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GUIDELINE FOR EUROPEAN TECHNICAL APPROVAL OF

FIRE PROTECTIVE PRODUCTS

PART 3: RENDERINGS AND RENDERING KITS INTENDED FOR FIRE RESISTING APPLICATIONS

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FOREWORD

Background

This draft ETA-Guideline has been established by the EOTA WG 11.01/04 dealing with Fire Protective Products.

This draft ETA-Guideline - Part 3 "Renderings and rendering kits intended for fire resisting applications" shall be used in conjunction with Part 1 "General",

This Complementary Part expands and/or modifies the requirements given in Part 1 “General”, taking into account the specific family of products referred to.

This ETA-Guideline is designed to deliver an ETA under the following options:

i) Option 1: the product (dry mix) evaluated in its end use application as a rendering directly applied to the substrate without the use of additional components such as a bonding agent, reinforcing mesh, fixings, top coat/sealing coat, additives,

ii) Option 2: an actual kit comprising the product plus one or more specified additional components such as a, bonding agent, reinforcing mesh, fixings, top coat/sealing coat, additives; evaluated in the end use application as a rendering and being supplied by the producer as a rendering kit. All components of the kit are required to be subject to; identification, assessment and factory production control (FPC) requirements as specified in this ETA-Guideline.

Note: Any additional components not supplied as part of an actual kit are considered to be a virtual kit as in Option 3.

iii) Option 3: a virtual kit comprising the product plus one or more identified additional components such as a primer, bonding agent, reinforcing mesh, fixings, top coat/sealing coat, additives; evaluated in the end use application as a rendering but with all additional components being placed on the market by other than the producer of the product. Identification of additional components may be specific (e.g. by trade name, type) or generic (*e.g.* by generic family of, say, primers, by minimum properties and/or performance). Not only the product (dry mix), but also the specified other components are subjected to the assessment, or part of it (in those cases where the assessment is an assembly test). The product (dry mix) is the only product that is subjected to the FPC requirements in this ETA-Guideline.

This ETA-Guideline for renderings is a basis to issue ETAs as specified in i), ii) and iii) above. This ETA-Guideline cannot be used to produce an ETA for a component or set of components not supplied as part of the kit with the product (dry mix) and which is, therefore, not part of that ‘kit’.

Manufacturers are responsible for ensuring that products covered by an ETA issued on the basis of this part 3 of ETAG 018 will comply with all relevant requirements from applicable European Directives e.g. Directive 67/548/EEC, Directive 76/548/EEC, Directive 76/769/EEC, Directive 91/155/EEC, Directive 1999/45/EC, Directive 1999/77/EC, before affixing the CE Marking.

Approval Bodies are responsible for ensuring that ETAs address all relevant provisions, when and where applicable.

List of reference documents

This draft ETA-Guideline Part 3 incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references subsequent amendments to, or revisions of these publications, apply to this ETA-Guideline only when incorporated in it by amendment or revision. For undated references the latest dated revision of the publication referred to, applies.

See Annex A.

Updating conditions of reference documents

The updating conditions of the ETA-Guidelines are given in Part 1 "General" - clause 1.1.

SECTION ONE:

INTRODUCTION

1. PRELIMINARIES

1.1 Legal basis

The legal basis of the ETA-Guidelines is given in Part 1 "General" - clause 1.1.

No existing ETA-Guideline is superseded.

1.2 Status of ETA-Guidelines

The Status of the ETA-Guidelines is given in Part 1 "General" - clause 1.2.

2. SCOPE

2.1 Scope

This Part 3 shall be used in conjunction with Part 1 "General".

This Complementary Part, ETA-Guideline Part 3 " Renderings and rendering kits intended for fire resisting applications" specifies the terminology and definitions, the specific methods of verification, the classification criteria for renderings and rendering kits intended for fire resisting applications and requirements for the identification of its component characteristics.

It also gives guidance for the assessment of the specific installation instructions and for the Attestation of Conformity for such products intended to be used for fire protection. It is applicable to renderings and rendering kits applied to the following substrate materials:

Steel[1];
Concrete;
Timber[2] (including wood based board products);
Masonry;
Boards (including, for example plasterboard and calcium silicate types)

2.2 Use categories, product families, kits and systems

2.2.1 General

For the purpose of this ETA-Guideline, the Fire Protective Products have been divided into:

- Part 2 - "Reactive coatings for fire protection of steel elements "
- Part 3 - "Renderings and rendering kits intended for fire resisting applications"
- Part 4 - "Fire Protective Boards, Slab and Mat Products and Kits"

[1] Other metals are not excluded but additional verification methods may be required
[2] The effect of any preservation treatment of timber and timber products is not considered. A case by case approach is necessary in order to demonstrate adhesion and compatibility for renderings without additional mechanical support.

In this part, additional specifications are given for renderings and rendering kits. The component specifications are specified in:

- this ETA-Guideline; or
- European technical specifications as referred to in the Construction Products Directive, i.e.
  - harmonised European product standards as published by CEN (see Annex A) or
  - European Technical Approvals as published by EOTA.

2.2.2 Use categories related to environmental conditions

The use categories related to the type of environmental conditions are based on the general principles specified in Part 1 'General' - clause 2.2.1. The use categories are the following:

- Type X: Renderings intended for all conditions (internal, semi-exposed and exposed.)
- Type Y: Renderings intended for internal and semi-exposed conditions. Semi-exposed includes temperatures below 0°C, but no exposure to rain and limited exposure to UV (but the effects of UV exposure are not assessed.)
- Type Z_1: Renderings intended for internal conditions excluding temperatures below 0°C, with high humidity [1].
- Type Z_2: Renderings intended for internal conditions excluding temperatures below 0°C, with humidity classes other than $Z_{1.}$

Note 1: Products that meet the requirements for type X, meet the requirements for all other types. Products that meet the requirements for type Y also meet the requirements for types Z_1 and Z_2. Products that meet the requirements for type Z_1 also meet the requirements for type $Z_{2.}$

Note 2: Requirements relevant for the establishment of the use categories are presented in clauses 6.7.1.2 to 6.7.1.6.

It is acceptable for a rendering to be intended for internal applications only, however, the construction process may result in a rendering being subjected to exposed outdoor conditions for an extended period before the building envelope is closed. In this case the possibilities are:

1, Special provisions to temporarily protect the exposed rendering according to the instructions of the producer included or referenced in the ETA, or,

2. Evaluation of the rendering as if it were to be used for exposed applications (type X), or

3. For established products only, evaluation of the rendering for type Y or type Z applications (as appropriate) and acceptance by the approval body of the possibility of short term exposure based on long term experience and evidence of such exposure.

For exposed and semi-exposed applications renderings may require the use of sealing coats / top coats to assist in the resistance to weathering.

[3] These uses apply for internal humidity class 5 in accordance with EN ISO 13788.

The resistance of the product to specific environmental conditions shall be assessed on a case by case basis. The approval body shall obtain suitable evidence for the assessment and present details in the ETA.

2.2.3 Use categories related to the element to be protected

The use categories are identified in Part 1 “General” as Types 1 – 10. This Guideline covers the application of renderings to use Types 1 and 3 – 10. Type 8 includes protection of plasterboard by plaster based rendering. Use category Type 2 is not covered by this ETA-Guideline.

2.3 Assumptions

The provisions, test and assessment methods in this guideline, or referred to, have been written based on an assumed working life of the product for the intended use of 25 years. The provisions are based upon the current state of art and the available knowledge and experience.

If a satisfactory performance of the product is not established in the durability tests then an estimated working life of 10 years may be attributed based on a favourable assessment of serviceability/identification tests(eg flexural, compressive strength and where possible adhesion) but only for use category Z_2. Additional evidence of the product in actual service may also be taken into account.

Additional assumptions made are given in Part 1 “General” - clause 2.3.

3 TERMINOLOGY

3.1 Common terminology and abbreviations

The common terminology and abbreviations are given in Part 1 "General" - clause 3.1

3.2 Particular terminology and abbreviations

For the purpose of this ETA-Guideline Part 3, the particular terminology and abbreviations as given in Part 1 "General" - Clause 3.2. The following specific terminology and abbreviations shall also apply:

Rendering (spray or trowel applied fire protective material)

The applied product for fire protection comprises only:

i) Spray-applied gypsum or cement binder mixed with one or more aggregates and/or fibres. The product is mixed with water to produce a slurry and sprayed wet;

ii) Spray-applied mineral wool mixed with a binder, filler or aggregates. The product is sprayed dry and mixed with water at the nozzle. The binder may be included as part of the dry mix in the bag or may be added with the water at the nozzle;

iii) Trowel applied gypsum or cement binder mixed with one or more aggregates and/or fibres mixed as a slurry at a consistency which enables it to be trowelled to conform with the profile of the substrate;

iv) Trowel applied material as defined in i, ii and iii above mixed at a consistency which allows the “patch repair” of “small areas” of materials described in sections i, ii and iii above.

The term ‘rendering’ used in this ETA-Guideline refers to the applied, dried and hardened material.

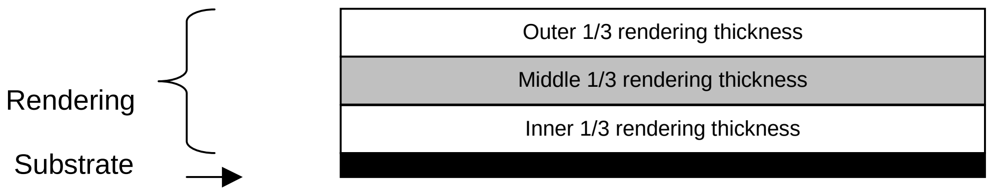
Mechanical fixings

Components to key or reinforce the rendering to the substrate.

- Keying mesh: mesh of metal or other material of relatively small aperture size, typically 10mm to 25mm which allows some penetration of spray to produce a good key and applied in close proximity or fixed to the substrate. Typical types; expanded metal lath, ribbed expanded lath, welded mesh, woven hexagonal mesh.

- Reinforcing mesh: mesh of metal or other material of relatively large aperture size, typically 25mm which allows full penetration of the rendering and hence provides reinforcement. Typical types; welded mesh, woven hexagonal mesh. A reinforcing mesh is typically positioned in the middle third of the rendering thickness.

ETA applicants should reference standard types of lath defined in EN 13658-2. (at the time of publication of this ETAG this standard is in draft form. The applicability of the published version will be confirmed, or otherwise, in a progress file at the appropriate time).



- Discontinuous metal fixings: pins welded, shot-fired or screwed to the substrate and bent, split or fixed with large diameter washers or spring clips to key the rendering or used to support keying or reinforcing mesh.

Primer

- Corrosion protection, a coating applied directly to a suitably prepared steel surface to provide corrosion protection, or,

- Bonding agent, a liquid component not part of the dry mix and not mentioned in its formulation, applied to the substrate separately or mixed with the rendering and applied as a thin first layer to ensure or to improve the adhesion of the rendering on the substrate, especially if no mechanical fixing is used.

Additives

Components not part of the dry mix and not mentioned in its formulation; added to the water or to the fresh mixed slurry before spraying to ensure or to improve the adhesion and/or cohesion of the rendering, to accelerate or retard the setting process or to influence the porosity.

Rendering Kit ('kit')

Bags of dry mix plus one or more other components such as bonding agent, reinforcing mesh, fixings, top coat / sealing coat or additives provided by the ETA holder.

Top Coats / Sealing Coats

These materials are generally components of an "external grade" rendering kit where the rendering requires additional weathering resistance. They may also be used to protect the rendering from mechanical damage, or be provided purely for decorative purposes without any claimed contribution to performance.

These materials can be:
- low viscosity coatings intended to soak into the surface of the rendering;
- high viscosity coatings which are either spray or brush applied as a surface sealing coat over the rendering.

Product

The dry mix as supplied by the ETA applicant excluding fixings, reinforcement or other components incorporated into the dry or wet mix on site. Recycled material as a constituent of the dry mix is acceptable under this ETA-Guideline, as far as the recycled constituent is part of the assessment performed in accordance with this ETA-Guideline.

Shelf life

The maximum time for which the bags of dry mix should be stored under the specified storage conditions.

Pot life

The maximum time within which the dry mix, once mixed with water and any other additives, should be used.

Batch

The unit or quantity of production in a single complete production operation. The volume which constitutes a batch in converting the raw material into the finished product is called "batch size".

SECTION TWO:

GUIDANCE FOR THE ASSESSMENT OF THE FITNESS FOR USE

4. REQUIREMENTS

4.0 General

The performance requirements, establishing the fitness for use of fire protective renderings and kits, shall be in accordance with Part 1 "General" - chapter 4, and with the following specific stipulations for this family of products.

The provisions, test and assessment methods in this guideline, or referred to, have been written based upon the assumed intended working life of the product for the intended use of 10 or 25 years, provided that the product is subject to appropriate use and maintenance in accordance with Chapter 7. These provisions are based upon the current state of art and the available knowledge and experience.

4.1 ER 1: Mechanical resistance and stability

See Part 1 “General”, Table 4.1

4.2 ER 2: Safety in case of fire

See Part 1 “General”, Table 4.1

4.3 ER 3: Hygiene, health and the environment

See Part 1 “General”, Table 4.1

Release of dangerous substances

Further restrictions compared to the European Directives (see FOREWORD) may be imposed by single Member States, If there exist national restrictions concerning dangerous substances reference should be made to the European Commission database on dangerous substances. Known cases of additional national restrictions will be recorded in a comprehension document.

