14374 Clause 4.4.9 using the assessment method specified in EN 789 clause 11.

The test specimen shall be conditioned according to EN 408 Clause 8 under (20 ± 2) ºC and (65 ± 5) % RH conditions.

The moisture content of the LSL products shall be determinate in the ETA according to EN 322.

The minimum number of samples shall be 30.

The calculation of the characteristic values from test results shall be carried out according to EN 14358 assuming a log-normal distribution. Coefficient k_s s is obtained from EN 14358 Table 1.

The characteristic value at the 5%-percentile of shear strength, parallel to grain, in N/mm^2 shall be given in the ETA.

2.2.10 Modulus of elasticity parallel to grain: edgewise

The modulus of elasticity parallel to grain of the LSL shall be determined according to EN 14374 Clause 4.5.2 and using the assessment method specified in EN 408 (local) Clause 9.

The test specimen shall be conditioned according to EN 408 Clause 8 under (20 ± 2) ºC and (65 ± 5) % RH conditions.

The moisture content of the LSL products shall be determinate in the ETA according to EN 322.

The minimum number of samples shall be 30.

The arithmetic mean value of modulus of elasticity parallel to grain, in N/mm^2 shall be given in the ETA.

2.2.11 Modulus of elasticity parallel to grain: flatwise

The modulus of elasticity parallel to grain of the LSL shall be determined according to EN 14374 Clause 4.5.2 and using the assessment method specified in EN 408 Clause 9.

The test specimen shall be conditioned according to EN 408 Clause 8 under (20 ± 2) ºC and (65 ± 5) % RH conditions.

The moisture content of the LSL products shall be determinate in the ETA according to EN 322.

The minimum number of samples shall be 30.

The arithmetic mean value of modulus of elasticity parallel to grain, in N/mm^2 shall be given in the ETA.

2.2.12 Modulus of elasticity perpendicular to grain

The modulus of elasticity perpendicular to grain of the LSL shall be determined according to EN 14374 Clause 4.5.3 and using the assessment method specified in EN 408 Clause 17.

The test specimen shall be conditioned according to EN 408 Clause 8 under (20 ± 2) ºC and (65 ± 5) % RH conditions.

The moisture content of the LSL products shall be determinate in the ETA according to EN 322.

The minimum number of samples shall be 30.

The arithmetic mean value of modulus of elasticity perpendicular to grain, in N/mm^2 shall be given in the ETA.

2.2.13 Shear modulus: edgewise bending

The shear modulus of the LSL shall be determined according to EN 14374 Clause 4.5.4 and using the assessment method specified in EN 789 Clause 10.

The test specimen shall be conditioned according to EN 408 Clause 8 under (20 ± 2) ºC and (65 ± 5) % RH conditions.

The moisture content of the LSL products shall be determinate in the ETA according to EN 322.

The minimum number of samples shall be 30.

The arithmetic mean value of shear modulus, in N/mm^2 shall be given in the ETA.

2.2.14 Shear modulus: flatwise bending

The shear modulus of the LSL shall be determined according to the 14374 Clause 4.5.5 and using the assessment method specified in EN 789 Clause 11.

The test specimen shall be conditioned according to EN 408 Clause 8 under (20 ± 2) ºC and (65 ± 5) % RH conditions.

The moisture content of the LSL products shall be determinate in the ETA according to EN 322.

The minimum number of samples shall be 30.

The mean value of shear modulus, in N/mm^2 shall be given in the ETA.

2.2.15 Density

The density of the LSL shall be determined using the assessment method specified in EN 323.

The test specimen shall be conditioned according to EN 408 Clause 8 under (20 ± 2) ºC and (65 ± 5) % RH conditions.

The moisture content of the LSL products shall be determinate in the ETA according to EN 322.

The minimum number of samples shall be 30

The arithmetic mean value of density, in kg/m^3 shall be given in the ETA.

2.2.16 Durability against biological attack

The environment for which the product is intended should be determined from the load duration classes and Service Classes 1 and 2 according to EN 1995-1-1 and by Hazard classes 1 and 2 according to EN 335.

When the products are chemically treated to improve the durability, the chemical treatment and treatment process shall be stated in the ETA when the manufacturer opts for it. The information required by (EU) 528/2012 for treated articles under article 58 “treated articles” shall be provided. The preservative treatment used should be evaluated to ascertain that the biocidal product fulfils the requirements set in the (EU) 528/2012.

