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GUIDELINE FOR EUROPEAN TECHNICAL APPROVAL
OF
PREFABRICATED STAIR KITS

**PREFABRICATED STAIR KITS IN GENERAL
(EXCLUDING SEVERE CLIMATIC CONDITIONS)**

EOTA

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PART ONE: GENERAL

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FOLLOWING PARTS CONCERNING DIFFERENT PRODUCT FAMILIES AND USE CATEGORIES

This ETA Guideline consists of two parts. Each of them may include annexes:

Part 1: Prefabricated stair kits in general (excluded severe climatic conditions)

Part 2 is used in addition to Part 1:

Part 2: Prefabricated stair kits, for use in severe climatic conditions

FOREWORD

Background of the subject

This Guideline has been drawn up by the EOTA Working Group 05.06/03 - *Prefabricated stair kits*. The WG consisted of active members from seven EU and EFTA countries [Austria, Finland (convenorship and secretariat), France, Germany, Norway, Portugal and the United Kingdom], with corresponding members from Netherlands, Poland, Sweden and the Czech Republic. In the participating Member States co-operation from industry has been taken care of by their representatives. Norway has been represented by the Norwegian joinery manufacturers association NTL. From C.E.I. Bois, one representative from Austria has been a member of the WG.

The scope of the Guideline is the result of a distinction between EOTA- and CEN-involvement in the area of stairs. The CEN technical committees 175 and 229 have been active in the fields of terminology and classification of stairs, timber in stairs and prefabricated concrete stairs. This EOTA WG has worked in liaison with these committees.

The scope of the Guideline excludes traditionally-made prefabricated stairs made of solid wood as a result of a discussion regarding the need of CE-marking of such a kit. It was agreed that EOTA would deal with systems as described in the scope of this Guideline, whilst stairs made on case by case basis on an individual request are excluded. These kinds of stairs might have parts with some degree of prefabrication such as shaping of the step edges, gluing of the wood material etc. but essentially they are made case by case. In general, such stairs are produced from solid wood for individual dwellings.

Where a stair kit acts as part of the loadbearing framework the mechanical resistance and stability needs to be assessed using the usual design calculations. This Guideline does not consider the requirements thereof.

The Guideline sets out the performance requirements for prefabricated stair kits, the verification methods used to examine the various aspects of performance, the assessment criteria used to judge the performance for the intended use and the presumed conditions for the design and execution of the kits in the works.

The general assessment approach of the Guideline is based on relevant existing knowledge and testing experience. Also, where relevant, national technical specifications have been discussed and taken into account. New specific test methods have not been developed, preference having been given to the use or amendment of existing test and calculation methods, especially EN and ISO methods.

The Guideline sets out the procedures to be followed when assessing the various properties of prefabricated stair kits. It shall be noted, however, that the choice of properties to be assessed and the choice of values and classes for each property is entirely that of the manufacturer.

In this first part, such conditions are considered, when there is no specific need to evaluate the effect of climatic factors, as snow and ice, frost, excessive moisture, high temperature or excessive radiation of sun. These aspects will be dealt with in the second part.

As most member countries, and the Interpretative Document on SAFETY IN CASE OF FIRE, use classes to define fire resistance and reaction to fire, so too does this Guideline. Otherwise, classes are not used throughout the Guideline. All remaining product characteristics, in general, are expressed as numerical values or in pass /fail terms. This approach is in accordance with the philosophy of the CPD that The Essential Requirements deal with the building works and an ETA is a favourable technical assessment of a construction product for an intended use, i.e. incorporation in the works. The ETA deals only with the product and states classes or just product characteristics to be used afterwards in the design of the works.

This Guideline deals with prefabricated stair kits before they are incorporated in the work. Behaviour in use depends on many factors including the design and the installation of the stair kit, the manufacturing quality and the installation in the works.

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** (mentioning the year of issue) for this ETAG is given in annex F. When additional parts for this ETAG are written afterwards, 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 ETA's 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.be 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.

Section one :

INTRODUCTION

1. PRELIMINARIES

1.1. Legal basis

This ETAG has been established in compliance with the provisions of the Council Directive 89/106/EEC (CPD) and has been established taking into account the following steps:

- the final mandate issued by the EC
- the final mandate issued by the EFTA
- adoption of the Guideline by the Executive Commission of EOTA
- opinion of the Standing Committee for Construction
- endorsement by the EC
- 30/09/98
- 30/09/98
- 12/06/2001
- 18 – 19/12/01
- 16/01/02

This document is published by the Member States in their official language or languages according to art. 11.3 of the CPD.

No existing ETAG is superseded.

1.2. Status of ETAG

a) **An ETA is one of the two types of technical specifications** in the sense of the EC 89/106 Construction Products Directive. This means that Member States shall presume that the approved stair kits are fit for their intended use, i.e. they enable works in which they are employed to satisfy the Essential Requirements during an economically reasonable working life, provided that :

- the works are properly designed and built;
- the conformity of the products with the ETA has been properly attested.

a) **This ETAG is a basis for ETAs**, i.e. a basis for technical assessment of the fitness for use of a stair kits for an intended use. An ETAG is not itself a technical specification in the sense of the CPD.

This ETAG expresses the common understanding of the approval bodies, acting together within EOTA, as to the provisions of the Construction Products Directive 89/106 and of the Interpretative Documents, in relation to the prefabricated stair kits and uses concerned, and is written within the framework of a mandate given by the Commission and the EFTA secretariat, after consulting the Standing Committee for Construction.

a) c) When accepted by the European Commission after consultation with the Standing Committee for Construction this **ETAG is binding** for the issuing of ETAs for the stair kits for the defined intended uses.

The application and satisfaction of the provisions of an ETAG (examinations, tests and evaluation methods) leads to an ETA and a presumption of fitness of a stair kit for the defined use only through an evaluation and approval process and decision, followed by the corresponding attestation of conformity. This distinguishes an ETAG from a harmonised European standard which is the direct basis for attestation of conformity.

Where appropriate, stair kits which are outside of the precise scope of this ETAG may be considered through the approval procedure without guidelines according to art. 9.2 of the CPD.

The requirements in this ETAG are set out in terms of objectives and of relevant actions to be taken into account. It specifies values and characteristics, the conformity with which gives the presumption that the requirements set out are satisfied, wherever the state of art permits and after having been confirmed as appropriate for the particular product by the ETA.

This Guideline indicates alternate possibilities for the demonstration of the satisfaction of the requirements.

2. SCOPE

2.1. Scope

The ETAG applies to complete prefabricated stair kits for uses as defined in 2.2. A stair kit is composed of, for example, steps, landings, strings, handrails, barriers, fixing elements and coverings. The term prefabricated indicates that products are manufactured in industrial series production or at least similar to series production. By 'Similar to series production' is meant production on the basis of predesigned system.

Single components (e.g. single steps, barrier) are not covered by the ETAG if they are not components of a stair kit. The minimum content of a stair kit is steps and fixings.

Excluded from the scope are:

- traditionally-made prefabricated stairs of solid wood, made to order to suit an individual request.
- loft ladders
- Precast monolithic concrete stairs (which have already been mandated to CEN)
- stair kits which contribute to the overall stability of the works or to the strength of the structure including structural response of the building under earthquake actions
- outdoor stairs not linked to the building, e.g. stairs on playgrounds or in gardens
- auxiliary stairs used for such purposes that the authorities have no requirements in the sense of essential requirements
- stairs for special technical purposes in working areas or in industrial production areas (e.g. service stations, silos, etc.)

2.2. Use categories, product families, kits

The prefabricated stair kits are intended to be attached to the building (indoor or outdoor).

Prefabricated stair kits can be classified in several ways:

- stairs in general (excluded severe climatic conditions)

General conditions are normally characterised by temperatures varying between + 5 and +30 °C and relative humidities varying between 30 and 70 %. For these stairs the performance against climatic conditions can be determined according to this Part 1.

- stairs to be used in severe climatic conditions

For these stairs the performance against climatic conditions (snow, frost, excessive moisture, high temperature, excessive sun radiation etc.) shall be determined according to Part 2 (not yet drafted).

In the materials' technical specifications the classifications are often based on the moisture content in a material, which depends on the relative humidity and the temperature. These classifications and technical specifications of materials referring to climatic conditions in general shall be taken into account. In absence of such technical specifications, the approval body shall consider, if the products are suitable to be used in severe climatic conditions.

The local regulations may have other subdivisions, e.g. as stairs for public use and stairs for private use.

2.3. Assumptions

The state of the art does not enable the development, within a reasonable time, of full and detailed verification methods and corresponding technical criteria/guidance for acceptance for some particular aspects or products. This ETAG contains assumptions taking account of the state of art and makes provisions for appropriate, additional *case-by-case approaches* when examining ETA-applications, within the general framework of the ETAG and under the CPD consensus procedure between EOTA members.

The guidance remains valid for other cases which do not deviate significantly. The general approach of the ETAG remains valid but the provisions then need to be used case by case in an appropriate way. This use of the ETAG is the responsibility of the ETA-body which receives the special application, and subject to consensus within EOTA. Experience in this respect is collected, after endorsement in EOTA-TB, in the ETAG-Format-Comprehension document.

3. TERMINOLOGY

3.1. Common terminology and abbreviations

Common terminology is listed and defined in Annex A.

3.2. Terminology and abbreviations specific to this ETAG

Terminology and abbreviations specific to this ETAG listed and defined in Annex B.

Section two :

GUIDANCE FOR THE ASSESSMENT OF THE FITNESS FOR USE

GENERAL NOTES

(a) Applicability of the ETAG

This ETAG provides guidance on the assessment of a family of prefabricated stair kits and their intended uses. It is the manufacturer or producer who defines the stair kit for which he is seeking ETA and how it is to be used in the works, and consequently the scale of the assessment.

It is therefore possible that for some stair kits, which are fairly conventional, only some of the tests and corresponding criteria are sufficient to establish fitness for use. In other cases, e. g. special or innovative stair kits or materials, or where there is a range of uses, the whole package of tests and assessment may be applicable.

(b) General layout of this section

The assessment of the fitness of stair kits with regard to their fitness for intended use in construction works is a process with three main steps:

- Chapter 4 clarifies *the specific requirements for the works* relevant to the stair kits and uses concerned, beginning with the Essential Requirements for works (CPD art. 11.2) and then listing the corresponding relevant characteristics of stair kits.
- Chapter 5 extends the list in Chapter 4 into more precise definitions and *the methods available to verify* product characteristics and to indicate how the requirements and the relevant product characteristics are described. This is done by test procedures, methods of calculation and of proof, etc. (selection of the appropriate methods)
- Chapter 6 provides guidance on *the assessing and judging methods* to confirm fitness for the intended use of the stair kits.
- Chapter 7 *assumptions and recommendations* is only relevant in as far as they concern the basis upon which the assessment of the stair kit is made concerning their fitness for the intended use.

(c) Levels or classes or minimum requirements, related to the Essential Requirements and to the product performance (see ID clause 1.2)

According to the CPD, "Classes" in this ETAG refer only to mandatory levels or classes laid down in the EC-mandate.

This ETAG indicates, however, the compulsory way of expressing relevant performance characteristics for the stair kit. If, for some uses, at least one Member state has no regulations, a manufacturer always has the right to opt out of one or more of them, in which case the ETA will state "no performance determined" against that aspect, except for those properties for which, when no determination has been made, the stair kit doesn't any longer fall under the scope of the ETAG; such cases shall be indicated in the ETAG.

(d) Working life (durability) and serviceability

The provisions, test and assessment methods in this guideline or referred to, have been written, based upon the assumed intended working life of the stair kit for the intended use of 50 years, provided that the stair kit is subject to appropriate use and maintenance (cf. Ch. 7). These provisions are based upon the current state of art and the available knowledge and experience.

An "assumed intended working life" means that it is expected 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.

The indications given as to the working life of a stair kit cannot be interpreted as a guarantee given by the producer or the approval body. They should only be regarded as a means for the specifiers to choose the

appropriate criteria for stair kits in relation to the expected, economically reasonable working life of the works (based upon ID. par. 5.2.2).

For stair kits or components with a shorter estimated working life, the intended use shall be limited to specific applications where the shorter durability is clearly stated.

(e) Fitness for the intended use

According to the CPD it has to be understood that within the terms of this ETAG, products shall “have such characteristics that the works in which they are to be incorporated, assembled, applied or installed, can, if properly designed and built, satisfy the Essential Requirements” (CPD, art. 2.1).

Hence, the stair kits shall be suitable for use in construction works which (as a whole and in their separate parts) are fit for their intended use, account being taken of economy, and in order to satisfy the essential requirements. Such requirements, shall, subject to normal maintenance, be satisfied for an economically reasonable working life. The requirements generally concern actions which are foreseeable. (CPD Annex I, preamble).

4. REQUIREMENTS FOR WORKS, AND THEIR RELATIONSHIP TO THE STAIR KIT CHARACTERISTICS

This chapter sets out the aspects of performance to be examined in order to satisfy the relevant Essential Requirements, by:

- expressing in more detail, within the scope of the ETAG, the relevant Essential Requirements of the CPD in the Interpretative Documents and in the mandate, for works or parts of the works, taking into account the actions to be considered, as well as the expected durability and serviceability of the works.
- applying them to the scope of the ETAG for prefabricated stair kits, and providing a list of relevant stair kit characteristics and other applicable properties.

When a product characteristic or other applicable property is specific to one of the Essential Requirements, it is dealt with in the appropriate place. If, however, the characteristic or property is relevant to more than one Essential Requirement, it is addressed under the most important one with cross reference to the other(s). This is especially important where a manufacturer claims “No performance determined” for a characteristic or property under one Essential Requirement and it is critical for the assessing and judging under another Essential Requirement. Similarly, characteristics or properties which have a bearing on durability assessments may be dealt with under ER 1 to ER 6, with reference under 4.7. Where there is a characteristic which only relates to durability, this is dealt with in 4.7

This chapter also takes into account further requirements, if any (e.g. resulting from other EC Directives) and identifies the aspects of serviceability including specifying characteristics needed to identify the stair kits. (cf. ETA-format par. II.2).

For all stair kit characteristics given in clause 4 values may be prescribed in national, regional or local level depending on the use of the stairs as well as the type and use of the works in which the stair kit is to be incorporated.

4.0. Tables linking the Essential Requirements to stair kit performance

Table 1. The relevant Essential Requirements, the relevant paragraphs of corresponding IDs and related product performance to be assessed.

ER	Corresponding ID paragraph for works	Corresponding ID paragraph for products performance	ETAG paragraph and product characteristics
1,4	4.2.4 Simplified rules	4.3.2 Performance of products	4.1.1 Loadbearing capacity 4.1.2 Stability and stiffness 4.1.3 Resistance of fixings
2	4.2.2 Loadbearing capacity of the construction	4.3.1.3 Products subjected to resistance to fire	4.2.1 Resistance to fire

	4.2.3 Limitation of the generation of fire and smoke within the room of origin 4.2.5 Evacuation of occupants	requirements 4.3.1.1 Products subjected to reaction to fire requirements	4.2.2 Reaction to fire
3	3.3.1 Indoor environment	3.3.1.1.3.2a Construction products (category B) a) Building materials	Release of: 4.3.1 Dangerous substances 4.3.2 Formaldehyde 4.3.3 Asbestos (content) 4.3.4 Pentachlorophenol 4.3.5 Radioactive emissions
4	3.3.1.2 Falling 3.3.2 Direct impacts	3.3.1.3 Falling after slipping, falling due to changes in level or sudden drops 3.3.2.2 Geometry, presence of sharp or cutting edges, nature of surfaces, behaviour on impact	4.4.1 Geometry of the stairs including landings 4.4.2 Slipperiness 4.4.3 Safety equipment 4.4.4 Safe breakage 4.4.5 Impact resistance
5	-		-
6	-		-

Aspects of durability, serviceability and identification	4.7.1 Resistance to deterioration caused by physical agents 4.7.2 Resistance to deterioration caused by chemical agents 4.7.3 Resistance to deterioration caused by biological agents 4.7.4 Finishes and surface layers
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4.1. Mechanical resistance and stability

The Essential Requirement laid down in the Council Directive 89/106/EEC is as follows:

The construction works must be designed and built in such a way that the loadings that are liable to act on it during its constructions and use will not lead to any of the following:

- *collapse of the whole or part of the work;*
- *major deformations to an inadmissible degree;*
- *damage to other parts of the works or to fittings or installed equipment as are result of major deformation of the load-bearing construction;*
- *damage by an event to an extent disproportionate to the original cause.*

According to the mandate, this essential requirement is of relevance in the sense of Essential Requirement 4. Prefabricated stair kits will usually be attached to the main structure which in itself ensures the stability of the building. Thus, the mechanical loadbearing capacity of the stair kit is a matter of safety such that the stairs will not be broken in use and that they will carry all the direct loads.

