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**BAUSÄTZE FÜR DEN HOLZBAU**

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## Vorbemerkungen zur Leitlinie für die europäische technische Zulassung für

# BAUSÄTZE FÜR DEN HOLZBAU

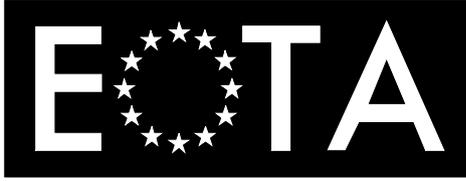
### Vorbemerkungen

Leitlinien für die europäische technische Zulassung wurden aufgrund eines von der Kommission der Europäischen Gemeinschaften nach Art. 11 Abs. 1 der Richtlinie des Rates vom 21. Dezember 1988 zur Angleichung der Rechts- und Verwaltungsvorschriften der Mitgliedstaaten über Bauprodukte (89/106/EWG) (Bauproduktenrichtlinie) erteilten Auftrages vom Gremium der von den Mitgliedstaaten bestimmten Zulassungsstellen (EOTA) erarbeitet.

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Stand, August 2013



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European Organisation for Technical Approvals  
Europäische Organisation für Technische Zulassungen  
Organisation Européenne pour l'Agrément Technique

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Established pursuant to Annex II of the Council Directive 89/106 of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products (Construction Products Directive)

## ETAG 007

### GUIDELINE FOR EUROPEAN TECHNICAL APPROVAL of TIMBER BUILDING KITS

Edition November 2012

This Guideline for European Technical Approval is established and published in accordance with Article 11 of the Construction Products Directive as a basis for the preparation and issue of European Technical Approvals in accordance with Article 9.1 of the Construction Products Directive.

European Technical Approvals are issued by approval bodies authorised and notified in accordance with Article 10 of the Construction Products Directive. These bodies are organized in EOTA.

The European Technical Approval, according to the Construction Products Directive, is a favourable technical assessment of the fitness for use of a construction product and the technical specification of the assessed product, serving as basis for the CE Marking of this product when and where a harmonised standard according to the Directive is not or not yet available.

Due to technical innovation and the progress of the state of the art, guidelines for technical approval might not reflect the latest developments and experiences gained in approval procedures. The reader of this Guideline is therefore advised to check with an EOTA member whether there are further provisions which have to be taken into account in the use of the Guideline.

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This edition replaces edition April 2001 of ETAG 007  
and edition June 2002 of ETAG 012

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## FOREWORD

### Background to the subject

This Guideline has been drawn up by EOTA Working Group 02.03/01 – Timber Frame Building Kits.

The Working Group for the first edition of this ETAG consisted of members from 11 EEC countries: Austria, Belgium, Finland, France, Germany, Italy, Netherlands, Norway (convenorship), Portugal, Sweden and United Kingdom. In addition Denmark, Iceland and Slovenia have been corresponding members together with members appointed by CEI-Bois.

The first edition of this Guideline was restricted to timber frame building kits and was setting out the performance requirements for timber frame building kits used in building construction, the verification methods used to examine the performance, the assessment methods used to evaluate the performance for the intended use, and the presumed conditions for the design and installation of the kits in the works.

Timber building kits according to this Guideline are construction products defined in the Mandate (ref Construct 98/307, Rev 1) as follows:

This Mandate covers those industrially prepared kits, marketed as a building, that are made of pre-designed and prefabricated components intended for production in series. This Mandate defines minimum requirements on the contents of such a kit. Partial kits falling below these minimum requirements are outside the scope of the Mandate and shall not be CE Marked on the basis of the resulting ETAG. These minimum requirements comprise all of the following: the structural elements of the building, the essential components of the external envelope including all necessary thermal insulation, and the internal linings in so far as they are necessary for the satisfaction of the Essential Requirements applied to the building.

The design process (including the approval of detailed plans, applications for planning permission, building permits,..) must comply with the procedures foreseen in the Member States in which the house is to be built. This Mandate does not amend this process in any way. The completed building (the works) must comply with the building regulations (regulations on works) applicable in the Member States in which the house is to be constructed. The procedures foreseen in that Member State for demonstrating compliance with the building regulations must also be followed by the entity held responsible for this act. This Mandate does not amend this process in any way.

Although some components may be prepared in different factories, only the final kit for delivery, and not the different components, can be CE Marked as a whole, under the responsibility of the seller.

The declared performance of the kit shall be compared with the relevant requirements in the building regulations from case to case, taking into account the intended use of the kit in relation to type of building, site, etc. An ETA is a favourable technical assessment of a construction product for an intended use, i.e. incorporated in the works. The ETA deals only with the kit, and states classes or levels of product characteristics to be used by the designer of the works.

Verification and assessment methods of loadbearing performance are based on the provisions in Eurocode 5 (EN 1995) which is replacing national structural design codes of timber structures in all the Member States. A condition for the application of this guideline to CE Marked timber frame building kits is that declared structural performance based on Eurocode 5 is accepted in the Member States in relation to their building regulations.

Verification of the performance of timber frame building kits requires an assessment of many construction details, such as the performance of joints between prefabricated elements with respect to air permeability and durability, the strength of lining materials with respect to impact loads and safety in use, or watertightness of internal wet areas. Relevant standardised verification methods may not always be available or judged to be necessary since the performance of many construction details has been proven to be acceptable by long-term experience from use in traditional designs. In accordance with the general advice in the Format of Guidelines for ETAs it is recognised in this Guideline that some kit properties can be assessed by a pass/fail approach on the basis of engineering judgement and experience from the use of well-known materials and designs.

### **Reference documents**

Reference documents are referred to within the body of the ETAG and are subject to the specific conditions mentioned therein.

The **list of reference documents** for this ETAG is given in section 7. Should new parts for this ETAG be added at a later date, they may comprise modifications to the list of reference documents applicable to that part.

### **Updating conditions**

The edition of a reference document given in this list is that which has been adopted by EOTA for its specific use. When a new edition becomes available, this supersedes the edition mentioned in the list only when EOTA has verified or re-established (possibly with appropriate linkage) its compatibility with the guideline.

**EOTA Technical Reports** go into detail in some aspects and as such are not part of the ETAG, but express the common understanding of existing knowledge and experience of the EOTA bodies at that moment. When knowledge and experience is developing, especially through approval work, these reports can be amended and supplemented.

**EOTA Comprehension Documents** permanently take on board all useful information on the general understanding of this ETAG as developed when delivering ETAs in consensus by the EOTA members. Readers and users of this ETAG are advised to check the current status of these documents with an EOTA member.

EOTA may need to make alterations/corrections to the ETAG during its life. These changes will be incorporated into the official version on the EOTA website [www.eota.eu](http://www.eota.eu) and the actions catalogued and dated in the associated History File.

Readers and users of this ETAG are advised to check the current status of the content of this document with that on the EOTA website. The front cover will indicate if and when amendment has taken place.

### **Second edition 2012**

The second edition of the ETAG was prepared in 2008/2011 by an EOTA WG consisting of members from eleven countries. The revision included the adoption of the new ETAG format, a general updating of references to applicable standards and amplification of some clauses where experience has shown the need for clarification.

The ETAG has also been widened in scope to cover all timber-based building kits, not only timber frame structures, and includes now the former ETAG 012 for log building kits. Log building kits are included due the fact that most clauses of ETAG 007 are equally applicable for log building kits.

# 1 SCOPE OF THE ETAG

## 1.1 Definition of the construction product

A “kit” is a special form of a “construction product” in the sense of the CPD. It consists of several “components” which are:

- placed on the market together with one common CE Marking
- assembled on site, and thus
- become an “assembled system” when installed in the construction works.

There shall be one manufacturer responsible for the kit to be delivered.

A kit component may itself, as a construction product in the sense of the CPD, bear the CE Marking in its own right on the basis of a product hEN or ETA. Nevertheless, it may need to be assessed again as a component of the kit.

This Guideline covers those industrially prepared timber-based building kits, marketed as a building, that are made of pre-designed and prefabricated main building parts intended for production in series. The main building parts of the kits are floor, wall and roof structures. These building parts may be assembled at the factory into larger entities, e.g. volumetric units.

The parts in a kit may be manufactured as pre-cut timber members, logs or prefabricated structural components supplemented with additional materials on site, as completely prefabricated two-dimensional building elements, or as building modules where the floors, walls and roof are connected in the factory. Although some parts may be prepared in different factories, only the final kit for delivery, and not the different components, can be CE Marked as a whole, under the responsibility of the ETA holder.

The minimum content of the kit to be assessed shall include the following items, as far as is necessary for the satisfaction of the Essential Requirements applied to the building:

- all structural elements necessary for the stability of the building including walls, floors, roof structures, their connections, and the connections of the building to the substructure
- all components of the external envelope, including all necessary thermal insulation, internal linings, fire protection, vapour control provisions and external waterproofing
- all components of the internal walls including acoustic insulation, internal linings and fire protection
- preparatory measures for the installation of plumbing, heating, cooling, ventilation and electrical services where applicable.

The kits are assembled according to pre-designed technical solutions for joints and construction details, which are part of the product specification for assessment and are supplied as part of each kit.

Components such as windows, external doors, thermal insulation, brick cladding, internal linings and roofing materials, which are essential for the performance of the external envelope, may not necessarily be part of the kit, but shall always be specified as a condition for the fitness in use of the kit. The connections and detailing of the interface between such components and the kit shall always be part of the kit description.

Products such as internal doors, stairs or surface coverings may be part of the timber building kit.

Service installations and complementary structures (including foundations or substructures) are not covered by this Guideline.

## 1.2 Intended use of the construction product

The ETAG covers timber building kits for low-rise and multi-storey residential, institutional, commercial and industrial buildings where timber-based construction is applicable.

Kits covered by this guideline can be used in seismic areas if assessed adequately. The assessment criteria and methods considered in this ETAG allow the assessment of the kit only as non-dissipative or low-dissipative structures, defined according to Eurocode 8 (EN 1998-1:2004) clauses 1.5.2 and 8.1.3 b), and applicable national rules on works. For the use as dissipative structures, defined according to EN 1998-1:2004, clause 8.1.3. a), the assessment shall be performed in accordance with the applicable necessary specific rules reported in EN 1998-1:2004 (clauses 8.1.3, 8.2, 8.3, 8.4, 8.5 and 8.6) and applicable national rules on works. When the manufacturer intends to declare a use of the kit also as dissipative structure, and while the necessary tests and criteria for the assessment as dissipative structures are not defined in the ETAG, the Approval Body shall define these necessary tests and criteria, taking into account the national regulatory requirements of the Member State(s) for the use of the kit. In these cases the tests and criteria shall be adequately detailed in the ETA, and all elements, connections and joints that are intended to ensure dissipative behaviour of a building kit shall be clearly defined and detailed in the ETA for the specific kit. The methods of verifications, suitable for possible types of elements, connections and joints (for example: according to EN 12512:2001), as well as the requirements (e.g.: according to Eurocode 8) shall be explicitly indicated in the ETA. If the specific assessment as dissipative structure is not performed, it shall be declared in the ETA that the kit has been assessed only as non-dissipative or low-dissipative structures.

## 1.3 Assumed working life of the construction product

The provisions and the verification and assessment methods included or referred to in this ETAG have been based upon the assumed working life of the timber building kit for the intended use of 50 years for the loadbearing structure and for non-accessible components and materials, and 25 years for repairable or replaceable components and materials such as claddings, roofing materials, exterior trims, and integrated components such as windows and doors, provided that the timber building kit is subject to appropriate installation, use and maintenance (see clauses 4.3 and 4.4). The use of components and materials with shorter intended working life shall be clearly stated in the ETA. These provisions are based upon the current state of the art and the available knowledge and experience.

“Assumed working life” means that, when an assessment following the ETAG provisions is made, and when this working life has elapsed, the real working life may be, in normal use conditions, considerably longer without major degradation affecting the Essential Requirements<sup>1</sup>.

The indications given as to the working life of the timber building kit cannot be interpreted as a guarantee given by the kit manufacturer or his representative or the Approval Body issuing the ETA, but are regarded only as a means for choosing the appropriate products in relation to the expected economically reasonable working life of the works (see clause 5.2.2 of the Interpretative Documents).

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<sup>1</sup> The real working life of a product incorporated in a specific construction depends on the environmental conditions to which that construction is subject and the particular conditions of the design, execution, use and maintenance of that construction. Therefore, it cannot be excluded that there are cases in which the real working life of the product may also be shorter than the assumed working life.