4.4 ER 4: Safety in use

4.4.1 Mechanical resistance and stability

See Part 1 “General”

4.4.2 Resistance to impact / movement

See Part 1 “General”

4.4.3 Adhesion

See Part 1 “General”

4.5 ER 5: Protection against noise

See Part 1 “General”, Table 4.1

4.6 ER 6: Energy economy and heat retention

See Part 1 “General”, Table 4.1

4.7 Related aspects of durability, serviceability and identification

4.7.1 Durability requirements

4.7.1.1 Deterioration may be caused by physical, biological or chemical agents. The materials and components of fire protective renderings shall not deteriorate during their assumed intended working life so as to affect significantly the performance of the products in relation to fulfilling all the Essential Requirements 2 to 6, especially the protective effects in case of fire. Where physical damage is able to be repaired, the specification, method and scope of damage repair together with any limitations shall be specified.

The rendering and its components shall not react adversely with the intended substrate(s)

4.7.1.2 Resistance against biological attack

Rendering products may be influenced by biological effects, i.e. mould growth and or subject to deterioration due to attack by insects or mammals, e.g. rodents. This ETA-Guideline foresees no assessment to cover this eventuality. In general, it is an assumption that design provisions will prevent deterioration from occurring (see chapter 7). Where approval bodies expect biological attack to be of particular importance for specific products, additional, case-by-case assessment should take place, taking into account the nature of the biological agent.

4.7.2 Serviceability requirements

See Part 1 “General” - clause 4.7.

4.7.3 Identification

See Part 1 “General”.

5. SPECIFIC METHODS OF VERIFICATION

5.0 General

5.0.1 Use of Methods of Verification

The methods of verification given in Part 1 "General" - chapter 5 apply, except where modified or specified below.

The performance characteristics for rendering kit components should be verified in accordance with European technical specifications for the kit or component under consideration:

- harmonised European standards as published by CEN and cited in OJEU (see Annex A), or

- European Technical Approvals as published by EOTA,

unless this ETA-Guideline considers product characteristics (including identification, serviceability and durability) that are not covered by those European technical specifications.

If such technical specifications are not available, the specifications referred to in this paragraph shall be used for verification purposes.

Kit components shall only be subjected to the verification methods specifed below if the corresponding characteristics are relevant for the kit component under consideration and as far as relevant for its fitness for intended use(s) Characteristics for which the NPD-option is not allowed (see Part 1 ‘General’, Table 6.1) shall always be verified.

5.0.2 Sampling and Test Specimens

Where possible samples of the product for all approval tests shall be taken at the manufacturing site and shall be representative of the rendering for which approval is being sought.

All samples for test specimens for each product shall be taken at the same time, and from the same batch, in accordance with EC Guidance Paper K, ensuring that approval test results can be validated for initial type testing under attestation of conformity (see chapter 8). If sampling at the same time is impossible for practical reasons, measures shall be taken to ensure that all samples taken have identical constituents and composition. In the latter case the Approval Body needs to provide relevant evidence of measures taken to those responsible for attestation of conformity.

The specimens for approval tests shall as far as possible be prepared at the same time and in accordance with the ETA-applicator's application method. in order to minimise differences caused by variations in specimen preparation. Simultaneously, samples for density determination shall be prepared (see below). This is in order to relate the characteristics of the material to the fire performance achieved.

In most cases, ETA-applicants will specify both spray (large surfaces) and trowel (small surfaces) applied rendering. Therefore, unless the ETA-applicant specifies the method of application, or the more onerous application method can be determined, tests shall be conducted with both spray and trowel applied material and the density of both shall be measured. The ETA will specify the densities and their tolerances for trowel and spray applied hardened and freshly mixed renderings. (The densities serve as benchmarks for site tests as referred to in 7.3.1);

The densities are determined on the basis of at least 10 samples in accordance with EN 1015-6 for fresh mortar and EN 1015 -10 for hardened mortar, as appropriate. On the basis of at least 10 measurements, the mean value will be determined and rounded to tens. The density of all test specimens is required to be within ± 15% of the mean value of the fire test specimens.

The declared density in the ETA will be the mean value and corresponding tolerances with a maximum tolerance of ±15% and accordingly all performances declared in the ETA, including fire resistance, will apply to the declared density. The application method will be specified in the ETA.

If measured densities are outside of the prescribed tolerance, either more specimens shall be prepared (within the tolerance) or additional tests conducted to evaluate a wider density range able to quote din the ETA.

The thickness of the hardened rendering of all test specimens shall be measured using a 1 mm diameter probe or drill, which shall be inserted into the material at each measurement position until the tip of the probe or drill touches the surface of the test specimen substrate. The probe or drill shall carry a circular steel plate of diameter 50 mm upon it, for accurate determination of the surface level.

For fire resistance tests, the thickness of the test specimen shall be measured in the proximity, between 50 mm and 100 mm away from each of the thermocouples fixed to the substrate, beneath the applied fire protection system.

For all other test specimen, the measurements will be geometrically uniformly distributed over the surface of the test specimen, but shall include visibly smaller thicknesses. The minimum number of measurements per test specimen is 10.

The thickness of test specimen shall not deviate by more than 20 % of the mean value over the whole of its surface. In this case, the mean value shall be used in the assessment of the results and the limits of applicability of the assessment. If it deviates by more than 20 %, the maximum thickness recorded shall be used in the assessment."

Unless specified differently for a particular test the following standard substrates shall be used for the tests.

a) Steel, this shall be that specified as ‘Type 1’ in ISO 1514, of nominal size 500 x 500mm and of thickness not less than 5 mm.

b) For concrete, this shall be as specified in EN 1323 of minimum size 300 x 400 mm and of nominal thickness 40mm.

c) For wood based panels (also covering solid timber), particle board as specified in EN 312, of density (700 ± 10%)kg/m^3, nominal size 500 x 500mm and (20 ± 2)mm thick

d) For boards other than those in c) the specific board type shall be used.

5.0.3 Effects of drying

The applied rendering is required to harden and cure with minimal shrinkage or cracking and to maintain dimensional stability and not crack during its working life. The samples prepared for the tests referenced in 5.7.2.2.1, 5.7.2.2.2 or 5.7.2.2.3 and those for fire testing can be used to evaluate the effects of drying of the rendering.

Hairline cracks that develop as a result of drying may be accepted providing the desired results are achieved in the fire tests with the presence of cracking. Observations shall be made on the effect of drying and hardening with respect to shrinkage and cracking.

Cracks up to the size and density of those exhibited by the fire test specimens prior to test are acceptable. This shall be expressed in the ETA as maximum width of crack and total length of cracks per square metre of rendering.

5.0.4 Conditioning of Tests Specimens and Test Conditions

Except where conditioning is specified in a referenced test method the prepared test specimens shall be conditioned at (23 ± 2) ^{o}C and (50 ± 5) % relative humidity for at least 28 days or until constant weight, i.e. until two subsequent weight measurements differ less than 1% over a 24 h period.

The laboratory conditions shall be (20 ± 10) ^{o}C and (50 ± 20) % relative humidity.

5.0.5 Assessment approach

5.0.5.1 General

Approval bodies will in many cases be confronted with a product or kit, consisting of the dry mix render and one or more primers and one or more top coats or an assessment that includes those other products (virtual kit approach). Primers, topcoats, reinforcements and mechanical fixings and additives may be referred to specifically (by trade name and type) or generically, by generic product or generic family in the case of primers The kit components are always referred to specifically. All others components, specific or generic, will be specified in the ETA according to the available technical specifications (e.g. EN or ETA) and, when it is not possible, by reference to proprietary items, physical dimensions and material performance. In case of primers, when they are not specific, reference to the generic families indicated in 5.0.5.2 should be done.

Some rendering systems, with or without top coat, can be applied directly on the substrate. In case of steel substrates, this is either due to the steel substrate not requiring additional protection, taking into account the intended use (e.g. weathering steels complying with EN 10025 -2 or stainless steels complying with prEN 10088-2 or -3) or because the steel substrate has been protected by metallic coatings, using hot-dip galvanizing (EN 10326 or EN 10327) or thermal zinc or aluminium spraying. If the rendering can be applied without primer, tests shall be performed accordingly.

It is recognized that in the majority of cases the steel elements will arrive on site already primed. In that case, it is necessary for the rendering applicator to ensure that the primer is compatible with the rendering. For this case provisions are given in chapter 7.

If renderings can be applied with and without primer(s), both situations shall be assessed.

5.0.5.2 Primers

5.0.5.2.1 Bonding agents provided for the purpose of providing a ‘key’ for the rendering

If the rendering system is intended to be used with one or more specifically referenced bonding agents, all system tests, i.e. all tests not performed on the individual components, foreseen in this chapter shall be carried out using the specifically referenced bonding agent(s). The specifically referenced bonding agent(s) shall be identified in the ETA and be subjected to FPC by the manufacturer, if they are kit components.

5.0.5.2.2 Corrosion protection primers, specific or generic

The most common types of generic primers (family) are:

- short/medium oil alkyd primers
- two component epoxy primers
- zinc rich epoxy primers (containing about 85% by weight of metallic zinc powder
- zinc silicate primers

Note 1: Primers not covered by the families identified above may be grouped in other families of primers based on the binder,(eg oil alkyd,epoxy), carrier, (organic, solvent/water) and pigment (eg inhibitive or non-inhibitive) type.

Durability testing with a primer from the generic type of zinc rich epoxy primer does not cover galvanized steel, for instance hot dip galvanised steel. Galvanized steel is treated as another form of “primer” and has to be tested separately.

All tests/assessments according to 5.2 to 5.7 shall be carried out with a primer chosen by the applicant. However, where the rendering is intended to be used with more than one primer, or with no primer, an insulation efficiency test (as specified in Annex, E9) is necessary for the additional primers. Only one primer from a primer family is subjected to testing.

Note 2: It is assumed that the result “pass” within the insulation efficiency test is an indication of a comparable behaviour in all other tests (e. g. fire resistance tests, durability test).

It is recognized that in the majority of cases the steel elements will arrive on site already primed. In such instances, it is necessary for the rendering applicator to ensure that the primer is compatible with the rendering. For this case provisions are given in chapter 7.

However, where the primer is found to be a type not covered by the ETA, the ETA does not cover the use of the rendering.

5.0.5.2.3 Existing Data

For existing products, in some circumstances, it might be possible to assess the performance in fire of systems with alternative primers using existing data from tests other than to the specified EN standard (for example to equivalent national test standards).

If the alternative data is from a fire resistance test which is substantially similar to the specified EN test, this data may be used in conjunction with the EN test data, corresponding to one specific primer, to support an assessment for an alternative primer. In particular, if the alternative test is substantially similar to the specified EN test in terms of thermal exposure, mechanical stress, scale of deformation and deflection etc, the “stickability” and overall performance of the rendering system might be assessed.

It is likely that existing test data may be from fire resistance tests where the furnace heating regime was not exactly the same as that in the specified EN test. For example, the plate thermometer may not have been used for measuring furnace temperatures. Nevertheless, the existing data may still be used if it provides a comparison of performance between the alternative primers in the same heating regime and was conducted at an accredited, independent laboratory.

5.0.5.3 Top coats,

All tests according to chapter 5.7.2 should be conducted without a top coat unless the top coat is necessary to provide the required performance under the particular exposure conditions. In this case the rendering should be tested with the specified top coat which will be specified in the ETA. The Approval Body should decide which characteristics are dependent on the top coat for their performance, (eg, adhesion is independent of the top coat.)

If the rendering is claimed to be equally suitable with and without topcoat for environmental conditions types Z_1 and Z_2 the initial tests (5.7.2.2.1) shall be performed with panels with and without topcoat to show that the topcoat has no influence on the insulation efficiency. For determining the insulation efficiency after exposure, it is sufficient to perform the tests without topcoat. The top coat is specified in the ETA. The colour of the topcoat has no influence on the result of the durability assessment for types Z_1 and Z_2. Therefore there is no need to test different colours of the topcoat and the ETA is valid for all top coat colours.

For environmental use categories type Y and type X the test results could be influenced by the various top coat types and their colours. No generic approach is possible in relation to the type of top coat and the applicant has to test all top coats. However, in order to cover all colours of a particular top coat, a colour having an index L< 50 on the CIELAB[1)] scale (see ISO 7724) shall be selected for test. The decision to choose the colour of the top coat used in durability assessment is taken by the Approval Body and the ETA-Applicant. The test results are valid for the tested top coat and all its different colours.

5.0.5.4 Reinforcements and mechanical fixings

All tests according to chapter 5.7.2 should be conducted without reinforcement or mechanical fixings unless the reinforcement or mechanical fixings are necessary to provide the required performance under the particular exposure conditions. In this case the rendering should be tested with the specified reinforcement or mechanical fixings which will be then be specified in the ETA.

Note 1: Determining the, reinforcement(s) and/or mechanical fixing(s) that lead(s) to worst performances within each family of primers is a decision taken by the Approval body and the ETA-applicant, on a case-by-case basis, until European consensus can be achieved.

- [1)] "Commission International de le Eclairage" (CIE) system of colour space defines lightness/darkness (L) scale in CIELAB units. White is defined as L = 100 and black as L = 0.