Those requirements resulting from the case whereby the stair kit will be fixed to the construction so that it will act as a loadbearing or stabilising part of the building (e.g. bracing) are not covered by this ETAG.

For stair kits in general, the following aspects of performance are relevant to this Essential Requirement:

4.1.1. Loadbearing capacity

4.1.1.1. Actions

The stair shall have sufficient mechanical resistance and stability to withstand static or dynamic loads from the actions without reaching its serviceability limit state or exceeding its ultimate limit state. The actions shall be in accordance with the laws, regulations and administrative provisions, applicable for the location where the product is incorporated in the works.

The actions relevant to stair kits are permanent actions, variable actions and accidental actions.

4.1.1.2. Avoidance of progressive collapse

The design of the stair kit shall be such that the failure of one step shall not lead to the failure of the whole stairs.

4.1.1.3. Residual load resistance

For brittle materials, the design of the stair kit shall be such that the failure of one step shall not lead to total loss of loadbearing capacity of the step causing the user to fall to a lower level.

4.1.1.4. Long-term behaviour

The long-term behaviour of the materials of the stair kit shall be verified for the intended working life. The loadbearing capacity shall retain its original value or the decrease in the capacity shall be considered in the design.

4.1.1.5. Design provisions for earthquake resistance

In seismic zones the stair kit, together with the fixings, shall be able to resist the seismic actions.

4.1.2. Stability and stiffness

Stability and stiffness are expressed as load-displacement behaviour and vibrations.

The stair as a whole and its parts, such as steps and barriers, shall be designed to limit the deflection and vibrations under working conditions.

4.1.3. Resistance of fixings

The fixing to the supporting structure and the connection of the stair components to each other shall be designed in such a way that the actions from the different parts of the stairs shall be transferred to the works in an appropriate way.

4.2. Safety in case of fire

The Essential Requirement laid down in the Council Directive 89/106/EEC is as follows:

The construction works must be designed and built in such a way that in the event of an outbreak of fire:

- *the loadbearing capacity of the construction can be assumed for a specific period of time.*
- *the generation and spread of fire and smoke within the works are limited*
- *the spread of fire to neighbouring construction works is limited*
- *occupants can leave the works or be rescued by other means*
- *the safety of rescue teams is taken into consideration.*

For stair kits in general, the following aspects of performance are relevant to this Essential Requirement:

4.2.1. Resistance to fire

In accordance with the "Horizontal complement to the mandates to CEN/CENELEC concerning the execution of standardisation work for the evaluation of construction products and elements in respect of their resistance to fire" of the European Commission, the loadbearing capacity R needs to be evaluated.

4.2.2. Reaction to fire

Materials which are parts of the kit shall have the necessary performance concerning reaction to fire in accordance with laws, regulations and administrative provisions applicable to the installed kit.

4.3. Hygiene, health and environment

The Essential Requirement laid down in the Council Directive 89/106/EEC is as follows:

The construction work, must be designed and built in such a way that it will not be a threat to the hygiene or health of the occupants or neighbours, in particular as a result of any of the following:

- *the giving-off of toxic gas,*
- *the presence of dangerous particles or gases in the air*
- *the emission of dangerous radiation,*
- *pollution or poisoning of the water or soil,*
- *faulty elimination of waste water, smoke, solid or liquid wastes,*
- *the presence of damp in parts of the works or on surfaces within the works.*

For components of stair kits in general, the following aspects of performance are relevant to this Essential Requirement:

4.3.1. Release of dangerous substances

The product/kit must be such that, when installed according to the appropriate provisions of the Member States, it allows for the satisfaction of the ER3 of the CPD as expressed by the national provisions of the Member States and in particular does not cause harmful emission of toxic gases, dangerous particles or radiation to the indoor environment nor contamination of the outdoor environment (air, soil or water).

4.3.2. Release of formaldehyde

The components shall be made of such materials, and the surface treatments shall be made, in order that release of formaldehyde is in accordance with laws, regulations and administrative provisions applicable for the location where the product is incorporated in the works.

4.3.3. Content of asbestos

The components shall be made of such materials that the content of asbestos is in accordance with laws, regulations and administrative provisions applicable for the location where the product is incorporated in the works (see clause 4.3.1).

4.3.4. Content of pentachlorophenol

The components shall be made of such materials, and the surface treatments shall be made, in order that the content of pentachlorophenol is in accordance with laws, regulations and administrative provisions applicable for the location where the product is incorporated in the works (see clause 4.3.1).

4.3.5. Radioactive emissions

The components shall be made of such materials that maximum allowed amount of radioactive emissions is in accordance with laws, regulations and administrative provisions, applicable for the location where the product is incorporated in the works (see clause 4.3.1).

4.4. Safety in use

The Essential Requirement laid down in the Council Directive 89/106/EEC is as follows:

The construction work must be designed and built in such a way that it does not present unacceptable risks of accidents in service or in operation such as slipping, falling, collision, burns, electrocution, injury from explosion.

For stair kits in general, the following aspects of performance are relevant to this Essential Requirement:

4.4.1. Geometry of the stairs including landings

Stair kits, including landings, shall be normally accessible and safe during their daily use and function as main escape in the case of fire where required.

The dimensions listed below are related to varying requirements set out in the relevant laws, regulations and administrative provisions applicable for the location where the product is incorporated in the works. For stairs to be used by special groups (e.g. handicapped people, children) specific values for these will have to be met.

4.4.1.1. Going

4.4.1.2. Minimum going for tapered steps

4.4.1.3. Maximum going for tapered steps

4.4.1.4. Rise

4.4.1.5. Pitch

Constant pitch line

Several Member States have regulations such that the pitch shall be constant along a specified line (also called walking line). The location of this line shall be defined in accordance with laws, regulations and administrative provisions applicable for the location where the product is incorporated in the works.

4.4.1.6. Overlap

4.4.1.7. Number of rises between landings

4.4.1.8. Maximum openings

The size and shape of the openings shall be such that a person is prevented from falling from the stair or being trapped. The following openings shall be considered when relevant:

- between barrier and other parts of stair (e.g. fig B7)
- between parts of stair kit and relevant parts of the works (e.g. fig B13)
- between consecutive steps in an open rise stair (e.g. figs B9 and B12)
- in the barrier (e.g. fig B7)

4.4.1.9. Minimum clear width of stair

4.4.1.10. Maximum clear width of stair

4.4.1.11. Minimum headroom

In cases where the minimum headroom is relevant for the stair kit itself (e.g. spiral stair kit) this performance characteristic shall be considered.

4.4.1.12. Dimensions of landing

4.4.2. Slipperiness

The steps and landings shall be made of such materials and such surface treatments shall be used that unacceptable slipperiness can be avoided.

4.4.3. Safety equipment

4.4.3.1. Handrails

Height of the handrail

The height of the handrail and additional handrail for children shall ensure that the user can firmly grasp and use the handrail in all cases (cf. Annex B Fig. B7) in an appropriate way.

The heights of the handrails shall comply with the different requirements set out in the relevant laws, regulations and administrative provisions, applicable for the location where the product is incorporated in the works, to allow users to go up and down safely.

Geometry of the handrail

The performance of the handrail and its end shall be such that the user can firmly grasp and use the handrail in an appropriate way. The gap between the wall and the handrail shall be sufficient to enable the safe use of the handrail. (c.f. Annex B figure B8).

Additional handrails shall be provided if demanded.

4.4.3.2. Barrier

The barriers shall prevent a person falling from the stair or being trapped.

Height of barrier

The height of the barrier shall comply with different requirements set out in the relevant laws, regulations and administrative provisions, applicable for the location where the product is incorporated in the works to allow users to go up and down safely.

Minimum and maximum height of the part of the barrier without openings

The height of the part of the barrier without opening shall comply with the different requirements set out in the relevant laws, regulations and administrative provisions, applicable for the location where the product is incorporated in the works, to allow users to go up and down safely.

Climbability for infants

Depending on the intended use and the local regulations where the product is incorporated in the works there may be a requirement to prohibit the ladder effect; i.e. some components of the barrier make it possible for infants to climb up the barrier.

To minimise the ladder effect, the maximum diameter of openings of the barrier in-fill and of the in-fill elements of the associated parts of the barrier shall comply with the different requirements set out in the relevant laws, regulations and administrative provisions, applicable for the location where the product is incorporated in the works, to allow users to go up and down safely.

4.4.3.3. Tactility and visibility

For some applications there may be a need of specific safety equipment to enable disabled people, children or elderly people to use the stairs. Tactility for blind people as well as the visibility for all users of the stairs shall be considered.

The safety equipment shall be such that the beginning and the end of the stairs and the handrail can be observed clearly. The edge of the steps and landings shall be marked clearly, this marking shall not increase the slipperiness of the stairs.

4.4.4. Safe breakage

The stairs shall be designed and installed with due consideration to passive safety to prevent occupants from being injured by the stairs or part of the stairs in normal use. In the case of a person falling against the stairs or barrier, the possible injuries shall be limited. Also, in the case of an accident, the injury caused to persons below or in the neighbourhood of the stairs shall be limited.

Any elements of the stair kit liable to brittle fracture failure shall not, when accidentally broken, be a danger to users. Glazing or corresponding materials shall be such, that, when broken, the pieces are kept in place and not detached in a way which would endanger users and those passing by.

4.4.5. Impact resistance

The properties of the construction and the materials shall be such that the stair kit is resistant to dynamic loads from persons or objects accidentally falling against the barrier or on the stairs.

4.5. Protection against noise

There are no regulatory requirements in Member States concerning ER 5 for stairs themselves. Where sound insulation or sound absorption is called for, the insulation is applied afterwards and is not part of the prefabricated kit.

4.6. Energy economy and heat retention

There are no regulatory requirements in Member States concerning ER 6 for stairs themselves. Where thermal insulation is relevant, the insulation shall be applied afterwards and not be part of the prefabricated kit.

4.7. Aspects of durability, serviceability and identification

The following are related to the Essential Requirements, but not to any one in particular. As a consequence, failure to meet these requirements means that more than one of the Essential Requirements can no longer be met.

To retain their properties during the estimated working life period, the components of the stairs and surfaces may need regular maintenance. The type and the intervals of such maintenance shall be specified as part of the approval. This may be especially important for outdoor stairs and stairs in public buildings.

The components and materials used in stair kits shall be defined by their properties, which have an influence on the fulfilment of the Essential Requirements.

4.7.1. Resistance to deterioration caused by physical agents

The stairs and the parts of them, especially joints, shall not be adversely affected (deteriorated, distorted or deformed) by the following conditions:

- Variations of temperature of the environment
- Variations of relative humidity of the environment
- Radiation of the sun, e.g. through the windows.

4.7.2. Resistance to deterioration caused by chemical agents

The stairs and the parts of them, especially joints, shall not be adversely affected by the following chemical agents:

- Cleaning agents
- Water, carbon dioxide, oxygen and other naturally occurring corrosives.

4.7.3. Resistance to deterioration caused by biological agents

The stairs and the parts of them, especially joints, shall not be adversely affected by the following biological agents:

- Fungi, bacteria and algae
- Insects.
- If preservative treatments are used, their use shall be in accordance with laws, regulations and administrative provisions applicable for the location where the product is incorporated in the works.

4.7.4. Finishes and surface layers

The finishes of the stairs shall protect against deterioration caused by physical, chemical or biological agents, when relevant. The finishes shall not increase the slipperiness of the stairs beyond safe limits.

If other functions of surface finishes are claimed, they shall be proven.

5. METHODS OF VERIFICATION

This chapter refers to the verification methods used to determine the various aspects of performance of the products in relation to the requirements for the works (calculations, tests, engineering knowledge, site experience, etc.) as set out in chapter 4.

Verification by testing shall be in accordance with the test methods given in this guideline.

When EUROCODES are quoted in this ETAG as the methods for the verification of certain product characteristics, their application in this ETAG, as well as in the subsequent ETAs issued according to this ETAG, shall be in accordance with the principles laid down in the EC Guidance Paper on the use of EUROCODES in harmonised European technical specifications

5.0. Tables linking the Essential Requirements to stair kit performance

Table 2. The relevant essential requirements, the related requirements to product performances (as given in chapter 4), the corresponding product characteristics to be assessed and the corresponding verification methods.

ER	ETAG paragraph and product characteristics	Product characteristics	ETAG paragraph on verification method
1,4	4.1.1 Mechanical resistance / load bearing capacity and stability 4.1.2 Stability and stiffness 4.1.3 Resistance of fixings	Resistance to structural damage from vertical and horizontal loads against the barrier Stiffness Resistance to structural damage of fixings	5.1.1 Load bearing capacity 5.1.2 Load / displacement behaviour and vibrations 5.1.3 Resistance of fixings
2	4.2.1 Resistance to fire 4.2.2 Reaction to fire - horizontal parts - all other parts	Loadbearing capacity R Euroclasses Decision	5.2.1 Resistance to fire 5.2.2 Reaction to fire
3	4.3.1 Release of dangerous substances 4.3.2 Release of formaldehyde 4.3.3 Release of asbestos (content) 4.3.4 Release of pentachlorophenol Radioactive emission	Dangerous substances (amount of pollutants, rate of release of pollutants, amount and activity of radiating material	5.3.1 Release of dangerous substances 5.3.2 Release of formaldehyde 5.3.3 Release of asbestos (content) 5.3.4 Release of pentachlorophenol 5.3.5 Radioactive emission
4	4.4.1 Geometry of the stair including landings 4.4.2 Slipperiness 4.4.3 Safety equipment 4.4.4 Safe breakage 4.4.5 Impact resistance	Definition of geometry Slipperiness of the surface materials of the steps and landings Adequate function Geometry and shattering properties of glass and other materials Resistance to structural damage from soft body, hard body and angular body impact load	5.4.1 Geometry of the stair including landings 5.4.2 Slipperiness 5.4.3 Safety equipment 5.4.4 Safe breakage 5.4.5 Impact resistance

Aspects of durability,	4.7.1 Resistance to deterioration caused by physical agents	Resistance to deterioration caused by physical agents	5.7.1 Resistance to deterioration caused by physical agents
serviceability and	4.7.2 Resistance to deterioration caused by chemical agents	Resistance to deterioration caused by chemical agents	5.7.2 Resistance to deterioration caused by chemical agents
identification	4.7.3 Resistance to deterioration caused by biological agents	Resistance to deterioration caused by biological agents	5.7.3 Resistance to deterioration caused by biological agents
	4.7.4 Finishes and surface layers	Resistance to deterioration caused by physical, chemical or biological agents Specific functions	5.7.4 Finishes and surface layers

Loadbearing capacities, displacements etc. may be achieved by calculation or testing. The principle is the same as described in Eurocode 1. Also, for products with unknown material properties and complicated design, testing is the only practical method.

If boxed values have been used in calculations, this shall be clearly indicated and the values used given.