## **1.4 Terminology**

### **1.4.1 Common terms relating to the Construction Products Directive**

The meaning of these terms is given in the EOTA document *Common terms used in Guidelines for ETAs* published on the EOTA website.

### **1.4.2 Specific terms used in this ETAG**

#### **1.4.2.1 Design climatic conditions**

Outdoor and indoor air temperatures and moisture levels, snow loads, wind speed levels, etc, which may be stated in national building regulations or in other specifications to be used for design are known as 'design climatic conditions'.

#### **1.4.2.2 Integrated components**

Integrated components such as windows, doors and conduits are built into the main building parts.

#### **1.4.2.3 Joint/Connection**

A joint or connection is a junction between two materials, components, elements or parts of a building.

#### **1.4.2.4 Pre-designed**

'Pre-designed' is defined as pre-determined technical solutions.

#### **1.4.2.5 Production in series**

Production of building kits for a series of buildings on the basis of the same, or similar materials, structural design and construction details is known as 'production in series'. The buildings and components do not have to be exactly the same size or shape.

#### **1.4.2.6 Separating walls and floors**

Walls and floors are described as 'separating' where national regulations can require sound insulation, fire resistance performance, etc.

#### **1.4.2.7 Suspended floors**

Floor structures with a free span between supports are known as suspended floors.

#### **1.4.2.8 Two-stage principle**

The two-stage principle is a design principle for claddings, joints, etc in the exterior envelope. An outer layer serves to protect an inner layer from direct driving rain and sun radiation. The space between these layers is ventilated and drained.

#### **1.4.2.9 Wet area**

A wet area is defined as a floor or wall area in a bathroom or other "wet room" where the surface may be exposed to water spray from showers, etc.

## **1.5 Procedure in the case of a significant deviation from the ETAG**

The provisions of this ETAG apply to the preparation and issue of European Technical Approvals in accordance with Art. 9.1 of the CPD and section 3.1 of the Common Procedural Rules.

In cases in which a certain provision of this ETAG is not, or not fully, applicable or a particular aspect of a kit, kit component, assembled system and/or intended use to be assessed is not, or not sufficiently, covered by the methods and criteria of the ETAG, the procedure of Art. 9.2 of the CPD and section 3.2 of the Common Procedural Rules may apply with regard to the deviation or aspect concerned.

## 2 ASSESSMENT OF FITNESS FOR USE

### 2.1 Meaning of “fitness for use”

“Fitness for (the intended) use” of a construction product means that the product has such characteristics that the **works** in which it is to be incorporated **can**, if properly designed and built:

1. **satisfy** the Essential Requirements when and where such works are subject to regulations containing such requirements (CPD Art. 2.1), and
2. **be fit** for their intended use, account being taken of economy, **and** in this connection **satisfy** the Essential Requirements for an economically reasonable working life, if normally maintained (see CPD, Annex I, sentences 1 and 2).

In the case of kits, “fitness for (the intended) use” refers to:

- a) the characteristics of the assembled system (they shall be such that the works in which the kit is to be incorporated, assembled, applied or installed, can, if properly designed and built, satisfy the Essential Requirements when and where such works are subject to regulations containing such requirements), as well as
- b) the characteristics of the components of the assembled system (they shall be such that the assembled system, if properly assembled, has the characteristics referred to in clause (a) above).

### 2.2 Elements of the assessment of fitness for use

In the case of kits, the assessment of the fitness for use includes:

- the identification of the characteristics of the assembled system which are relevant to its fitness for use (in the following referred to as “regulatory system characteristics”)
- the establishment of methods for the verification and assessment of the regulatory characteristics of the assembled system and the expression of the respective performances
- the identification of regulatory characteristics to which the option “No Performance Determined” (NPD) applies for the reason that in one or more Member States they are not relevant for the fulfilment of the requirements applicable to the works
- the identification of regulatory characteristics for which limit values (threshold values) have to be respected for technical reasons;

and for the components of the assembled system, as far as is relevant:

- the identification of the component characteristics which are relevant to the fitness for use of the assembled system (referred to as “regulatory component characteristics” in the following items)
- the establishment of methods for the verification and assessment of the regulatory component characteristics and the expression of the respective performances
- the identification of regulatory component characteristics to which the option “No Performance Determined” (NPD) applies for the reason that in one or more Member States they are not relevant for the fulfilment of the requirements applicable to the works
- the identification of regulatory component characteristics for which limit values (threshold values) have to be respected for technical reasons.

Note:

According to Art. 9.1 of the CPD, the ETA shall be based on examinations, tests and assessment.

## 2.3 Relationship of requirements to the characteristics of the assembled system and its components and methods of verification and assessment

The characteristics of the assembled system, methods of verification and assessment criteria, which are relevant for the fitness of the timber building kit for the intended use referred to in clause 1.2, are given in Table 1.

Table 1 Characteristics of the kits and methods of verification and assessment

Characteristic	Option "No Performance Determined" permitted	Method of verification and assessment	Expression of performance
(1)	(2)	(3)	(4)
<b>Essential Requirement 1: Mechanical resistance and stability</b>			
Resistance of walls, floor and roof structures and their connections against vertical and horizontal loads	No <sup>1)</sup>	Clause 2.4.1	Declared values (options according to clause 2.4.1.1)
<b>Essential Requirement 2: Safety in case of fire</b>			
Reaction to fire of materials and components	Yes	Clause 2.4.2.1	Classification
Resistance to fire		Clause 2.4.2.2	
External fire performance of roof covering		Clause 2.4.2.3	
<b>Essential Requirement 3: Hygiene, health and environment</b>			
Vapour permeability and moisture resistance	Yes	Clause 2.4.3.1	Declared performance (in the sense of estimated performances for the works)
Watertightness: - External envelope - Internal surfaces	No	Clause 2.4.3.2.1	
	Yes	Clause 2.4.3.2.2	
Content and/or release of dangerous substances	-- <sup>2)</sup>	Clause 2.4.3.3	Declaration
<b>Essential Requirement 4: Safety in use</b>			
Slipperiness of floors	Yes	Clause 2.4.4.1	Declared values/performance
Impact resistance		Clause 2.4.4.2	
<b>Essential Requirement 5: Protection against noise</b>			
Airborne sound insulation of walls, floors and roof structures	Yes	Clause 2.4.5.2	Declared values (in the sense of estimated values for the works)
Impact sound insulation of floors		Clause 2.4.5.3	
Sound absorption		Clause 2.4.5.4	
<b>Essential Requirement 6: Energy economy and heat retention</b>			
Thermal resistance	Yes	Clause 2.4.6.1	Declared values (in the sense of estimated values for the works)
Air permeability		Clause 2.4.6.2	
Thermal inertia		Clause 2.4.6.3	

<sup>1)</sup> With specific exceptions in relation to the intended use (e.g. resistance to seismic actions only relevant for seismic areas)
<sup>2)</sup> For meaning of npd option regarding ER3 see EOTA TR "General checklist for ETAGs/CUAPs/ETAs - Content and/or release of dangerous substances in products/kits".

### Note:

Instead of using the methods and criteria given in Table 1, column 3 for ER3 and of aspects of durability and serviceability, the performance with regard to the characteristic(s) concerned may also be established by long-term experience on site, provided that:

- 1 this long term experience is well documented, and
- 2 the kit/system for which the performance is established by this long-term experience is relevant for the approval procedure.
- 3 Long term experience is applicable only when it is based on experience on similar climatic conditions compared to the intended use of the kit

Table 1 continued

Characteristic	Option "No Performance Determined" permitted	Method of verification and assessment	Expression of performance
(1)	(2)	(3)	(4)
General aspects relating to fitness for use <sup>3)</sup>			
Aspects of durability: - Durability in relation to intended use and the effect on the declared performance related to ER1 – ER6	No	Clause 2.4.7.1	Declared performance
Aspects of serviceability: - Deflections related to the resistances declared under ER1 - Stiffness against floor vibrations - Settling of construction	Yes	Clause 2.4.7.2	Declared values
Identification of materials and performance	No	Clause 2.4.7.3	Declared identification parameters and performance

<sup>3)</sup> Aspects of durability and economy of the works (see CPD, Annex 1, sentences 1 and 2) which are not dealt with under Essential Requirements 1 to 6. Such aspects are also referred to as "serviceability".

## 2.4 Characteristics of the assembled system relevant for the fitness for use

### 2.4.1 Mechanical resistance and stability (ER 1)

#### 2.4.1.1 Method of verification

##### 2.4.1.1.1 Verification of mechanical resistance in general

Mechanical resistance and stability can be verified either by calculation or testing, or a combination of both (design assisted by testing), and shall when relevant include resistance against disproportionate collapse. Mechanical resistance of pre-designed structural parts of the kit, including relevant connections/joints, shall be verified for conformity with the basis of design as given in EN 1990. The need and extension of further structural calculations depends on which verification method is chosen for the ETA and the CE-marking.

The properties of structural materials and components related to mechanical resistance and stability shall be specified in the ETA as simply as possible with regard to the needs of fulfilling national provisions. This may be done by expressing the properties in terms of one of the methods indicated in EC Guidance Paper L Application and use of Eurocodes:

- Method 1: Indication of geometrical data of the components and of properties of the materials and constituent products used
- Method 2: Declaration of the structural performance of standard structures, expressed as characteristic or design values
- Method 3a: Reference to design documents of the purchaser
- Method 3b: Reference to design documents produced and held by the manufacturer according to the order for the works

##### *Method 1*

Method 1 is used to provide the basis for case by case calculations of the structural parts of the kit related to specific works. The standard components of the kit shall be defined by geometrical data and mechanical properties. Mechanical properties may be based on standardised values or by test results.

### *Method 2*

Method 2 is used to declare mechanical resistance directly when the kit has one or a limited number of load-bearing structural designs. Characteristic resistance values compatible with the Eurocode system shall be calculated, or determined on the basis of test results.

Design resistance values may be given. In that case, the parameters used for calculation shall be declared, including special National Determined Parameters when such have been applied.

### *Method 3a*

Method 3a is related to the situation where the design calculations are made by the designer of the works, and the structural design specifications are given by the purchaser of the kit to the manufacturer.

### *Method 3b*

Method 3b is related to the situation where the structural design calculations are made case by case by the manufacturer, following the provisions of the client's order for the works. The approval body shall ensure that the manufacturer has the necessary competence to perform the structural design calculations.

The chosen methods shall be clearly specified in the ETA and the CE-marking.

## **2.4.1.1.2 Verification by calculation**

### *General*

Calculations of structural performance declared in ETAs shall be based on EN 1995-1-1, as well as relevant parts of EN 1991 and EN 1998, supported by relevant harmonised product standards and relevant supporting reference standards.

The detailed structural analyses to verify the declared mechanical resistance and stability shall always be available to the Approval Body as part of the technical file for the ETA.

### *Special provisions for log building kits*

There are no special calculation methods in EN 1995-1-1 for log building structures, and the verification of mechanical resistance must to some extent be based on calculation methods which are described case by case, if necessary supported by tests. The following principles should normally be accepted:

- The vertical load bearing surface may be assumed to be the whole seam area between logs. The seam between logs does not transfer tensional forces
- An inclination up to 1:1 for calculating vertical point load distribution according to EN 1995-1-1 cl.6.1.5 may be used
- Resistance against buckling under vertical load is improved by cross corners or additional reinforcing components. Because of buckling, reduced value for compression perpendicular to the log shall be used. When required by the Approval body, buckling resistance shall be verified by tests.
- Resistance against horizontal loads may be considered to be acceptable without special calculations. Limitations concerning constructional details as height of the building, size of the walls, openings in the walls, structure of the intermediate floor, log thickness etc. shall be given in the ETA. When required by the Approval body, resistance against horizontal loads shall be verified by tests.

### *Seismic actions*

Supplementary calculations relevant for the resistance against seismic actions should be carried out according to the provisions in EN 1998-1.

Other information on resistance against seismic actions based on the various national determined parameters given in national annexes or other national regulations may be taken into account for the specific structural design for each individual works.

#### **2.4.1.1.3 Verification by testing**

The test procedures shall, in general, follow EN 380 and other relevant EN standards for testing of wood-based components and materials, see chap. 7. When the distribution of the tested property can be assumed to be lognormal, EN 14358 should be used to calculate the characteristic value. Otherwise, a nonparametric method as given in EN 384 should be used.

Test methods used for the assessment of the loadbearing performance shall be specified with complete references to the number and edition of the standard, the conditioning of the specimens and, if relevant, any deviations made from the standard.

When full scale tests of main building parts are used, the verification of the loadbearing performance should normally be based on tests of at least three similar test specimens.