Table 5.1

Relationship between the ETAG paragraph on product performance and the ETAG paragraph on the verification method

ER	ETAG Paragraph on product performance	ETAG Paragraph on verification method of product characteristics Rendering (Renderings & fixings)
1	4.1 Mechanical resistance and stability	Not relevant for these products
2	4.2. Safety in case of fire	5.2.1 Reaction to fire
		5.2.2 Fire Resistance
3	4.3 Hygiene health and environment	5.3.1 Water absorption 5.3.2 Release of dangerous substances
4	4.4 Safety in use 4.4.1 Mechanical resistance and stability	
	4.4.2 Resistance to impact/movement	
	4.4.3 Adhesion	5.7.2.6 Adhesion
5	4.5 Protection against noise	5.5 See general document
6	4.6 Eergy, economy and heat retention	5.6 See general document 5.6.1 Thermal insulation 5.6.1.1 Method for mineral wool based renderings 5.6.1.2 Method for renderings other than mineral wool based ones 5.6.2 Water vapour permeability
	4.7 Durability,serviceability and identification 4.7.1 Durability	5.7.1 Durability 5.7.1.1 General 5.7.1.2 Resistance to UV exposure 5.7.1.3 Resistance to deterioration caused by heat and rain 5.7.1.4 Resistance to deterioration caused by high humidity 5.7.1.5 Resistance to deterioration caused by heat and cold 5.7.1.6 Resistance to deterioration caused by freezing and thawing 5.7.1.7 Resistance to corrosion of a steel substrate by the rendering 5.7.1.8 Resistance to corrosion of the fixings by the rendering
	4.7.2 Serviceability	5.7.2 See general document 5.7.2.1 Mechanical resistance and stability 5.7.2.2 Resistance to impact/ movement 5.7.2.3 Air erosion 5.7.2.4 Water permeability 5.7.2.5 Water absorption 5.7.2.6 Adhesion and cohesion
	4.7.3 Identification	5.7.3 Identification

5.1 ER 1: Mechanical resistance and stability

Not relevant for these products, see Part 1 “General” - clause 5.1.

5.2 ER2: Safety in case of fire

5.2.1 Reaction to fire

See Part 1 “General” - clause 5.2.1.

The rendering shall be classified in accordance with EN 13501 – 1. If the rendering is intended to be used with and without a top coat then both situations shall be tested.

Guidance on mounting and fixing arrangements for the relevant tests is given in Annex B of this document.

5.2.2 Fire Resistance

See Part 1 “General” - clause 5.2.2.

In order for an ETA to be issued for the rendering it shall be the subject of at least one fire resistance test and shall be classified in accordance with EN 13501 – 2 or prEN 13501 – 3 as appropriate.

Separate testing and classification shall be conducted for each type of substrate.

There also exists the possibility of applying calculation methods nased on Eurocodes, see Part 1 ‘General’ – clause 9.2

Note 1; The test standard ENV 13381- 4 is currently under revision. The Progress File should be consulted for the latest position.

5.3 ER 3: Hygiene, health and the environment

5.3.1 Water absorption

Not relevant under this ER but see serviceability 5.7.2.5

5.3.2 Release of dangerous substances

See Part 1 “General” - clause 5.3.2.

The ETA-applicant shall declare that no dangerous substances as specified in the EC-database of dangerous substances are contained in, or will be released by the rendering. (see also 4.3.2).

5.4 ER4: Safety in use

Not relevant under this ER but see serviceability 5.7.2

5.5 ER 5: Protection against noise

See Part 1 “General” - clause 5.5.

5.6 ER 6: Energy economy and heat retention

5.6.1 Thermal insulation

In addition to tabulated values, see Part 1 “General” - clause 5.6, the following methods may be used to determine thermal insulation.

5.6.1.1 Method for mineral wool based renderings (see Annex F)

5.6.1.1.1 Lambda fractile value at 10°C, at dry conditions

The lambda fractile value at 10°C, at dry conditions ($\lambda_{10,dry,90/90}$), representing at least 90% of the production with a confidence limit of 90% shall be stated in the ETA.

5.6.1.1.2 Moisture conversion factor ($f_{u,1}$)

The moisture conversion factor ($f_{u,1}$) for the conversion of $\lambda_{10,dry}$ to $\lambda_{23,50}$ shall be declared in the ETA.

5.6.1.1.3 Lambda declared at 23°C and 50% relative humidity $\lambda_{D(23,50)}$

The calculated value of the lambda declared at 23°C and 50% relative humidity shall be stated in the ETA.

5.6.1.1.4 Conversion factor to high moisture content ($f_{u,2}$)

The conversion factor to high moisture content ($f_{u,2}$), and the moisture content mass by mass (*m*/*m*) at 23°C and 50% relative humidity and 23°C and 80% relative humidity shall be given in the ETA.

Note 1: In the ETA it shall be stated that in the value of the lambda declared at 23°C and 50% relative humidity the influence of moisture has been taken into account

5.6.1.2 Method for renderings other than those based on mineral wool

The determination of the thermal conductivity of renderings not covered by 5.6.1.1 shall be determined in accordance with EN 1745, clause 4.2.2. The design value shall be determined in accordance with EN 1745, clause 4.3.

Note 1: In the ETA it shall be stated that the intended use of the product is restricted to places not exposed to wetting or weathering. However, in certain cases it may be necessary to know the influence of high moisture content in relation to the declared lambda value at 23°C and 50% relative humidity ($\lambda_{D(23,50)}$). This conversion factor to high moisture content ($f_{u,2}$) is then only to be seen as information.

5.6.2 Water vapour permeability

See Part 1 “General” - clause 5.6.2

5.7 Related aspects of durability, serviceability and identification

5.7.1 Durability requirements

5.7.1.1 General

The following verification methods shall be conducted on the rendering, including if used, any mechanical fixings which are intended to be used as a part of a kit, unless similar tests have been performed on the basis of European product standards or European Technical Approvals. The need to conduct each of the following tests is determined by the claimed exposure and environmental conditions for the product or system as given in Table 5.2.

Durability is demonstrated by comparing the performance of unexposed specimens with specimens subjected to artificial ageing. The appropriate tests for the intended exposure types are given in Table. 5.2 The references are to the detailed test requirements given in

Annex E. The test indicated in E9 of Annex E should also be used to compare the insulation efficiency of the rendering with additional primers and different top coats.

Table 5.2

Test requirements for different exposure types

Use Categories (Clause 2.2.2)	**UV**	**Moisture**		**Temperature (high/low)**	**Freeze/ Thaw**
		Rain	**High Humidity**		
X	yes[1], E.3	yes, E.4	yes [2]	yes, E.6	yes, E.7a
Y	no	no	yes, E.5	yes, E.6	yes E7b
Z_1	no	no	yes, E.5	no	no
Z_2	no	no	no	no	no

[1] *Only necessary for renderings with topcoats of organic composition*
[2] *Covered by 'resistance to water test*

Note 1: consideration should be given not only to the final end use environmental conditions but also to the possibility of exposure to more severe conditions during the construction process. See clause 2.2.2.

5.7.1.2 Resistance to UV exposure

This exposure condition is a requirement for renderings claimed to be suitable for Type X climatic conditions. The test method is given in Annex E, clause E3.

5.7.1.3 Resistance to deterioration caused by heat and rain

This exposure condition is a requirement for renderings claimed to be suitable for Type X environmental conditions. The test method is given in Annex E, clause E4.

5.7.1.4 Resistance to deterioration caused by high humidity

This exposure condition is a requirement for renderings claimed to be suitable for Types Y and Z_1 environmental conditions. The test method is given in Annex E, clause E5.

5.7.1.5 Resistance to deterioration caused by heat and cold

This exposure condition is a requirement for renderings claimed to be suitable for Types X and Y environmental conditions. The test method is given in Annex E, clause E6.

5.7.1.6 Resistance to deterioration caused by freezing and thawing

This exposure condition is a requirement for renderings claimed to be suitable for Types X and Y environmental conditions. The test method for Type X is given in Annex E, clause E7a. The test method for Type Y is given in Annex E, clause E7a.

5.7.1.7 Resistance to corrosion of a steel substrate by the rendering

If the rendering is claimed by the ETA applicant to be suitable for application direct to unprimed steel an assessment of the compatibility with and protective ability to the steel shall be made using the test method given in Annex C.

If a primer is part of the kit, and is claimed to provide corrosion protection, then the performance of the primer shall be proven by tests to the relevant part of EN ISO 12944.

5.7.1.8 Resistance to corrosion of the fixings by the rendering

Any fixing method will be contained entirely within the thickness of the rendering and therefore will not be exposed to environmental conditions after installation. The fixings shall, however, be shown to be compatible with the rendering and not exhibit any adverse reaction. Since the suitability of fixings will depend on the chemical nature of the rendering no specific test method can be prescribed. The Approval body shall determine what is required to establish compatibility.

For galvanised steel reinforcement, the minimum thickness of zinc coating required is verified using the relevant EN method: EN ISO 1460 or EN ISO 1461.

5.7.2 Serviceability requirements

5.7.2.1 **Mechanical resistance and stability**

The following tests for fixings are designed to define the minimum values required for the rendering system to achieve its designed performance. The tests for fixings are designed for metallic fixings. For non-metallic fixings or non-metallic reinforcement additional assessment may be required.

5.7.2.1.1 Pull out resistance of discontinuous fixings (into timber, masonry and concrete)

This test method shall be carried out for mechanically fixed systems only and establishes the pull-out resistance of a fixing system. This test shall be conducted on each substrate (including different types of concrete, softwood and hardwood, masonry,) for which the rendering is intended to be used and for each type of fixing.

For each substrate and fixing type 5 samples are tested. The minimum sample size shall be 300 x 300mm.

The apparatus consists of a dynamometer,

The fixing system is installed in accordance with the manufacturer's specifications.

The tensile strength for pulling out the fixing shall be measured with a dynamometer. The tensioning speed is (20 ± 2) mm/min.

The pull-out resistance of each test is expressed in N. The test results, the mode of failure and mean value are recorded in the test report.

5.7.2.1.2 Bending resistance of discontinuous fixings (for steel)

These tests shall be carried out to confirm the bending resistance of fixings on each type of steel substrate (*e.g.* galvanised, primed, thick, thin), to which the rendering kit is to be applied.

For “Straight Fixing Welded Pins” - A purpose made tool (100mm in length) shall be provided to sleeve over the fixing “pin”, leaving a gap of 15-20 mm between the end of the tool and the surface of the steel. The tool is then bent to an angle of 45° and back to vertical without any failure of the pin or weld. See Figure 5.1. (This shall be repeated on no less than 10 fixings without failure).

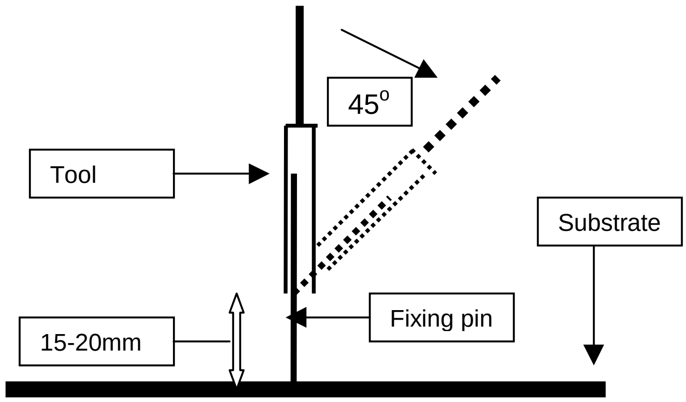


Figure 5.1- Schematic of bending test for fixing pins

For “Helical Welded Pins” – A purpose made tool shall be used to twist the fixing through 90° and back without any failure of the pin or weld. (This shall be repeated on no less than 10 fixings without failure). The tool is required to engage the top portion of the fixing in such a way as to allow the twisting motion required.

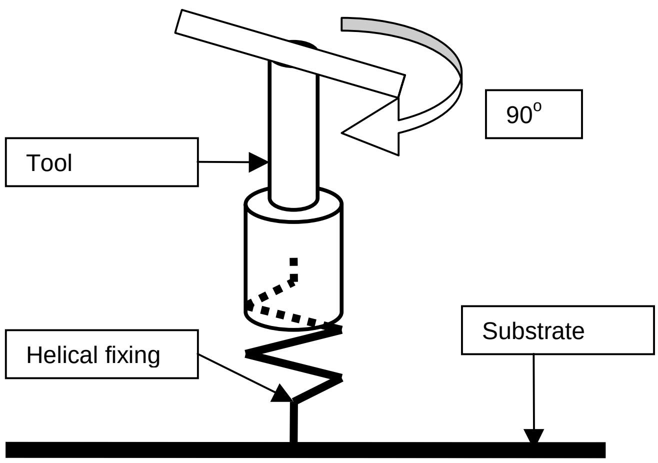


Figure 5.2 - Schematic of bending test for fixing pins

Fixings different from the types described above should be tested following the principles of the two methods above. In addition to being an approval test to define the approved specification, this method, being non-destructive, is also suitable for use on site to check the efficacy of the fixings.

5.7.2.1.3 Pull off resistance of keying mesh

This test is to be carried out to test the weld strength (pull off resistance) of expanded metallic meshes where these are resistance welded to the substrate.

A “T - shaped” tool shall be inserted under the mesh adjacent to the welded strands so as to straddle two strands of the mesh aperture. A load is applied normal to the plane of the mesh and is measured with a simple spring balance. The load values in N are recorded.

5.7.2.1.4 Pull off resistance of rendering

This characteristic is addressed under 5.7.2.6, Adhesion

5.7.2.2 **Resistance to impact / movement**

5.7.2.2.1 Resistance to functional failure from hard body impact load – 0.5 kg steel ball

The need for evaluating the resistance to hard body impact is restricted to products intended to be used in applications where hard body impact to the rendering is likely to occur and for which impact resistance is claimed. Tests are not required where the rendering is protected by independent mechanical means.

If tests are not performed the ETA should limit the applications to those where impact will not occur.

Tests are not required to be conducted on structural steel sections provided that the material is continuously bonded to the steelwork unless a top coat is used to improve impact resistance.