5.1. Mechanical resistance and stability

The loadbearing capacity and the load-displacement behaviour and vibrations of the stair as a whole or of its parts (including fixings) shall be verified according to the limit states design method as proposed in prEN 1990, if not otherwise stated in the national regulations.

The verification shall be made by calculation, in general, or by testing, when necessary.

- *Verification by calculation*

Calculations shall be performed using appropriate design models for the structural behaviour of the stairs. The appropriate limit states shall be considered.

The calculation of the internal forces and moments caused by the actions given in the technical specifications (Eurocodes) can be carried out using an idealised static system. When relevant, the system can be presented as a two-dimensional system. The calculations shall be carried out to Eurocodes. All relevant design situations and actions within section 4.1 of this ETAG shall be considered. The horizontal load shall only be taken into account as a force acting from the stairs towards the outside.

The calculation rules and material properties are given in the following Eurocodes:

prEN 1990: Eurocode - Basis of structural design

ENV 1991: Eurocode 1 *Basis of design and actions on structures*

ENV 1992: Eurocode 2 *Design of concrete structures*

ENV 1993: Eurocode 3 *Design of steel structures*

ENV 1994: Eurocode 4 *Design of composite steel and concrete structures*

ENV 1995: Eurocode 5 *Design of timber structures*

ENV 1999: Eurocode 9 *Design of aluminium structures*

- *Verification by testing*

Where the calculation methods given in the Eurocodes listed above are not sufficient, testing shall be carried out to substantiate the performance of the stair. The Approval Body shall consider any available data derived from existing testing (e.g. on prototype samples).

The same principle applies for other materials and combination of materials, provided a relevant calculation method is used. In specific cases and where calculation methods are not appropriate, the design can be based on test data.

The test procedures in general shall follow the relevant EN standards for testing components and materials. See list of reference documents.

In general, if testing is used, the principles in Annex C shall be followed. The test results shall be adjusted to correspond to the minimum characteristic values of the materials.

5.1.1. Loadbearing capacity

Loadbearing capacity shall be calculated in ultimate limit states. If testing is used, it is not necessary to load the stair kit or part of it until failure, if a sufficient load level is reached before the failure.

For stairs with loadbearing bolts, specific calculation methods are given in Annex E.

5.1.1.1. Safety factors to be used in the calculations

If not specified in national regulations, the materials partial safety factor γ_M is to be used for the minimum value of three tests:

- wood and wood-based products $\gamma_M = 1,5$
- cement or resin bonded concrete stone $\gamma_M = 1,6$
- natural stone $\gamma_M = 1,8$
- polyamide tested in normal environmental conditions (21°C±3°C, humidity of polyamide 2,5%±0,5%) $\gamma_M = 3$
- polyamide tested in extreme environmental conditions under influence of temperature and humidity of polyamide $\gamma_M = 2$

If not specified in national regulations, the materials partial safety factor γ_M to be used for the 5 %-fractile (for a confidence level of 75 %) of at least 10 tests:

- wood and wood-based products $\gamma_M = 1,3$
- cement or resin bonded concrete stone $\gamma_M = 1,5$
- steel $\gamma_M = 1,1$

For new materials, the approval body shall propose the materials partial safety factors to be approved by the other approval bodies.

5.1.1.2. Avoidance of progressive collapse

The design of the stair kit shall be evaluated.

5.1.1.3. Residual load resistance

For brittle materials, the residual load resistance shall be determined by testing.

5.1.1.4. Long-term behaviour

For certain products (e.g. plastics) it is necessary to carry out long-term tests. In these tests, the behaviour under sustained loading as well as the effect of prevailing environmental conditions (e.g. effect of UV) shall be determined. In the same way, pulsating loads and recurrent loads have to be taken into account.

5.1.1.5. Design provisions for earthquake resistance

The stair kit, and the fixings to the main structure, shall be verified to resist the seismic action and its combination with the relevant permanent and variable actions.

The verification shall be made according to clause 3.5 of ENV 1998-1-2:1994 "Eurocode 8 - Design provisions for earthquake resistance of structures - Part 1-2 General rules - General rules for buildings", including the boxed values given in this standard or in the national application documents.

The resistance of fixings shall be proven as referred to in 5.1.3.

5.1.2. Load / displacement behaviour and vibrations

Load / displacement behaviour shall be calculated in serviceability limit states.

Calculation can be based on linear behaviour. The displacement shall be calculated or tested separately for the step and the bearing elements. The worst case shall be considered. Bending due to imposed horizontal load shall not be taken into account here. The median line of the flight width is taken as length l .

When assuming a realistic 3-D-representation, the function of the wall fastener as well as the shear resistance of the steps shall be taken into account. The influence of the barrier may be taken into account.

For the railing, a verification of bending due to imposed horizontal loads will not be required.

Vibrations shall be assessed via the displacement caused by a single point load of 1 kN. The proper oscillation frequency of stairs exposed to dead load as well as to an additional single load of 1 kN acting on the most unfavourable point shall be evaluated.

Alternatively, the lowest natural frequency shall be evaluated.

5.1.3. Resistance of fixings

The loads for the fixings and connections shall be calculated according to Eurocodes. The resistance of fixings shall be proven according to Eurocodes or other harmonised technical specification. The resistance of connections shall be proven according to Eurocodes or other harmonised technical specification or by testing. If testing is used, the principles in Appendix C shall be followed.

The deformation of the fixings shall be taken into account when the loadbearing capacity and deformations of the stairs are considered.

5.2. Safety in case of fire

5.2.1. Resistance to fire

For resistance to fire, the evaluation for the R-characteristics shall be made as specified in prEN 13501-2, *Fire classification of products and building elements. Part 2 Classification using data from fire resistance tests*.

Resistance to fire may also be evaluated by calculation according to Eurocodes (to be used in those Member States where the calculation method is recognised). The relevant NDPs shall then be used.

5.2.2. Reaction to fire

For reaction to fire, an evaluation shall be made as specified in prEN13501-1, *Fire classification of construction products and building elements – Part 1 Classification using test data from reaction to fire tests*.

For the upper side of steps and landings (analogous to flooring) the classification for flooring elements shall be considered, see Commission Decision 2000/147/EC.

All other parts shall be considered and handled as specified in the classification for walls and ceilings, see Commission Decision 2000/147/EC.

Products comprising materials included in the Commission Decision 2000/605/EC should be considered as Euroclass A₁ without testing.

5.3. Hygiene, health and environment

5.3.1. Release of dangerous substances

5.3.1.1. Presence of dangerous substances in the product

The applicant shall submit a written declaration stating whether or not the product/kit contains dangerous substances according to European and national regulations, when and where relevant in the Member States of destination, and shall list these substances.

5.3.1.2. Compliance with the applicable regulations

If the product/kit contains dangerous substances as declared above, the ETA will provide the method(s) which has been used for demonstrating compliance with the applicable regulations in the Member States of destination, according to the dated EU data-base (method(s) of content or release, as appropriate).

5.3.1.3. Application of the precautionary principle

An EOTA member has the possibility to provide to the other members, through the Secretary General, warning about substances which, according to Health authorities of its country, are considered to be dangerous under sound scientific evidence, but are not yet regulated. Complete references about this evidence will be provided.

This information once agreed upon, will be kept in an EOTA data base, and will be transferred to the Commission services.

The information contained in this EOTA data base will also be communicated to any ETA applicant.

On the basis of this information, a protocol of assessment of the product, regarding this substance, could be established on request of a manufacturer with the participation of the Approval Body which raised the issue.

5.3.2. Release of formaldehyde

The general inspection of manufacturing methods can be used to verify, that the kit has no components containing formaldehyde.

For stair kits with wood-based panels, testing of them with respect to the emission of formaldehyde is dependent on panel type, and shall be performed as described in prEN 13986, Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking.

5.3.3. Content of asbestos

The general inspection of manufacturing methods can be used to verify that the kit does not contain asbestos.

There is no European test method available concerning testing of materials with respect to the content of asbestos. Where components of the stair kit contain asbestos, the manufacturer shall give information on the content of:

Crocidolite
Amosite
Anthophyllite
Tremolite
Chrysotile.

(see clause 5.3.1)

5.3.4. Release of pentachlorophenol

The general inspection of manufacturing methods can be used to verify that the kit has no parts with pentachlorophenol.

There is no European test method available concerning testing of materials with respect to the emission/content of pentachlorophenol. Where components of the stair kit contain pentachlorophenol, the manufacturer shall give information on the content (see clause 5.3.1).

5.3.5. Radioactive emissions

The general inspection of manufacturing methods and the origin of the materials and components as stated in clause 5.3.1 can be used to verify that the kit is not contaminated by radioactive elements.

5.4. Safety in use

5.4.1. Geometry of the stair including landings

5.4.1.1. Going

The going shall be measured as horizontal distance between two consecutive nosings measured on the walking line.

5.4.1.2. Minimum going for tapered steps

The minimum going shall be measured as the minimum unobstructed horizontal distance between the nosings of two consecutive tapered steps projected on plan.

5.4.1.3. Maximum going for tapered steps

The maximum going shall be measured as the maximum unobstructed horizontal distance between the nosings of two consecutive tapered steps projected on plan.

5.4.1.4. Rise

The distance shall be measured vertically from the tread of a step to the tread of the consecutive step.

The rise of all steps in one flight shall be measured.

5.4.1.5. Pitch

The pitch of the stair shall be expressed as the angle in degrees between the pitch line and the horizontal plane.

The pitch of all steps in one flight shall be measured.

Constant pitch line

If the applicant has indicated the location of the constant pitch line, the pitch values along this line shall be measured.

5.4.1.6. Overlap

The dimension of the overlap shall be measured horizontally on plan between the nosing of a step and the rear edge of the tread of the consecutive step below.

5.4.1.7. Number of rises between landings

The rises within one flight shall be counted.

5.4.1.8. Maximum openings

The size of the openings shall be tested with a cube with a fixed edge length of ϕ . The length of the edges of the cube shall be such that the cube cannot be put through the opening in any position. The edge length of this cube can also be calculated from the three-dimensional geometry of the opening.

In addition to the cube test, a similar test may be carried out with a sphere. However, the cube edge length shall always be given in the ETA.

The following openings shall be considered when relevant:

- between barrier and other parts of stair (e.g. fig B7)
- between parts of stair kit and relevant parts of the works (e.g. fig B13)
- between consecutive steps in an open rise stair (e.g. figs B9 and B12)
- in the barrier (e.g. fig B7)

It shall be noted, that the measured value by cube and by sphere are not equivalent. Depending on the shape of the opening, the sphere might be the one that can be fitted inside the cube or the one that embraces the cube or something in between.

5.4.1.9. Minimum clear width of stair

The distance shall be measured perpendicular to the walking line on plan between (restricting) elements as shown in Figure 13.

5.4.1.10. Maximum clear width of stair

The distance shall be measured perpendicular to the walking line on plan between (restricting) elements as shown in Figure 13.

5.4.1.11. Minimum headroom

In cases when relevant, the distance shall be measured in vertical planes above the nosing.

5.4.1.12. Dimensions of landings

The dimensions of the landings shall be measured so that the shape of the landings can be specified e.g. by a drawing.

5.4.2. Slipperiness

The test method for resistance to slip, as described for floorings shall be used. The method is under development by CEN.

5.4.3. Safety equipment

5.4.3.1. Handrails

Height of the handrail

The height of the handrail and additional handrail for children shall be measured vertically from the nosing of the step or upper surface of the landing to the upper surface of the barrier (see Figure B 7).

Geometry of the handrail

Geometry of handrails and the gap between wall and handrail shall be assessed by general examination with respect to Figure B 8.

5.4.3.2. Barrier

Height of barrier

The height of the barrier shall be measured vertically from the nosing of the step or upper surface of the landing to the upper surface of the barrier (see Figure B 7).

Minimum and maximum height of the part of the barrier without openings

The minimum and maximum height of the relevant part of the barrier shall be measured vertically from the nosing or upper surface of the landing to the upper surface of the barrier.

Climbability for infants

The openings in the barrier and the filling elements themselves shall be measured in the vertical direction. The minimum and maximum height of the relevant part of the barrier shall be measured vertically from the nosing or upper surface of the landing to the upper surface of the barrier.

5.4.3.3. Tactility and visibility

Tactility and visibility shall be proven to meet the Essential Requirements as for floorings according to the methods to be developed by CEN or national rules applicable in the Member State of destination as long as CEN methods are missing.

5.4.4. Safe breakage

The breaking properties of the flat components of brittle materials such as glass or plastics shall be proven according to prEN 12600 Glass in building – Pendulum test – Impact test method for flat glass and performance requirements.

For materials other than glass, the test requirements for safe breakage shall be formulated in a comparable way:

- a) no shear or opening develops within the test piece through which a 76 mm diameter sphere can pass freely
- b) when disintegrated, the sum of the weight of the 10 largest particles shall not weigh more than 0,1 kg.

5.4.5. Impact resistance

The impact test methods for the different parts of the stair kit are described in Annex D.

5.5. Protection against noise

Not relevant.

5.6. Energy economy and heat retention

Not relevant.

5.7. Aspects of durability, serviceability and identification

Identification of the components and materials may be done by reference to a harmonised standard or ETA or by testing. The identification shall cover mechanical properties, fire properties, release of dangerous substances and durability aspects.

The steps of stairs shall be made of materials and components with the loadbearing capacity verified according to the relevant technical specifications (Eurocodes) including the standard values given therein. If this is not the case, then proof of the loadbearing capacity of the stair kit shall be made by tests carried out on structural members, or the characteristic values of the materials shall be determined by testing for static calculation of the kit.

Serviceability may be assessed empirically. If there is not enough experience, the following procedures shall be used.

5.7.1. Resistance to deterioration caused by physical agents

The resistance to physical agents shall be evaluated by general examination of the materials and the construction subjected to the effects of temperature and variations of relative humidity. When relevant, a calculation of the effects shall be made. Hence, the variation limits for the environment shall be assumed to be as defined in the Eurocodes or in the national standards, according to the manufacturer's specified use conditions or as follows:

General conditions (heated environment)

Temperature	+5 - +30 °C
Relative humidity	30 - 70 %

Because of the radiation of the sun, some materials may have an uneven temperature distribution causing distortion of the structural parts of the stair kit.

Radiation of the sun can cause excessive warming of some surfaces the effects of which shall be assessed by general examination.

Radiation of the sun can cause ageing of the materials or surface treatments, the effects of which shall be assessed by general examination, and, when relevant, by testing as described in Part 2.

5.7.2. Resistance to deterioration caused by chemical agents

The resistance against chemical agents shall be assessed by general examination of the materials and the construction regarding the effects of cleaning agents, water, carbon dioxide, oxygen and naturally occurring corrosives and pollution agents in the air. When relevant, testing shall be used, e.g. for materials of unknown composition or performance, or if the manufacturer makes specific claims.

5.7.3. Resistance to deterioration caused by biological agents

The resistance against biological agents shall be assessed by general examination of the materials and the construction regarding the effects of fungi, bacteria, algae and insects. When relevant, testing shall be used, e.g. for materials of unknown composition or performance, or if the manufacturer makes specific claims.

The natural durability of wood or wood based materials shall be verified according to EN 460 and EN 350-2 in relation to the appropriate hazard class described in EN 335-2 and EN 335-3. Stairs covered by this Part 1 of the ETAG are normally delivered without any preservative treatment. If preservative treatment is needed, it shall be evaluated in accordance with laws, regulations and administrative provisions applicable for the location where the product is incorporated in the works.

5.7.4. Finishes and surface layers

The assumed function of the finish or surface course shall be assessed by general inspection. When relevant, testing shall be used, e.g. for surface treatments and materials of unknown composition or performance, or if the manufacturer makes specific claims.