2.2.17 Reaction to fire

The LSL shall be tested, using the test method(s) relevant for the corresponding reaction to fire class following the procedures according to EN 13501-1, in order to be classified according to Commission Delegated Regulation (EU) 2016/364.

The class of reaction to fire of the product is stated in the ETA.

2.2.18 Charring rate

The charring rate value of structural composite lumber shall be determined using one of the test methods described in the Annex A. In case of dispute, the method 1 will be considered as reference method.

The corresponding performance for the resistance to fire shall be expressed in the ETA in terms of declared charring rate (β_0) for one dimensional charring and for notional Charring (β_n).

2.2.19 Content, emission and/or release of dangerous substances

The performance of the product related to the emissions and/or release and, where appropriate, the content of dangerous substances will be assessed on the basis of the information provided by the manufacturer[3] after identifying the release scenarios taking into account the intended use of the product and the Member States where the manufacturer intends his product to be made available on the market.

The identified intended release scenarios for this product and intended use with respect to dangerous substances are:

- **IA1: Product with direct contact to indoor air**
- **IA2: Product with indirect contact to indoor air (e.g. covered by permeable products)**

The following dangerous substances have to be considered:

2.2.19.1 Substance/s classified as EU-cat. Carc. 1A and/or 1B

It has to be determined whether a substance classified as "Carcinogenic" (H350, H350i) in accordance with *Regulation (EC) No 1272/2008* in the currently valid version is actively used[4]. This information is obtained from a manufacturer's declaration and respectively stated in the ETA.

2.2.19.2 Substance/s classified as EU-cat. Muta. 1A and/or 1B

It has to be determined whether a substance labelled with "Mutagenic" (H340) in accordance with *Regulation (EC) No 1272/2008* in the currently valid version is actively used[2]. This information is obtained from a manufacturer's declaration and respectively stated in the ETA.

2.2.19.3 Substance/s classified as EU-cat. Reproductive toxicity" category 1A and/or 1B

The use of substances classified as "Toxic for reproduction" (H360, H360F, H360D, H360FD) in accordance with *Regulation (EC) No 1272/2008* in the currently valid version with ≥ 0.1 wt.% *(for IA1)* respectively > 0.3 wt.% *(for S/W 1, S/W 2)* has to be determined. This information is obtained from a manufacturer's declaration. Taking into account this information the Technical Assessment Body assesses the respective dangerous substance, whether it is completely reacted in the product, whether it is released by the final specific product and whether it is otherwise regarded as critical in the product, taking into account all possible release scenarios. If an assessment based on a manufacturer´s declaration is not sufficient to clarify a potential release, an additional assessment method determined by the TAB has to take place. A respective statement has to be given in the ETA.

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3 The manufacturer may be asked to provide to the TAB the REACH related information which he must accompany the DoP with (cf. Article 6(5) of Regulation (EU) No 305/2011).

The manufacturer is not obliged:

- to provide the chemical constitution and composition of the product (or of constituents of the product) to the TAB, or

- to provide a written declaration to the TAB stating whether the product (or constituents of the product) contain(s) substances which are classified as dangerous according to Directive 67/548/EEC and Regulation (EC) No 1272/2008 and listed in the "Indicative list on dangerous substances" of the SGDS.

Any information provided by the manufacturer regarding the chemical composition of the product may not be distributed to EOTA or to TABs.

4 Active use is the targeted use of substances to achieve specific product characteristics. Not actively used substances are constituents being an impurity or an additional ingredient, except for the case they fully react to a chemical compound within the manufacturing process and thus do not pose any risk for indoor air quality and health

2.2.19.4 SVOC and VOC

For the intended use covered by the release scenario IA1 and/or IA2 semi-volatile organic compounds (SVOC) and volatile organic compounds (VOC) shall be determined in accordance with EN 16516.

The respective loading factor [m^2/m^3] used for emission testing can be taken from the following table:

Table 2 Loading factor L, depending on the product type (in accordance with EN 16516)

Intended use	Loading factor [m^2/m^3]
Walls	1.0
Ceiling	0.4
Walls and ceiling	1.4

The generation of the representative test specimen will be carried out according to EN ISO 16000-11

Once the test specimen has been produced, as described above, it should immediately be placed in the emission test chamber. This time is considered the starting time of the emission test.

The test results have to be reported for the relevant parameters (e.g. chamber size, temperature and relative humidity, air exchange rate, loading factor, size of test specimen, conditioning, production date, arrival date, test period, test result) after 3 and/or 28 days testing.

The product performance shall be stated in the ETA [unit µg/m³ or mg/m^3].