If the conditions above do not apply the test shall be conducted in accordance with the test method as specified in EOTA Technical Report TR 001, for serviceability characteristics with the following modifications:

a) For flat or essentially flat large surfaces the test sample shall be a section of substrate of minimum dimensions 1 $\times$ 1 m.

b) For flat, or essentially flat, large surfaces the impact resistance shall be measured both at fixing points, if any and between fixings.

c) For evaluation on structural steelwork the test sample shall be a section of steel rhs column of nominal size 1m long of section size 200 $\times$ 200 mm by 165A/V. The rendering shall be mixed and sprayed in accordance with the manufacturer’s specification and incorporating the appropriate mechanical fixings, if any as specified. The test shall be repeated at the minimum thickness of rendering for each intended type of substrate, variation of fixings, including no mechanical fixings if appropriate, and for each fixing pattern. If the worst case fixings and fixing pattern is able to be identified only the worst case need be tested.

d) For structural steelwork the impact resistance shall be measured at three points determined to be the weakest points, *e.g.* at corners and ends of flanges.

The height of the ball before the release shall depend on the claims made by the manufacturer.

The sample shall be inspected for visible signs of damage (cracking, spalling or delamination from the substrate) and the dimensions of any detached pieces measured.

The test report shall show the impact resistance (energy in Nm) that the system resisted without visible damage. The test report shall record all visible damage sustained at higher impact levels.

5.7.2.2.2 Resistance to functional failure from soft body impact load – 50 kg bag

The need for evaluating the resistance to soft body impact is restricted to products intended to be used in applications on large flat vertical surfaces (greater than 1m by 1m) in zones where soft body impact is likely to occur. If tests are not performed the ETA should limit the applications to those where impact will not occur. Tests are not required to be conducted on structural steel sections provided that the material is continuously bonded to the steelwork.

Separate tests should be conducted on each type of substrate for which the rendering is intended to be used except that the results of tests conducted on rendering applied to sheet steel may be applied to all other substrates defined in this ETA-Guideline. The steel sheet should be of the minimum thickness for which the rendering is suitable and the steel should be supported as it would be in practice.

Test method as specified in EOTA TR 001 with the following modifications:

The test sample shall be a section of substrate of minimum dimensions 1 $\times$ 1 m. The rendering shall be mixed and sprayed in accordance with manufacturer's specification and incorporating the appropriate mechanical fixings, if any as specified. The test shall be repeated for each intended type of substrate, maximum and minimum thickness of rendering, variation of fixings, including no mechanical fixings if appropriate, and for each fixing pattern. If the worst case fixings and fixing pattern can be identified only the worst case need be tested.

The bag is suspended at a specified height above the impact point and released. The point of impact shall be the centre of the sample.

The height of the bag before the release shall depend on the claims made by the manufacturer. To prevent progressive damage from influencing the test results, impact resistance test shall always be conducted on new assemblies.

The sample shall be inspected for visible signs of damage (cracking, spalling or delamination from the substrate) and the dimensions of any detached pieces measured.

The test report shall show the impact resistance (energy in Nm) that the system resisted without damage. The test report shall record all visible damage sustained at higher impact levels.

5.7.2.2.3 Flexural performance

Satisfactory performance of a rendering depends on its ability to withstand the stress induced by deflection of the substrate as evidenced by cracking, spalling or delamination of the rendering. The effect of deflection of a substrate is demonstrated in a loaded fire test as the load is applied after application of the rendering. This does not, however, evaluate the effect of repeated flexure where that may occur. For applications where the rendering is expected to be subject to repeated flexure the flexural performance shall be evaluated in accordance with the test method given in Annex G. If tests are not performed the ETA should limit the applications to those where repeated flexure of the substrate will not occur.

An alternative method of evaluating this property is under investigation and will be reported in the Progress File.

5.7.2.3 Air erosion

In applications where the rendering is subject to air movement, such as in a plenum or ducting the erosion of the material shall be evaluated in accordance with the test method given in Annex D.

Note 1: The evaluation of erosion by air is only required for applications where the rendering is intended to be subjected to higher than normal air flow such as would be experienced in a duct or plenum used to carry air. If tests are not performed the ETA should limit the applications to those where the rendering is not subjected to higher than normal airflows.

5.7.2.4 Water vapour permeability

The test specified in clause 5.6.2 is also used for serviceability.

5.7.2.5 Water absorption (capillarity test)

This test need only be performed for intended use category Type X and if the intended use involves conditions, such as contact with the ground, which would make capillarity relevant. In that case the method given in ETAG No. 004 for ETICS shall be used. If tests are not performed the ETA should limit the applications to those where capillarity will not occur

5.7.2.6 Adhesion

The following tests are designed to establish the minimum values required for the rendering to achieve the requisite fire performance. See 5.0.2 regarding sample preparation for tests which in the case of adhesion may alternatively be conducted on the fire test sample itself. It is assumed that adhesion adequate for fire performance will also be appropriate for serviceability. As a minimum, a value for adhesion shall be determined at the minimum and maximum intended rendering thicknesses.

5.7.2.6.1 The adhesion of renderings which do not incorporate either a keying or reinforcing mesh, shall be determined by testing in accordance with EGOLF method SM/5. This test is mandatory because it is essential that the minimum value of bond strength for fire resistance be established.
Note 1: Failure in the test will be either adhesive or cohesive, depending which is weaker. It is not possible to predetermine the mode of failure and accordingly not possible to measure bonding between different layers by design.

5.7.2.6.2 For renderings which incorporate discontinuous fixings the fixings shall be tested in accordance with clause 5.7.2.1.

5.7.2.6.3 For renderings which incorporate a continuous keying or reinforcement mesh there is no requirement for testing since it is assumed that the reinforcement is independently fixed to the substrate and the fixings are evaluated separately. See clause 5.7.2.3.

5.7.3 Identification

Products, components and materials used in fire protective rendering shall be identified, either through verification methods specified in a European product standard, a European Technical Approval or as detailed in this Guideline.

See Part 1 “General” - clause 5.7.2.

The product and applied rendering shall be identified. Examples of methods which may be used are as follows:

Table 5.3

Testing for identification

Properties	Dry mix	Fresh mortar	Rendering	Bonding agent, Primers and Top coats (if any)	Reinforce-ments (if any)	Fixings
Description	X		X	X		
Formulation, or fingerprint, providing the following information: binder and pigment content, infrared spectra, non-volatile matter by mass	X			X		
Fingerprint [4]	X			X		
Mixing ratio (if applicable)		X		X		
Colour (visual verification)	X		X	X		
Particle size (grading)	X[6]					
Fibre type length and aspect ratio (mineral wool only)	X					
Density: - Apparent density (dry mix) - Bulk density (fresh mortar) - EN 1015-6 - Density (hardened mortar) - EN 1015-10	X[5]	X[6]	X[6]			
Density (relevant part of EN ISO 2811, determined at (23 ± 2) °C and (50 ± 5) % RH)				X		
pH value		X		X		
Dry extract (105 °C)	X			X		
Ash content (450 °C or 900 °C)				X		
Flexural and compressive strength (hardened mortar) EN 1015-11			X[6]			
Volatile organic components (VOC) (ISO 3233, determined at (23 ± 2) °C and (50 ± 5) % RH)				X		
Nominal film thickness				X		
Description of the component (incl. corrosion resistance)					X	X
Geometry					X	X
Tensile strength					X	X

[4] If "Fingerprinting" is used, for most products FTIR (Fourier Transform Infra-Red Spectroscopy), TGA (Thermo-Gravimetric Analysis) or DTA (Differential Thermal Analysis) will be appropriate.
[5] This method is not applicable to mineral wool
[6] This measurement is mandatory

Ancillary components including additives should be identified by reference to name, reference codes, formulation, manufacturer, compliance with relevant ENs, corrosion protection, dimensions or other appropriate means. When any additional components are supplied as part of a kit the rendering producer should obtain a declaration of conformity from the supplier with the agreed specification

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

6.0 General

The assessment and judging should be performed in accordance with Part 1 "General" - chapter 6, except where modified or specified below.

Unless other specifications have been given in this chapter, extended application of the test result (if any) shall be declared under the ETA, under the responsibility of the Approval Body.

The Approval Body shall assess and judge the fitness for use of the kit for each characteristic that was verified. Every declaration in the ETA represents a favourable assessment of the kit's performance taking in to account the intended use made under the responsibility of the Approval Body.

The mean value of density of the resistance to fire test specimens shall be taken as the nominal value that together with a tolerance of ±15 % representing the field of direct application shall be quoted in the ETA.A larger upper tolerance may be able to be established based on further consideration of the implications of increased weight. This constitutes a field of extended application (See also clause 9.1.4)

6.1 ER 1: Mechanical resistance and stability

Not relevant for these products, see general part clause 6.1

6.2 ER2: Safety in case of fire

See general part, clause 6.2.

6.2.1 Reaction to fire

The fire protective rendering shall have a declared fire reaction classification, in accordance with EN 13501-1.

6.2.2 Fire resistance

The fire resistance shall be classified in accordance with EN 13501-2 or prEN 13501 –3 as appropriate and shall specify the elements (substrate) to be protected and the specification of those elements, eg the steel section.

Because a rendering does not possess fire resistance in its own right, the classification applies to the protected element, including the rendering, and not to the protection itself.

The ETA will include the characterisation data and their field of application.

6.3 ER3: Hygiene, health and the environment

See general document

6.3.1 Release of dangerous substances

See clause 5.3.2

6.4 ER 4: Safety in use

Not relevant

6.5 ER 5: Protection against noise

See Part 1 “General” - clause 6.5.

6.6 ER 6: Energy economy and heat retention

6.6.1 Thermal insulation

See Part 1 “General” - clause 6.6.

The tabulated or measured value of the thermal resistance or thermal transmittance shall be declared.

6.6.2 Water vapour permeability

The water vapour transmission coefficient shall be declared.

6.7 Related aspects of durability, serviceability and identification

6.7.1 Durability

6.7.1.1 General

- working life of 25 years:

  Favourable assessment for the relevant complete durability verification. The relevancy depends on the intended use based on the environmental conditions.

- working life of 10 years

  If a satisfactory performance of the product is not established in the durability verification tests then *a*n estimated working life of 10 years may be attributed based on the applicant’s demonstration of the satisfactory use of the rendering system for a period of 10 years in the environmental conditions claimed.

6.7.1.2. Resistance to UV exposure

Relevant to environmental condition Type X.

After exposure to the conditions prescribed in 5.7.1.2 the adhesion shall be not less than 80% of that achieved by the unexposed samples. Where the result falls outside these criteria, 4 additional specimens may be exposed, tested and assessed. All 4 specimens shall fulfil the pass criteria.

6.7.1.3 Resistance to deterioration caused by heat and rain

Relevant to environmental condition Type X.

After exposure to the conditions prescribed in 5.7.1.3 the adhesion shall be not less than 80% of that achieved by the unexposed samples nor shall the insulation efficiency be less than 85% of the average value of the unexposed samples. Where the result falls outside these criteria, 4 additional specimens may be exposed, tested and assessed. All 4 specimens shall fulfil the pass criteria.

6.7.1.4 Resistance to deterioration caused by high humidity

Relevant to environmental condition Types Y and Z_1.

After exposure to the conditions prescribed in 5.7.1.4 the adhesion shall not be less than 80% of that achieved by the unexposed samples nor shall the insulation efficiency be less than 85% of the average value of the unexposed samples. Where the result falls outside these criteria, 4 additional specimens may be exposed, tested and assessed. All 4 specimens shall fulfil the pass criteria.

6.7.1.5 Resistance to deterioration caused by heat and cold

Relevant to environmental condition Types X and Y.

After exposure to the conditions prescribed in 5.7.1.5 the adhesion shall be not less than 80% of that achieved by the unexposed samples nor shall the insulation efficiency be less than 85% of the average value of the unexposed samples. Where the result falls outside these criteria, 4 additional specimens may be exposed, tested and assessed. All 4 specimens shall fulfil the pass criteria.

6.7.1.6 Resistance to deterioration caused by freezing and thawing

Relevant to environmental conditions Type X and Type Y.

After exposure to the conditions prescribed in 5.7.1.6 the adhesion shall be not less than 80% of that achieved by the unexposed samples nor shall the insulation efficiency be less than 85% of the average value of the unexposed samples. Where the result falls outside these criteria, 4 additional specimens may be exposed, tested and assessed. All 4 specimens shall fulfil the pass criteria.

6.7.1.7 Resistance to corrosion of the substrate by the rendering

The value of weight loss to be declared. ‘No performance determined’ option is permitted.

6.7.1.8 Resistance to corrosion of the fixings by the rendering

Compatibility of the fixings and rendering is established by the particular test for the specific fixing/rendering combination.

For galvanised fixings/reinforcementthe thickness of zinc coating Shall be declared.

6.7.1.9 Demonstration of experience of 10 years favourable performance

If the ETA applicant uses the option of providing documented proof that the product under consideration has been used satisfactorily for at least 10 years, the ETA shall specify which evidence was presented to the Approval Body. The Approval Body may restrict the use of the product as specified in the ETA and the decision shall be dependant on the composition of the product having not changed significantly in the 10 year period. If the Approval Body considers the evidence provided as sufficient, the working life as specified in the ETA shall be 10 years. The evidence provided becomes part of the Approval Body's confidential file

6.7.2 Serviceability requirements

See Part 1 "General" - clause 6.7.

Durability characteristics identified in 6.7.1 can also be used for the purpose of defining serviceability.

6.7.2.1 Mechanical resistance and stability

6.7.2.1.1 Pull out resistance of discontinuous fixings (into timber and concrete)

The value, in N, shall be quoted in the ETA. 'No performance determined' option is permitted.

6.7.2.1.2 Bending resistance of discontinuous fixings (on steel)

The value, in N, shall be quoted in the ETA. 'No performance determined' option is permitted.

6.7.2.1.3 Pull off resistance of keying mesh

The value, in N, shall be quoted in the ETA. 'No performance determined' option is permitted.

6.7.2.1.4 Pull off resistance of rendering

See 6.7.2.7 Adhesion.