6. ASSESSING AND JUDGING THE FITNESS OF PRODUCTS FOR AN INTENDED USE

This chapter details the performance requirements to be met (Chapter 4) in precise and measurable (as far as possible and proportional to the importance of the risk) or qualitative terms, related to the product and its intended use, using the outcome of the verification methods (Chapter 5).

6.0. Tables linking the Essential Requirements to stair kit performance

Table 3 The product characteristics to be assessed and the corresponding assessment methods. For all performances, the NPD (no performance determined) option is possible.

ER	ETAG paragraph on product performance to be assessed	Class Use category Numeric value
1,4	6.1.1 Mechanical resistance / loadbearing capacity and stability 6.1.2 Load / displacement behaviour and vibrations 6.1.3 Resistance of fixings	Loadbearing capacity, variable actions, kN or kNm Displacement in mm, proper oscillation frequency Hz Loadbearing capacity, variable actions and permanent actions, kN or kNm
2	6.2.1 Resistance to fire 6.2.2 Reaction to fire - horizontal parts - all other parts	R20-R120 Euroclasses A ₁ fl-Ffl Euroclasses A ₁ -F
3	6.3.1 Release of dangerous substances 6.3.2 Release of formaldehyde 6.3.3 Release of asbestos (content) 6.3.4 Release of pentachlorophenol 6.3.5 Radioactive emissions	Indication of release of dangerous substances Formaldehyde class (Wood based panels) Indication of content of asbestos Indication of content of pentachlorophenol Indication of content of radioactive materials
4	6.4.1 Geometry of the stair including landings 6.4.2 Slipperiness 6.4.3 Safety equipment 6.4.4.Safe breakage 6.4.5 Impact resistance	Numerical values as specified Numerical values as specified, qualitative assessment of slip resistance Assessment as specified Assessment as specified Assessment as specified

Aspects of durability, serviceability and identification	6.7.1 Resistance to deterioration caused by physical agents	Environmental limits
	6.7.2 Resistance to deterioration caused by chemical agents	Pass/fail or test result
	6.7.3 Resistance to deterioration caused by biological agents	Pass/fail or hazard class
	6.7.4 Finishes and surface layers	Pass/fail or test result

6.1. Mechanical resistance and stability

6.1.1. Loadbearing capacity

The calculated or measured characteristic loadbearing capacity for the stair kit shall be given with reference to the classes in *Eurocode 1*.

The characteristic value of the following loads in ultimate limit state shall be given:

- The distributed load when all the steps and landings are loaded uniformly
- The distributed load when all the steps are loaded so that the unfavourable case for the torsion of the stairs is encountered
- The line load acting on the barrier at the level of the handrail
- The point load acting on the barrier at the level of the handrail in the most unfavourable position.
- The point load or a line load acting on a step in the most unfavourable position.

Optionally the following characteristics may also be given:

- Characteristic bending moment resistance of the strings
- Characteristic shear resistance of strings
- Characteristic torsion resistance of the stairs

6.1.2. Load / displacement behaviour and vibrations

Under service loads, the deflection of the stairs on the wall free side shall be given related to the median line of the flight, l . Usually the deflection shall not exceed the value of $l/200$. Bending due to imposed horizontal load shall not be taken into account here.

When assuming a realistic 3-D-representation, the function of the wall fastener as well as the shear resistance of the steps shall be taken into account. The influence of the railing may be taken into account. For the railing, a verification of bending due to imposed horizontal loads will generally not be required.

The proper oscillation frequency of stairs exposed to dead load as well as to an additional single load of 1 kN acting on the most unfavourable point shall be given. Usually, this value shall not be smaller than $< 5,0$ Hz. The deflection of the stairs on the wall free side under a single load of $F = 1,0$ kN acting on the most unfavourable point shall be given. In absence of national regulations, this deflection shall not exceed the value of 5 mm. The effect of the railing as far as its mass and rigidity are concerned may be taken into account.

Alternatively, the lowest natural frequency shall be given.

6.1.3. Resistance of fixings

The loads submitted to the works by the fixings shall be given in kN. The resistance of the fixings shall be given in kN. The following characteristic values in ultimate limit state shall be given:

- Tensile load of fixings / tensile resistance of fixings
- Shear load of fixings / shear resistance of fixings.

6.2. Safety in case of fire

6.2.1. Resistance to fire

Classification of stair kits with respect to fire resistance is undertaken in accordance with:

prEN 13501-2, *Fire classification of products and building elements. Part 2 Classification using data from fire resistance tests*.

The following range of classifications is used:

R 15 20 30 45 60 90 120 180 240

or no performance determined

where R is the classification with respect to loadbearing capacity alone.

The actual classification(s) for a stair kit is to be chosen by the manufacturer in accordance with the specifications for the intended use

If the value is based on calculation, this shall clearly be stated in the ETA specifying the boxed values used.

6.2.2. Reaction to fire

Classification of stair kits with respect to reaction to fire is undertaken in accordance with:

prEN13501-1, *Fire classification of construction products and building elements – Part 1 Classification using test data from reaction to fire tests*

For parts analogous to flooring parts the Euroclasses A₁fl - Ffl shall be used.

For all other parts the Euroclasses A₁ - F shall be used.

6.3. Hygiene, health and environment

6.3.1. Release of dangerous substances

The product/kit shall comply with all relevant European and national provisions applicable for the uses for which it is brought to the market. The attention of the applicant should be drawn on the fact that for other uses or other Member States of destination there may be other requirements which would have to be respected. For dangerous substances contained in the product but not covered by the ETA, the NPD option (no performance determined) is applicable.

6.3.2. Release of formaldehyde

Classification of materials with respect to the release of formaldehyde is undertaken in accordance with the technical specifications for the materials themselves.

6.3.3. Content of asbestos

For components containing asbestos, the content of the following materials, as stated by the manufacturer, shall be given as a percentage by mass of the component containing the asbestos:

Crocidolite
Amosite
Anthophyllite
Tremolite
Chrysotile.

6.3.4. Release of pentachlorophenol

The content of pentachlorophenol, as stated by the manufacturer, shall be given as a percentage by mass of the component containing the pentachlorophenol.

6.3.5. Radioactive emissions

The assessment methods for radioactive emissions follow the general rule of clause 6.3.1.

6.4. Safety in use

6.4.1. Geometry of the stair including landings

6.4.1.1. Going

The values shall be given on basis of measurement laid down in cl. 5.4.1.1.

Tolerances between actual value and nominal value of going within one flight and of consecutive steps shall be given.

6.4.1.2. Minimum going for tapered steps

The values shall be given on basis of measurement laid down in cl. 5.4.1.2.

Tolerances between actual value and nominal value of minimum going within one flight and of consecutive steps shall be given.

6.4.1.3. Maximum going for tapered steps

The values shall be given on basis of measurement laid down in cl. 5.4.1.3.

Tolerances between actual value and nominal value of maximum going within one flight and of consecutive steps shall be given.

6.4.1.4. Rise

The values shall be given on basis of measurement laid down in cl. 5.4.1.4. When there is more than one designed value for rise within the same flight, e.g. for the first step, this shall be declared.

Tolerances between actual value and nominal value of rise within one flight shall be given.

6.4.1.5. Pitch

The value, given in degrees, shall be assessed, verified and the result given on basis of measurement laid down in cl. 5.4.1.5.

Constant pitch line

The location of the constant pitch line shall be indicated on the plan drawing of the stairs in the ETA.

6.4.1.6. Overlap

Dimensions shall be assessed, verified and the result given on basis of measurement laid down in cl. 5.4.1.6.

6.4.1.7. Number of rises between landings

The value shall be assessed giving the verification result on basis of count laid down in cl. 5.4.1.8.

6.4.1.8. Maximum openings

The size of the following openings shall be given as the edge length of the cube as specified in 5.4.1.8, when relevant:

- between barrier and other parts of stair (e.g. Fig B7)
- between parts of stair kit and relevant parts of the works (e.g. Fig B13)
- between consecutive steps in an open rise stair (e.g. Figs B9 and B12)
- in the barrier (e.g. Fig B7)

Additionally, if a sphere has been used for the test, then the diameter may be given.

6.4.1.9. Minimum clear width of stair

Dimensions shall be assessed, verified and the values given on basis of measurement laid down in cl. 5.4.1.9.

6.4.1.10. Maximum clear width of stair

Dimensions shall be assessed, verified and the values given on basis of measurement laid down in cl. 5.4.1.10.

6.4.1.11. Minimum headroom

Dimensions shall be assessed, verified and the values given on basis of measurement laid down in cl. 5.4.1.11

6.4.1.12. Dimensions of landings

Dimensions shall be assessed, verified and the values given on basis of measurement laid down in cl. 5.4.1.12 e.g. by a drawing.

6.4.2. Slipperiness

Test results shall be given on the basis of methods for determining slipperiness, currently under development by CEN.

6.4.3. Safety equipment

6.4.3.1. Handrails

Height of the handrail

Dimensions shall be assessed, verified and the values given on basis of measurement laid down in cl. 5.4.3.1.

Geometry of the handrail

Dimensions shall be assessed, verified and the values given on basis of measurement laid down in cl. 5.4.3.1.

6.4.3.2. Barrier

Height of barrier

Dimensions shall be assessed, verified and the values given on basis of measurement laid down in cl. 5.4.3.2.

Minimum and maximum height of the part of the barrier without openings

Dimensions shall be assessed, verified and the values given on basis of measurement laid down in cl. 5.4.3.2.

Climbability for infants

Maximum dimensions shall be assessed giving the values on basis of measurement laid down in cl. 5.4.3.2.

6.4.3.3. Tactility and visibility

The evaluation results according to clause 5.4.3.3 shall be given.

6.4.4. Safe breakage of materials

The safe breaking of barrier filling shall be assessed.

The result for the barrier filling shall be given on basis of prEN 12600, cl. 6.

6.4.5. Impact resistance

The impact resistance of a stair kit and its components shall be assessed giving the type of impact test, angle of the impact and the impact point, the type and weight of the impact body and the drop height without damage (Appendix D).

6.5. Protection against noise

Not relevant.

6.6. Energy economy and heat retention

Not relevant.

6.7. Aspects of durability, serviceability and identification

The description of all components including the materials of the stair kit shall be clearly identified. Where possible, reference to harmonised European specifications shall be made.

The chemical constitution and composition of the materials will be submitted by the applicant to the Approval Body which will observe strict rules of confidentiality. Under no circumstances will such information be disclosed to any other party.

This composition shall be checked by the Approval Body on the basis of the declaration made by the applicant, and it will be documented by fingerprint whenever possible.

All components shall be specified either by weight or volume percentage, with appropriate tolerances and trade names of raw materials as far as they represent their chemical and physical properties.

The ETA is issued for the product/kit with the chemical composition and other characteristics as deposited with the issuing Approval Body. Changes of materials, of composition or characteristics, should be immediately notified to the Approval Body, which will decide whether a new assessment will be necessary.

Where components are not covered by relevant harmonised European specifications, they shall be precisely defined by reference to physical characteristics, such as:

- a) adequate materials properties
- a) geometry, dimensional stability
- b) how the components are to be put together

Where applicable, the determination of the product characteristics shall be based on testing in accordance with the appropriate test methods.

6.7.1. Resistance to deterioration caused by physical agents

The effect of physical agents shall be described in qualitative terms with regard to the potential risk that the stairs will lose their integrity and cease to fulfil the relevant Essential Requirements. The intended use conditions shall be given. Alternatively, specific test results may be given.

6.7.2. Resistance to deterioration caused by chemical agents

The effect of chemical agents shall be described in qualitative terms with regard to the potential risk that the stairs will lose their integrity and cease to fulfil the relevant Essential Requirements. Alternatively, specific test results may be given.

In some MS there may be regulations regarding the material used in elements not easily accessible and not visible and thus not controllable. Therefore, the ETA shall give the material of that kind of parts.

6.7.3. Resistance to deterioration caused by biological agents

The effect of biological agents shall be described in qualitative terms with regard to the potential risk that the stairs will lose their integrity and cease to fulfil the relevant Essential Requirements. Alternatively, specific test results may be given.

Regarding the decay of wooden parts, it shall be proven that the use conditions are such that there will be no risk of decay, or that the parts are adequately treated.

The intended hazard class for wooden components shall be given as defined in EN 335.

6.7.4. Finishes and surface layers

The result of the assessment shall be described in qualitative terms with regard to the ability of the finish or surface layer to fulfil the assumed function e.g. prevention against corrosion or wood decay, decreasing slipperiness or wear.

7. ASSUMPTIONS AND RECOMMENDATIONS UNDER WHICH THE FITNESS FOR USE OF THE PRODUCTS IS ASSESSED

This chapter sets out the assumptions and recommendations for design, installation and execution, packaging, transport and storage, use, maintenance and repair under which the assessment of the fitness for use according to the ETAG can be made (only when necessary and in so far as they have a bearing on the assessment or on the products).

7.1. Design of works

The conditions for design and execution of the stair kit into the works shall be taken from the manufacturer's installation instructions. The quality and sufficiency of these installation instructions shall be assessed, in particular concerning the aspects on the following check list:

Definition and verifying the space needed for proper installation of stairs

- a) co-ordinating stair width
- b) floor height
- c) thickness of the ceiling
- d) stair opening
- e) any special construction details e.g. movement joints in the context of log buildings

Ability of the works to carry the loads from the stairs

- a) capacity of the works
- b) displacements of the works

Design of fixings between the stairs and the main structure

- a) location
- b) any demands for the stiffness or load bearing capacity of the works at the fixing points
- c) deformations of the works at the fixing points
- d) transmission of vibrations
- e) transmission of noise
- f) seismic requirements, when appropriate.

Note: The designer has to ensure that the fixings adopted are such that there is no interference between the stair kit and the overall seismic response of the building.

- g) The calculated resulting forces from the stairs which act on the supports anchored to the construction works shall be transmitted accordingly. The connection between stairs and construction works shall be such that any additional loads resulting from the construction works cannot act on the stairs.

Dimensional stability of the works

- a) due to changes in moisture content
- b) due to changes of temperature

It shall always be stated in the ETA that the installation instructions form part of the ETA and thus shall always accompany the delivered kit. The ETA may take over the essential parts of the installation instructions.

7.2. Packaging, transport and storage

The conditions for packaging, transport and storage of the stair kit shall be taken from the manufacturer's terms of delivery. The quality and sufficiency of these terms of delivery shall be assessed, in particular concerning the aspects on the following check list:

- a) resistance to unfavourable environmental effects
- b) resistance to external damage, that may put at risk the proper assembling of the stairs

7.3. Execution of works

(installation, assembling, incorporation, etc., including, if necessary, test methods for verifications on site)

The conditions for execution of works shall be taken from the installation instructions. The quality and sufficiency of this installation instruction shall be assessed, in particular concerning the aspects on the following check list:

- a) the responsibilities regarding the assembling of the kit
- b) any verifying measurements taken before the assembly
- c) any specific measures taken regarding fixings or supporting members to be installed beforehand into the works etc. so that the stairs can be properly installed
- d) sufficient support during assembly

installation of the steps without restraint.

In some Member States there are regulations regarding who is allowed to assemble the stairs. It shall, therefore, be stated in the ETA, that installation shall be carried out by trained personnel under the supervision of the person responsible for technical matters on site, if required according to the rules of the Member State where the stair kit is to be used.

7.4. Maintenance and repair

The manufacturer's instructions for maintenance and repair shall be assessed. The product specification, surface materials and treatments of the stair kit shall be assessed, in particular concerning the aspects on the following check list:

- a) sensitive parts which are likely to be damaged or worn shall be designed to allow for easy repair or replacement.
- b) standard products and standard equipment shall be sufficient for ordinary maintenance.
- c) maintenance shall be possible without special precautions
- d) maintenance shall be specified so that slipperiness of the stairs is not increased.
- e) the attachment of anti-slip strips is declared in cases where they are needed by the users
- f) environmental conditions for which the stair kit has been designed shall be clarified for the user in commonly understandable terms, to avoid situations where the stairs would be subject to deterioration as specified in 5.7 and 6.7.