#### **2.4.1.1.4 Verification by calculation assisted by testing**

Calculation assisted by testing can be used to extrapolate test results obtained from one type of structure to another (e.g. varying thickness or detailing) or to other use conditions (e.g. humidity or eccentricity of the load). In order to obtain specific data for calculation (e.g. resistance of wall connections or reinforcements) tests on small specimens may also be used.

Calculation assisted by testing shall be carried out according to EN 1990. Accompanying calculations shall be based on relevant parts of EN 1991, EN 1995 as well as EN 1998.

Tests, and the analysis of tests, shall be based on reference standards of EN 1995-1-1 and on the harmonised product standards, so that the resulting properties are compatible with the Eurocodes system. When the underlying distribution of the tested property can be assumed to be log-normal, calculations based on the guidance given in EN 14358 should be used to calculate the characteristic value. Otherwise, a non-parametric method as given in EN 384 should be used.

### **2.4.1.2 Method of assessing and judging**

#### **2.4.1.2.1 Assessment and declaration according to Method 1**

##### *Load-bearing walls*

For timber frame walls, the standard parts of the frame shall be defined by cross section, spacing and (maximum) length. The strength of the timber material shall be given, e.g. by reference to the strength class according to EN 14080, EN 14081-1 or other harmonized specifications for loadbearing timber products.

For log walls, the overall cross section of the logs shall be defined (thickness, depth and overall shape). The strength of the timber material shall be given, preferably by reference to the strength class according to EN EN 14081-1. The maximum height of the wall shall be given. Also, the maximum unsupported length of the wall shall be given together with information about which kinds of supports are considered to be structural.

For other wall types, corresponding information shall be given as relevant.

Any standard constructions at wall openings shall be described correspondingly.

##### *Suspended floors and roof structures*

For timber beam construction, the standard load bearing components shall be defined by cross section, spacing and (maximum) span width. The strength of the timber material shall be given, e.g. by reference to the strength class according to 14080, EN 14081-1 or other harmonized specifications for loadbearing timber products.

For other construction types, corresponding information shall be given as relevant.

Any standard load bearing components at floor or roof openings shall be described correspondingly.

#### *Other structural components*

If the construction has other standard components as e.g. beams and posts, they shall be defined by relevant dimensions and strength properties.

### **2.4.1.2.2 Assessment and declaration according to Method 2**

#### *Parameters for calculating design resistances*

National Determined Parameters may apply according to EN 1995-1-1 and EN 1991. It shall be declared in the ETA and the CE-marking which parameters have been used in the assessment for the ETA.

#### *Loadbearing walls*

For timber frame walls, the following properties are normally declared:

- Characteristic or design vertical resistance kN/m
- Characteristic or design racking resistance kN/m in plane of the wall
- Characteristic or design horizontal resistance kN/m<sup>2</sup> perpendicular to the wall

Racking resistance should normally be declared on the basis that vertical uplift of walls is prevented by separate anchors designed for each individual works. Anchorage may be achieved by the permanent actions on the construction.

For other wall types such as log walls or massive timber walls, at least vertical resistance shall normally be declared. Also, the maximum unsupported length of log walls shall be declared together with information about the kinds of supports to be considered structural. Loadbearing performance shall be declared for specific wall heights.

#### Notes:

- Vertical load resistances for wall structures may include openings for windows and doors where the kit has standard openings with specified dimensions, and standard load bearing components around the openings.
- Racking load resistances are normally declared only for wall sections without openings. The racking load should normally also be declared on the basis that vertical uplift of walls are prevented by separate anchors designed for each individual works.

#### *Suspended floors and roof structures*

For standard timber beam construction, the following structural performances are normally declared:

- Resistance in kN/m<sup>2</sup> against uniformly distributed vertical imposed load for specified maximum spans
- Resistance in kN against concentrated vertical load

Another option is to declare the following parameters, where relevant, for the floor structure:

- Characteristic bending moment resistance in kNm/m
- Characteristic shear force resistance in kN/m
- Characteristic horizontal diaphragm shear resistance in kN/m
- Stiffness of the construction in serviceability limit state, EI, in kNm<sup>2</sup>/m
- Weight of the construction kN/m<sup>2</sup>

For other construction types, corresponding information shall be given as relevant.

#### *Other structural components*

If the kit has other standard components as e.g. beams and posts and anchorages, the following properties may be declared:

- Characteristic bending moment resistance kNm/m

- Characteristic shear force resistance kN/m
- Characteristic normal force resistance in kN/m
- Stiffness of the components in serviceability limit state, EI, in kNm<sup>2</sup>/m
- Characteristic anchorage resistance of standard fixings, kN or kN/m

#### **2.4.1.2.3 Assessment and declaration according to Method 3a**

For Method 3a reference shall be made in an unambiguous way to the purchaser's structural design documents for the works. Being the design calculations carried out by the designer of the works, the approval body cannot take responsibility for the values of the mechanical resistance and stability.

#### **2.4.1.2.4 Assessment and declaration according to Method 3b**

For Method 3b reference shall be made in an unambiguous way to the manufacturer's structural design documents for the specific parts of the works according to the order. The approval body shall verify that the calculation methods are applied appropriately by the manufacturer.

#### **2.4.1.2.5 Resistance against seismic actions**

Density of material or components or total mass of the parts of a kit should be declared to determine the resistance against seismic actions for a kit, in addition to the mechanical resistance and stability mentioned in clause 2.4.1.2.2 and 2.4.1.2.3. In areas where structural design for seismic action is required, the resistance of connections between the parts of the kit which are relevant for the calculation of the resistance of the works shall also be declared for kits, as well as stiffness of wall elements and connections to allow calculation of interstorey drifts according to EN 1998-1:2004, chap. 4.4.3.1.

If the kit is intended to be used in areas with seismic actions its behaviour in this respect should be considered and clarified case-by-case, taking into account national rules on works, if needed.

### **2.4.2 Safety in case of fire (ER 2)**

#### **2.4.2.1 Reaction to fire of materials or components**

##### **2.4.2.1.1 Method of verification**

*Option 1: Materials or components not covered by Options 2 or 3*

The materials or components shall be tested, using the test method(s) relevant for the corresponding reaction to fire class, to be classified according to EN 13501-1.

*Option 2: Materials or components satisfying the requirements for the fire reaction class A1, without the need for testing*

The materials or components are considered to satisfy the requirements for performance class A1 of the characteristic reaction to fire, in accordance with the provisions of EC decision 96/603/EC (as amended) without the need for testing on the basis of their listing in that decision.

*Option 3: Materials or components classified without the need for further testing (CWFT)*

The materials or components are considered to satisfy the requirements for performance class of the characteristic reaction to fire, in accordance with the relevant EC decision without the need for further testing on the basis of their conformity with the specification of the materials or components detailed in that decision and their intended end use application being covered by that decision.

#### **2.4.2.1.2 Method of assessing and judging**

The materials or components shall be classified using one of the methods in 2.4.2.1.1. Mounting and fixing provisions in accordance with harmonised standards for the kit components shall be followed or, where relevant, they shall be in accordance with the intended use of the component in the kit.

### **2.4.2.2 Resistance to fire**

#### **2.4.2.2.1 Method of verification**

Resistance to fire can be verified by calculation or testing. In case of calculation EN 1995-1-2 applies, in addition to the methods for declaration of mechanical resistance according to clause 2.4.1.1.1 when method 2 or 3b is applied.

Tests shall be done on representative units according to the test methods specified in EN 13501-2. Other units may be evaluated to these test results. In case of testing fire resistance, load-bearing values and performance parameters considered in the test procedure shall be given in the evaluation report.

#### **2.4.2.2.2 Method of assessing and judging**

The range of classifications according to EN 13501-2 is applicable.

For load bearing building components with a classified resistance R to fire, the mechanical resistance when exposed to fire shall be given in accordance with EN 1991-1-2 and EN 1995-1-2, as well as the provisions in clause 2.4.1.2.

Note:

Resistance to fire R cannot be specified in the ETA or the CE-marking in case of Method 1.

### **2.4.2.3 External fire performance of the roof covering**

#### **2.4.2.3.1 Method of verification**

*Option 1: Roof covering not covered by Options 2 or 3*

The roof covering shall be tested using the test method relevant for the corresponding external fire performance roof class, to be classified according to EN 13501-5.

*Option 2: Roof covering is satisfying the requirements for the external fire performance, due to the deemed to satisfy list*

The roof covering is considered "deemed to satisfy" all the provisions for external fire performance of all national regulations of the Member States without the need for testing on the basis that it is included within the definitions given in EC decision 2000/553/EC and provided that any national provisions on the design and execution of works are fulfilled.

*Option 3: Roof covering is classified without the need for further testing (CWFT)*

The roof covering is considered to satisfy the requirements for performance class of the characteristic external fire performance in accordance with the relevant EC decision without the need for further testing on the basis of its conformity with the specification of the roof covering detailed in that decision and its intended end use application being covered by that decision.

#### **2.4.2.3.2 Method of assessing and judging**

The roof covering shall be classified using one of the methods in 2.4.2.3.1.

## **2.4.3 Hygiene, health and environment (ER 3)**

### **2.4.3.1 Vapour permeability and moisture resistance**

#### **2.4.3.1.1 Method of verification**

Assessment of the relevant building parts, including wet room envelopes, shall be undertaken on the basis of calculations according to EN ISO 13788, taking into account the relevant design climatic conditions. The assessment may also be based on experience, under the condition that the provisions for the assessment are laid down in the Evaluation Report.

The assessment of interstitial or internal surface condensation risk shall be based on the assumption that growth of micro-organisms is avoided if humidity in the timber structures inside the external sheathing or breather membrane only exceeds 80% RH for limited periods of time at design climatic conditions.

The risk of condensation can normally be verified on the basis of hygrothermal characteristics of the products used in each component and the construction details.

The water vapour resistance of the relevant layers should be based upon:

- Design values given in EN ISO 10456 or European technical specifications (harmonized product standards, ETAs)

or

- Tests according to EN ISO 12572 or European technical specifications (harmonized product standards, ETAs).

Note:

Design water vapour resistance factor  $\mu$  for materials is given in EN ISO 10456. The water vapour resistance is recommended to be converted in ETAs and evaluation reports to water vapour diffusion-equivalent air layer thickness  $s_d$  for a specific material thickness, as given directly in EN ISO 10456 for thin products.

In addition, the design of joints and any fixings/services penetrating any vapour control element or membrane shall be assessed in relation to the risk of airborne moisture coming into contact with cold surfaces within the construction.

Verification of condensation risks due to low surface temperatures or air leaks is given in clause 2.4.6. Moisture resistance of materials in terms of durability is covered under clause 2.4.7.

#### **2.4.3.1.2 Method of assessing and judging**

The assessment is undertaken with respect to both interstitial and internal surface condensation. The performance of the kit may be stated in the form of acceptable intended uses relevant to the design climatic conditions, e.g. types of buildings and geographical zones.

The water vapour resistance of the water vapour control layer inside the thermal insulation and of the breather membrane or wind barrier outside the thermal insulation shall be declared.

The water vapour resistance for internal watertight membranes or surface layers in bathrooms shall also be declared.

## **2.4.3.2 Watertightness**

### **2.4.3.2.1 External envelope**

#### *2.4.3.2.1.1 Method of verification*

The ability of the external building envelope to resist water leakages from precipitation, including driving rain on facades and possibly snow penetration, shall primarily be assessed by the Approval Body on the basis of the standard construction details for the kit, and by using the available technical knowledge and experience from similar well-known technical solutions.

Normally, the assessment of resistance against the penetration of driving snow into the external envelope may be based upon design or engineering knowledge. The assessment shall include the full external envelope, including joints between prefabricated components in the kit and principal solutions for joints between the kit and other parts of the works (e.g. the substructure).

The external envelope should normally be designed according to the two-stage principle unless other acceptable solutions can be demonstrated. According to national specifications, a series of external envelope systems are deemed to satisfy the watertightness requirement under normal climatic conditions.

For log buildings without additional external cladding the Approval Body shall take special care to assess the tightness of the wall, including exposed corner details, and to evaluate the ability of the construction to dry within a reasonable time.

If the resistance against weather influence cannot be assessed by the use of existing knowledge, e.g. because of unfamiliar solutions to the relevant construction details, the Approval Body may find it necessary to require testing of the external envelope performance. Laboratory tests for external walls shall be carried out in accordance with the provisions in EN 12155, EN 12865 or EN 1027.