6.7.2.2 Resistance to impact / movement

6.7.2.2.1 Resistance to functional failure from hard body impact load – 0.5 kg steel ball

Value of impact energy (Nm) sustained without damage shall be declared. 'No performance determined' option is permitted.

6.7.2.2.2 Resistance to functional failure from soft body impact load – 50 kg bag

Value of impact energy (Nm) sustained without damage shall be declared. 'No performance determined' option is permitted.

6.7.2.2.3 Flexural performance

Since fire test specimens deflect, realisation of the required fire resistance is indication of the adequacy of flexural resistance.

For applications subject to repeated flexural movement the specimens subjected to the test prescribed in Annex G shall show no visible deterioration of the rendering in terms of cracking, spalling, cohesive failure or adhesive failure.

'No performance determined' option is permitted.

6.7.2.3 Air erosion

Declared value as weight loss in $g/m^2/24h$.

'No performance determined' option is permitted.

6.7.2.4 Water vapour permeability

The measured or tabulated value of the water vapour transmission coefficient (μ-value) shall be declared. 'No performance determined' option is permitted.

6.7.2.5 Water absorption (capillarity test)

The water absorption of the rendering system after one hour shall be less than 1 kg/m^2 'No performance determined' option is permitted.

6.7.2.6 Adhesion

6.7.2.6.1 For renderings which do not include reinforcement or discontinuous fixings the bond strength in N/mm^2 shall be declared. 'No performance determined' is not permitted. A value for the adhesion of the rendering to the substrate shall be established since it is necessary to determine the exact conditions under which the fire resistance is achieved.

6.7.2.6.2 For renderings which rely on discontinuous fixings the bending resistance or pull- out resistance of the fixings shall be declared (see clause 6.7.2.1). 'No performance determined' option is permitted.

6.7.2.6.3 No value is required for renderings which incorporate a continuous keying or reinforcement mesh. 'No performance determined' option is therefore permitted.

6.7.3 Identification

Products and materials used in fire protective renderings and kits will be identified, either by the means specified in a European product standard, a European Technical Approval or as specified in this Guideline.

The rendering shall be characterised by appropriate means from the options identified in 5.7.3. declaring values and tolerances.

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

7.0 General

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 ETA-Guideline 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

See ETA-Guideline Part 1 “General”.

Fire protective renderings and kits shall be assessed under the presumption that the element being protected, the substrate, is suitable for the rendering to be used in the way intended and in full compliance with the ETA such that then when installed in the prescribed manner the works will comply with all relevant Essential Requirements.

The approval body should assess the risks involved and, if deemed necessary, carry out relevant tests from those described in Clause 5 or foresee limitations in order for the rendering or rendering kit to be fit for application in the intended use

An ETA holder may place on the market bags of dry mix only for use without any additional components such as fixings or reinforcement (this is ‘Option 1’ as defined in clause 2.1). Any other components required to be used but supplied by others, eg fixings, mesh, additives, will be specified in the ETA according to the available technical specifications (e.g. EN or ETA), and when it is not possible by reference to proprietary items, physical dimensions and material performance or by compliance with relevant product specifications. (This is ‘Option 3’ as defined in clause 2.1). It is therefore assumed that in designing the works the correct components will be used.

Alternatively an ETA applicant may place on the market bags of dry mix plus one or more other components such as bonding agent, reinforcing mesh, fixings, additives. This constitutes a ‘kit’ and in this case the ETA covers the ‘kit’ and the ETA applicant is responsible for both the specification and compliance with specification of all the components he supplies as part of the kit (this is ‘Option 2’ as defined in clause 2.1). It is assumed that the design of the works will accommodate the kit as supplied and that the kit will be installed as specified.

It is assumed that the possible effect of other fire protection measures, such as sprinklers, on the rendering will be taken into account in the design of the building.

It is assumed that where the works may be subject to say, vibration either during the construction or during use that precautions will be specified, for example the use of a keying or reinforcement mesh.

Biological attack

In rare cases, deterioration of these products may occur due to biological attack, i.e. mould growth on the products and/or the products being subject to deterioration due to insects or mammals infestation. This ETA-Guideline does not foresee product assessment for resistance to biological attack, but where approval bodies expect biological attack to be of particular importance for specific products, additional, case-by-case assessment should take place (see 4.7.1.1).

Moulds and other fungi that may damage products require warm (10°C to 35°C), humid conditions (relative humidity > 70%), and a suitable food source. Mould growth is encouraged by dark conditions and lack of air movement. Design solutions should prevent the possibility of mould growth by ensuring that areas where these products are used can be ventilated sufficiently. Users should ensure that adequate ventilation is provided to discourage mould and fungal growth.

Proper water tightness of the building envelope, using appropriate design principles and details are essential. During the exposed and partially enclosed phases of construction, to minimize the potential for mould growth, it is important to minimize the risk of water damage and wet surfaces due to external factors such as rain, snow, flooding, and high relative humidity. During construction, the following should be considered to minimize the potential for mould growth: minimizing the exposure of interior building products to exterior conditions; protecting stored materials from moisture; minimizing moisture accumulation within the building; prevent spillage of water within the building; maintaining the integrity of the building envelope components through ongoing monitoring and inspections; achieving balance control of thermal comfort and relative humidity in the building; checking all material deliveries to validate that components are dry and clean; reject wet or mouldy materials, and monitoring installations to ensure they remain clean and dry (including heating, ventilation and air conditioning systems).

In addition, where animals (insects, mammals) might attack these products, design solutions should prevent animal access to places where the products have been used and habitable voids that might harbour animals should be either avoided or sealed.

7.2 Packaging, transport and storage

See Part 1 “General”.

7.3 Execution of works

It is assumed the site environmental conditions of exposure, temperature and humidity will be within the parameters prescribed for the application of the rendering.

Rendering systems intended for indoor applications may be temporarily exposed before the building envelope is closed. If the rendering is able to sustain short term exposure this will be stated in the ETA and recommendations should be given as to how to deal with this situation. This should include, for example, how to dry the material if it has become wet; details of inspection required for cracks, delamination and mould growth; details of measurement of thickness and adhesion and a procedure for patch repair of damaged areas.

It is also assumed that the elements (substrates) to be protected are suitably prepared to the requirements specified in the ETA and, where appropriate, a suitable primer applied.

The primer used in the approval tests will be specified in the ETA. The ETA may also include generic/primer families for which the compatibility and adhesion have been proved by testing.

Where rendering is to be applied on steel that is already primed, the compatibility of the primer should be established. If its identification or generic type is not known the adhesion between the primer and rendering with a bonding agent, if used, should be tested.

For cement-rich primers the pH of the primer to be used should be tested and be within the limits prescribed for the rendering
The ETA-Guideline is not designed to cover the application of rendering over any existing coating (*e.g.* ‘old’ existing paint) or rendering. It is therefore assumed that:

i) any existing coating or rendering is completely removed, or;

ii) if it is not removed, that the compatibility and adhesion between the new rendering and the existing coating or rendering is not less than 80% of that which would exist between the new rendering and the substrate, or;

- mechanical fixing is employed *e.g.* a keying mesh secured independently of the existing coating or rendering direct to the substrate.

It is assumed that there is no contribution to performance from the existing substrate.

It is assumed that special attention will be paid to any additives required to be used with the rendering. In particular their specification, quantity, ratio and conditions of use as specified in the ETA and in the ETA applicant's instructions.

Preparation of the product and its application is critical to the performance of renderings and their ability to fulfil the Essential Requirements. The ETA holder shall provide comprehensive installation instructions which will clearly identify the installation criteria for the rendering or rendering kit. together with training requirements for operatives. These should accompany the product or associated documentation and contain, as a minimum, the information specified in clauses 9.1.4 Installation and 9.1.5 Maintenance and repair.

7.3.1 Site tests

Where fixings are required to be used the evaluation tests of pins and keying mesh prescribed in 5.7.2.1.1, 5.7.2.1.2 and 5.7.2.1.3, being non-destructive, are appropriate to use as quality control tests on site to check the efficacy of fixings and are recommended to ensure that the same performance is achieved in practice as was type tested.

Where the rendering is self-bonded to the substrate without fixings the method described in 5.7.2.6.1 is appropriate to ensure that at least 80% of the value of the bonding is achieved in practice as was type tested.

The thickness should be measured at a frequency sufficient to determine the mean and minimum thickness. A suitable method for thickness measurement is given in clause 5.0.2 (for non-fire tests)

The density of the rendering should be measured by a method recommended by the ETA holder and be within the tolerances specified in the ETA. A suitable method for density measurement is given in clause 5.0.2 except that the number of samples may be reduced to an appropriate level.

When some renderings dry and cure a certain amount of shrinkage of the material inevitably occurs with resultant cracking. Within limits this behaviour is acceptable. Hairline cracks are acceptable up to the size and number of those recorded in the fire test samples before testing. The maximum degree of cracking permitted for a rendering will be included in the ETA.

7.4 Maintenance and repair

See Part 1 – "General".

Renderings can generally be repaired should there be small areas of damage caused by accident or disruption by other trades. The requirements for the repair: shape and maximum size of repair, preparation, the material, fixings, reinforcement and the method of application shall be specified in the instructions. Particular attention should be paid to the difficulties in bonding the repair to old rendering.

7.5 Auxiliary Components

See Part 1 – “General”.

SECTION THREE

ATTESTATION OF CONFORMITY

8. ATTESTATION OF CONFORMITY

8.1 EC-decision

The EC-decision is given in Part 1 "General" - clause 8.1.

8.2 Responsibilities

Unless modified or supplemented below, the responsibilities are given in Part 1 "General" - clause 8.2.

8.2.1 Tasks for the ETA holder

8.2.1.1 Factory Production Control (FPC)

See Part 1 "General".

8.2.1.2 Inspection and Testing

8.2.1.2.1 General

The ETA holder remains responsible for the product and any components supplied as part of a kit although the ETA may not manufacture all or any of them. The ETA holder's FPC system should identify the evaluation to be conducted to ensure consistency of manufacture and equivalent confidence in all components together with who is responsible (eg supplier or ETA holder) for conducting the evaluation.

If the product or kit components are supplied to the ETA-holder, the supplier shall meet the requirements in table 8.1 and the ETA-holder shall ensure conformity with the supplier's declaration of conformity, by sample inspection of the incoming product or incoming components.

Note 1: Supplier's declarations of conformity should correspond with the principles of EN ISO 17050-1 and -2"

8.2.1.2.2 Inspection and testing of kit components

Where the ETA holder offers a rendering kit the FPC must address appropriate conformity testing or inspection of all items in the kit to ensure consistency of performance of the rendering. Batch sampling of components may be appropriate dependent on the volume of production of such items.

In circumstances where the kit components are manufactured on the product manufacturer's behalf, the FPC should address sample inspection of incoming components. Where the material from which the components are made is critical to the component's end use or a corrosion resistant coating may be required on the component in order for it not to create a detrimental effect on the primary product with which it is used, these criteria shall be addressed in the FPC. Where such criteria are critical to the overall performance of the kit, the ETA holder shall require declarations of conformity to accompany the externally manufactured components.

Where incoming material is released for urgent production purposes prior to verification it shall be identified and recorded in order to facilitate immediate recall in the event of non conformity.

8.2.1.2.3 Product testing

On going semi - manufactured and finished product testing will be carried out in accordance with the manufacturer's documented FPC in order to verify continued conformity with the product specification. All materials, semi manufactured and finished products subject to testing and inspection shall be traceable through batch numbers or other manufacturer production references.

This production related testing shall be carried out by suitably trained / qualified personnel either directly employed by the manufacturer or by an external body acting on behalf of the manufacturer.

Records of all semi - manufacturing / finished product inspection and testing will be traceable to raw material / admix constituent conformity testing records.

Table 8-1 – Properties and Manufacturer's Test Plan

Property	**Paragraph with relevant test method**	**Basis of acceptance**	**Minimum frequency of tests**
Dry Mix and top coat (manufactured by rendering manufacturer)			
Incoming materials	Declaration of Conformity	ETA holder's specification	Per batch supplied
Bulk density of aggregate		ETA holder's specification	Per batch (of aggregate)
Bulk density of dry mix		ETA holder's specification	Once per batch or five times per day (24h) at regular intervals[1]
Rendering (fresh mortar)			
Apparent density		As established in approval tests	Once *per batch* or five times per day (24h) at regular intervals
Setting time/ workability (pot life)		ETA holder's specification	Once *per batch* or five times per day (24h) at regular intervals
Rendering (hardened mortar)			
Density		As established in approval	Once per month

[1] As an alternative to control testing the ETA applicant may demonstrate control of production by other means, eg by automatic recording balances and processes

Property	Paragraph with relevant test method	Basis of acceptance	Minimum frequency of tests
		tests	
Adhesion			Once every per month
Insulation efficiency (Annex E) or any alternative test designed to ensure consistency of fire performance (to be agreed between the Approval Body, the Notified Body and the Manufacturer)	Annex E	Time to 500 ^{0}C	Once per month
Bonding agent **Top coat** (manufactured by others)			
Agreed specification based on, e.g., description, type of material, viscosity, pH, colour,volatile content		ETA holders's specification	Each delivery
Fixings, lath and reinforcement			
Agreed specification based on eg description, type of material,coating, dimensions, geometry and design		ETA holder's specification	Each delivery

8.2.1.2.4 Inspection and test status

The ETA holder's FPC shall detail the methods employed to demonstrate the inspection and test status of raw materials / admix constituents, semi manufactured product and finished product.

8.2.2 Tasks for the Approved Body

8.2.2.1 Initial type testing of the product

See Part 1 'General'

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

The factory production control shall be subject to initial inspection by the approved body and to continuing surveillance at a frequency of not less than twice a year to ensure continuing compliance with the ETA.