Screw connections shall be such that they will not be loosened by vibrations. Stairs shall be executed in a way that systematic maintenance (e.g. periodical tensioning of the bolt connections after periods of heating) will not be necessary.

The result of the assessment in relation to Safety in use, impact resistance and related aspects of serviceability shall also be considered in the context of any likely maintenance and repair of the system in use.

Section three :

ATTESTATION AND EVALUATION OF CONFORMITY (AC)

8. ATTESTATION AND EVALUATION OF CONFORMITY

8.1. EC decision

The systems of attestation of conformity specified by the European Commission in mandate Construct 97/252 REV.1, Annex 3, and published in the Official Journal of the European Communities (1999/89/EC), as amended by Commission Decision 2001/596/EC, are as follows:

System 1 for stair kits

- with Euroclasses A₁⁽¹⁾, A₂⁽¹⁾, B⁽¹⁾, C⁽¹⁾, D⁽¹⁾, E⁽¹⁾ concerning Reaction to fire
- a) tasks for the manufacturer
- factory production control
 - further testing of samples taken at the factory by the manufacturer in accordance with a prescribed test plan
- b) tasks for the approved body
- initial type-testing of the product
 - initial inspection of the factory and of factory production control
 - continuous surveillance, assessment and approval of factory production control

System 3 for stair kits

- with Euroclasses A₁⁽²⁾, A₂⁽²⁾, B⁽²⁾, C⁽²⁾, D⁽²⁾, E⁽²⁾ concerning Reaction to fire
- a) tasks for the manufacturer
- factory production control
 - initial type-testing of the product by an approved laboratory

System 4 for stair kits

- with Euroclasses A₁⁽³⁾ or F concerning Reaction to fire.
- a) tasks for the manufacturer
- factory production control
 - initial type-testing

System 2+ for all stair kits concerning

- Resistance to fire
- Release of dangerous substances
- Mechanical resistance / loadbearing capacity

⁽¹⁾ Products/materials for which a clearly identifiable stage in the production process results in an improvement of the reaction to fire classification (e.g. an addition of fire retardants or a limiting of organic material)

⁽²⁾ Products/materials not covered by footnote ⁽¹⁾

⁽³⁾ Products/materials that do not require to be tested for reaction to fire (e.g. products/materials of Class A₁ according to Commission Decision 2000/605/EC)

- Stability / stiffness
 - Resistance of fixings
 - Resistance to horizontal loads
 - Impact resistance
 - Safe breakage
 - Slipperiness.
- a) tasks for the manufacturer
- initial type-testing of the product
 - factory production control
 - further testing of samples taken at the factory by the manufacturer in accordance with a prescribed test plan
- b) tasks for the approved body
- certification of factory production control on the basis of
 - initial inspection of the factory and of factory production control
 - continuous surveillance, assessment and approval of factory production control

8.2. Responsibilities

8.2.1. Tasks for the manufacturer

8.2.1.1. Factory production control (All systems of AC)

The manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures. This production control system shall ensure that the product is in conformity with the ETA.

Manufacturers having an FPC system which complies with EN ISO 9001/2 and which addresses the requirements of an ETA are recognised as satisfying the FPC requirements of the Directive.

Organisation and responsibility

The name and position of the persons responsible for the manufacturing and factory production control shall be given. The person responsible for the FPC shall not be organisationally dependent on the person responsible for the manufacturing. This can be shown by an organisation chart.

Control

Depending on the type and material of the stairs, different control procedures may be needed. The scope and extent of the control is defined by the EOTA body responsible for the ETA.

Control of raw and constituent materials

The materials (steel, concrete, wood etc.) shall be identifiable with regard to mechanical properties, fire properties, release of dangerous substances and durability aspects.

For every delivery, e.g. the following data shall be recorded:

manufacturer or supplier

date of manufacturing or lot or corresponding identification

recipient

date of delivery

adequate data confirming the properties of the material

Control of the production process

The production process shall be identifiable with regard to production methods and production equipment.

Control of test equipment

When test equipment is used in FPC, the control and calibration of the test equipment shall be described and recorded.

Control of the product

The control of the product shall be described and recorded. The controlled products shall be marked.

Inspection and testing

General

Depending on the type and material of the stairs, different inspection and testing procedures may be needed. The scope and extent of the inspection and testing is defined by the EOTA body responsible for the ETA.

In process testing

The factory production control shall be able to distinguish the status of testing and inspection of the components and materials for stairs.

Testing

When testing called for under FPC, the test methods shall be described including the equipment and the test procedure, the recorded values. Any necessary calculation of characteristics shall also be described.

Records

The records regarding control, inspection and testing shall be maintained for 5 years from the delivery of the finished product.

Handling of non-conforming products

Non-conforming products shall clearly be distinguished and shall not be CE-marked.

Handling, storage, packaging, delivery, traceability

Handling, storage, packaging and delivery shall be described and recorded. The CE-marking of the final product shall be the link to the manufacturer's records so that traceability of all essential components is possible.

Training of personnel

The training of the personnel, especially those responsible for the control, inspection and testing, shall be described and recorded.

8.2.1.2. Testing of samples taken at the factory

The tests shall only be carried out on the final product or samples representative of the final product.

8.2.1.3. Declaration of Conformity

When all the criteria of the Conformity Attestation are satisfied the manufacturer shall make a Declaration of Conformity.

8.2.2. Tasks for the manufacturer or the approved body

8.2.2.1. Initial type testing

Approval tests will have been conducted by the approval body or under its responsibility (which may include a proportion conducted by a laboratory or by the manufacturer, witnessed by the approval body) in

accordance with section 5 of this ETAG. The approval body will have assessed the results of these tests in accordance with section 6 of this ETAG, as part of the ETA issuing procedure.

These tests shall be used for the purposes of Initial Type Testing.

EITHER (System 1)

Any work for reaction to fire and resistance to fire for materials for which the reaction to fire performance is susceptible to change during production shall be validated by the approved body for Certificate of Conformity purposes.

OR (System 3)

Any work for reaction to fire and resistance to fire for materials for which the reaction to fire performance is not susceptible to change during production process shall be validated by an approved laboratory for Declaration of Conformity purposes by the manufacturer.

OR (System 2+)

Any work for resistance to fire, reaction to fire, release of dangerous substances, mechanical resistance / loadbearing capacity, stability / stiffness, resistance of fixings, resistance of horizontal loads, impact resistance, safe breakage and slipperiness shall be taken over by the manufacturer for Declaration of Conformity purposes

OR (System 4)

Any work for reaction to fire and Euroclasses A₁ for materials according to the Decision 2000/605/EC, D, E and F shall be taken over by the manufacturer for Declaration of Conformity purposes

8.2.3. Tasks for the Approved Body

8.2.3.1. Audit testing

Not relevant for stair kits.

8.2.3.2. Assessment of the factory production control system – initial inspection and continuous surveillance

Assessment of the factory production control system is the responsibility of the approved body.

An assessment shall be carried out of each production unit to demonstrate that the factory production control is in conformity with the ETA and any subsidiary information. This assessment shall be based on an initial inspection of the factory.

Subsequently continuous surveillance of factory production control is necessary to ensure continuing conformity with the ETA.

It is recommended that surveillance inspections be conducted at least twice per year.

8.2.3.3. Certification,

The approved body shall issue Certification of Conformity of the product (System 1).

The approved body shall issue Certification of Factory production control (System 2+).

8.3. Documentation

The approval body issuing the ETA shall supply the information detailed below. This information and the requirements given in EC guidance paper B will:

EITHER

generally form the basis on which the factory production control (FPC) is assessed by the approved body (Systems 1 and 2+)

OR

generally form the basis of FPC.

This information shall initially be prepared or collected by the approval body and shall be agreed with the manufacturer. The following gives guidance on the type of information required:

1. The ETA

See section 9 of this guideline

The nature of any additional (confidential) information shall be declared in the ETA

2. Basic manufacturing process

The basic manufacturing process shall be described in sufficient detail to support the proposed FPC methods.

3. Product and material specifications

These may include:

- detailed drawings (including manufacturing tolerances)
- incoming (raw) materials specifications and declarations
- references to European and/or international standards or appropriate specifications
- manufacturer's data sheets.

4. Test plan (as a part of FPC)

The manufacturer and the approval body issuing the ETA shall agree an FPC test plan.

An agreed FPC test plan is necessary as current standards relating to quality management systems (Guidance Paper B, EN 29002, etc.), do not ensure that the product specification remains unchanged and they cannot address the technical validity of the type or frequency of checks/tests.

The validity of the type and frequency of checks/tests conducted during production and on the final product shall be considered. This will include the checks conducted during manufacture on properties that cannot be inspected at a later stage and for checks on the final product. These will normally include:

- material properties
- dimensions of component parts

Where materials/components are not manufactured and tested by the supplier in accordance with agreed methods, then where appropriate they shall be subject to suitable checks/tests by the manufacturer before acceptance.

5. Prescribed test plan (testing of samples at factory - Systems 1 and 2+)

The manufacturer and the approval body issuing the ETA shall agree a prescribed test plan.

The characteristic to be addressed for System 1 as described in the mandate is Reaction to fire and Euroclasses A₁, A₂, B, C, D and E for materials for which a clearly identifiable stage in the production process results in an improvement of the reaction to fire classification (e.g. an addition of fire retardants or a limiting of organic material). This will be controlled at least twice per year by analysis/measurement of the relevant characteristics of the components for the kit from the following list:

- composition
- dimensions
- physical properties
- mechanical properties
- construction.

The characteristics to be addressed for System 2+ as described in the mandate are:

- Resistance to fire
- Release of dangerous substances
- Mechanical resistance / loadbearing capacity
- Stability / stiffness
- Resistance of fixings
- Resistance to horizontal loads
- Impact resistance
- Safe breakage

- Slipperiness.

These will be controlled at least twice per year by analysis/measurement of the relevant characteristics for the components of the kit from the following list:

- composition
- dimensions
- physical properties
- mechanical properties
- construction.

8.4. CE marking and information

The ETA shall indicate the information to accompany the CE-marking. According to the EC Guidance Paper D on CE-marking the required information to accompany the symbol "CE" is:

- Identification number of the notified body (A/C-system 1+, 1 or 2+)
- Name / address of the manufacturer of the kit
- The last two digits of the year in which the marking was affixed and if necessary, time of manufacturing and production number
- Number of the EC Certificate of Conformity (A/C-system 1+, 1 or 2+), where appropriate
- Number and issuing date of ETA
- Part of the guideline that has been used
- If the ETA comprises a set of options for the product, e.g. different barrier heights, the options shall be specified

Section four :

ETA CONTENT

9. THE ETA CONTENT

9.1. The ETA-content

9.1.1. Model ETA

The format of the ETA shall be based on the Commission Decision 97/571/EC dated 1997-07-22, EC Official Journal L236 of 1997-08-27.

9.1.2. Checklist for the issuing body

The technical part of the ETA shall contain information on the following items, in the order and with reference to the relevant 4 Essential Requirements. For each of the listed items, the ETA shall either give the declared indication/classification/statement/description or state that the verification/assessment of this item has not been carried out. The items given here are with reference to the relevant clause of this guideline:

- Indication of the assumed working life (Section Two, introduction), and any need of maintenance to achieve it.
- The climatic or environmental conditions where the stairs are intended to be used
- Loadbearing capacity of stair kit, (Clause 6.1.1), including the evaluation method used
- Load displacement behaviour and vibration characteristics of stair kit, (Clause 6.1.2), including the evaluation method used
- Loadbearing capacity of fixings of stair kit, (Clause 6.1.3), including the evaluation method used
- Classification of stair kit with respect to resistance to fire, (Clause 6.2.1), including test method used
- Classification of stair kit with respect to reaction to fire, (Clause 6.2.2), including test method used
- Statement on the presence and concentration or rate of emission, etc. of formaldehyde, asbestos, pentachlorophenol, radioactive materials, other dangerous substances or statement on no presence of dangerous materials (Clause 6.3)
- Geometry of stair kit (Clause 6.4.1)
- Slipperiness of stair kit (Clause 6.4.2)
- Description of the safety measures present in the stair kit (Clause 6.4.3)
- Indication of result from impact load resistance test, including test method used (Clause 6.4.4)
- Indication of resistance to physical agents (Clause 6.7.1)
- Indication of resistance to chemical agents (Clause 6.7.2) e.g. the material used in parts not controllable
- Indication of resistance to biological agents (Clause 6.7.3).
- Description of the ability of finishes and surface layers to maintain their function (Clause 6.7.4)

In section II.2 “characteristics of products and methods of verification “ the ETA shall include the following note:

“In addition to the specific clauses relating to dangerous substances contained in this European Technical Approval, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the EU Construction Products Directive, these requirements need also to be complied with, when and where they apply.”

9.2. Additional information

It shall be stated in the ETA that the manufacturer's installation instructions forms part of the ETA, see clause 7.1 of this Guideline.

Similarly, it shall be stated in the ETA whether or not any additional (possibly confidential) information shall be supplied to the approved body for the evaluation of conformity, see clause 8.3 of this Guideline.

Special provisions concerning packaging, storage and transport which are essential for the use of the kit shall be given in the ETA.

ANNEX A: COMMON TERMINOLOGY

(DEFINITIONS, CLARIFICATIONS, ABBREVIATIONS)

This common terminology is based upon the EC Construction Products Directive 89/106 and the Interpretative documents as published in the Official Journal of the EC on 28.2.1994. It is limited to items and aspects relevant for approval work. They are partly definitions and partly clarifications.

1. WORKS AND PRODUCTS

1.1. Construction works (and parts of works) (often simply referred to as “works”) (ID 1.3.1)

Everything that is constructed or results from construction operations and is fixed to the ground.

(This covers both building and civil engineering works, and both structural and non structural elements).

1.2. Construction products (often simply referred to as “products”) (ID 1.3.2)

Products which are produced for incorporation in a permanent manner in the works and placed as such on the market.

(The term includes materials, elements, components and prefabricated systems or installations)

1.3. Incorporation (of products in works) (ID 1.3.2)

Incorporation of a product in a permanent manner in the works means that:

- its removal reduces the performance capabilities of the works, and
- that the dismantling or the replacement of the product are operations which involve construction activities.

1.4. Intended use (ID 1.3.4)

Role(s) that the product is intended to play in the fulfilment of the Essential Requirements.

(N.B. This definition covers only the intended use as far as relevant for the CPD)

1.5. Execution (ETAG-format)

Used in this document to cover all types of incorporation techniques such as installation, assembling, incorporation, etc.

1.6. System (EOTA/TB guidance)

Part of the works realised by:

- particular combination of a set of defined products, and
- particular design methods for the system, and/or
- particular execution procedures.

2. PERFORMANCES

2.1. Fitness for intended use (of products) (CPD 2.1)

Means that the products have such characteristics that the works in which they are intended to be incorporated, assembled, applied or installed, can, if properly designed and built, satisfy the Essential Requirements.

(N.B. This definition covers only the intended fitness for intended use as far as relevant for the CPD)

2.2. Serviceability (of works)

Ability of the works to fulfil their intended use and in particular the essential requirements relevant for this use.

The products must be suitable for construction works which (as a whole and in their separate parts) are fit for their intended use, subject to normal maintenance, be satisfied for an economically reasonable working life. The requirements generally concern actions which are foreseeable (CPD Annex I, Preamble).

2.3. Essential requirements (for works)

Requirements applicable to works, which may influence the technical characteristics of a product, and are set out in objectives in the CPD, Annex I (CPD, art. 3.1).

2.4. Performance (of works, parts of works or products) (ID 1.3.7)

The quantitative expression (value, grade, class or level) of the behaviour of the works, parts of works or of the products, for an action to which it is subject or which it generates under the intended service conditions (works or parts of works) or intended use conditions (products).