#### *2.4.3.2.1.2 Method of assessing and judging*

The performance of the kit will normally have to be declared in qualitative terms in relation to the intended use such as potential climatic zones, and with respect to durability aspects (see EC Guidance Paper F on Durability and the Construction Products Directive), as well as to the requirements concerning prevention of leakage and gathering of water from rain and melting snow into the works.

When a kit is not assessed to be adequate in certain regions (for example in areas with exceptional amounts of driving rain or potential snow penetration), the limitations on the intended use shall be clearly stated in the ETA.

### **2.4.3.2.2 Internal surfaces**

#### *2.4.3.2.2.1 Method of verification*

The performance of watertight membranes or surface layers in wet areas of bathrooms shall be assessed on the basis of the provisions in ETAG 022 *Watertight covering kits for wet room floors and or walls*.

#### *2.4.3.2.2.2 Method of assessing and judging*

It shall be clearly indicated in the ETA which parts of the kit are classified as watertight surface areas.

### 2.4.3.3 Content and/or release of dangerous substances

The applicant shall either:

- submit the chemical constitution and composition of the materials and components of the kit to the Approval Body which will observe strict rules of confidentiality
- or
- submit a written declaration to the Approval Body stating whether or not and in which concentration the materials and components of the kit contain substances which have to be 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 EGDS - taking into account the installation conditions of the construction product and the release scenarios resulting from there.

The use of recycled materials shall always be indicated, because this could lead to the implementation of further assessment and verification methods.

The information concerning the presence of dangerous substances listed in Council Directive 67/548/EEC and Regulation (EC) No 1272/2008 regulated at European level and/or listed in the "Indicative list on dangerous substances" of the EGDS and/or of other dangerous substances, shall be circulated as part of the evaluation report by the issuing Approval Body to the other Approval Bodies, under strict conditions of confidentiality.

#### 2.4.3.3.1 Method of verification

Materials and components of the timber building kit listed in the EOTA TR 034 "General Checklist for ETAGs/CUAPs/ETAs - Content and/or release of dangerous substances in products/kits", which have to be considered will be verified by the given methods, taking into account the installation conditions of the assembled system/component of the assembled system and the release scenarios resulting from there. Regulations related to placing the product on the market may also need to be taken into account.

Regarding the release scenarios referred to in the EOTA TR 034, the following use categories have to be considered:

- Category IA1: Product with direct contact to indoor air
- Category IA2: Product with no direct contact to (e.g. covered products) but possible impact on indoor air
- Category IA3: Product with no contact to and no impact on indoor air
  
- Category S/W1: Product with direct contact to soil-, ground- and surface water
- Category S/W2: Product with no direct contact to but possible impact on soil-, ground- and surface water
- Category S/W3: Product with no contact to and no impact on soil-, ground- and surface water

Categories IA1 and S/W1 are applicable for products which are in contact with indoor air, soil or water in a way that dangerous substances could be released directly out of the product.

Category IA2 is applicable for products which are covered with other products but nevertheless could release dangerous substances to indoor air (e.g. products covered with porous/unsealed coverings incapable of avoiding migration, such as gypsum panels).

Category S/W2 is applicable for products which can be leached by rain (e.g. external claddings) and could release dangerous substances which can have impact on soil and water.

Categories IA3 and S/W3 are applicable for products which are completely covered with tight products capable of avoiding any kind of migration of dangerous substances to indoor air, soil or water.

Note: Content restrictions have to be considered in all cases.

#### **2.4.3.3.2 Method of assessing and judging**

Materials and components of the timber building kit listed in the EOTA TR 034: "General Checklist for ETAGs/CUAPs/ETAs -Content and/or release of dangerous substances in products/kits" (or equivalent EOTA document), and the related dangerous substances which have to be considered, will be assessed by the given methods taking into account the installation conditions of the construction product and the release scenarios resulting from there.

Note (to be implemented in the ETA):

For dangerous substances falling under the scope of the CPD for which

- no assessment and verification methods are given (or cannot be found in TR 034)  
or
- "no performance determined" is declared  
or
- the chosen verification and assessment method does not comply with the regulatory requirement of a particular Member State

there might be the necessity for an additional assessment.

### **2.4.4 Safety in use (ER 4)**

#### **2.4.4.1 Slipperiness of floor finishes**

##### **2.4.4.1.1 Method of verification**

Verification of slipperiness of flooring materials shall be undertaken in accordance with the relevant EN standards for the specified finished flooring products.

##### **2.4.4.1.2 Method of assessing and judging**

When this performance is determined, the slip resistance of finished floorings shall be declared according to the relevant standard for the specified flooring product.

#### **2.4.4.2 Impact resistance**

##### **2.4.4.2.1 Method of verification**

Mechanical resistance against impact loads shall primarily be assessed by the Approval Body on the basis of experience related to the intended use, unless a quantified performance is declared. Timber walls with well-known internal lining materials, such as standard gypsum boards, wood-based panel products and solid timber boards with suitable thickness and stud spacing, shall generally be accepted to have a satisfactory impact resistance for normal use in residential housing, office buildings, etc. as long as the deemed-to-satisfy conditions are met:

- stud spacing 0,65 m
- minimum thickness of internal board lining:
  - Particleboard type P2-7: t 10 mm
  - Plywood: t 8 mm
  - OSB/2-4: t 10 mm
  - Gypsum plasterboard: t 10 mm
  - Solid wood lining: t 10 mm

- MDF: t 10 mm

Log walls have a satisfactory impact resistance for normal use in residential buildings, office buildings etc.

When the performance of the kit is not known to be acceptable, or a quantified performance is to be declared, the impact resistance shall be tested or calculated. Testing of walls and ceilings is undertaken according to EOTA TR 001. Floors and roofs are tested according to EN 1195.

The minimum accepted impact resistance for walls should normally be 100 Nm for soft body impact with the 50 kg bag and 10 Nm for hard body impact with the 1 kg steel ball, when the intended use is kits for residential housing, office buildings, etc.

For wood-based panels used as loadbearing subfloor panels on joists and as roof sheathing the impact resistance should be accepted as adequate when the panels conform to the requirements in EN 12871.

Note:

National building regulations in some Member States may have specific requirements. E.g. minimum soft body impact resistance for walls, floors or roofs can be required, or descriptive requirements such as window glass thickness and type may have been set.

#### **2.4.4.2 Method of assessing and judging**

Impact resistance can normally be declared as acceptable under defined conditions and not be quantified. Any limitations on intended use shall be stated in the ETA.

When wall and ceiling structures have been tested according to EOTA TR 001, and/or floors and roof according to EN 1195, the determined impact resistance shall be declared in the ETA.

#### **2.4.5 Protection against noise (ER 5)**

Note:

Acoustic performances and assessment methods specified in chap. 2.4.5 will be replaced by the methods and criteria specified in a Technical Report of EOTA when available. Such a Technical Report shall include methods to assess elements of the building kit (floors, walls...), as well as the lightweight building structure based on the kit.

The acoustics performances may also be verified by references to data for common timber construction designs given in national standards, textbooks or authoritative guides, provided that such data are based upon tests and classification in accordance with the EN ISO standards mentioned in the TR.

##### **2.4.5.1 General**

Sound insulation performance of building elements shall be declared in the ETA as estimated values for airborne sound insulation and impact noise level to be expected in completed buildings. The performance shall be specified with designations according to EN ISO 717, Parts 1 and 2, and should preferably be specified as given in clause 2.4.5.2. Other designations for the sound insulation performance mentioned in ISO 717 may be added in the approval, to agree with the verification methods according to national building regulations based on such designations.

Note:

National Regulations in some Member States may require field testing of each completed building (such testing is not part of the assessment according to this ETAG).

## **2.4.5.2 Airborne sound insulation of walls, floors and roof structures**

### **2.4.5.2.1 Method of verification**

The airborne sound insulation performance (between rooms, of facades and of roofs, dependent on regulatory provisions in the destination Member State) of the main building parts of an assembled kit shall be verified by either laboratory or field tests according to the relevant parts of EN ISO 10140 (laboratory tests) and EN ISO 140 (field tests), see list of standards in chap. 7. The rating of airborne sound insulation shall be undertaken according to EN ISO 717-1.

Estimated values for airborne sound insulation in completed buildings, based on laboratory tests, can be determined according to EN 12354, Parts 1, 3 and 4.

The sound insulation performance may also be verified by references to data for common timber construction designs given in national standards, textbooks or authoritative guides, provided that such data are based upon tests and classification in accordance with the EN ISO standards mentioned above.

### **2.4.5.2.2 Method of assessing and judging**

The airborne sound insulation between rooms, of facades and/or of roofs, as relevant, shall be declared in the ETA, as weighted apparent sound reduction index  $R'_w(C;C_{tr})$ , according to EN ISO 717-1. Other designations mentioned in EN ISO 717-1 may be added in the approval, to agree with the verification methods according to national building regulations based on such designations.

## **2.4.5.3 Impact sound insulation of floors**

### **2.4.5.3.1 Method of verification**

The impact sound insulation performance of the floors of a kit assembly shall be verified by either laboratory or field tests according to the relevant parts of EN ISO 10140-1,3,4 and 5 (laboratory tests) and EN ISO 140-7 (field tests), and the rating of impact sound insulation shall be undertaken according to EN ISO 717-2.

Estimated values for impact noise level in completed buildings, based on laboratory tests, shall be determined according to EN 12354-2.

Indicative field testing of an assembly within a manufacturer's range may be possible, as part of the approval process.

The sound insulation performance may also be verified by references to data for common timber construction designs given in national standards, textbooks or authoritative guides, provided that such data are based upon tests and classification in accordance with the ISO standards mentioned above.

### **2.4.5.3.2 Method of assessing judging**

The impact sound insulation for floors shall be declared in the ETA, as weighted normalised impact sound pressure level  $L'_{n,w}$  (band width 1/3 octave), according to EN ISO 717-2.

Other designations mentioned in EN ISO 717-2 may be added in the approval, to agree with the verification methods according to national building regulations based on such designations.

#### **2.4.5.4 Sound absorption**

##### **2.4.5.4.1 Method of verification**

The sound absorption performance of internal surfaces, when declared, shall be verified by laboratory tests according to EN ISO 354.

##### **2.4.5.4.2 Method of assessing and judging**

The measured acoustic absorption coefficient shall be expressed as a single number rating  $\alpha_w$  in accordance with EN ISO 11654.

#### **2.4.6 Energy economy and heat retention (ER 6)**

##### **2.4.6.1 Thermal resistance**

###### **2.4.6.1.1 Method of verification**

Thermal resistance (R-value) and the corresponding thermal transmittance (U value) of the main building parts in a kit shall be calculated according to EN ISO 6946.

For insulation products, the declared thermal conductivity according to harmonized product standards or according to an ETA for a special insulation product shall be used for calculations. For other components the design thermal conductivity values for materials according to EN ISO 10456 can be used. Alternatively, the thermal resistance may be verified by testing according to EN ISO 8990.

For walls made of logs the calculations can be based on an assumed homogeneous wood section where the thickness is equal to the maximum log thickness for rectangular logs. For round logs the area-equal thickness may be used. Effects of seals or cracks are neglected.

EN 14351-1 shall be applied to windows and doors when relevant.

If the design has technical solutions with special thermal bridging not covered by the ordinary verification of the thermal resistance as mentioned above, the effect on the overall thermal resistance and the surface temperatures in relation to clause 2.4.3.1.1 shall be verified when the Approval Body finds this necessary, e.g. the effect of moisture due to thermal bridges. Such verification may be undertaken by calculations according to EN ISO 10211, or by testing according to EN ISO 8990 or relevant test standards for specific products.

###### **2.4.6.1.2 Method of assessing and judging**

Thermal resistance values for the main building parts in the kit shall be declared as the total thermal resistance  $R_t$  in ( $m^2K/W$ ), including the surface resistances. The thermal resistance shall be a value covering homogenous and inhomogeneous layers, including the effect of studs, joists, plates, etc based on a mean length in relation to  $1 m^2$  of the building part. The declared / design thermal conductivities of the components according to clause 2.4.6.1.1 shall be given in the ETA.

The corresponding thermal transmittance shall be specified as the corrected thermal transmittance  $U_c = 1/R_t + \Delta U$ , where the correction term  $\Delta U$  is calculated according to EN ISO 6946.

When specific thermal bridges are present, the thermal transmittance in addition to the normal thermal transmittance  $U_c$ , shall be declared in units of  $W/mK$ . If relevant, the potential surface condensation risk due to these thermal bridges shall be stated in the ETA.

The insulation products shall be sufficiently defined in the ETA (e.g. by designation code in accordance with the harmonized product standards or ETAs). Thermal transmittance of

windows and doors in the external envelope which are included in the kit shall be declared separately in accordance with EN 14351-1.