2.2.19.5 Wood preservatives

Only wood preservatives that are approved according to Regulation (EU) No. 528/2012 (BPR) may be used. A respective statement has to be given in the ETA stating the trade name of the wood preservative(s) as well as the chemical name(s) and the amount(s) of the active agent(s).

The test accordance with the standard CEN/TR 14823:2003 „Durability of wood and wood-based products – Quantitative determination of pentachlorophenol in wood – Gas chromatographic method". should be carried out only for wood treated with the preservatives which contain PCP. **2.2.19.6 Formaldehyde**

The formaldehyde release shall be determined according to EN 717-1 if raw materials containing formaldehyde are used in the production process.

The test results shall be expressed in [mg/m^3] and stated in the ETA according to "Classification criteria for the class E1 and E2, for the emission of formaldehyde" as follows:

E1 Equilibrium concentration of formaldehyde in the air of a test chamber: ≤ 0,124 mg/m³

E2 Equilibrium concentration of formaldehyde in the air of a test chamber: > 0.124 mg/m³

2.2.19.7 Phenol

The release of phenol should be determined according to EN ISO 16000-9 if raw materials containing phenol are used in the production process.

The test results, according to EN ISO 16000-9, of the equilibrium concentration of phenol in the air of a test chamber shall be expressed in [µg/m^3] and stated in the ETA.

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System(s) of assessment and verification of constancy of performance to be applied

For the products covered by this EAD the applicable European legal act is: Decision 97/176/EC for "structural timber products and ancillaries", amended by the decision 2001/596/EC.

The system is: 1.

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 2.

Table 2 Control plan for the manufacturer; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC) [**including testing of samples taken at the factory in accordance with a prescribed test plan**]					
1	Swelling in thickness	EN 317	Acc. to the Control Plan	3	Every batch
2	Tolerances and dimensions	EN 324		3	Every batch
3	Edge bending strength (alternatively flat bending)	See Clause 2.2.1 (See Clause 2.2.2)		3 (≥ 1 per shift and production line)	Every batch
4	Parallel MOE	See Clause 2.2.10		3 (≥ 1 per shift and production line)	Every batch
5	Density	EN 323		3 (≥ 1 per shift and production line)	Every batch
6	Reaction to fire	ISO 5660-1		3	Every year or every 300 m^3 of production volume

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance for LSL are laid down in Table 3.

Table 3 Control plan for the notified body; cornerstones

No	Subject/type of control	Test or control method	Criteria	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control					
1	The notified body shall ascertain that, in accordance with the prescribed control plan (FPC), the manufacturing plant of the product manufacturer, in particular personnel and equipment, and the factory production control are suitable to ensure a continuous and orderly manufacturing of the Laminated Strand Lumber (LSL) considering production gluing stage, additives, preservation against bio attack and fire-retardant addition stages	-	Laid down in control plan	-	When starting the production or a new production line-
Continuous surveillance, assessment and evaluation of factory production control					
2	It shall be verified by routine inspections of the notified body that the system of factory production control and the specified manufacturing process are maintained taking account of the prescribed control plan (FPC). like gluing stage, additives, preservation against bio attack and fire-retardant addition stages	-	Laid down in control plan	-	Once a year

4 REFERENCE DOCUMENTS

CEN/TR 14823:2003	Durability of wood and based-wood products-quantitative determination of pentachlorophenol in wood-gas chromatographic method.
EN 317:1993	Particleboards and fibreboards. Determination of swelling in thickness after immersion in water.
EN 322:1993	Wood-based panels – Determination of moisture content.
EN 323:1993	Wood-based panels – Determination of density.
EN 324-1:1993	Wood-based panels – Determination of dimensions of boards – Part 1: Determination of thickness, width and length.
EN 324-2:1993	Wood-based panels – Determination of dimensions of boards – Part 2: Determination of squareness and edges straightness
EN 335:2013	Durability of wood and wood-based products – Use classes: definitions, application to solid wood and wood-based product.
EN 408:2010/A1:2012	Timber structures – Structural timber and glued laminated timber – Determination of some physical and mechanical properties.
EN 717-1:2004	Wood-based panels – Determination of formaldehyde release – Part 1: Formaldehyde emission by the chamber method.
EN 789:2006	Timber structures – Test methods – Determination of mechanical properties of wood based panels.
EN 1363-1:2012	Fire resistance tests - Part 1: General Requirements.
EN 1995-1-1:2004/ AC:2006/A1:2008/A2:2014	Eurocode 5 – Design of timber structures – Part 1-1: General rules and rules for building.
EN 1995-1-2:2004/AC:2009	Eurocode 5 – Design of timber structures – Part 1-2: General rules – Structural fire design.
EN 13501-1:2018	Fire classification of construction products and building elements – Part 1: Classification using test data from reaction to fire tests.
EN 14358:2016	Timber structures - Calculation and verification of characteristic values.
EN 14374:2004	Timber structures – Structural laminated Veneer Lumber – Requirements.
EN ISO 16000-9:2006	Indoor air -- Part 9: Determination of the emission of volatile organic compounds from building products and furnishing – Emission test chamber method (ISO 1600-9:2006)
EN ISO 16000-11:2006	Indoor air -- Part 11: Determination of the emission of volatile organic compounds from building products and furnishing -- Sampling, storage of samples and preparation of test specimens.
EN 16516:2018	Construction products: Assessment of release of dangerous substances - Determination of emissions into indoor air
ISO 5660-1:2015	Reaction-to-fire tests -- Heat release, smoke production and mass loss rate -- Part 1: Heat release rate (cone calorimeter method) and smoke production rate (dynamic measurement).