As far as practicable the characteristics of products, or groups of products, should be described in measurable performance terms in the technical specifications and guidelines for ETA. Methods of calculation, measurement, testing (where possible), evaluation of site experience and verification, together with compliance criteria shall be given either in the relevant technical specifications or in references called up in such specifications.

2.5. Actions (on works or parts of the works) (ID 1.3.6)

Service conditions of the works which may affect the compliance of the works with the essential requirements of the Directive and which are brought about by agents (mechanical, chemical, biological, thermal or electro-magnetic) acting on the works or parts of the works.

Interactions between various products within a work are considered as "actions".

2.6. Classes or levels (for essential requirements and for related product performances) (ID 1.2.1)

A classification of product performance(s) expressed as a range of requirement levels of the works, determined in the IDs or according to the procedure provided for in art. 20.2a of the CPD.

3. ETAG - FORMAT

3.1. Requirements (for works) (ETAG-format 4.)

Expression and application, in more detail and in terms applicable to the scope of the guideline, of the relevant requirements of the CPD (given concrete form in the IDs and further specified in the mandate, for works or parts of the works, taking into account the durability and serviceability of the works.

3.2. Methods of verification (for products) (ETAG-format 5.)

Verification methods used to determine the performance of the products in relation to the requirements for the works (calculations, tests, engineering knowledge, evaluation of site experience, etc.).

These verification methods are related only to the assessment of, and for judging the fitness for use. Verification methods for particular designs of works are called here "project testing", for identification of products are called "identification testing", for surveillance of execution or executed works are called "surveillance testing", and for attestation of conformity are called "AC-testing".

3.3. Specifications (for products) (ETAG-format 6.)

Transposition of the requirements into precise and measurable (as far as possible and proportional to the importance of the risk) or qualitative terms, related to the products and their intended use. *The satisfaction of the specifications is deemed to satisfy the fitness for use of the products concerned.*

Specifications may also be formulated with regard to the verification of particular designs, for identification of products, for surveillance of execution or executed works and for attestation of conformity, when relevant.

4. WORKING LIFE

4.1. Working life (of works or parts of the works) (ID 1.3.5(1))

The period of time during which the performance will be maintained at a level compatible with the fulfilment of the Essential Requirements.

4.2. Working life (of products)

Period of time during which the performances of the product are maintained - under the corresponding service conditions - at a level compatible with the intended use conditions.

4.3. Economically reasonable working life: (ID 1.3.5(2))

Working life which takes into account all relevant aspects, such as costs of design, construction and use, costs arising from hindrance of use, risks and consequences of failure of the works during its working life and cost of insurance covering these risks, planned partial renewal, costs of inspections, maintenance, care and repair, costs of operation and administration, of disposal and environmental aspects.

4.4. Maintenance (of works) (ID 1.3.3(1))

A set of preventive and other measures which are applied to the works in order to enable the works to fulfil all its functions during its working life. These measures include cleaning, servicing, repainting, repairing, replacing parts of the works where needed, etc.

4.5. Normal maintenance (of works) (ID 1.3.3(2))

Maintenance, normally including inspections, which occurs at a time when the cost of the intervention which has to be made is not disproportionate to the value of the part of the work concerned, consequential costs (e.g. exploitation) being taken into account.

4.6. Durability (of products)

Ability of the product to contribute to the working life of the work by maintaining its performances, under the corresponding service conditions, at a level compatible with the fulfilment of the essential requirements by the works.

5. CONFORMITY

5.1. Attestation of conformity (of products)

Provisions and procedures as laid down in the CPD and fixed according to the directive, aiming to ensure that, with acceptable probability, the specified performance of the product is achieved by the ongoing production.

5.2. Identification (of a product)

Product characteristics and methods for their verification, allowing to compare a given product with the one that is described in the technical specification.

6. APPROVAL AND APPROVED BODIES

6.1. Approval Body

Body notified in accordance with Article 10 of the CPD, by an EU Member State or by an EFTA State (contracting party to the EEA Agreement), to issue European Technical Approvals in (a) specific construction product area(s). All such bodies are required to be members of the European Organisation for Technical Approvals (EOTA), set up in accordance with Annex II.2 of the CPD.

6.2. Approved Body*

Body nominated in accordance with Article 18 of the CPD, by an EU Member State or by an EFTA State (contracting party to the EEA Agreement), to perform specific tasks in the framework of the Attestation of Conformity decision for specific construction products (certification, inspection or testing). All such bodies are automatically members of the Group of Notified Bodies.

ABBREVIATIONS

Concerning the Construction products directive:

AC:	Attestation of Conformity
CEC:	Commission of the European Communities
CEN:	Comité Européen de Normalisation / European Committee for Standardization
CPD:	Construction Products Directive
EC:	European Communities
EFTA:	European Free Trade Association
EN:	European Standards
FPC:	Factory Production Control
ID:	Interpretative Documents of the CPD
ISO:	International Standardisation Organisation
SCC:	Standing Committee for Construction of the EC

Concerning approval:

EOTA:	European Organisation for Technical Approvals
ETA:	European Technical Approval
ETAG:	European Technical Approval Guideline
TB:	EOTA-Technical Board
UEAtc:	Union Européenne pour l'Agrément technique dans la construction / European Union of Agrément

General:

TC:	Technical Committee
WG:	Working Group

* also known as Notified Body

ANNEX B: TERMINOLOGY AND ABBREVIATIONS SPECIFIC TO THIS ETAG

Particular terminology is based on the work of ISO and CEN (ISO 3880-1: *Building construction – Stairs – Vocabulary – Part 1*). In this guideline, only those terms, which may have a meaning in the context of assessing the fulfilment of the Essential Requirements are listed.

PRINCIPLES

Stair

A succession of horizontal stages (steps or landings) which makes it possible to pass on foot to other floors or other levels on the same floor.

The main terms are shown in Figures B1 and B2.

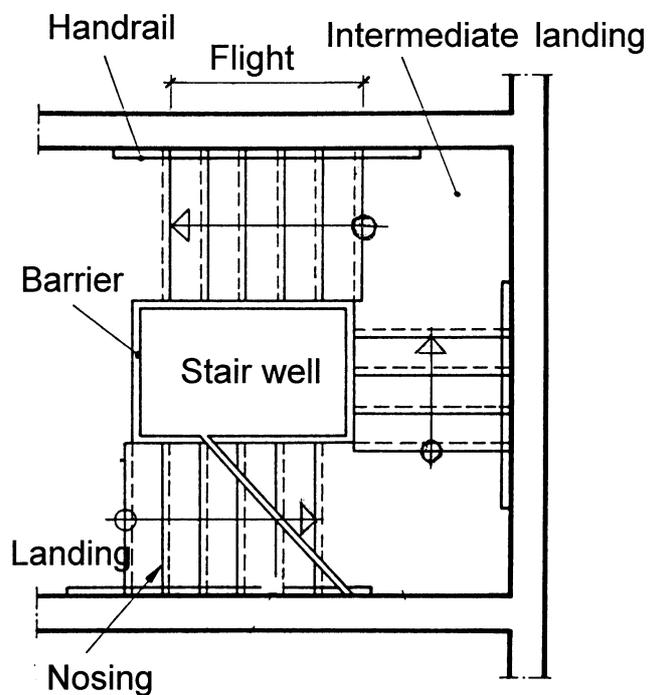


Figure B1: Principles

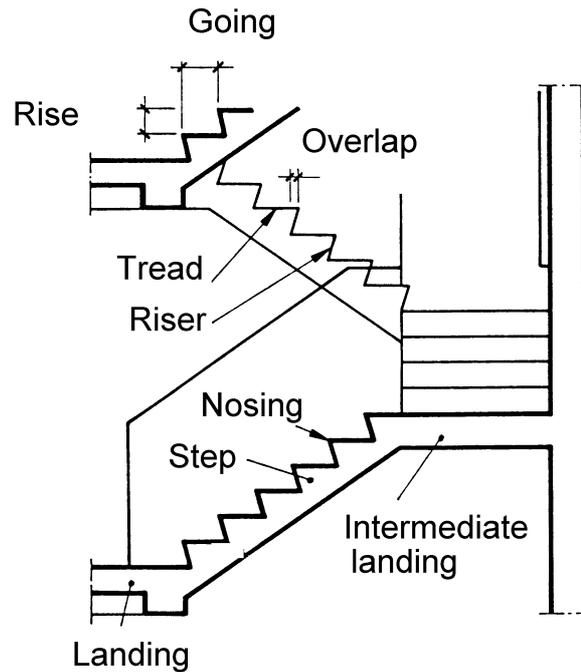


Figure B2: Principles

TYPES OF STAIRS

Open rise stair

A stair in which the vertical space between successive steps is not fully filled by risers.

Helical stair

A stair that describes a helix around a central void.

Open well stair

Turning stair around an inner well.

Spiral stair

A stair that describes a helix around a central column.

Stair with loadbearing bolts

Stairs where the steps are connected to another - at least at one end of the steps - by loadbearing elements (e.g. bolts). Examples are shown in Figures B3 and B4.

On the wall side, the steps are embedded in the wall or connected to the wall either directly or indirectly by wall fasteners. The wall or part of the wall may be replaced by a loadbearing element (e.g. beam).

In spiral stairs the steps are connected to the central post (Figure B5).

Stair with effective load-carrying barrier

Steps of stairs with effective load-carrying barrier are each connected to another on the wall-free side by a loadbearing bolt as well as being connected to the load-carrying barrier by balusters. On side of the wall the steps are connected to the wall or embedded in a string made of wood or steel, respectively. The wall or string may also be replaced by a load-carrying barrier. An example is shown in Figure B6.

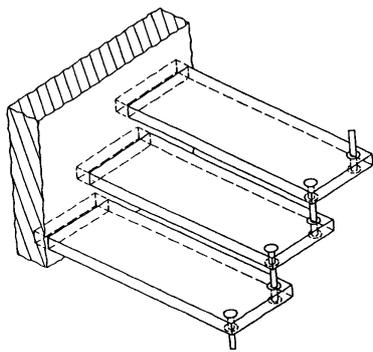


Figure B3: One-bolt stair

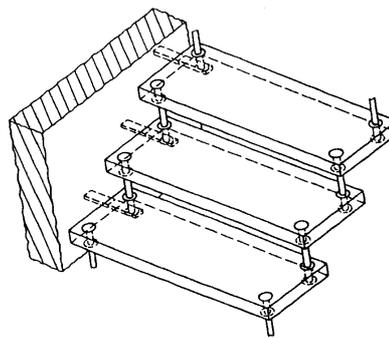


Figure B4: Two-bolt stair

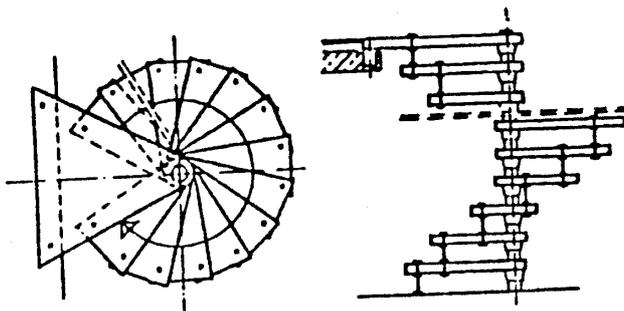


Figure B5: Spiral stair with loadbearing bolts

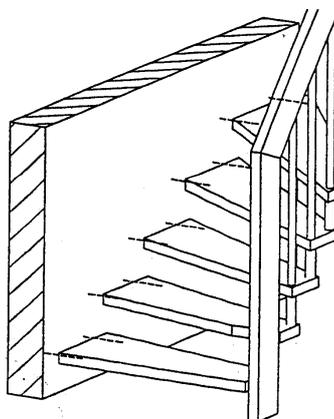


Figure B6: Stair with effective load-carrying barrier

Straight stair

Stair in which the direction is the same throughout.

Turning stair

Stair in which the direction is changed.

Winding stair

Stair which changes direction by using tapered steps.

ELEMENTS

Baluster

Normally vertical infilling component of a barrier, generally for protection.

Base plate

Construction element of the central post which fixes to the floor in spiral stairs.

Connections

A component to keep two elements of the stair kit together.

Loadbearing bolts

Loadbearing bolts are fixing elements used for the connection of the individual steps in a way that they are resistant to tension, compression and, if necessary, bending, or for their connection to the supports (landings), respectively.

Fixings

A component to attach the stair to the work.

Wall fasteners

A wall fastener consists of metal elements connected to the step and embedded in the wall using mortar. It is also possible to use a supporting element such as an anchor or other fixing elements placed in the wall or in the loadbearing element (e.g. beam).

Flight

A continuous series of steps between two landings.

Barrier

A protective element (e.g. railing, balustrade, etc.) designed to give a satisfactory degree of safety for someone falling down (figure B7).

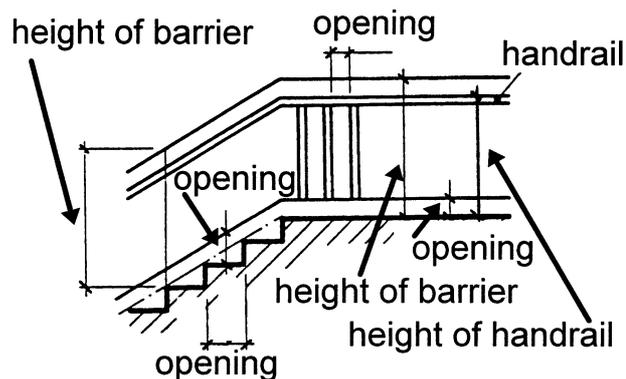


Figure B7: Barrier and handrail

Railing

A protective element consisting of components such as frame, filling elements and handrail.

Handrail

An element attached to a wall or barrier and designed to afford a grip to persons using the stair (figure B8).

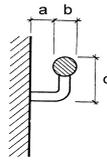


Figure B8: Handrail

Intermediate landing

A landing inserted between two floors (Figures B1, B2).

Landing

A platform or part of the floor structure at the beginning and/or at the end of a flight (Figures B1 and B2).

Nosing

The front edge of a tread (Figure B2).

Post

The vertical structural element of a stair.

Central post

The vertical structural element in the centre of a (spiral) stair.

Newel

The structural vertical element or post either at the end or in the middle of a flight into which the flight or string and handrail are fixed.

Riser

The vertical or inclined part closing the face of the step (figure B2).

Listel riser step

Vertical element closing part of the gap between consecutive steps (Figure B9).

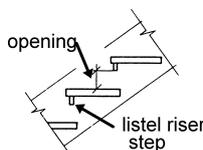


Figure B9: Listel riser step

Step

A part of a stair including a horizontal surface on which the foot is placed when going up and down. (Figure B2).

Bottom step

First step in the flight.

Tapered step

A step where the nosing is not parallel to that of the step or landing above.

Top step

Last step in the flight.

String

A inclined member supporting the ends of steps.

Outer string

String not adjacent to a wall.

Wall string

String against a wall.

Tread

Horizontal part or upper surface of a step (figure B2).

Undercarriage

An inclined member placed against the underside of the steps to add support.

TERMS FOR MEASUREMENT**Constant pitch line**

A line along the stair where the pitch is constant.

Going

The horizontal distance (g) between the nosings of consecutive steps, measured on the walking line (Figures B2 and B12).

Headroom

The minimum unobstructed vertical distance above a theoretical area prescribed by connecting consecutive nosings of the flight (Figure B10). Depending on the type of stair the theoretical area might be curved.