## **2.4.6.2 Air permeability**

### **2.4.6.2.1 Method of verification**

Assessment of the air permeability of the external envelope is normally undertaken by judgement of the construction details, on the basis of the knowledge and experience from traditional technical solutions. The assessment shall include joints between components in the kit and, if relevant, joints between the kit and other building parts. For example, joints in timber constructions may generally be regarded as sufficiently airtight when the following principles are applied:

Overlapped joints of plastic films, breather paper or similar roll products continuously clamped by parallel timber members or by panel products

or

Joints filled with a building sealant or foam protected from direct weathering and with movements in the joint limited by mechanical fasteners.

When the Approval Body finds it necessary, e.g. when non-traditional joints are applied, the air permeability shall be verified by testing. Tests may be carried out by pressurisation of completed buildings according to EN 13829, or by laboratory testing according to EN 1026, EN 12114 or other relevant test standards. The tests shall include long-term performance when relevant.

Note:

National Regulations in some Member States may require field testing of completed buildings (such testing is not part of the assessment according to this ETAG).

The assessment of air permeability shall be undertaken with regard to energy economy (unintended ventilation), cold draughts and risks of water vapour condensation inside the construction. The assessment shall be undertaken on the basis of the intended use of the building kit, taking into account the internal and external design climates (e.g. geographical areas).

### **2.4.6.2.2 Method of assessing and judging**

Quantified national building regulations concerning air permeability are related to energy economy in the Member States, although there may be no quantified requirements related to health and the effect on the indoor climate. This assessment can only be handled at the level of the full finalized building, but the ETA could contain elements to help the designer to satisfy the regulatory requirements thereon. There are the following possibilities to declare air permeability in the ETA for the kit:

- No performance determined (NPD)
- A general statement in qualitative terms of air tightness, based on the assessment of construction details and kit components. The statement should take into account the intended use, including climatic zones, energy economy and heat retention, risk of cold draughts, and risk of condensation within the construction
- Estimated possible air permeability for a completed building, based on tests of buildings with similar kits. The estimated air permeability shall be expressed as the air volume of the building exchanges per hour at a pressure difference of 50 Pa ( $n_{50}$ )
- Assessment by testing at the level of components

When a kit is assessed to be inadequate in certain regions, the limitations on the intended use shall be clearly stated in the ETA.

### **2.4.6.3 Thermal inertia**

#### **2.4.6.3.1 Method of verification**

Verification of thermal inertia is undertaken on the basis of the following properties of the main building parts: the total mass per unit area, density and specific heat capacity of relevant materials and thermal resistance. Specific heat capacities and material densities are tabulated in EN ISO 10456.

#### **2.4.6.3.2 Method of assessing and judging**

The information on total mass per unit area of the main building parts, and on density, specific heat capacity and thermal resistance of relevant materials, shall be declared as a means for the designer to calculate the thermal inertia of the building.

### **2.4.7 Durability, serviceability and identification**

#### **2.4.7.1 Aspects of durability**

##### **2.4.7.1.1 Method of verification**

Verification of durability is related to the assumed working life of the building kit (see 1.3). The Approval Body shall examine the building details presented by the manufacturer in order to state that the provisions under 1.3 are fulfilled. In so doing the Approval Body shall take into account the influence of climatic conditions in the intended place of end use. The EC Guidance Paper F on Durability and the EOTA Guidance document 003 (Assessment of working life of products) may be consulted with regard to the use of relevant degradation factors and climatic sub-divisions of Europe.

The most important aspects related to the durability of timber building kits are:

- Biological degradation of timber material by fungi as a result of excessive moisture content
- Degradation of wood materials by insects
- Degradation of glued joints and glued components
- Ageing of the vapour barrier and roof underlays etc. especially due to elevated temperatures
- Corrosion of metal fasteners

Verification of material and component durability shall be done as stated in the relevant technical specifications for each component of the kit.

##### **2.4.7.1.2 Method of assessing and judging**

The Approval Body shall assess the working life of the kit on basis of building details presented by the manufacturer and the verification results of the components and materials. Normally the intended working life of 50 years for the load-bearing structure and for non-accessible components and materials, and 25 years for repairable or replaceable components and materials, is achieved if:

- The moisture content of the timber as expressed by the service class according to EN 1995-1-1 corresponds to the durability class of the timber (see corresponding reference standards for durability of wood).
- Wood material exposed to external climate has the ability to dry between wetting periods in a way that keeps the overall mean moisture content of the wood below 20 %.
- Sufficient measures against insects have been taken into account. This may imply chemical treatment in areas where insects are a problem. When chemical treatment is used, the treatment shall be specified.

- Glued joints and glued components have been manufactured, tested and found satisfactory according to requirements for the relevant service class and the relevant standards.
- Ageing of the vapour barrier has been tested and the estimated life time corresponds to the intended working life of the load-bearing structure.
- Corrosion protection of metal fasteners corresponds to the requirements of the intended service class (see EN 1995-1-1 and the corresponding reference standards). For especially corrosive conditions consideration should be given to heavier hot dip coatings or stainless steel.

The ETA shall declare that the durability of the kit in relation to the intended use and performances related to Essential Requirements 1 to 6 corresponds to the assumed intended working life stated in 1.3. Assessment may be given either in terms of service classes or in the way of description of the product (e.g. thickness of coating or preservative treatment).

When relevant the following shall also be declared in the ETA:

- possible geographical limitations or climatic zones
- possible conditions regarding maintenance

## **2.4.7.2 Aspects of serviceability**

### **2.4.7.2.1 Method of verification**

#### *Stiffness of structures*

Verification of the structural performance of the loadbearing structures described under clause 2.4.1.1 shall consider stiffness and deformations of the constructions.

Vibrations of residential floor structures shall be considered according to EN 1995-1-1.

Note:

EN 1995-1-1 allows different national approaches for dealing with vibrations.

Otherwise reference may be made to design documents for the individual works.

#### *Seismic actions*

For kits to be used in areas where design for seismic action is required the limitation of interstorey drift according to EN 1998-1, chap. 4.4.3.2, shall be taken into account to fulfil “damage limitation requirement” for works. This shall be part of the evaluation of structural performance of the loadbearing structures described under clause 2.4.1.1.

#### *Settling of log walls*

The settling of log walls shall be assessed on the basis of experience. Measures taken and maintenance proposed by the manufacturer to sufficiently control settling shall be evaluated. Settling is mainly caused by the following factors,:

- tightening of the seams between logs due to vertical loads (typically up to 5 mm per seam)
- drying of the logs from the moisture content at the time of erection to equilibrium for heated buildings (typically about 2 mm/m wall height per one percent change in moisture content)
- change of round logs shape because of drying

### **2.4.7.2.2 Method of assessing and judging**

#### *Stiffness of structures*

Assessment and declaration of the structural performance of the loadbearing structures described under clause 2.4.1.2 shall consider stiffness and deformations of the constructions. Maximum deflections at serviceability limit states, applied in the verification of structural performance related to ER 1, shall be declared in the ETA, when this is relevant

for the serviceability or to meet possible national regulations. The deflections shall be given according to the rules in EN 1995-1-1, chapter 7.3.3.

The parameters used for calculation shall be declared, including special National Determined Parameters if such have been applied.

The declaration of performances shall be in accordance with the declaration method used for properties of mechanical resistance and stability as given in cl. 2.4.1.2. Declared deflections shall be in conformity with the relevant load-duration classes.

For residential floors, assessment of vibrations shall follow EN 1995-1-1.

#### *Seismic actions*

Assessment and declaration of serviceability against seismic actions shall be part of the evaluation of structural performance of the loadbearing structures described under clause 2.4.1.2.

#### *Settling of log walls*

The expected settling of log walls shall be declared in mm/m.

## **2.5 Components of the assembled system and their characteristics which are relevant for the fitness for use**

The assessment of the components will be carried out either by reference to a hEN, another ETAG, a commonly agreed assessment method by all ABs, or by an EOTA Technical Report. Those components without a technical specification which are of major importance for the performance of the assembled kit or system will be assessed according to an existing EOTA Technical Report or commonly agreed assessment method by all Abs, or to elaborated if not existing yet.

## 3 EVALUATION AND ATTESTATION OF CONFORMITY AND CE MARKING

### 3.1 System of attestation of conformity

According to the decision 1999/455/EC of the European Commission<sup>(2)</sup>, system 1 of attestation of conformity applies [see Directive 89/106/EEC, Annex III(2)(i), without audit testing of samples]. The system of attestation of conformity is defined as follows:

System 1: Certification of the conformity of the product by a notified certification body on the basis of:

- (a) Tasks for the manufacturer;
  - (1) factory production control
  - (2) further testing of samples taken at the factory by the manufacturer in accordance with a prescribed test plan
- (b) Tasks for the notified body:
  - (3) initial type-testing of the product
  - (4) initial inspection of factory and of factory production control
  - (5) continuous surveillance, assessment and approval of factory production control.

### 3.2 Tasks and responsibilities of the manufacturer and notified bodies

#### 3.2.1 *General*

In transposing the relevant system of attestation of conformity to the notified body, the Approval Body has to lay down the specific tasks of the manufacturer and the notified body in the process of attestation of conformity in control plans. There is a wide variation in the materials and related test methods used, and a precise test plan can only be set up on a case-by-case basis. The general principles on the derivation of these plans is given below. They shall be specified by the Approval Body for the approved product under consideration of the specified production process of the manufacturer.

Timber building kits may consist of one or more of the following possibilities:

- components produced by the ETA-holder
  - components produced by an independent manufacturer (supplier)
  - components purchased by the ETA-holder on the open market
- In any case, sufficient proof shall be established to show that permanent internal control takes place. When materials/products are delivered for incorporation into the production process, verification of conformity with specifications in the ETA shall take place.

#### 3.2.2 *Tasks of the manufacturer*

##### *General*

The manufacturer is responsible for the conformity of the kit with the ETA. The manufacturer shall exercise permanent internal control of production related to:

- the specification and verification of the raw materials, components and constituents
- the description of the production and the internal control of the production
- the test methods (when necessary) or control methods to be carried out during manufacture
- the minimum frequency of controls.

##### *Factory production control*

The manufacturer has to establish a factory production control (FPC) manual to describe the factory production control system. All the essential parts of the kit manufacturing process, the working instructions, check lists, description of tests, etc relevant for the individual manufacturing process shall be considered.

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<sup>(2)</sup> Official Journal of the European Communities L 178/56 of 14.7.1999

A control plan, which is part of the factory production control, shall deal with the permanent internal control of the production to be exercised and documented by the manufacturer. Deviations/non-conformities have to be documented as do the handling of them e.g. separating, corrective actions.

Each ETA shall include an individual control plan based on the general principles for the control plan given in this ETAG. Typical examples for principles normally to be applied in the control plan are given in Table 3.

**Table 3 – Control plan for manufacturers of timber building kits – Principles**

	Subject/type of control	Test or control method *	Criteria, if any**	Minimum number of samples	Minimum frequency of control
<b>Factory production control (FPC)</b>					
1	Design process - especially product planning and structural design	I  I, C			each design  each new design
2	Control of raw materials and components - conformity of the product (standard) - optical damages - dimensions - additional for timber products: timber quality - especially verification of purchased components	I  M  M	size tolerances  moisture	where relevant 1x  10x	each delivery
3	Control of the component production - workmanship (e.g. tolerances, measurement of the diagonals, assembly of windows, distances of fasteners, etc) - conformity of the component according to the ETA - testing of samples (e.g. structural glued components)	I, M  M	e.g. diagonals	1x	1/series
as specified in standard or ETA					
4	Handling of non-conforming products	I			each
5	End control and CE Marking	I			each kit
6	Assembling of the kit (when carried out in manufacturer plant)	I, M			each kit
7	Packaging - CE Marking - protecting the kit from weather exposure and mechanical damage	I			each kit
8	Storing and delivering - protecting the kit from weather exposure and mechanical damage - identification (specification sheet)	I			each kit

- \* I = inspection by the person responsible for the process.
- C = calculation by the person responsible for the process.
- M = measurement by the person responsible for the process.

#### *Control of materials and components*

For test or control methods of kit components (materials and units) that may be part of the FPC, the provisions given in relevant technical specifications (harmonized standard, individual European Technical Approval) shall be applied as far as is possible. Tests shall be carried out on products or samples which are representative for the final kit. Test results which are part of the factory production control shall be filed.

For all kit components with their own CE-marking the kit manufacturer shall file the declaration of conformity and the CE-marking of the products.