8.2.2.3 Certification of Conformity

The approved body shall issue the Certification of Conformity of the product

8.3 Documentation

The documentation is given in Part 1 "General" - clause 8.3.

8.4 CE-marking and information

The general requirements for CE-Marking and information instructions are given in Part 1 "General" - clause 8.4.

The CE Marking shall be applied to the immediate packaging.

Kit components other than the bags of dry mix should not be CE marked as a component of the kit that is the subject of the ETA but should be detailed in the documentation accompanying the dry bags.

CE	"CE"-Marking
xxxx	Number of Notified Body
Any Company Rue du Producteur, 50 Country	Name and address of the producer (legal entity responsible for placing the product onto the market)
Xx xxxx-CPD-xxxx	Two last digits of year of affixing CE- Marking Number of EC certificate of conformity (where relevant)
ETA N° XX/XXXX ETAG 018, Parts 1 and 3	ETA Number ETAG Reference
Fire Protective Product Type …	Relevant performance characteristics and/or designation code

Notes:
- If the ETA provides all the information regarding the performance characteristics, then reference to the ETA is sufficient.
- If the ETA covers more than one type of a Fire protective product, and the type designation provides all the information regarding the performance characteristics, then reference to the ETA and the relevant type is sufficient.
- Only when the above two options do not provide all the necessary information regarding the mandated performance characteristics (table 4.1), then additional information regarding the performance characteristics needs to accompany the CE Marking.

SECTION FOUR

ETA CONTENT

9. THE ETA CONTENT

9.1 The ETA-content

The requirements for the content of the ETA are given in Part 1 “General” –clause 9.

The ETA shall specify any components in addition to the product (dry mix) supplied or that may be supplied by the ETA holder as part of a kit and hence intended to be covered by the same CE Marking.

The specification of components supplied by other than the ETA holder shall also be specified in terms of their characteristics or by reference to proprietary details.

The ETA shall specify the results of the assessment given in Chapter 6 9.1.1 Working life

The ETA shall identify an assumed working life for the cured rendering when *in situ*.

9.1.1 Identification of materials

See Part 1 "General" – clause 9.1.2.3.

9.1.2 Performance

See Part 1 "General" – clause 9.1.2.4.

In addition the ETA shall specify the required different thicknesses of rendering for different substrates and periods of fire resistance. It is recommended that for application to structural steel elements this is best expressed in the form of a matrix showing the section factor A/V versus the period of fire resistance.

9.1.3 Drawings

See Part 1 "General" – clause 9.1.2.5.

9.1.4 Installation

The specification of components of the kit, eg fixings and reinforcement shall be given together with a description of how they are used.

The installation / application instructions will identify the minimum requirements for satisfactory installation of the product in respect of training, competence and / or experience.

Where the sale of the product is restricted by the ETA holder to specialist fire protection industry contractors this should be clearly identified on the packaging in addition to inclusion in the installation instructions.

The instructions shall clearly identify the correct tools and equipment for application of the rendering or rendering kit in all of the various forms, (clearly identifying equipment which may be additional to the “norm” for certain types of application).

The ETA shall state if a rendering intended for indoor or semi-exposed applications is approved to be temporarily exposed to outdoor conditions before the building envelope is closed. Instructions shall identify any special provisions such as; to temporarily protect the rendering or, for example, drying, adhesion testing and inspection requirements in the event of exposure.

The installation instructions shall clearly describe the method of installation of the product or kit including but not restricted to:

- storage conditions for the products, including the shelf life of the bagged product, and other components where relevant; the 'pot life', or 'workability' of prepared material and the time to full cure

- any substrate preparations required before application (including levels of substrate cleanliness, compatibility of the rendering with different substrates)

-any substrate keycoat / barrier coat which may be required in certain circumstances including the detailed instructions for mixing (as applicable), environmental conditions required for application and requirements for correct application

- details of the requirements for primers on substrates and for the checking of compatibility with the rendering (by reference to pH, for example) and solution if not compatible (see below).

- the circumstances under which the product requires additional support / reinforcement for example when the substrate is coated with an unsuitable or unknown product where compatibility with the rendering, and hence the degree of adhesion, cannot be established

- details on the type / size of fixing required to reinforce or retain reinforcement to the substrate to be coated. The frequency, fixing pattern and method of installing the fixings (where required)

- the test methods to be used on site to determine adequacy of fixings and of primer coats

- the test methods to be used on site to determine adhesion/cohesion of the rendering together with the minimum values given in the ETA

- the values required to be achieved for fixing strength and adhesion will be 80% of the values achieved in the approval tests;

- the specification for the reinforcement media (which may be fixed to the pre-installed fixings) for the particular scenario

- the installation instructions for the location and retention of the reinforcement media (including it's intended end position within the rendering thickness)

- the environmental conditions under which the rendering product may be mixed (as applicable) and applied

- the instructions for mixing (as applicable) including product to water quantity ratio's; the quality of water, *e.g.* 'potable'; any additives, their specification, ratio, conditions of use; the type of equipment required to effect correct mixing of the product and the mixing cycle time

- the pressure settings and recommended spray tip sizes for correct application of the rendering using the specified type of equipment (where rendering is sprayed), if not sprayed

- the method of application of the product

- details of rendering thicknesses (with tolerances) required for different periods of fire resistance and substrate type and section size.

- instructions on, overcoat times and restrictions (if any) on re coating

- guidance on trowelling, tamping or any other form of truing the surface of the rendering to produce a more regular finish than that achievable by initial application (if required)

- details of the maximum amount of cracking permitted expressed in the ETA as a maximum width of crack and total length of cracks per square metre of rendering.
- details on overcoating the rendering with either proprietary coatings of another manufacture or those made by the rendering ETA holder as part of the kit(should this be necessary for whatever reason (such as weather protection)

- guidance on masking work locations during the application of such products

The mean density quoted in the ETA is that at which the approval tests were conducted and for which the performance characteristics are valid. A tolerance of ±15% on the quoted mean is accepted as the field of 'direct application' for which the quoted performance characteristics are deemed valid.
It is recognised that in practice it is difficult to control the density of the sprayed material, however, the density of the sprayed rendering should not fall outside the lower tolerance. If the density exceeds the upper tolerance it will be necessary to evaluate other parameters. This constitutes a field of extended application. Although performance characteristics are unlikely to be compromised at higher densities the effect of additional weight needs to be considered. Consequently, adhesion (if the rendering is not reinforced or mechanically fixed), the thickness of the rendering and the substrate type, for example flat or with re-entrant angles, need to be examined in order to establish the acceptability or otherwise of the higher density. As a guide a density of the mean plus 20% might be acceptable except possibly at the upper limit of thickness (eg a high fire resistance period combined with a slender steel profile with high A/V), where the additional weight of the rendering may give rise for concern.

Similarly, if sprayed at thicknesses greater than those specified whilst not detracting from performance the additional weight should be considered, particularly if combined with a higher density.

The installation information should also clearly specify any limitations for the product's use such as the product's incompatibility with certain environments or fire protection scenarios.
If the product cannot withstand mechanical damage without additional cladding of a specified type, this should be identified.

Recommendations should be given on the sequencing of works such that rendering is not applied until adjacent works, which might cause damage to it, are completed.

A recommendation to provide ventilation around completed works to avoid biological attack such as mould growth should be included.

If the works are, for example, likely to be subject to vibration, special provisions such as the use of keying or reinforcing mesh may need to be specified.

Where the product is not compatible with being used in conjunction with another fire protection product to effect a fire protected structure this should be identified.

Information shall be included on how to deal with junctions between elements and between old and new areas of rendering.

Guidance shall be given on how to deal with over-spraying existing rendering (if that is a recommended practice.)

9.1.5 Maintenance and repair

The ETA holder shall identify in the installation instructions for the application /installation of the rendering specific instructions relating to the maintenance and repair of the rendering.

This shall include routine inspections of the rendering to check for damage, cleaning, re-application of the top coat / sealing coat (as applicable).

The repair procedure must identify the controls to be imposed on the repair activity relating to:

- preparation of the damaged rendering for repair including the removal of damaged material and “dressing” of the surrounding rendering to achieve a sound perimeter bond surface

- cleaning of the substrate and remaining original rendering

- instructions on the replacement of reinforcing media (as applicable)

- identifying whether a special repair rendering product is required or whether the original product can be used effectively

- mixing (as applicable) of the repair material

- application of the repair material

- re-application of top coat / sealing coat (as applicable).

9.2 Additional information

The additional information is given in Part“1 "General" – clause 9

9.3 Exceptions

There are no exceptions to the content information mentioned in Part“1 "General" – clause

ANNEX A

LIST OF REFERENCE DOCUMENTS

EN 1015-6 Methods of test for mortar for masonry. Determination of bulk density of fresh mortar

EN 1015-10 Methods of test for mortar for masonry. Determination of dry bulk density of hardened mortar

EN 1015-11 Methods of test for mortar for masonry. Determination of flexural and compressive strength of hardened mortar

EN ISO 1182 Reaction to fire tests for building products. Non-combustibility test

EN 1323 Adhesives for tiles. Concrete slab for test

EN 1363-1 Fire resistance tests. General requirements

EN ISO 1460 Metallic coatings. Hot dip galvanized coatings on ferrous materials. Gravimetric determination of the mass per unit area

EN ISO 1461 Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods

ISO 1514 Paints and varnishes. Standard panels for testing

EN ISO 1716 Reaction to fire tests for building products. Determination of the heat of combustion

EN 1745 Masonry and masonry products. Methods for determining design thermal values

EN ISO 2811 Paints and varnishes.

ISO 3233 Paints and varnishes -- Determination of percentage volume of non-volatile matter by measuring the density of a dried coating

EN ISO 3506-1 Mechanical properties of corrosion-resistant stainless-steel fasteners. Bolts, screws and studs

EN ISO 4892-3: 1999 Plastics. Methods of exposure to laboratory light sources. Fluorescent UV lamps

ISO 7892 Vertical building elements -- Impact resistance tests -- Impact bodies and general test procedures

EN 10025-1 Hot rolled products of non-alloy structural steels – general delivery conditions

EN 10025-2 Hot rolled products of non-alloy structural steels – technical delivery conditions for flat products

EN 10088-2   Stainless steels. Technical delivery conditions for sheet/plate and strip for general purposes

EN 10088-3   Stainless steels. Technical delivery conditions for semi-finished products, bars, rods and sections for general purposes

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

EN 10327 Continuously hot-dip coated strip and sheet of low carbon steels for cold forming. Technical delivery conditions

EN ISO 11925-2 Reaction to fire tests. Ignitability of building products subjected to direct impingement of flame. Single-flame source test

EN 12467 Fibre-cement flat sheets. Product specification and test methods

EN ISO 12572 Hygrothermal performance of building materials and products. Determination of water vapour transmission properties

EN 12664 Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods. Dry and moist products of medium and low thermal resistance

EN 12667 Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods. Products of high and medium thermal resistance

EN 12939 Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods. Thick products of high and medium thermal resistance

EN ISO 12944 Paints and varnishes

ENV 13381-4 Test methods for determining the contribution to the fire resistance of structural members. Applied protection to steel members

EN 13501-1 Fire classification of construction products and building elements. Classification using test data from reaction to fire tests

EN 13501-2 Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services

prEN 13501-3 Fire classification of construction products and building elements. Classification using data from fire resistance tests systems and services

prEN 13658-2 Metal lath and beads. Definitions, requirements and test methods. External rendering

EN ISO 13788 Hygrothermal performance of building components and building elements. Internal surface temperature to avoid critical surface humidity and interstitial condensation. Calculation methods

EN 13823 Reaction to fire tests for building products. Building products excluding floorings exposed to the thermal attack by a single burning item

ISO 898-1 Mechanical properties of fasteners made of carbon steel and alloy steel - Bolts, screws and studs

ETAG 004 External thermal insulation composite systems with rendering

EOTA TR 001   Determination of impact resistance of panels and panel assemblies

EGOLF SM5   Fire Testing – Method for the measurement of bonding properties of fire protection materials applied to steel, concrete and steel/concrete composite structures

ANNEX B

Reaction to fire tests for building products – Mounting and Fixing Arrangements for Renderings

B.1 Testing according to EN 13823 (SBI)

- Rendering and rendering kits intended for fire resisting applications shall be tested when applied in a laminar fashion to the substrate. Installation is according to how the product will be used in practice e.g. with reinforcing fabric enclosed in the rendering and with any surface coating.

- Specimens for each wing are to be produced separately. Specimens will be produced according to 5.0.2 and conditioned according to 5.0.4Assembly of both wings shall be performed on the sample trolley of the SBI testing device.

- A standard substrate according to EN 13238 shall be used, which is to be set up at a distance of ≥ 80 mm to the backing board. The result applies to all substrates used in practice which are represented in EN 13238. If a non-standard substrate is used for testing the result applies only to that substrate.

- On substrates of classes A1 or A2 the renderings and rendering kits shall be tested with the maximum applied dry thickness. The result applies to all application thicknesses up to the thickness tested.

- For substrates of classes B, C, D, or E the renderings and rendering kits shall be tested with the maximum and minimum applied dry thickness. Three specimens shall be tested at each thickness. The result applies to all thicknesses between and including the thicknesses tested.

If the renderings and rendering kits have surface coatings the test shall be carried out with the coating which from experience based on formulation, existing experience or testing.will give the most unfavourable result

- In case of combustible substrates (ie those classified as other than A1) the joint between the wings should be protected by A1 classified mineral wool or similar material to prevent a contribution to the energy releasefrom the substrate that would never happen in practice. (see Figure B1).

- Wire mesh may need to be fixed to the substrate to ensure that therendering adheres to the wings.