ANNEX A DETERMINATION OF THE CHARRING RATE

A.1 Method 1: Pilot Furnace Test

A.1.1 Characteristics of the samples to be tested

Three samples of identical dimensions of 300 mm in length are tested. The section, according to the thickness to be tested with the face exposed to fire, of a minimum width of 90 mm and maximum of 120 mm. The thickness will be depending on the nominal to be tested between 30 and 100 mm.

In the case of exposure to face fire, a piece of 300x120 mm board will be used directly. To this board another piece will be glued in the sense of the thickness in case of being inferior to 60 mm.

In the case of exposure to edge fire, if the thickness of the board is less than 90 mm, two boards will be glued symmetrically, one for each side, until this thickness is reached at least.

A.1.2 Conditioning

The samples will be conditioned by a minimum of 48 h at stable conditions of 50 % humidity and 23 ºC, until reaching the stability demonstrated by a difference of less than 0.1% between consecutive weighing carried out at 24 h periods.

Once stabilized, density and humidity shall be determined according to EN 322.

A.1.3 Samples preparation

Samples will be adequately protected so that they are only exposed to heating conditions on two of their faces (see Figure A1 and A2). To determine the progress of carbonization, suitable thermocouples will be used according to Annex C of EN 1363-1.

Two thermocouples will be placed at 30 mm from the exposed face and at least 50 mm apart, so that they do not affect the heating process. All probes should be kept at least 100 mm from the edges (see Figure A3).

A.1.4 Placement of the samples in the test position

The samples will be installed in the furnace soffit in a horizontal position, fixed on the roof by means of a suitable fixing system that does not interfere in the heating process. A distance of 100 mm shall be stored between each sample and 150 mm with the vertical walls of the furnace.

A.1.5 Test conditions

The heating curve will be the cellulosic curve specified in point 5.1.1 of EN 1363-1.

The roof from where the sample will be held will be made of inert material.

The furnace control thermocouples will be in accordance with EN 1363-1, placed 100 mm from the bottom of the sample, on the axis between samples, see Figure A1.

The pressure level inside the furnace will be controlled according to the indications of clause 5.2.1 of the EN 1363-1 standard in order to maintain an overpressure of 5 Pa to 100 mm below the specimens.

A.1.6 Test procedure

To determine the progress of carbonization, initially the temperature of 300 ºC is considered adequate.

The heating curve will be maintained until the probes placed at 30 mm reach 300 ºC, at which time the test will end. The times in which the aforementioned temperature is reached in each probe will be recorded, both those placed as control thermocouples, $T_{300\,(0)}$, and 30mm, $T_{300\,(30)}$, of the exposed surface.

Immediately after finishing the test, the sample will be turned off with water and the progress of the carbonization in the sample will be checked visually, making cross sections. The procedure is considered adequate when:

- There is a difference of less than 10% between the carbonization depth recorded visually and that registered by measuring temperatures.

- It is observed that the maximum depth of carbonization has been representative with the line of thermocouples.

After performing the visual check and in case of having to make any adjustment, the adjustment will be made on the carbonization temperature of the material tested. This adjustment will be clearly indicated in the test report.

The values of T_{300} in the 3 samples will be recorded and will be indicated in the reports next to the $T_{300\ media.}$

Being:
- T_{300}: Time in minutes to reach 300ºC.
- $T_{300media}$: Average value between the control thermocouples ($T_{300\ (0)}$), as at 30 mm ($T_{300\ (30)}$).