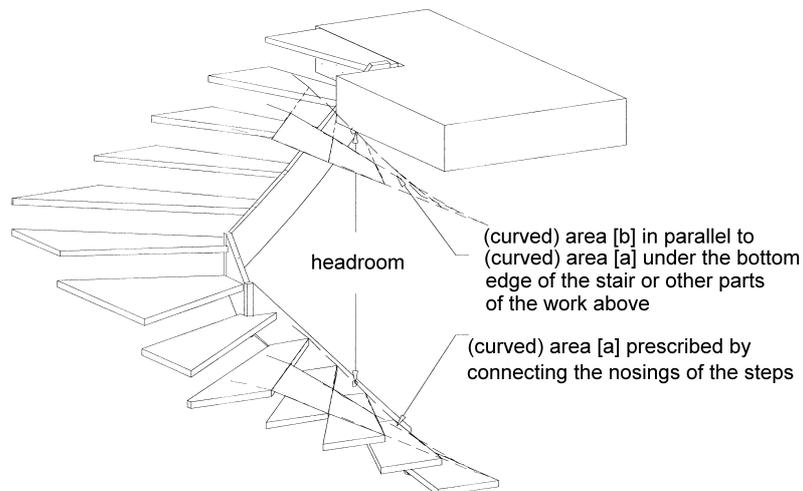


Figure B10: Minimum unobstructed headroom

Length of the step

Shortest possible distance (l) at right angles to the width of the step. Various examples are shown in Figure B11. (For manufacturing purposes.)

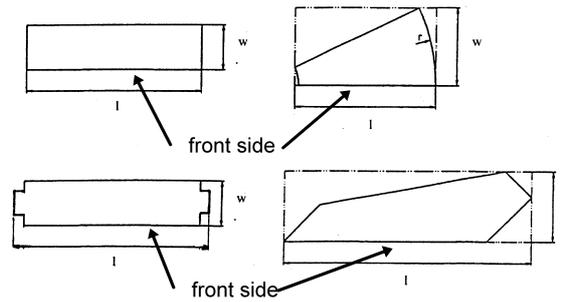


Figure B11: Length (l) and width (w) of steps

Median line

The median line is the line connecting the median points of the front edges of the steps. The line starts at the first step and ends with the last one.

Overlap

The horizontal distance (o) between the rear edge of the tread and the consecutive nosing (figure B12).

Pitch

The angle between the pitch line and the horizontal plane.

Pitch line

A notional line connecting the nosings of successive steps taken on the walking line and which extends down to the landing at the bottom of the flight.

Rise

The vertical distance (r) from one tread to the next.(Figures B2 and B12).

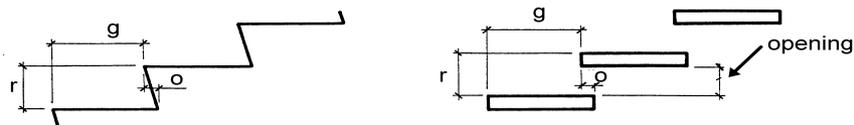


Figure B12: Rise (r), going (g), overlap (o)

Stair clear width

Unobstructed minimum distance on plan at right angles to the walking line (Figure B13).

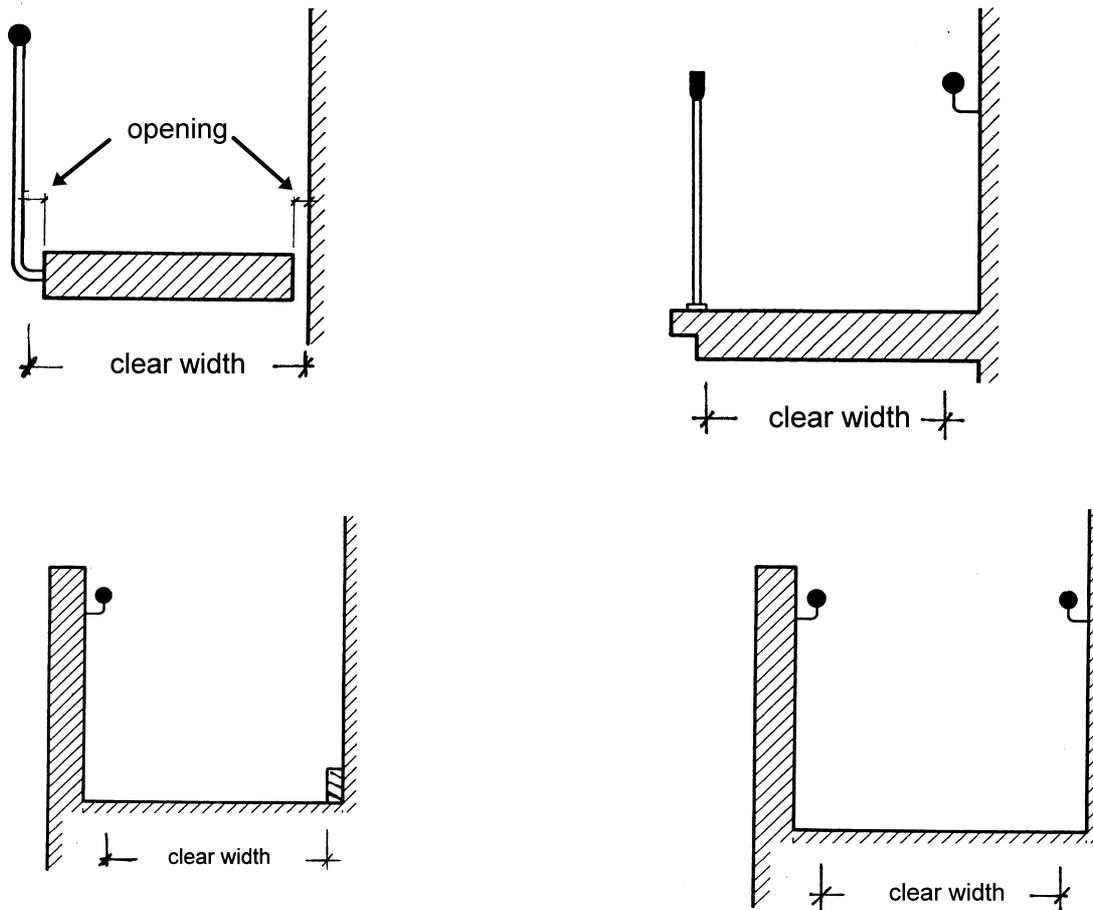


Figure B13: Stair clear width

Walking line

A theoretical line indicating the hypothetical average path of the users of the stair.

Walking zone

A theoretical zone including the walking line and indicating the area of the stair which will be used regularly in normal practice.

Width of the step

Shortest possible distance (w) at right angles to the front edge of the step. Various examples are shown in Figure B11. (For manufacturing purposes.)

ANNEX C: GENERAL TEST PRINCIPLES FOR STRUCTURAL TESTING OF STAIR KITS AND THEIR COMPONENTS AND MATERIALS

Sampling

When a harmonised European technical specification is not available for a component or a material to be used in a stair kit, the identification of the component or material can be made by testing. A similar method can be used to test the mechanical properties of the whole stair kit.

The stair kits, components or materials to be tested shall be a representative sample of the kits manufactured.

Testing

If a material is to be tested, the shape and size of the specimen shall be similar to that of the component to be used in the stair kit, if possible. The actions considered shall correspond to the actions on the component and of the static system. Thus, e.g. for natural stone intended to be used in steps for stairs with loadbearing bolts, bending, shear and torsion tests shall be carried out.

If a component is to be tested, the component shall be fixed in the same manner as it will be in the stair kit. Thus, e.g. for a connection intended to be used between a step and a string, the specimen shall be made as a fragment of a step and a string, and shear, bending and pull out shall be considered, if relevant.

If a complete stair kit is to be tested, the kit shall be installed according to the manufacturer's instructions and the loading shall be planned to fit the stair type. The worst case shall always be considered. Simplified calculations can be used to find out the worst case. Before loading in worst case, the different parts may be loaded sequentially e.g. to find the deflection values. If some parts are broken during these preceding loadings, they may be repaired in such a way that the overall function of the stair kit is not essentially changed.

The approval body will decide on the kind of testing to be carried out and the number of specimens tested.

The tests in general shall be carried out under normal environmental conditions according to clause 5.7.1. of the ETAG.

For materials like wood and wood-based products the moisture content of the samples after execution of the tests shall be determined.

The characteristic values of the relevant materials properties shall be checked and the test result shall be reduced to correspond to the minimum guaranteed values of the materials properties.

Evaluation of the test results

The fifth percentile characteristic value shall be given as the 5 % fractile value determined using a confidence level of 75 %.

For a normal distribution the characteristic value x_k is given by:

$$x_k = x_{mean} - k_n x_{stdev} \quad (1)$$

where x_{mean} is the mean value and x_{stdev} is the standard deviation of the material property. k_n depends on the number of tests. Values for k_n are given in Table 1.

Table 1. Values for k_n to be used in Equation (1), ISO 12491.

Number of tests	3	4	6	8	10	20	30	40	50	100	∞
k_n	3.15	2.68	2.34	2.19	2.10	1.93	1.87	1.83	1.81	1.76	1.64

For a log-normal distribution the characteristic value x_k is given by:

$$x_k = e^{(\ln x)_{mean} - k_n (\ln x)_{stdev}} \quad (2)$$

NOTE: When it is reasonable to assume that a material or component property is better described by a log-normal distribution function than by a normal distribution function the logarithm of the material property may be used instead of the material property itself for determination of the fifth percentile characteristic values.

NOTE: If it is impossible to test a representative sample of the product, the value of the standard deviation shall not be taken as less than 20 % of the value for the mean value. For example, this is the situation when the product to be tested is produced at a pilot production line. This value shall be checked against the factory production control results.

NOTE: The characteristic values determined according to this method are the highest values that may be declared as the characteristic values. It may be advisable to declare lower values to avoid an unreasonable amount of rejections during the evaluation of conformity process.

ANNEX D: IMPACT RESISTANCE TEST METHODS

General

The testing shall be carried out on sample stair kit parts representative of those to be supplied and/or erected in practice fitted into an appropriate test rig. Whenever possible the installation of the test sample shall be carried out by those who ordered the test.

The test methods used are mainly based on ISO methods but certain elements are modified or amended.

Unless otherwise stated in the test methods, loads and forces shall be accurate to within $\pm 2\%$, dimensions to within $\pm 1\%$, temperatures to within $\pm 5^\circ\text{C}$ and relative air humidity to within $\pm 5\%$ of the stated values.

Sample

The selection of the sample needs careful consideration to ensure that it fully represents the stair kit to be tested. Normally, the sample shall be a part of a stair kit fabricated in strict accordance with the manufacturer's drawings, specifications and installation instructions.

As a general rule, the largest stair kit parts in the range shall be tested as this will tend to be the weakest and, therefore, will allow stair kit parts of lesser dimensions to be assessed as being at least as good. However, several specimens may need to be tested to gain information about the full range of options available for a given system. The number and position of connections between panels and other parts of a stair kit shall also be considered.

Barrier

The barrier sample shall comprise of at least three modules with a total length not exceeding 2 m and shall be a straight run of barrier made in the same way as a production unit, incorporating all components and fixings. The modules shall be of the same dimension. The height of the sample shall be that set by the manufacturer.

The method of connecting components together shall reproduce actual conditions of use, particularly with respect to the nature, type and position of the connections and the distance between them.

The impact is directed to the element in the middle. If the barrier has a reinforcing member at the supposed impact point, another point shall be chosen as indicated in the barrier elements at the both sides of the element to be impacted.

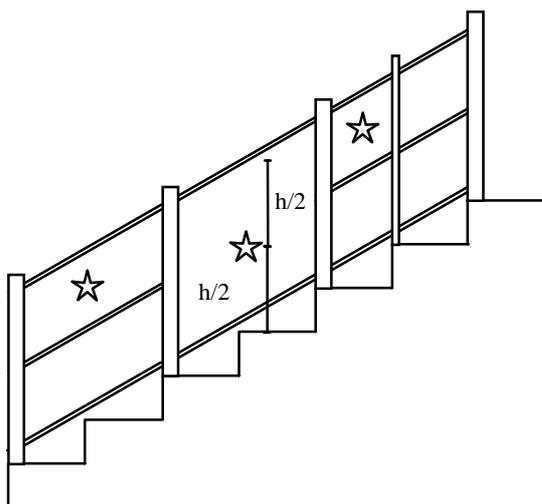


Figure D1. Impact test arrangement.

Steps

The sample shall comprise of a production unit having at least six treads and five rises incorporating all components and fixings.

Conditioning

The sample conditioning shall be recorded. The conditioning period shall be agreed between those who ordered the test and the test authority.

Test rig

For the pendulum tests, (for example barrier, riser and handrail) the test rig shall be as identified in ISO 7892:1988. For the drop tests (for example steps), the test rig shall give appropriate support for the sample.

Pendulum tests

Sequence of tests

ISO 7892:1988, *Vertical Building Components – Impact Resistance – Impact Bodies and General Test Procedures shall be applied with the following modifications:*

Testing to determine the impact resistance for barrier shall follow the sequence given below:

- Hard body impact load – 0,5 kg steel ball – Functional failure test
- Soft body impact load – 50 kg bag – Functional failure test
- Hard body impact load – 1 kg steel ball – Structural damage test
- Soft body impact load – 50 kg bag – Structural damage test.

Testing to determine the impact resistance for handrail shall follow the sequence given below:

- Soft body impact load - 30 kg bag

Testing to determine the impact resistance for riser shall follow the sequence given below:

- Hard body impact – 3,5 kg steel ball

Test Methods

- Hard body impact load – 0,5 kg steel ball

The load shall be applied at least ten times, each time in a new position.

The diameter of any indentation shall be reported. Note shall be made of any damage caused.

- Hard body impact load – 1 kg steel ball

The load shall be applied at all points considered weak, once at each position.

The diameter of any indentation shall be reported. Note shall be made of any damage caused.

- Hard body impact load – 3,5 kg steel ball

The load shall be applied at all points considered weak, once at each position.

Any fracture, puncture, deformation or loss of integrity shall be reported. The maximum deformation shall be recorded.

- Soft body impact load – 30 kg bag

The centre of the impact shall be at the handrail. The test shall be repeated three times.

Any damage shall be recorded.

- Soft body impact load – 50 kg bag

The impact load shall be applied in the centre of a middle module of the barrier above the steps unless this interferes with a member in a frame construction. However, the point of impact can be chosen by the approved body to be as severe as possible.

The deflection transducers shall be fixed to the back of the test sample immediately opposite the point of impact.

The structural damage impact is carried out at a new point and this should be at the weakest part of the barrier. The impact may need to be repeated if the weakest point is not obvious. The maximum deflection

during each impact and the residual deflection after each impact shall be reported. The residual deflection shall be measured five minutes after the impact.

Drop tests

Sequence of tests

Testing to determine the impact resistance for steps shall follow the sequence given below:

- Hard body impact load – 4,5 kg steel rod \varnothing 25 mm – Functional failure test
- Soft body impact load – 50 kg bag – Structural damage test.

Test Methods

- Hard body impact load – 4,5 kg steel rod

Increase the drop height until the step is broken. Record the drop height in mm causing failure and the art of the damage.

- Soft body impact load – 50 kg bag

This type of test is only necessary for materials tending to sudden failure in case of pulsating loading or overloading (e.g. natural stone).

The impactor is dropped from a height of 200 mm. Any damage is recorded.

Impact tests might be followed by a static test to show that the loadbearing capacity has not been changed.

ANNEX E: SPECIFIC PROVISIONS REGARDING STAIRS WITH LOADBEARING BOLTS

General

This Annex to Part 1 applies to the installation of stairs with loadbearing bolts with straight or newelled flights or parts of flights (e.g. winding stairs and helical stairs) as well as to spiral stairs. In this annex, the calculation methods and test information are given. The numbers refer to the corresponding clauses in the main text of the ETAG.