B.2 Testing according to EN ISO 11925-2 (small burner test)

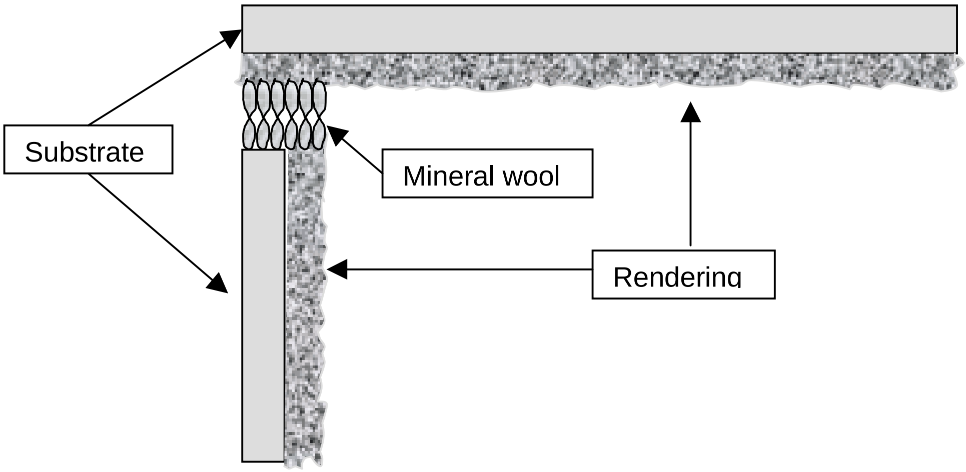
- If used the production of the test specimens and execution of the test shall be carried out in accordance with the requirements of EN ISO 11925-2.

B.3.Testing according to EN ISO 1716 and EN ISO 1182

- The production of test specimens and execution of the tests shall be carried out in accordance with the requirements of EN ISO 1716 and ENISO 1182.

- The test shall be carried out with the coating which from experience based on formulation, existing experience or testing.will give the most unfavourable result.

Figure B.1



ANNEX C

Test Method for Evaluating Corrosion of Steel by Renderings

C.1 Scope

This test method covers a procedure for measuring corrosion to steel induced by renderings.

C.2 Summary of Test Method

In this test method panels of bare, primed and galvanized steel[1] are sprayed with rendering and subjected to room temperature and humidity conditions for 240 h in a temperature and humidity controlled chamber. Corrosion is determined by weight loss of the sheets.

[1] Note: only steel with the finishes claimed by the ETA holder to be suitable for use with the rendering are required to be tested.

C.3 Significance and Use

C.3.1 It is the intent of this test method to determine the relative corrosive properties of renderings to provide an indication of serviceability. Satisfactory performance of a rendering applied to structural members and assemblies depends upon its ability to withstand the various influences that occur during the life of the structure, as well as upon its satisfactory performance under fire conditions.

C.3.2 This test method evaluates the relative corrosion of steel induced by rendering and determines whether the presence of rendering increases or has no effect on the corrosion characteristics of steel.

C.4 Apparatus

C.4.1 Standard Temperature Humidity Cabinet, equipped to maintain a temperature of (35 ± 2)°C and (95± 5)% relative humidity. The cabinet and all accessories shall be of a material that does not affect the corrosiveness of the atmosphere in the cabinet. Additionally, all parts that come into contact with the test samples shall be made of material that will not cause electrolytic corrosion. Adequate circulation of the atmosphere over the samples shall be provided.

C.4.2 Weighing Scales, having a capacity of 5 kg and a sensitivity of ± 0.1 g.

C.4.3 Wire Brush, with brass wire bristles approximately 25 mm long mounted in a handle. The bristle section shall be nominally 127 mm long by 19 mm wide.

C.5 Materials

C.5.1 This test method requires the application of rendering in accordance with the manufacturer's instructions. The apparatus, materials, and procedures used to apply the rendering shall be representative of application for the fire test and in practice.

C.5.2 The density of the prepared sample shall be nominally the same as the density fire tested within ±15% of the declared tolerance.

C.5.3 Steel sheets shall be nominally $200 \times 200 \times 5$ mm and shall be:

bare steel - to EN 10025 grade S235 or S355 primed - - to EN 10025 grade S235 or S355 steel coated with iron oxide alkyd primer, or other specified by the manufacturer

galvanized steel -- to EN 10025 grade S235 or S355 galvanised in accordance with EN 10326

C.6 Laboratory Test Samples

C.6.1 There shall be four steel sheets of each type to be evaluated, *e.g.* bare, primed, galvanised steel.

C.6.2 The sheets in each set shall be designated a, b, c and d.

C.6.3 The steel sheets shall be free of all surface rust.

C.7 Procedure

C.7.1 Wash the steel sheets with alcohol or acetone to remove any oil or grease. Dry at room temperature.

C.7.2 Weigh each sheet to the nearest 0.1 g and record the weights.

C.7.3 Protect the edges of the sheets and apply a suitable coating to one face. This coating shall be stable under the conditions of this test method and shall not promote corrosion; paraffin wax is suggested.

C.7.4 Apply the rendering at a minimum thickness for which the ETA holder has a fire resisting classification.

C.7.5 Determine the density and thickness of each laboratory prepared sample.

C.7.6 Samples a and b of each Set:

C.7.6.1 Condition the samples for (240 ± 2) h at room temperature (23 ± 2)°C and relative humidity not greater than 60%.

C.7.6.2 Remove the rendering, as well as the protective wax coating, from the steel sheets.

7.6.3 Remove all surface rust from the sheets with the wire brush described in Section 4 and clean with solvent as described in C.7.1.

C.7.6.4 Weigh the sheets to the nearest 0.1 g, and record the weights.

C.7.7 Samples c and d of each Set:

C.7.7.1 Place the sheets into the temperature humidity cabinet and keep at (35± 2)°C and (95 ± 5)% relative humidity for a duration of (240 ± 2)h.

C.7.7.2 At the completion of the 240 h period, remove the samples from the cabinet.

C.7.7.3 Remove the rendering and the protective wax coating, from the sheets.

C.7.7.4 Remove all surface rust from the sheets with the wire brush described in Section 4 and clean with solvent as described in C.7.1

C.7.7.5 Weigh the sheets to the nearest 0.1 g, and record the weights.

C.8 Calculation

C.8.1. Calculate the average weight loss at the end of the initial aging period, samples a and b,(see C.7.6) and the weight loss at the end of the 240h humidity test, samples c and d (see C.7.7) as follows:

For each sample:

$$\text{Weight loss } (g/mm^2) = \frac{\text{Weight before (g)} - \text{Weight after (g)}}{\text{Area of sheet } (mm^2)}$$

C.8.2 Calculate the average weight loss at the end of the initial ageing period (see C.7.6), and the average weight loss at the end of the 240 h humidity test (see C.7.7) as follows:

$$\text{Average weight loss} = \frac{\text{Weight loss of a} + \text{Weight loss of b}}{2}$$

$$\text{Average weight loss} = \frac{\text{Weight loss of c} + \text{Weight loss of d}}{2}$$

C.9 Report

C.9.1 Report the thickness of the rendering in millimetres, the density of the rendering in $kg/m^{3,}$ and the individual and average loss in weight in g/mm^2 of each sample or set, respectively.

C.9.2 Report information on the steel including the grade; the nature of the primer, including the product name and manufacturer; the measured dry film thickness; and the elapsed time (number of days or hours) between application of primer and application of rendering.

ANNEX D

Test Method for Air Erosion of Renderings

D.1 Scope

This test method covers a procedure for determining the effect of an air stream upon renderings.

D.2 Terminology

Definitions:

denier, n-the number of grams per 9000 m.

end (fabric), n-an individual warp yarn (single or ply) cord.

pick, n-an individual filling yarn.

air erosion- the action or process of being eroded by an air stream.

D.3 Summary of Test Method

D.3.1 This test method covers a procedure for determining the effect of an air stream upon renderings in plenums. The rendering is subjected to a tangential air stream for a minimum of 24h. Collection filters downstream from the sample are weighed at frequent intervals to determine the amount of material removed from the sample.

D.4 Significance and Use

D.4.1 It is the intent of this test method to determine properties of renderings that may be used to provide an indication of serviceability. Satisfactory performance of a rendering depends upon its ability to withstand the various influences that may occur during construction and during the life of the system, as well as upon its performance under fire conditions.

D.4.2 Air erosion tests on renderings are conducted to evaluate the behaviour of the rendering when subjected to plenum air streams during normal service conditions. Such tests evaluate the resistance to dusting, flaking, spalling, and delamination of the rendering.

D.5 Apparatus

D.5.1 Duct System, made of galvanized steel, horizontally positioned, with one rectangular opening of minimum size 0.36 m^2 in the centre of the top of the duct and 50 mm from each vertical side.

D.5.2 Pitot Tube, used in conjunction with a suitable manometer to measure air velocities in the duct.

D.5.3 Blower, capable of moving air at a temperature of (20 ± 10) ^{o}C and (50 ± 20%) Relative Humidity through the entire cross section of the duct at a velocity sufficient to handle the test requirement.

D.5.4 Filters, upstream from the test sample (at the blower end) and located downstream of the test sample. These filters shall be made of 30-denier nylon. The nominal construction of the fabric shall be 37 ends per 10 mm and 32 picks per 10 mm, or finer.

D.5.5 Scale, having a capacity of 100 g and a sensitivity of ± 0.001 g.

D.6 Materials

D.6.1 This test method requires the application of rendering in accordance with the manufacturer's normal method and representative of application on site.

D.6.2 The density of the prepared sample shall be similar to that of the fire tested sample(s).

D.7 Test Sample

D.7.1 The test sample shall consist of rendering applied to the substrate. A separate test shall be conducted for each substrate intended to be used.

D.7.2 The substrate shall be of minimum area $0.36 m^2$ with the rendering being a minimum of 19mm thick.

D.7.3 Prepare duplicate samples and allow to dry and harden at a temperature of (20 ± 10)°C and an RH not greater than 60% until successive weights, taken at 24 h intervals, differ by less than 1%.

D.8 Procedure

D.8.1 Test one sample to determine thickness and density.

D.8.2 Dry the collecting filter at (50 ± 2)°C for 1 h, weigh and place in the apparatus.

D.8.3 Place the second sample into the duct opening so that the face of the sample and the inside face of the duct are positioned flush and in the same plane. All edges shall extend at least 50 mm beyond the duct opening.

D.8.4 Place the pitot tube (100 ± 2) mm from the upstream edge of the sample at the centreline of the duct and 50 mm below the top side of the duct.

D.8.5 With both filters and the sample in position, maintain the blower at the velocity of (6 ±0.25) m/s.

D.8.6 At elapsed times of 1, 6 and 24 h, stop the blower and carefully remove, fold, dry at (50±2)°C and then reweigh the collecting filter. If the collecting filter continues to show a weight gain at 24 h, continue the test, making measurements every 24 h until a constant weight is reached.

D.9 Report

D.9.1 Report the weight of the collecting filter in grams before and after each test interval. After each interval, record the net weight gain both individually and cumulatively. Also report the total net weight gain.

D.9.2 Report the thickness in mm and the density in kg/m^3 of the sample.

D.9.3 Indicate the techniques such as tamping, trowelling, surface sealing, or similar finishing operations and the extent that they are made.

D.9.4 Report the dates of the test and of the report. [in accordance with Guidance Paper K]

ANNEX E

Durability Testing of Renderings

E.1 The durability of renderings is based on comparative data between samples subjected to artificial exposure conditions and control samples.

The parameters used are:

- Adhesion
- Insulation efficiency;
- Visual observations.

Note 1: In the following tests adhesion is used as a characteristic to determine changes before and after the test. Adhesion is, therefore, required to be measured in these tests even though in practice reinforcement or mechanical fixings may be used.
Note 2: The insulation efficiency test is conducted only on a steel substrate since the durability characteristics of the rendering are considered to be independent of the substrate. Adhesion and observations are relevant to all substrates.

E.2 Specimens

The substrate specifications are given in clause 5.0.2.

If the rendering system requires the steel to be primed, the steel should be primed.

If the rendering is able to be used without a top coat it should be tested without a top coat.

The rendering should be applied at a nominal thickness of 25 mm or at the minimum thickness if greater than 25 mm or the maximum thickness if less than 25 mm. In case a thickness different from 25 mm is used a formula is given in EGOLF SM5,

The rendering thickness shall be measured and recorded at ≥ 10 uniformly distributed points prior to testing.

The edges of the specimens should be sealed in order to prevent the joint between rendering and substrate being subjected to the exposure conditions.

For panels, used for durability testing, it will be necessary to apply a protective coating (primer) to the back and edges of these (including all control panels), to prevent rust contamination of the cabinet.

For each exposure condition to be tested four specimens shall be prepared; two for adhesion testing and two for insulation efficiency. In addition four specimens shall be prepared as controls; two to establish values for adhesion and two to establish insulation efficiency.

The specimens to be prepared and conditioned in accordance with 5.0.2 and 5.0.3 and with the manufacturer's instructions for the rendering system. Control specimens should then be stored under conditions and for a period of time as specified by the manufacturer. After exposure to the specified durability tests the specimens should be stored in the conditions specified in 5.0.3 until constant weight is attained before either the adhesion or insulation efficiency test is conducted.

It is recommended that photographs be taken before and after the durability tests.

E.3 UV Exposure

Two specimens shall be tested in accordance with EN ISO 4892-3:1999 for 112 cycles (equivalent to 28 days).

Exposure mode 2 with combined lamps;

Note 2: reference is made to a dated Standard as it contains the required exposure conditions.

E.4 Heat - Rain

Four specimens to the specification in E.2 shall be subjected to the exposure conditions specified in EN12467, clause 7.4.2 for 50 cycles.

E.5 High humidity

Four specimens to the specification in E2 shall be exposed for four weeks to (35 ± 2) ^{0}C and (95 ± 5) % relative humidity.