The kit manufacturer shall provide access for the notified body to the premises of the component manufacturer, if the component is not CE-marked and the notified body finds it necessary to inspect the production of the component.

#### *Responsibility related to structural design*

Depending on the method of verification of mechanical resistance according to clause 2.4.1.1 the manufacturer has the following responsibility for each individual delivered kit:

- Method 1: The manufacturer shall file all the relevant product properties and dimensions of the loadbearing components
- Method 2: The manufacturer shall file all the relevant calculations and verifications which are the basis for the mechanical resistances declared in the ETA
- Method 3a: The manufacturer shall file the reference to the structural design worked out for the kit by the responsible structural designer, and file all the relevant specifications for the production
- Method 3b: The manufacturer has the full responsibility for working out the structural design of the kit case by case, and shall file all the relevant calculations and verifications

In all cases the manufacturer shall file the drawings of the relevant structural details of each kit.

### **3.2.3 Tasks of the notified body**

#### *General*

The approval tests will have been conducted by the approval body or under its responsibility in accordance with this ETA-Guideline. These tests shall be used for the purposes of Initial Type Testing.

#### *Factory production control*

The notified body shall perform continuous inspection of the factory and the factory production control by normally visiting the kit manufacturer at least twice a year. The purpose of the inspection is to check that the manufacturer has an updated control plan for the production of the kits, and that the control plan is followed.

The notified body shall check that the manufacturer has filed the verification of component specifications and the mechanical resistance of each individual kit as stated in clause 3.2.2. During the factory inspection the notified body shall also check that the manufacturer has maintained the necessary structural design competence when method 3b is applied for declaring mechanical resistance.

Typical examples for the principles normally to be applied in the control plan are shown in Table 4.

Table 4 Control plan for the notified body (bodies) - Principles

Nr	Subject/type of control	Test or control method *	Criteria, if any**	Minimum number of samples	Minimum frequency of control
<b>Initial type-testing of the kit (ITT)</b>					
1	Design process, especially product planning and structural design	A	Clause 2.4	one design	When starting the production, or a new production line
	Identification of the kit and the components of the kit (for the relevant characteristics see table 1 in clause 2.3)	A			
	No tests necessary when approval testing (clause 2) has been carried out on products coming from the production process related with the ETA				
<b>Initial inspection of factory and factory production control (FPC)</b>					
6	Design process	I			
7	Control of raw materials and components	I			
8	Control of component production	I			
9	Handling of non-conforming products (incoming materials, own production)	I			
10	End control and CE Marking	I			
11	Assembling the kit (when carried out in manufacturer plant)	I			
12	Packaging	I			
13	Storing and delivering	I			
<b>Continuous surveillance, judgement and assessment of factory production control (FPC)</b>					
14	Implementation of the quality system	A			2/Y
15	Design process	A			2/Y
16	Control of raw materials and components	A			2/Y
17	Control of component production	A			2/Y
18	Handling of non-conforming products (incoming materials, own production)	A			
19	End control and CE Marking	A			
20	Assembling the kit (when done in manufacturer plant)	A			2/Y
21	Packaging	A			2/Y
22	Storing and delivering	A			2/Y

\* I = inspection.

A = auditing (continuous surveillance, judgement, assessment).

\*\* The criteria shall be defined in the quality manual of the manufacturer, based on the ETA, and assessed by the notified body.

A factory production control system that complies with EN ISO 9001 and that addresses the requirements of the ETA is recognised as a good technical basis for evaluation of the FPC requirements of the Directive.

### 3.3 CE Marking and accompanying information

According to Council Directive 93/68/EEC<sup>(3)</sup>, the CE Marking consists of the letters “CE” in the form laid down in the Directive, followed by the identification number of the notified certification body. The manufacturer or his authorized representative established within the EEA is responsible for the affixing of the CE marking.

The CE marking of the timber building kit shall contain the following information:

- identification number of the notified certification body
- the name and address of the producer (legal entity responsible for the manufacture)
- the last two digits of the year in which the CE Marking was affixed
- the number of the EC certificate of conformity for the product
- the number of the European Technical Approval
- indication to clarify the intended use (e.g. order number of the manufacturer)

Example of CE Marking and accompanying information:

 xxxx	Letters “CE”  Identification number of notified certification body
Any Company Street 1, City, Country  xx xxxx-CPD-yyyy	Name and address of the producer (legal entity responsible for the manufacture)  Two last digits of year of affixing CE Marking Number of EC certificate of conformity
ETA-xx/yyyy ETAG 007	ETA number ETAG number
Reference to order number or other identification of each individual kit, and to the accompanying documentation of kit properties and performance	Reference to the intended use and characteristics of the kit, including method for verification of mechanical resistance

The full CE marking of a kit will normally be accompanied by a following documentation for each delivered kit, including the content of the CE marked kit (materials, components , construction details) and a table containing the characteristics and performances of the delivered kit. The informations are extracted from the ETA. The relevant characteristics of the kit shall include mechanical resistance characteristics resulting from the application of the EC Guidance Paper L methods for the use of Eurocodes, , etc. Table 5 – 8 shows examples of performance declarations for each method.

Note:

The tables are not complete lists of all relevant performances that may be declared for a kit, but illustrates how to specify performances as part of the CE-marking.

(3) Official Journal of the European Communities L 220 of 30.8.1993

Table 5 Examples of declared performance of a kit. Method 1 for ER 1  
(kit identification number XXXXXX)

Characteristic	Performance
<b>Whole kit</b>	
ER 1 Mechanical resistance and stability	Method 1 Strength grade of timber: C24 Production drawings no. xxxxxx
ER 2 Fire resistance	Method 1 Production drawings no. xxxxxx
ER 2 Reaction to fire	As specified in list of component specifications
ER 3 Hygiene, health and environment Dangerous substances	No substances on EU's observation list. Formaldehyde class according to list of component specifications
Vapour permeability, moisture resistance	As stated in the ETA
Watertightness	As stated in the ETA
ER 6 Air permeability	Estimated $n_{50}$ 2.5 for a completed house
<b>External Walls</b>	
ER 6 Thermal transmittance	$U = 0.22 \text{ W/m}^2\text{K}$
<b>Internal walls</b>	
ER 5 Sound insulation, separating double walls	Estimated $R'_w$ 55dB
<b>Suspended floors</b>	
ER 5 Sound insulation, separating floors	Estimated $R'_w$ 52dB and $L'_{n,w}$ 58 dB
ER 6 Thermal transmittance, floor above ground	$U = 0.18 \text{ W/m}^2\text{K}$
<b>Roof</b>	
ER 2 Reaction to fire of roof covering	$B_{\text{roof}}$
ER 6 Thermal transmittance	$U = 0.15 \text{ W/m}^2\text{K}$

Table 6 Examples of declared performance of a kit. Method 2 for ER 1  
(kit identification number XXXXXX)

Characteristic	Performance
<b>Whole kit</b>	
ER 1 Mechanical resistance and stability	Method 2 Declared mechanical and stability performances are based on the national determined structural design parameters of xxxxxx according to EN 1991 and 1995 (indicate relevant country). Alternatively: List the applied relevant safety factors that may be nationally determined
ER 2 Reaction to fire	As specified in list of component specifications
ER 3 Hygiene, health and environment Dangerous substances	No substances on EU's observation list. Formaldehyde class according to list of component specifications
Vapour permeability, moisture resistance	As stated in the ETA
Watertightness	As stated in the ETA
ER 6 Air permeability	Estimated $n_{50}$ 2.5 for a completed house
<b>External Walls</b>	
ER 1 Mechanical resistance and stability	Method 2 Resistance against vertical load, medium term load-duration class: 50 kN/m Resistance against horizontal wind load perpendicular to the wall, short term load-duration class: 1.5 kN/m <sup>2</sup> Resistance against horizontal wind load in the plane of minimum 1.2 m long wall sections without openings, short term load-duration class: 5.0 kN/m
ER 2 Fire resistance	REI 30
ER 6 Thermal transmittance	$U = 0.22 \text{ W/m}^2\text{K}$
<b>Internal walls</b>	
ER 1 Mechanical resistance and stability, load bearing walls	Method 2 Resistance against vertical load, medium term load-duration class: 40 kN/m
ER 2 Fire resistance, load bearing walls	REI 15
ER 5 Sound insulation, separating double walls	Estimated $R'_w$ 55dB
<b>Suspended floors</b>	
ER 1 Mechanical resistance and stability	Method 2 Resistance against maximum imposed load ( $g_k$ kN/m <sup>2</sup> and $Q_k$ kN) according to EN 1991-1-1: XX kN/m <sup>2</sup>
ER 2 Fire resistance, separating floors	REI 30
ER 5 Sound insulation, separating floors	Estimated $R'_w$ 52dB and $L'_{n,w}$ 58 dB
ER 6 Thermal transmittance, floor above ground	$U = 0.18 \text{ W/m}^2\text{K}$
<b>Roof</b>	
ER 1 Mechanical resistance and stability	Method 2 Resistance against maximum snow load according to EN 1991-1-3, short term load-duration class: 4.0 kN/m <sup>2</sup> Resistance against maximum load at peak wind velocity according to EN 1991-1-4, instantaneous load-duration class: 30 m/s
ER 2 Fire resistance Reaction to fire of roof covering	REI 15 $B_{\text{roof}}$
ER 6 Thermal transmittance	$U = 0.15 \text{ W/m}^2\text{K}$

Note:

Resistance values indicated in the above table are design values and should be accompanied by National safety factors to obtain these design values.

Table 7 Examples of declared performance of a kit. Method 3a for ER 1  
(kit identification number XXXXXX)

Characteristic	Performance
<b>Whole kit</b>	
ER 1 Mechanical resistance and stability	Method 3a Structural design production drawings xxxxx performed by yyyy (indicate reference to the structural design for the relevant building project and the name of the designer).
ER 2 Fire resistance	
ER 2 Reaction to fire	As specified in list of component specifications
ER 3 Hygiene, health and environment Dangerous substances	No substances on EU's observation list. Formaldehyde class according to list of component specifications
Vapour permeability, moisture resistance	As stated in the ETA
Watertightness	As stated in the ETA
ER 6 Air permeability	Estimated $n_{50}$ 2.5 for a completed house
<b>External Walls</b>	
ER 6 Thermal transmittance	$U = 0.22 \text{ W/m}^2\text{K}$
<b>Internal walls</b>	
ER 5 Sound insulation, separating double walls	Estimated $R'_w$ 55dB
<b>Suspended floors</b>	
ER 5 Sound insulation, separating floors	Estimated $R'_w$ 52dB and $L'_{n,w}$ 58 dB
ER 6 Thermal transmittance, floor above ground	$U = 0.18 \text{ W/m}^2\text{K}$
<b>Roof</b>	
ER 2 Reaction to fire of roof covering	$B_{\text{roof}}$
ER 6 Thermal transmittance	$U = 0.15 \text{ W/m}^2\text{K}$

Table 8 Examples of declared performance of a kit. Method 3b for ER 1  
(kit identification number XXXXXX)

Characteristic	Performance
<b>Whole kit</b>	
ER 1 Mechanical resistance and stability	Method 3b Structural design and production drawings xxxxx (indicate reference to the structural design for the relevant building project).
ER 2 Reaction to fire	As specified in list of component specifications
ER 3 Hygiene, health and environment Dangerous substances	No substances on EU's observation list. Formaldehyde class according to list of component specifications
Vapour permeability, moisture resistance	As stated in the ETA
Watertightness	As stated in the ETA
ER 6 Air permeability	Estimated $n_{50}$ 2.5 for a completed house
<b>External Walls</b>	
ER 2 Fire resistance	REI 30
ER 6 Thermal transmittance	$U = 0.22 \text{ W/m}^2\text{K}$
<b>Internal walls</b>	
ER 2 Fire resistance, load bearing walls	REI 15
ER 5 Sound insulation, separating double walls	Estimated $R'_w$ 55dB
<b>Suspended floors</b>	
ER 1 Mechanical resistance and stability	Method 3b Production drawings no. xxxxxx
ER 2 Fire resistance, separating floors	REI 30
ER 5 Sound insulation, separating floors	Estimated $R'_w$ 52dB and $L'_{n,w}$ 58 dB
ER 6 Thermal transmittance, floor above ground	$U = 0.18 \text{ W/m}^2\text{K}$
<b>Roof</b>	
ER 2 Fire resistance Reaction to fire of roof covering	REI 15 $B_{\text{roof}}$
ER 6 Thermal transmittance	$U = 0.15 \text{ W/m}^2\text{K}$

## **4 ASSUMPTIONS UNDER WHICH THE FITNESS FOR THE INTENDED USE IS ASSESSED**

### **4.1 Manufacture of the kit**

The manufacturing system and manufacturing plant shall be assessed by the Approval Body to ensure that the manufacturer has adequate premises, equipment and competent staff for the production.