5 METHODS OF VERIFICATION

5.1 Methods of calculation

5.1.1 Simplified calculation method for one-bolt stairs

Steps of one-bolt stairs are embedded in the wall or connected to the wall by two wall fasteners. On the wall-free side they are connected to one another by one loadbearing bolt each.

If a more detailed static calculation is not carried out the following may be assumed:

The loadbearing bolts are connected to the steps as hinged connections.

The steps are fixed to the wall under torsion - not bending.

With these approximations, in general, a simple statically indeterminate structural system is obtained.

5.1.2 Simplified calculation method for two-bolt stairs

Steps of two-bolt stairs are connected to one another on the wall side and on the wall-free side by a loadbearing bolt each. On the side of the wall, each step is connected to the wall by means of a wall fastener.

If a more detailed verification is not carried out, the following may be assumed:

The load-bearing bolts are connected to the steps as hinged connections.

The wall fasteners are connected to the step in a way resistant to bending; fixing to the wall shall be freely supported.

5.1.3 Calculation method for other loadbearing bolt stairs

If the steps are connected to one another by two loadbearing bolts each (double bolts) or by prestressed deflection resistant loadbearing bolts on the side of the wall as well as on the wall-free side (four-bolt stairs), or by a loadbearing bolt each on the wall-free side (three-bolt stairs), respectively; or if the railing is taken into account for assessment of the load resistance of the stairs, the calculation shall assume a 3-D representation of the system. The connection, e.g. between stairs and railing or loadbearing bolt and step, shall be taken into account in a realistic way. The design of the components and their connections shall be based on the relevant technical specifications (Eurocodes) or on the results of tests carried out on structural members.

5.1.4 Load/displacement behaviour

The deflection of the stairs in the area of the bolts on the free side shall be verified.

5.2 Tests carried out on parts of the stairs

5.2.2 Testing of steps

5.2.2.1 General

The thickness of steps depends on the requirements for loadbearing capacity, load/displacement behaviour and impact resistance.

The minimum values of spacings between loadbearing bolts and edges of steps shall be determined from tests. Sufficient safety against failure shall be verified by torsion, bending and shear tests carried out on individual steps.

Steps may be made of materials whose properties are defined in the relevant technical specifications including Eurocodes and therefore their stability and load/displacement behaviour (e.g. reinforced concrete, steel) can be calculated.

They may also be made of materials whose properties deviate from those defined in the technical specifications including Eurocodes due to a particular choice (e.g. timber). For these materials, the characteristic material values such as modulus of elasticity, G-modulus, torsional and bending strength, shall be determined from tests.

A third group of materials to be used are materials whose properties are not defined in the relevant technical specifications including Eurocodes. Such products are for example slabs made of natural stone or cement or resin bonded concrete slabs bonded to form steps. For these materials, the characteristic material values such as modulus of elasticity, G-modulus, torsional and bending strength, shall be determined from tests.

Resistance to torsion and to bending shall be determined from at least three tests carried out on single steps. E- and G-moduli shall be determined from at least three tests each, carried out with application of about 50 % of service load (imposed load). The shear resistance in the area of the loadbearing bolts shall be determined in a realistic way, for example by shear tests carried out on single steps.

5.2.2.2 Torsion test

Shear modulus, torsional stress at failure as well as residual load resistance shall be determined by short-term tests carried out on single rectangular steps (for spiral stairs on single trapezoidal steps). The steps shall be fixed on one side and the free end torqued. Load is applied, for example, on the wall-free side via the loadbearing bolts. An example of test equipment is shown in Figure E1. The displacements due to torsion shall be determined at the longitudinal edge of the steps. The shear modulus shall be determined at about 50 % of service load.

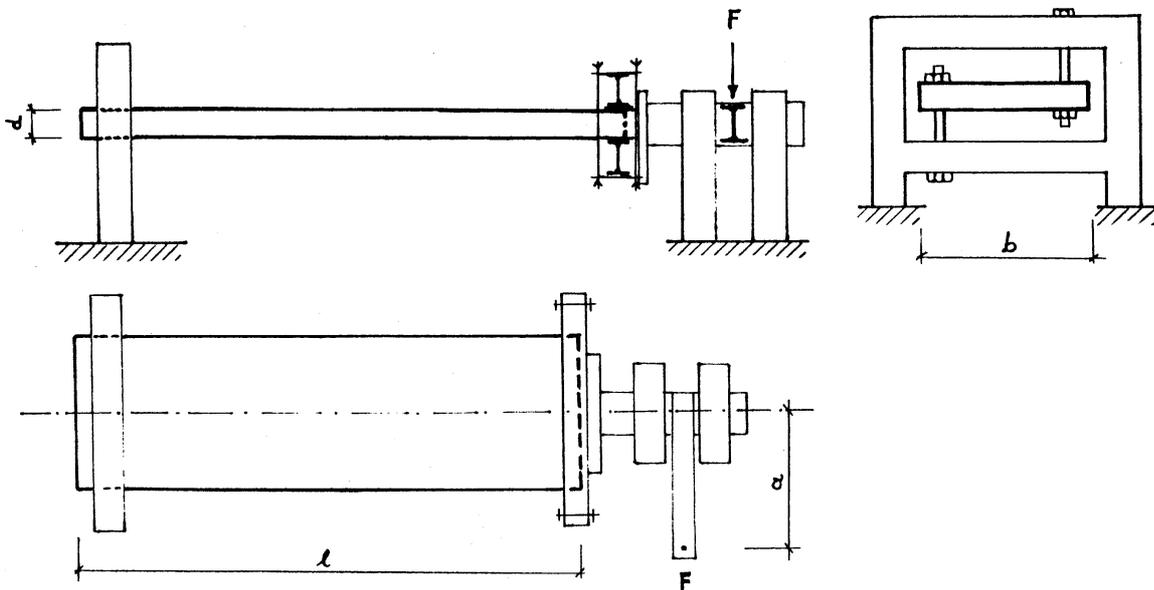


Figure E1. Example of a test equipment for torsion tests

5.2.2.3 Bending test

The elastic bending modulus, the bending stress at failure as well as the residual load resistance shall be determined by short-term tests carried out on single rectangular steps (for spiral stairs on single trapezoidal steps) and for stairs with an effective loadbearing handrail, also on single pieces of handrail. The steps or the pieces of handrail shall be subjected to the three-point bending test. Load is applied via a loading element in the form of a rail with a linear load acting parallel to the supports. An example of test equipment is shown in Figure E2. The elastic bending modulus shall be determined at about 50 % of service load. The residual load resistance shall achieve at least 1.1 times the value of service load.

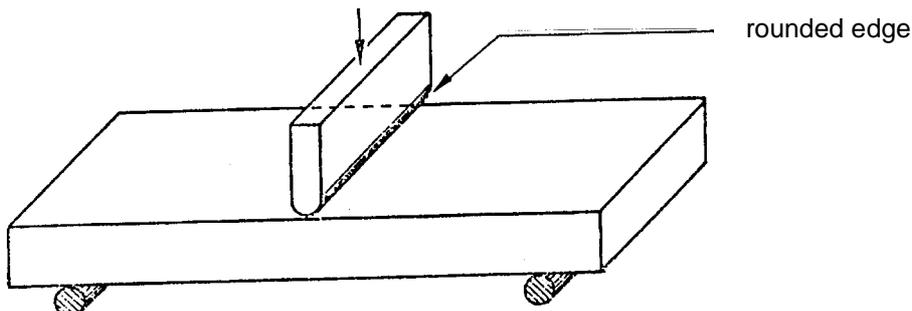


Figure E2. Example of test equipment for bending tests.

For spiral stairs the bending stress at failure of the steps shall be determined directly at the point of fixing (section of spindle) by a test carried out on structural members. An example of test equipment is shown in Figure E3.

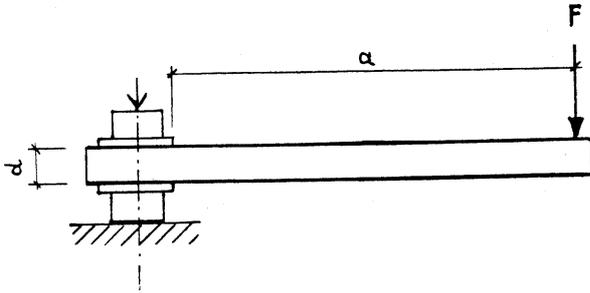


Figure E3. Example of bending test equipment for spiral stairs

5.2.2.4 Shear test

The shear resistance of the steps for three- and four-bolt stairs as well as for stairs with prestressed bending resistant loadbearing bolts shall be determined by a test carried out on the structural member. For this purpose, step sections of half length of the step shall be fixed to an upper or lower double bolt or to a prestressed bending resistant loadbearing bolt and loaded until failure. An example of test equipment is shown in Figure E4.

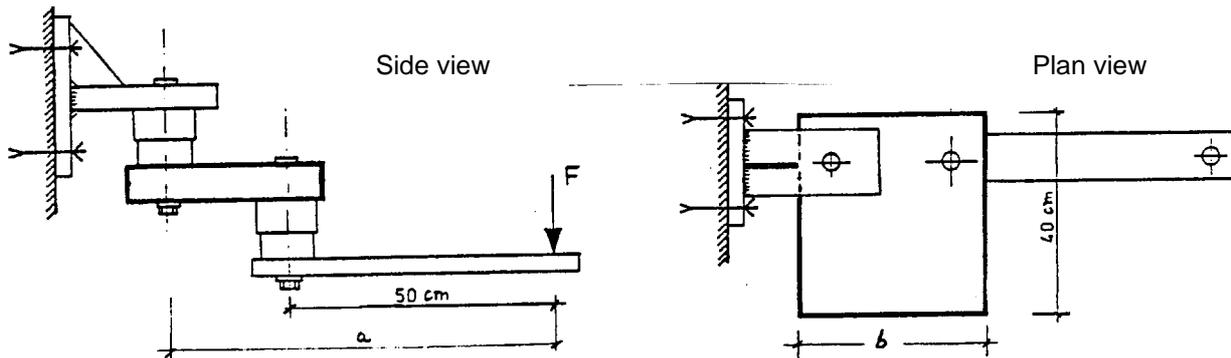


Figure E4. Examples of shear test equipment.

5.2.2.5 Drop test

This type of test is only necessary for materials tending to sudden failure in case of pulsating loading or overloading (e.g. natural stone).

A possible test would be to drop a mass of 50 kg from a height of 20 cm, followed by a torsion test. The impact test shall be followed by a torsion test. Any decrease in the torsion capacity is evaluated.

5.2.2.5 Load resistance of wall fasteners embedded in the step

The loadbearing capacity of circular bars embedded in the step and fixed to the staircase wall by mortar shall be verified on the basis of tests carried out on structural members. By measurements of deformation in structural member tests, the characteristic values to be used for static design (e.g. torsional rigidity and rigidity at elongation) shall be determined. An example of test equipment is shown in Figure E5. The steps shall be loaded once at their centre (F_1) and once at the edge just above the wall fastener (F_2). As an alternative, this test may also be carried out on a step cut in half longitudinally.

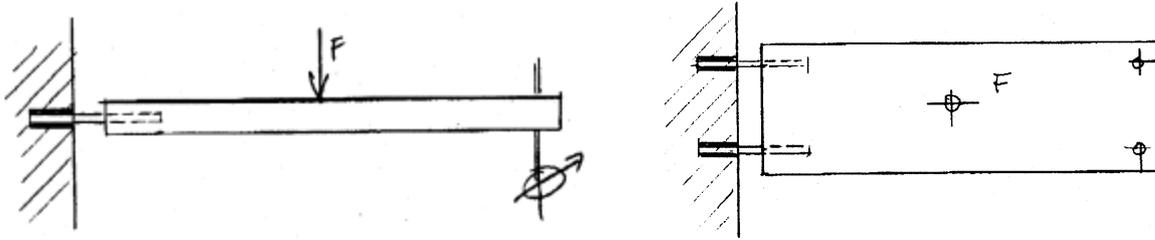


Figure E5. Examples of wall fastener test equipment

5.2.3 Testing of loadbearing bolts and their anchorage

If in the static calculation bending strength of the loadbearing bolts is taken into account, the stability of the loadbearing bolts shall be determined, if necessary, from tension, compression and bending tests. For concealed sleeves embedded in the steps it is necessary to deliver proof of their stability by carrying out a test on structural members.

ANNEX F: REFERENCE DOCUMENTS

ETAG Chapter	Document title
4.1.1.1	prEN 1990 Eurocode - Basis of structural design <i>ENV 1991: Eurocode 1 Basis of design and actions on structures.</i>
5.1	prEN 1990 Eurocode - Basis of structural design <i>ENV 1991-1 Eurocode 1: Basis of design and actions on structures.</i> <i>ENV 1991: Eurocode 1: Basis of design and actions on structures.</i> <i>ENV 1992: Eurocode 2: Design of concrete structures.</i> <i>ENV 1993: Eurocode 3: Design of steel structures.</i> <i>ENV 1994: Eurocode 4: Design of composite steel and concrete structures.</i> <i>ENV 1995: Eurocode 5: Design of timber structures.</i> <i>ENV 1999: Eurocode 9: Design of aluminium structures.</i>
5.1.1.2	<i>ENV 1998-1-2:1994 "Eurocode 8 - Design provisions for earthquake resistance of structures - Part 1-2 General rules - General rules for buildings"</i>
5.2.1	<i>prEN 13501-2, Fire classification of products and building elements. Part 2 Classification using data from fire resistance tests.</i>
5.2.2	<i>prEN13501-1, Fire classification of construction products and building elements – Part 1 Classification using test data from reaction to fire tests.</i>
5.3.1	<i>prEN 13986, Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking.</i>
5.3.4	<i>Radiological protection principles concerning the natural radioactivity of building materials. Radiation protection 112. European Commission, Luxembourg, 1999</i>
5.4.4	<i>prEN 12600 Glass in building – Pendulum test – Impact test method for flat glass and performance requirements.</i>
5.7.3	<i>EN 335-1 Durability of wood and wood-based products. Definition of hazard classes of biological attack. Part 1: General.</i> <i>EN 335-2 Durability of wood and wood-based products. Definition of hazard classes of biological attack. Part 2: Application to solid wood.</i> <i>EN 335-3 Durability of wood and wood-based products. Definition of hazard classes of biological attack. Part 3: Application to wood-based panels.</i> <i>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</i> <i>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</i> <i>EN 351-1 Durability of wood and wood-based products. Preservative-treated solid wood. Part 1: Classification of preservative penetration and retention</i> <i>EN 351-2 Durability of wood and wood-based products. Preservative-treated solid wood. Part 2: Guidance on sampling for the analysis of preservative-treated wood</i> <i>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.</i>
6.1.1	<i>ENV 1991: Eurocode 1. Basis of design and actions on structures.</i>
6.2.1	<i>prEN 13501-2, Fire classification of products and building elements. Part 2 Classification using data from fire resistance tests.</i>

ETAG Chapter	Document title
6.2.2	<i>prEN13501-1, Fire classification of construction products and building elements – Part 1 Classification using test data from reaction to fire tests.</i>
6.4.4	<i>prEN 12600 Glass in building – Pendulum test – Impact test method for flat glass and performance requirements.</i>
6.7.3	<i>EN 335-1 Durability of wood and wood-based products. Definition of hazard classes of biological attack. Part 1: General.</i> <i>EN 335-2 Durability of wood and wood-based products. Definition of hazard classes of biological attack. Part 2: Application to solid wood.</i> <i>EN 335-3 Durability of wood and wood-based products. Definition of hazard classes of biological attack. Part 3: Application to wood-based panels.</i>
Annex B	<i>ISO 3880-1: Building construction – Stairs – Vocabulary – Part I</i>
Annex C	<i>ISO 12491: Statistical methods for quality control of building materials and components</i>
Annex D	<i>ISO 7892:1988, Vertical Building Components – Impact Resistance – Impact Bodies and General Test Procedures</i>