E.6 Heat - Cold

Four specimens to the specification in E.2 shall be subjected to the following exposure conditions, which shall be repeated five times. The test shall be conducted at ambient humidity.

Time (eg)	Period hr	Temperature (^{o}C ± 2)
09.00 – 11.00	2	1st cycle -Increase from ambient temp. to 60 Subsequent cycles – increase from -15 to 60
11.00 – 15.00	4	Hold at 60
15.00 – 17.00	2	Decrease from 60 to -15
17.00 – 09.00	16	Hold at -15

E.7 Freeze-Thaw

a) For use category Type X : Four specimens to the specification in E.2 shall be subjected to the following exposure conditions, which shall be repeated twenty five[1] times. The test shall be conducted at ambient humidity.

Time (eg)	Period hr	Condition, Temp (^{o}C ± 2) and Water immersion
11.00 – 15.00	4	Immersion in water at 23
15.00 – 17.00	2	Remove from water, reduce temperature to –5 over 2h
17.00 – 09.00	16	Hold at –5 (out of water)
09.00 –11.00	2	Increase temp from –5 to 23 (out of water)

b) For use category Type Y: Four specimens to the specification in E.2 shall be subjected to the following exposure conditions, which shall be repeated twenty-five[1] times.

[1] Experience may enable the relatively high number of cycles to be reduced in which case this will be covered in the Progress File

Time (eg)	Period hr	Temp ($^oC \pm 2$)	Relative humidity (± 5%)
11.00 – 15.00	4	23	**95**
15.00 – 17.00	2	Reduce from 23 to -10	**<2**
17.00 – 09.00	16	Hold at -10	**<2**
09.00- 11.00	2	Increase from -10 to 23	**95**

E.8 Adhesion - Test procedure

Two control specimens (unexposed specimens) as specified in E.2 and two specimens after being exposed to the testing regimes in E.3 to E.7 (as appropriate) shall be tested in accordance with method EGOLF SM5. Four tensile bond tests shall be conducted on each panel (ie four on each panel). For each pair of specimens the highest and lowest values shall be discarded and the remaining six averaged, as specified in SM5.

Test Results

The average value of the tensile bond after durability testing shall be not less than 80% of the control value.

E.9 Insulation efficiency - Test Procedure

E.9.1 General

The small scale furnace fire test shall be carried out under the condition of the standard time - temperature curve as defined in EN 1363-1.

The specimens should be prepared, conditioned and measured as specified in clause 5.0.4.

After exposure to environment conditions, if any, the specimens should again be stored in the conditions specified in 5.0.4 for a minimum of one week before fire testing.

E.9.2 Specimens

Two control specimens (unexposed specimens) as specified in E.2 and two specimens after being exposed to the testing regimes in E.4 to E.7 (as appropriate) are required to be tested.

E.9.3 Test Procedure

The specimens may be tested individually or in one test. The specimen(s) shall be placed in the furnace in a vertical or in a horizontal position such that the side with the rendering system is exposed to the fire. The specimen(s) shall be mounted in a frame which forms part of one side (wall or ceiling) of the furnace. The non-fire side shall be covered using vermiculite or calcium silicate board with a minimum thickness of 5mm with a bulk density of (475 $\pm$ 25) kg/m^3 or mineral wool (stone wool) with a bulk density of (110 $\pm$ 10) kg/m^3 .[2]

Two thermocouples shall be attached to the non-fire side of the steel panels. These thermocouples should be located close to the centre 20mm apart. The thermocouples shall be of the K type according to EN 1363-1 but without a copper disc and without insulation pad. The thermocouples should be fixed to the back of the steel panels by welding (resistance spot welding)

The time for the non-fire side of the steel to reach an average temperature of 500 ºC should be recorded.

E.9.4 Test Results

The time for the non-fire side of the steel to reach an average temperature of 500 ºC should be recorded. For information purposes furthermore, observation should be made of the rendering noting any detachment, delamination or cracking and be reported. The average time for the non-fire side of the steel of the specimens exposed to the durability tests shall be not less than 85 % of the time for the non-fire side of the steel of the control specimens to reach an average of 500 °C. No single result shall be less than 80% of the average time to 500^oC of the initial test.

Where the result falls outside these criteria, additional 4 specimens may be exposed, tested and assessed. All 4 specimens shall fulfil the pass criteria.

E.10 Visual Observations

The condition of all specimens after testing should be visually inspected and changes from the pre-test condition recorded. This should include a record of all cracking and fissuring including the size and density of such cracks and fissures. This shall be expressed in the ETA as maximum width of crack and total length of cracks per square metre of rendering.

[2] As the Insulating Efficiency Test is an indirect testing for comparison (durability, different primers, different top coats) all tests of one assessment shall be carried out under identical conditions/parameters

ANNEX F

Determination of the declared thermal conductivity and the conversion factor to high moisture content (for mineral wool based renderings)

F.1 Determination of the λ fractile value at 10°C, at dry conditions ($\lambda_{10,dry,90/90}$)

F.1.1 Measurement of the λ_{dry} at 10°C

F.1.1.1 Test specimens for the determination of the thermal conductivity λ at 10°C shall be conditioned in accordance with 5.0.4.

F.1.1.2 The thermal conductivity of the test specimens conditioned according to F.1.1.1 shall be measured according to EN 12667 or EN 12939 for thick products at a mean temperature of (10 ± 0,3)°C.
During the measurement, precaution shall be taken to avoid moisture absorption by the specimen. It is acceptable, for instance, to put the test specimen into a thin plastic bag.

F.1.2 Calculation of the λ fractile value at 10°C, at dry conditions ($\lambda_{10,dry,90/90}$)

F.1.2.1 The λ fractile at 10°C, at dry conditions ($\lambda_{10,dry,90/90}$) as a limit value representing at least 90% of the production with a confidence limit of 90% shall be calculated using the procedures as detailed in EN 13162 Annex A. It shall be noted that the λ_D shall be calculated in accordance with F.3.

F.2 Determination of the moisture conversion factor ($f_{u,1}$)

For the determination of the moisture conversion factor $f_{u,1}$, two sets of measurements are needed.

<u>Set 1</u>

Two measurements on dry test specimens, to determine $\lambda_{10,dry}$ and u_{dry} (moisture content mass by mass).

<u>Set 2</u>

Two measurements on test specimens conditioned at (23 ± 2)°C and (50 ± 5)% relative humidity, to determine $\lambda_{10,(23,50)}$ and $u_{23,50}$ (moisture content mass by mass).

F.2.1 Procedure

F.2.1.1 Set 1

F.2.1.1.1 Dry the two test specimens following the procedure in F.1.1.1.

F.2.1.1.2 Determine for each test specimen the mass in dry condition. Average the two values to determine the m_{dry}. The u_{dry}, being the moisture content in dry condition, is by definition set to 0.

F.2.1.1.3 Determine for each test specimen the λ value at 10°C following the procedure in F.1.1.2. Average the two values to determine the $\lambda_{10,dry}$.

F.2.1.2 Set 2

F.2.1.2.1 Condition the two test specimens at (23 ± 2)°C and (50 ± 5)% relative humidity following the procedures detailed in EN 13169 clause 5.2, step 2.

F.2.1.2.2 Determine for each test specimen the mass at (23 ± 2)°C and (50 ± 5)% relative humidity.

Average the two values to determine the mass at 23°C and 50% relative humidity as $m_{23,50}$.

F.2.1.2.3 Calculate $u_{23,50}$ by the following formula:

$$u_{23,50} = \frac{m_{23,50} - m_{dry}}{m_{dry}}$$

where
$m_{23,50}$ is the mass at 23°C and 50% relative humidity according to F.2.1.2.2
m_{dry} is the mass according to F.2.1.1.2

F.2.1.2.4 Determine for each test specimen conditioned according to B.2.1.2.1 the λ value in accordance with EN 12667 or EN 12939 for thick products at a mean temperature of (10 ± 0,3)°C.
Average the two values to determine $\lambda_{10,(23,50)}$.

F.2.1.3 Calculation of the moisture conversion factor ($f_{u,1}$)
The moisture conversion factor $f_{u,1}$ shall be calculated by the following formula (derived from ISO 10456, formula 4):

$$f_{u,1} = \frac{\ln \frac{\lambda_{10,(23,50)}}{\lambda_{10,dry}}}{u_{23,50} - u_{dry}}$$

where,
$\lambda_{10,(23,50)}$ is determined according to F.2.1.2.4;
$\lambda_{10,dry}$ is determined according to F.2.1.1.3;
$u_{23,50}$ is determined according to F.2.1.2.3;
u_{dry} is determined according to F.2.1.1.2 and is defined to be 0.

F.3 Calculation of the declared thermal conductivity λ_D

The declared thermal conductivity λ_D shall be calculated using the following formula:

$$\lambda_{(23,50)} = \lambda_{10,dry,90/90} * e^{f_{u,1}(u_{23,50} - u_{dry})}$$

where,
$\lambda_{10,dry,90/90}$ is determined according to B.1.2;
$f_{u,1}$ is determined according to F.2.1.3;
$u_{23,50}$ is determined according to F.2.1.2.3;
u_{dry} is determined according to F.2.1.1.2 and is defined to be 0.

The calculated value $\lambda_{(23/50)}$ shall be rounded upwards to the nearest 0,001W/(m.K) and declared as $\lambda_{D(23,50)}$.

F.4 Determination of the conversion factor ($f_{u,2}$) to high moisture content

For the determination of the conversion factor to high moisture content $f_{u,2}$, two sets of measurements are needed.
Set 1
Two measurements on test specimens conditioned at (23 ± 2)°C and (50 ± 5)% relative humidity, to determine $\lambda_{10,(23,50)}$ and $u_{23,50}$ (moisture content mass by mass).
Set 2
Two measurements on test specimens conditioned at (23 ± 2)°C and (80 ± 5)% relative humidity, to determine $\lambda_{10,(23,80)}$ and $u_{23,80}$ (moisture content mass by mass).

F.4.1 Procedure

F.4.1.1 Set 1

Determine the $\lambda_{10,(23,50)}$ and $u_{23,50}$ in accordance with F.2.1.2

F.4.1.2 Set 2

F4.1.2.1 Condition the two test specimens at (23 ± 2)°C and (80 ± 5)% relative humidity following the procedures detailed in EN 13169 clause 5.2, step 2.

F.4.1.2.2 Determine for each test specimen the mass at (23 ± 2)°C and (80 ± 5)% relative humidity.
Average the two values to determine the mass at 23°C and 80% relative humidity as $m_{23,80}$.

F.4.1.2.3 Calculate $u_{23,80}$ by the following formula:

$$u_{23,80} = \frac{m_{23,80} - m_{dry}}{m_{dry}}$$

where,

$m_{23,80}$ is the mass at 23°C and 80% relative humidity according to F.4.1.2.2
m_{dry} is the mass according to F.2.1.1.2

F.4.1.2.4 Determine for each test specimen conditioned according F.4.1.2.1 the λ value in accordance with EN 12667 or EN 12939 for thick products at a mean temperature of (10 ± 0,3)°C.
Average the two values to determine $\lambda_{10,(23,80)}$.

F.4.1.3 Calculation of the conversion factor to high moisture content ($f_{u,2}$)

The conversion factor to high moisture content $f_{u,2}$ shall be calculated by the following formula (derived from ISO 10456, formula 4):

$$f_{u,2} = \frac{\ln \dfrac{\lambda_{10,(23,80)}}{\lambda_{10,(23,50)}}}{u_{23,80} - u_{23,50}}$$

where,

$\lambda_{10,(23,80)}$ is determined according to F.4.1.2.4;
$\lambda_{10,(23,50)}$ is determined according to F.2.1.2;
$u_{23,80}$ is determined according to F.4.1.2.3.
$u_{23,50}$ is determined according to F.2.1.2.

Note 1: For the determination of the moisture conversion factor $f_{u,1}$ and the conversion factor to high moisture content $f_{u,2}$, the test specimens shall be taken from the same production run.

Note 2: Thermal conductivity may also be measured at mean temperatures other than 10°C, providing that the accuracy of the relationship between the temperature and thermal properties is well documented.

ANNEX G

Method to evaluate the effect of a deforming substrate on the rendering

G.1 The specimen shall consist of a section of cellular steel deck of nominal dimensions 3600mm long by 600 mm wide by 40 mm thick consisting of a 1.5 mm thick steel fluted top section and a 1.2 mm thick steel flat bottom section welded to form four cells nominally 150 mm wide running longitudinally.

G.2 The underside of the flat steel plate is sprayed with rendering at a thickness equal to the maximum at which it is to be used, applied in accordance with the procedure recommended for the rendering and in accordance with the requirements of clause 5.0.2 The ends of the deck (steel plate) for 300 mm shall not be sprayed as these are the deck support areas.

G.3 The thickness and density of the dried rendering shall be measured together with adhesion measured in accordance with the method specified in clause 5.7.2.7.1.

G.4 The specimen shall be conditioned for 28 days in laboratory conditions corresponding to (20 ± 10) ^{o}C and (50 ± 20) % relative humidity. If a small sample able to be easily weighed is prepared at the same time as the test specimen it should be of the same thickness as the main specimen with edges protected to ensure moisture loss only from the top surface as for the main specimen with which it should be kept. The testing may commence after the sample has attained equilibrium with no further weight loss.

G.5 After conditioning the specimen is placed on a support at either end such that there is a clear span of 3000 ±10 mm.

G.6 A downward vertical load is applied to the specimen at mid-span to produce a mid-span deflection of span/120 or 25 mm.

G.7 The condition of the rendering on the deflected deck is inspected immediately after the test. Any cracking, spalling, adhesive or cohesive failure shall be recorded.