The carbonization rate will be the quotient of the distance between probes, 30 mm divided by the difference between the elapsed time $T_{300\ (0)\ media}$ and the $T_{300\ (30)\ media}$, for each sample.

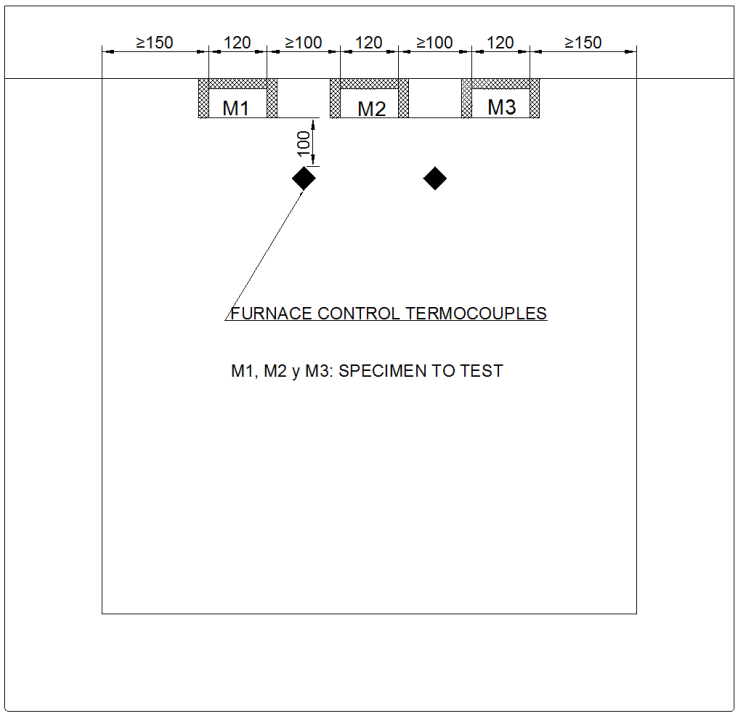
To determine the characteristic carbonization rate of the material, the characteristic temperatures of 3 identical samples will be studied. So that:

$$T_{300}\ characteristic = (T_{300\ min} + T_{300\ media}) / 2.$$

As a result of this test, the characteristic carbonization velocity will be presented in both directions: perpendicular to the face of the board ($ß_{0fchar}$) and perpendicular to the edge of the board ($ß_{0echar}$).

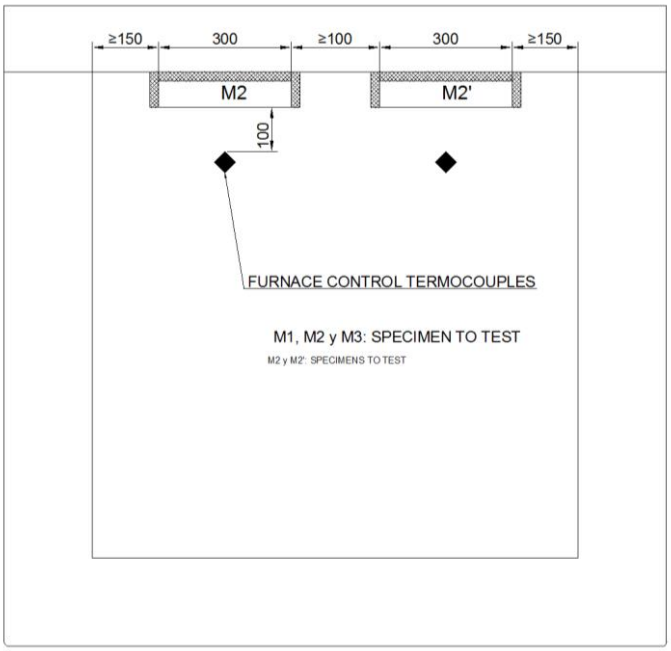
A.1.7 Specifications

Given the possible heterogeneity of the LSL material, 3 samples will be tested in each direction, three on the face and three on the edge, with two probes at 30 mm each, which will give six values for each of the depths for the face and another six for edge.



M1, M2, M3: Samples in test layout
♦ Thermocouples control of the furnace to 100 mm of the samples

Figure A.1: Samples placed in the top of furnace chamber. Cross section.



M1, M2: Samples in test layout

♦ Thermocouples control of the furnace to 100 mm of the samples

Figure A.2.Samples located on the top of the furnace. Longitudinal section.