### **4.2 Packaging, transport, storage of the kit**

Instructions for the packaging, transport and storage of the building kit shall be available from the manufacturer, and assessed by the Approval Body. In particular the manual shall cover requirements concerning handling equipment and transportation systems, and means and requirements for protecting the kit from weather exposure and mechanical damage during transportation.

### **4.3 Assembly and installation of the kit in the works**

#### **4.3.1 *Design of the works***

##### **4.3.1.1 Local building regulations**

Those characteristics of the kit which are subject to regulatory requirements in the intended end use shall be assessed.

The design process of the works where the kit is intended to be used (including the approval of detailed plans, applications for planning permissions, building permits, etc) shall comply with the procedures foreseen in the Member States in which the building is to be built. An ETA for a timber building kit does not amend this process in any way.

The structural design and execution documents for a kit shall on request be made available to the responsible parties involved in the works, even if they are drafted under the manufacturer's responsibility and checked in the context of methods 2 and 3b according to clause 2.4.1.1.1.

In some Member States, chemical treatment of wood components is allowed or required. Such treatment shall be done in compliance with the local provisions and the Biocides Directive.

##### **4.3.1.2 Structural design**

Manufacture of a kit for a particular application shall be made on the basis of a specific structural design for the building (the works), where the kit is to be used. The structural design shall confirm that the actions on the main building parts according to the structural requirements for the works do not exceed the loadbearing capacities of the kit.

In case of CE-marking by using method 1 for mechanical resistance, the party responsible for the design of works shall prepare all necessary structural analysis needed for the use of the kit in the works as a basis for the manufacturer's production.

In case of CE-marking by using method 2, the values given in the ETA and the CE-marking shall be used as basis for the structural design of the works.

In case of CE-marking by using method 3a, the CE-marked kit is manufactured in accordance with a structural design that already has been made by the responsible designer of the works.

In case of CE-marking by using method 3b, the kit manufacturer takes the responsibility for the structural design of the kit, which must correspond with the requirements for the works where the kit is to be used.

The structural design of the works shall include specifications of any wind load anchors and other supplementary structural works when these are not a part of the kit, but are essential for the fitness in use of the kit in the works.

The settlement of log building kits shall be taken into account in the design of works. Special care shall be taken to avoid that non-settling parts (stairs, water drain pipes, doors, columns, sanitary canalisation's, timber frame partitions) do not prevent the settlement of the settling parts.

#### **4.3.1.3 Substructure**

The maximum required tolerances of the substructure dimensions and levelling shall be assessed for the timber building kit, and be specified in the ETA.

Requirements concerning damp-proof membranes or other protection against moisture from the substructure shall be specified.

#### **4.3.1.4 Ventilation**

Buildings shall be assumed to be designed to have adequate ventilation rates in relation to the intended use.

### **4.3.2 Execution of works**

A general manual for the installation of the kit in the works shall be available from the manufacturer, and shall be assessed by the Approval Body. The manual shall cover all important aspects related to the site work, such as:

- erection techniques and necessary equipment
- temporary bracing and weather protection
- completion of joints between kit components (structural fixing, weather sealing, etc)
- measures taken to control settlement of log walls
- fixing of wind and any seismic anchorage to the substructure and between building parts
- additional materials and components applied on the site, and which are a precondition for the fitness in use of the kit.

As a supplement to the general manual, a specific manual which contains special aspects related to each individual building project (e.g. special crane requirements, hoisting strap positions, etc) should normally be required. Reference to the general manual for installation of the kit shall be made in the ETA.

The completed building (the works) shall comply with the building regulations (regulations on the works) applicable in the Member States in which the building is to be constructed. The procedures foreseen in the Member State for demonstrating compliance with the building regulations shall also be followed by the entity held responsible for this act. An ETA for a timber building kit does not amend this process in any way.

The completed buildings (the works) based on the kits fully remains under the responsibility of the user. The installation shall be designed and verified according to the specific regulations of MS, also considering all the environmental actions linked to the actual use of

the building and the actual geotechnical conditions of the foundations soils. For these verifications, the designer/user may ask the manufacturer (ETA holder) for all necessary data and details.

The design and execution documents shall be made available to the parties involved in the construction, even if they are drafted under the manufacturer's responsibility and checked in the context of the procedure of attestation of conformity (for methods 2 and 3b according to 2.4.1.2.1).

The completed buildings (the works) based on the kits are not under the responsibility of the ETA holder, unless the ETA holder also is responsible for the installation and formally designated as a responsible actor in the building project. The way in which it is ensured that the final building meets the local regulatory requirements shall be provided for on national level. The person(s) responsible for fulfilment of the essential requirements of the completed building may ask the manufacturer (ETA holder) for all data and details that are necessary.

#### **4.4 Use, maintenance, repair**

It is normally assumed that a timber building kit needs certain regular maintenance to retain its performance and to obtain the estimated working life. The type and frequency of such maintenance shall be specified in a manual, and shall be part of the assessment of the kit.

## 5 IDENTIFICATION OF THE KIT

The ETA shall clearly identify which materials and components are part of the timber building kit. The components and materials shall be identified either by reference to:

- Harmonised product standards
- European Technical Approvals
- Non-harmonised European or other international product standards
- EOTA Technical Reports <sup>4</sup>
- Descriptive identification, identifying the products by their composing materials, function, properties and performance
- Identification by direct reference to product brand name, type and manufacturer

Material and component specifications may be presented in the ETA by a table, see example in Addendum 2. Reference to products which are CE-marked according to harmonised product standards or ETAs shall be done when applicable.

If there are several options for the performances given in a technical specification for a product, the chosen option shall be clearly indicated in the identification of the kit.

In addition to the specification of materials, components and constituents the kit shall also be identified by relevant drawings of the kit build-up and construction details (see Addendum 1).

For the purpose of the identification, construction drawings with individual material and component specifications shall be worked out for each assembled timber building kit delivery as a set of project documents. These specifications shall be in accordance with the drawings presented in the Annex to the ETA.

When the ETA has several possible performance levels (e.g. several resistance to fire classes or U-values for a component) the performance of the kit to be delivered shall be specified on the drawings or in the attached documentation. Parts of the delivery of the ETA holder falling outside the ETA (e.g. stairs, internal walls and doors) shall clearly be marked not to be within the CE-marking of the kit.

The ETA is issued for the kit on the basis of agreed data, deposited at the Approval Body. Changes to the kit or production process which could result in this deposited data being incorrect, shall be notified to the Approval Body which issued the ETA before the changes are introduced. The Approval Body will decide whether or not such changes affect the ETA and consequently the validity of the CE marking on the basis of the ETA and if so whether further assessment/alterations to the ETA, shall be necessary.

## 6 FORMAT OF ETAS ISSUED ON THE BASIS OF THE ETAG

European Technical Approvals issued on the basis of this ETAG shall be in accordance with the Model ETA for kits. An EOTA Guidance Document with a model ETA may be developed.

The following shall be stated in the ETA:

The design and execution documents shall be made available to the parties involved in the construction, even if they are drafted under the manufacturer's responsibility and checked in the context of the procedure of attestation of conformity (for methods 2 and 3b according to 2.4.1.2.1).

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<sup>4</sup> EOTA Technical Report concerning assessment and identification of logs as a building component shall be used when available.

The ETA shall comprise all elements (e.g. by means of drawings.) in order to identify the product in a proper way.

Note:

The ETA may include annexes which normally contain construction drawings, see also Addendum 1. They are an integral part of the technical specification even when they are separate documents.

An example of a specification list in an ETA for the materials and components in timber building kits is included in Addendum 2.

Reference to instructions regarding packaging, transport, storage of the kit shall be made in the ETA.

## 7 REFERENCE DOCUMENTS

This ETA-Guideline incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed below. For dated references subsequent amendments to, or revisions of these publications, apply to this ETA-Guideline only when incorporated in it by amendment or revision. For undated references the latest dated revision of the publication referred to applies..

The list below is considered as a list of standards that normally may be used in this field.

### **Verification of mechanical resistance**

EN 380 *Timber structures - Test methods - General principles for static load testing*

EN 338 *Structural timber – Strength classes*

EN 384 *Structural timber – Determination of characteristic values of mechanical properties and density*

EN 594 *Timber structures - Test methods - Racking strength and stiffness of timber frame wall panels*

EN 595 *Timber structures - Test methods - Test of trusses for the determination of strength and deformation behaviour*

EN 1990 *Eurocode - Basis of structural design*

EN 1991-1-1 *Eurocode 1: Actions on structures - Part 1-1: General actions - Densities, self-weight, imposed loads for buildings*

EN 1991-1-3 *Eurocode 1 - Actions on structures - Part 1-3: General actions - Snow loads*

EN 1991-1-4 *Eurocode 1: Actions on structures - Part 1-4: General actions - Wind actions*

EN 1995-1-1 *Eurocode 5 - Design of timber structures - Part 1-1: General - Common rules and rules for buildings*

EN 1998-1:2004 *Eurocode 8 - Design of structures for earthquake resistance - Part 1: General rules, seismic actions and rules for buildings*

EN 12512:2001 *Timber structures – Test methods – Cyclic testing of joints made with mechanical fasteners*

EN 14358 *Timber structures - Calculation of characteristic 5-percentile values and acceptance criteria for a sample*

EN 26891 *Timber structures – Joint made with mechanical fasteners – General principles for the determination of strength and deformation characteristics (ISO 6891)*

### **Verification of fire resistance and reaction to fire**

EN 1991-1-2 *Eurocode 1: Actions on structures - Part 1-2: General actions - Actions on structures exposed to fire*

EN 1995-1-2 *Eurocode 5: Design of timber structures - Part 1-2: General - Structural fire design*

EN 13501-1 *Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests*

EN 13501-2 *Fire classification of construction products and building elements – Part 2: Classification using data from fire resistance tests, excluding ventilation systems*

EN 13501-5 *Fire classification of construction products and building elements - Part 5: Classification using data from external fire exposure to roofs tests*

### **Verification of vapour permeability and moisture resistance**

EN ISO 10456 *Building materials and products – Hygrothermal properties – Tabulated design values and procedures for determining declared and design thermal values (ISO 10456)*

EN ISO 12572 *Hygrothermal performance of building materials and products - Determination of water vapour transmission properties (ISO 12572:2001)*

EN ISO 13788 *Hygrothermal performance of building components and building elements – Internal surface temperatures to avoid critical surface humidity and interstitial condensation - Calculation methods (ISO 13788)*

EN 1931 *Flexible sheets for waterproofing - Bitumen, plastic and rubber sheets for roof waterproofing - Determination of water vapour transmission properties.*  
EN 12023 *Self adhesive tapes - Measurement of water vapour transmission in a warm humid atmosphere*  
EN 12086 *Thermal insulating products for building applications - Determination of water vapour transmission properties*  
EN 13469 *Thermal Insulating products for building equipment and industrial installations - determination of water vapour transmission properties of performed pipe insulation*  
EN ISO 12572 *Hygrothermal performance of building materials and products - Determination of water vapour transmission properties (ISO 12572:2001)*  
EN ISO 15106-1 *Plastics - Film and sheeting - Determination of water vapour transmission rate - Part 1: Humidity detection sensor method*  
EN ISO 15106-2 *Plastics - Film and sheeting - Determination of water vapour transmission rate - Part 2: Infrared detection sensor method*  
EN ISO 15106-3 *Plastics - Film and sheeting - Determination of water vapour transmission rate - Part 3: Electrolytic detection sensor method*

### **Verification of watertightness**

EN 12155 *Curtain walling - Watertightness - Laboratory test under static pressure*  
EN 12865 *Hygrothermal performance of building components and building elements – Determination of the resistance of external wall systems to driving rain under pulsating air pressure*  
ETAG 022 *Watertight covering kits for wet room floors and or walls*