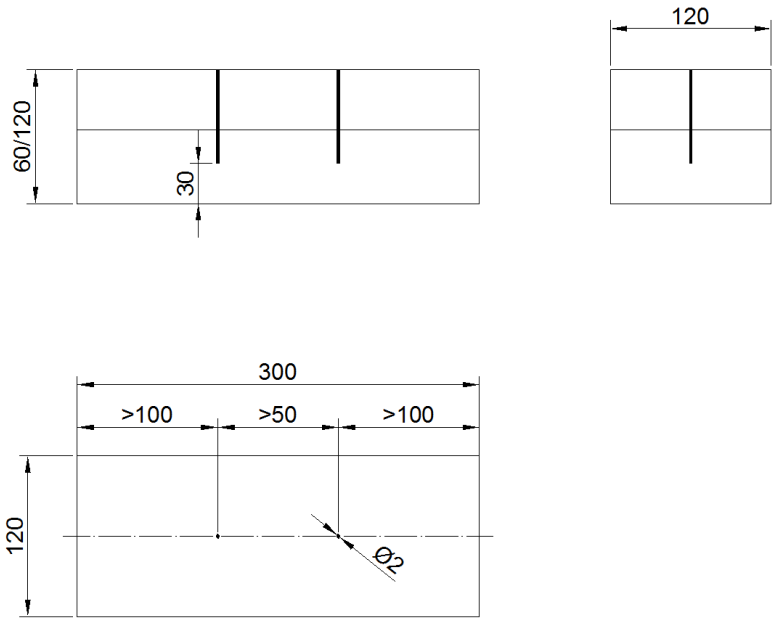


Figure A.3: Thermocouples situation. Exposed face of the sample.

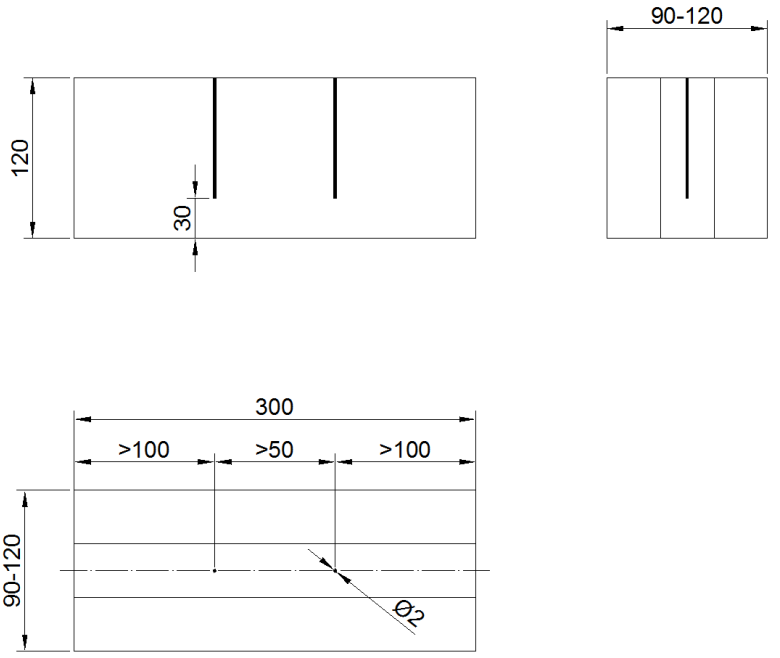


Figure A.4: Thermocouples situation. Exposed edge of the sample.

A.2 Method 2: Cone calorimeter

The determination of the charring rate (β_0) may be carried out using the cone calorimeter and the following procedure:

- The minimum number of samples shall be 3. Another 3 samples could be required depending on the results, as described in the ISO 5660-1.
- Conditioning of samples with given dimensions at (20±2) °C and (65±5) % relative humidity.
- Instrumentation of the samples using thermocouples placed in the central region of the blocks and at different depths from the face.
- Exposition of the samples to a constant heat flux (carry out the test for three different heat fluxes, e.g. 35, 50, and 65 $kW \cdot m^2$).
- Determination of the char depth using the thermocouples to locate the 300 °C isotherm, which characterizes the char front within the samples.
- Interpolation of the time to reach 300 °C through the samples and averaging of the results for all the samples and all heat fluxes.
- Evaluation of the one dimensional charring and the notional charring (β_n). The mean value of the charring rate will be expressed in mm/min and shall be given in the ETA.