### **Verification of slipperiness of floor finishes**

EN 1339 *Concrete paving flags - Requirements and test methods*  
EN 12057 *Natural stone products - Modular tiles - Requirements*  
EN 12058 *Natural stone products - Slabs for floors and stairs - Requirements*  
EN 13893 *Resilient, laminate and textile floor coverings - Measurement of dynamic coefficient of friction on dry floor surfaces*  
EN 14041 *Resilient, textile and laminate floor coverings - Essential characteristics*  
EN 14231 *Natural stone test methods - Determination of the slip resistance by means of the pendulum tester*  
CEN/TS 15676 *Wood flooring – Slip resistance – Pendulum test*  
EN 14342 *Wood flooring - Characteristics, evaluation of conformity and marking*  
EN 14411 *Ceramic tiles - Definitions, classification, characteristics and marking*  
EN 15285 *Agglomerated stone - Modular tiles for flooring and stairs (internal and external)*  
prEN 13552 *Ceramic tiles - Determination of coefficient of friction*  
prEN 14617-3 *Agglomerated stone - Test methods - Part 3: Determination of slipperiness*  
ISO/DIS 10545-17 *Ceramic tiles - Part 17: Determination of coefficient of friction*

### **Verification of impact resistance**

EN 596 *Timber structures – Test methods – Soft body impact test of timber framed walls*  
EN 1195 *Timber structures - Test methods - Performance of structural floor decking*  
EN 12871 *Wood-based panels - Performance specifications and requirements for load bearing boards for use in floors, walls and roofs*  
EN 13497 *Thermal insulation products for building applications - Determination of the resistance to impact of external thermal insulation composite systems (ETICS)*  
EN 14019 *Curtain walling - Impact resistance - Performance requirements*  
ETAG 003 *Internal partition kits for use as non-loadbearing walls*  
ISO 7892 *Vertical building elements - Impact resistance tests - Impact bodies and general test procedures*  
EOTA Technical Report TR 001 *Determination of impact resistance of panels and panels assemblies*

### **Verification of sound insulation performance**

EN ISO 140-4 *Acoustics - Measurement of sound insulation in buildings and of building elements – Part 4: Field measurements of airborne sound insulation between rooms (ISO 140-4)*

EN ISO 140-5 *Acoustics - Measurement of sound insulation in buildings and of building elements – Part 5: Field measurements of airborne sound insulation of facade elements and facades (ISO 140-5)*

EN ISO 140-7 *Acoustics - Measurement of sound insulation in buildings and of building elements – Part 7: Field measurements of impact sound insulation of floors (ISO 140-7)*

EN ISO 140-14 *Acoustics - Measurement of sound insulation in buildings and of building elements - Part 14: Guidelines for special situations in the field (ISO 140-14) additional lining (ISO 140-16)*

EN ISO 140-18 *Acoustics - Measurement of sound insulation in buildings and of building elements - Part 18: Laboratory measurement of sound generated by rainfall on building elements (ISO 140-18)*

EN ISO 354 *Acoustics – Measurement of sound absorption in reverberation room (ISO 354)*

EN ISO 717-1 *Acoustics - Rating of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation; Amendment 1: Rounding rules related to single number ratings and single number quantities (ISO 717-1)*

EN ISO 717-2 *Acoustics - Rating of sound insulation in buildings and of building elements - Part 2: Impact sound insulation; Amendment 1 (ISO 717-2)*

EN ISO 10140-1 *Acoustics – Laboratory measurement of sound insulation of building elements - Part 1: Application rules for specific products (ISO 10140-1)*

EN ISO 10140-2 *Acoustics – Laboratory measurement of sound insulation of building elements - Part 2: Measurement of airborne sound insulation (ISO 10140-2)*

EN ISO 10140-3 *Acoustics – Laboratory measurement of sound insulation of building elements - Part 3 Measurement of impact sound insulation (ISO 10140-3)*

EN ISO 10140-4 *Acoustics – Laboratory measurement of sound insulation of building elements - Part 4: Measurement procedures and requirements (ISO 10140-4)*

EN ISO 10140-5 *Acoustics – Laboratory measurement of sound insulation of building elements - Part 5: Requirements for test facilities and equipment (ISO 10140-5)*

EN 12354-1 *Building acoustics - Estimation of acoustic performance of buildings from the performance of elements - Part 1: Airborne sound insulation between rooms*

EN 12354-2 *Building acoustics - Estimation of acoustic performance of buildings from the performance of elements - Part 2: Impact sound insulation between rooms*

EN 12354-3 *Building acoustics - Estimation of acoustic performance of buildings from the performance of elements - Part 3: Airborne sound insulation against outdoor sound*

EN 12354-6 *Building acoustics - Estimation of acoustic performance of buildings from the performance of elements - Part 6: Sound absorption in enclosed spaces elements - Part 1: Requirements for laboratory test facilities with suppressed flanking transmission; Amendment 1: Specific requirements on the frame of the test opening for lightweight twin leaf partitions (ISO 140-1:1997+AM 1:2004)*

### **Verification of thermal insulation**

EN 1991-1-1 *Eurocode 1: Actions on structures - Part 1-1: General actions - Densities, self-weight, imposed loads for buildings*

EN ISO 6946 *Building components and building elements - Thermal resistance and thermal transmittance- Calculation method (ISO 6946)*

EN ISO 8990 *Thermal insulation – Determination of steady-state thermal transmission properties – Calibrated and guarded hot box (ISO 8990)*

EN ISO 10077-1 *Thermal performance of windows, doors and shutters – Calculation of thermal transmittance – Part 1: General (ISO 10077-1)*

EN ISO 10211 *Thermal bridges in building construction - Heat flows and surface temperatures - Detailed calculations (ISO 10211)*

EN ISO 10456 *Building materials and products - Hygrothermal properties - Tabulated design values and procedures for determining declared and design thermal values (ISO 10456)*

### **Verification of air permeability**

EN 1026 *Windows and doors - Air permeability - Test method*

EN 12114 *Thermal performance of buildings - Air permeability of building components and building elements – Laboratory test method*

ISO 9972 *Thermal performance of buildings - Determination of air permeability of buildings - Fan pressurization method*

### **Verification of durability and serviceability**

EN 1995-1-1 *Eurocode 5 - Design of timber structures - Part 1-1: General - Common rules and rules for buildings*

EN 335-1 *Durability of wood and wood-based products - Definition of use classes – Part 1: General*

EN 335-2 *Durability of wood and wood-based products - Definition of use classes – Part 2: Application to solid wood*

EN 335-3 *Durability of wood and wood-based products - Definition of hazard classes of biological attack – Part 3: Application to wood-based panels*

EN 350-1 *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 350-2 *Durability of wood and wood-based products - Natural durability of solid wood - Part 2: Guide to natural durability and treatability of selected wood species of importance in Europe*

EN 351-1 *Durability of wood and wood-based products - Preservative- treated solid wood - Part 1: Classification of preservative penetration and retention*

EN 460 *Durability of wood and wood-based products - Natural durability of solid wood - Guide to the durability requirements for wood to be used in hazard classes*

EN 599-1 *Durability of wood and wood-based products - Performance of preventive wood preservatives as determined by biological tests - Part 1: Specification according to hazard class*

EN 599-2 *Durability of wood and wood-based products - Performance of preventive wood preservatives as determined by biological tests - Part 2: Classification and labelling*

EN 10326 *Continuously hot-dip coated strip and sheet of structural steels - Technical delivery conditions*

ISO 2081 *Metallic coatings - Electroplated coatings of zinc on iron or steel*

### **Quality management system**

EN ISO 9001 *Quality management systems – Requirements*

**CHECKLIST FOR PRINCIPAL CONSTRUCTION DETAILS****1. General**

- 1.1. Global structural system

**2. External walls**

- 2.1. Vertical cross-section of the walls with all layers
- 2.2. Horizontal cross-section of the walls with all layers
- 2.3. Typical view of the structural system (e.g. positions of studs, plates, lintels, logs, including openings)
- 2.4. Horizontal racking resistance system
- 2.5. System for wall ties and uplift anchors
- 2.6. Horizontal cross-section of joints between prefabricated elements or components, including corner joints
- 2.7. Vertical cross-section of joint between exterior wall and foundation/ground floor
- 2.8. Vertical cross-section of joints between exterior wall and suspended floors
- 2.9. Vertical cross-section of joints between ext. wall and roof, both at gables and facades
- 2.10. Basic design of joints between wall and windows/doors
- 2.11. Fire stops

**3. Internal walls**

- 3.1. Horizontal cross-section of the walls with all layers
- 3.2. Typical view of the structural system with positions of studs, plates, lintels, logs, including openings
- 3.3. Horizontal racking resistance system
- 3.4. Vertical cross-section of joint between wall and foundation/ground floor
- 3.5. Vertical cross-section of joints between wall and suspended floors

**4. Separating walls between house units**

- 4.1. Horizontal cross-section of the walls with all layers
- 4.2. Typical view of the structural system with positions of studs and plates
- 4.3. Horizontal racking resistance system
- 4.4. Horizontal cross-section of joints between prefabricated elements
- 4.5. Vertical cross-section of joint between wall and foundation/ground floor
- 4.6. Vertical cross-section of joints between wall and suspended floors
- 4.7. Vertical cross-section of joints between wall and roof structure
- 4.8. Position of fire stops in voids between double wall leafs

**5. Suspended floors**

- 5.1. Vertical cross-section of the floors with all layers
- 5.2. Horizontal plan of structural system with positions of joists, blockings, etc
- 5.3. Structural system for floor openings
- 5.4. Detail of possible structural joist splices
- 5.5. Vertical cross-section of element joints
- 5.6. Vertical cross-section of support details on foundations and walls

**6. Roofs**

- 6.1. Vertical cross-section of complete roof structure with all layers
- 6.2. Plan of structural system with positions of rafters and possible intermediate supports
- 6.3. Structural system for openings to attics
- 6.4. Basic design of joints around ducts, pipes, chimneys, etc penetrating the roof
- 6.5. Vertical cross-section of support details at exterior walls and intermediate supports
- 6.6. Vertical cross-section of element joints
- 6.7. Basic design of joints between roof and roof windows

**7. Shafts for service installations**

- 7.1. Vertical cross-section of shaft walls
- 7.2. Horizontal cross-section of shaft walls
- 7.3. Principle design of fire stops between separate fire compartments

**EXAMPLE OF A SPECIFICATION LIST IN AN ETA FOR MATERIALS AND COMPONENTS IN TIMBER BUILDING KITS**

The following table shows how materials and components of a kit may be specified. The list contains only examples, and is not a complete list of all relevant materials and components in a timber building kit. Products which are not CE-marked must be specified by their brand name and type, or by another description which ensure the properties that has been assumed when assessing the characteristics of the kit.

<b>Material / component</b>	<b>Specification</b> (None specified dimensions shall be in accordance with specifications worked out individually for each delivery)	<b>Reaction to fire class according to EN 13501-1</b>
<b>Structural components</b>		
Solid timber members in walls, floors and roof	Untreated structural graded spruce timber, class C18 and C24 according to specific calculations, CE-marked according to EN 14081-1	D-s2, d0
Roof sheathing	15 mm OSB/3, formaldehyde class E1, CE-marked according to EN 13986	D-s2, d0
Subfloor	22 mm particleboard type P5 Floor, formaldehyde class E1, CE-marked according to EN 13986	D-s2, d0
<b>Insulation materials</b>		
Thermal insulation	Mineral wool, with declared thermal conductivity $\lambda_D = 0,037$ W/mK, CE-marked according to EN 13162	A1
Acoustic boards	30 mm xxxxx (brand name specification)	A2-s1,d0
<b>Membranes and barriers</b>		
Water vapour control layer	0,15 mm reinforced polyethylene with water vapour resistance $s_d = 10$ m, CE-marked according to EN 13984	F
Wind barrier	Spunbonded polyethylene sheet with water vapour resistance $s_d = 0.5$ m, CE-marked according to EN 13859-2 Class W1	F
Wet room floor and wall covering	Liquid applied covering xxxxx (brand name specification), CE-marked according to ETA xx/xxxx	
<b>Claddings and linings</b>		
External cladding	21 mm spruce or pine solid wood panelling, CE-marked according to EN 14915	D-s2, d0
Internal lining	- 12 mm particleboard type P4, formaldehyde class E1, CE-marked according to EN 13986 - 13 mm gypsum board type A, CE-marked according to EN 520	D-s2, d0 A2-s1, d0
<b>Roofing</b>		
Roofing	Single layer reinforced bitumen sheets, CE-marked according to EN 13707	B <sub>roof</sub> , t2
<b>Sealing products</b>		
Foam for window installation	PU Foam xxxxx (brand name specification)	F
Joint seal for window installation	Silicone mastic xxxxx (brand name specification)	F
<b>Fasteners</b>		
Load bearing screws	xxxxx (brand name specification), CE-marked according to ETA xx/xxxx	A1
Glue for wood based board installation	PVAc-adhesive xxxxx (brand name specification)	F