Leitlinie für die
europäische technische Zulassung (ETAG)

ETAG 018

BRANDSCHUTZPRODUKTE

TEIL 2: REAKTIVE BRANDSCHUTZBESCHICHTUNGEN AUF STAHLBAUTEILEN

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Vorbemerkungen zur
Leitlinie für die europäische technische Zulassung für

BRANDSCHUTZPRODUKTE
TEIL 2: REAKTIVE BRANDSCHUTZBESCHICHTUNGEN AUF STAHLBAUTEILEN

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GUIDELINE FOR EUROPEAN TECHNICAL APPROVAL
OF

FIRE PROTECTIVE PRODUCTS

PART 2

REACTIVE COATINGS FOR FIRE PROTECTION OF STEEL ELEMENTS

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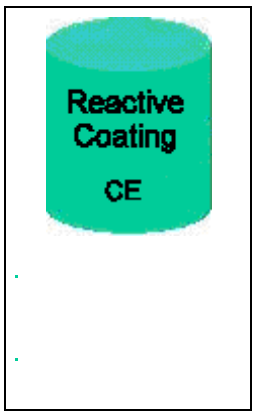
FOREWORD

Background

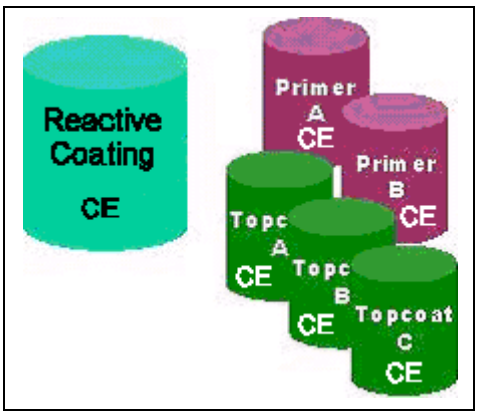
This ETA-Guideline has been drawn up by the EOTA Working Group 11.01/04 *Fire Protective Products.*
This ETA-Guideline – Part 2 “Reactive coatings for fire protection of steel elements” shall be used in conjunction with the ETA-Guideline “Fire protective products” Part 1 “General”. This complementary 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 can be used to issue an ETA for fire protective coatings or fire protective coating kits. In all cases the ETA covers the reactive coating.

There are three options:

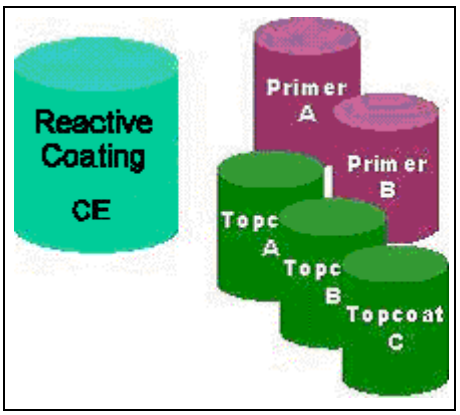
- Option 1: The ETA only covers the reactive coating product. This option can only be used for products that can be used directly on the steel substrate without any primer and/or topcoat.
- Option 2: The ETA covers a reactive coating kit, i.e. in all cases the reactive coating product, and depending on the kit one (or more) primers and/or one (or more) topcoats and/or one (or more) reinforcements. All components need to be identified, subjected to the assessment and all FPC requirements. The reactive coating kit shall comprise at least two components.
- Option 3: The ETA is issued for a “final assembly”. The ETA only covers the reactive coating product, but one (or more) primers and/or one (or more) topcoats and/or one (or more) reinforcements are also identified. This identification may be specific (e.g. trade name, type) or generic (e.g. family of primers). All components of the “final assembly” are subjected to the assessment, but only the reactive coating product is subjected to the FPC requirements.



Option 1: Reactive Coating Product



Option 2: Reactive Coating Kit



Option 3: Reactive Coating Final Assembly

Note 1: The CE marking in the drawings indicates which component(s) will be covered by the ETA. In option 2, only the kit is CE marked, the individual components do not need to be.

List of reference documents

This ETA-Guideline Part 2 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 in annex F. For dated references subsequent amendments to, or revisions of these publications, apply to this ETAG only when incorporated in it by amendment or revision. For undated references the latest dated revision of the publication referred to, applies.

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 this ETA-Guideline is given in Part 1: “General” – clause 1.1.

1.2. Status of ETA-Guidelines

The Status of this ETA-Guideline is given in Part 1: “General” – clause 1.2.

2. SCOPE

2.1 Scope

This part 2 shall be used in conjunction with Part 1 “General”.

This ETA-Guideline Part 2 “Reactive Coatings for fire protection of steel elements” specifies the terminology and definitions, the specific methods of verification and for identification. It also gives guidance on the installation instructions and for the Attestation of Conformity for these products.

An ETA issued on the basis of this ETA-Guideline will cover reactive coatings or reactive coating kits to be used on steel elements. In each case, the ETA will cover at least the reactive coating layer (see Foreword). This ETA-Guideline can also be used as a basis for the assessment of cast iron. Properties that are independent of the substrate can be assessed with steel substrate (e.g. durability).

This ETA-Guideline does not cover

- Factory-coated steel elements, where the ‘product’ is the element itself.
- Products placed on the market in the form of prefabricated, preformed shells which are applied to structural elements on site.

In this ETA-Guideline, unless the phrase "Product or kit" is used, the term "product" refers either to the reactive coating sold alone or to the kit.

2.2 Use categories, product families, kits and systems

2.2.1 General

The ETA-Guideline 018 is divided into the following parts:

- Part 1: General
- 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

In this part, additional specifications are given for reactive coating systems. The component specifications are either specified in:

- this ETA-Guideline; or
- European technical specifications as referred to in the Construction Products Directive, i.e. harmonized European product standards as published by CEN 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” of this ETAG, clause 2.2.2. The use categories are the following:

- Type X: Reactive coating system intended for use in all conditions (internal, semi-exposed and exposed)

- Type Y: Reactive coating system intended for use in internal and semi-exposed conditions. Semi exposed includes temperatures below zero, but no exposure to rain and limited exposure to UV (but UV is not assessed).

- Type Z_1: Reactive coating system intended for use in internal conditions with humidity equal to or higher than 85 % RH, excluding temperatures below 0°C. [1]

- Type Z_2: Reactive coating system intended for use in internal conditions with humidity lower than 85 % RH, excluding temperatures below 0°C

Note 2: 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, however, that although a reactive coating system is intended for internal use only the construction process may result in a reactive coating system being subjected to exposed conditions for a period before the building envelope is closed. There are two possibilities:

1. Special provisions shall be made to protect temporarily the exposed reactive coatings according to the instructions of the manufacturer which are referenced in the ETA.
2. The reactive coating shall be evaluated as if it were to be used for exposed applications (type X).

This ETAG does not give specific test or assessment methods for resistance to specific environmental conditions, but this may be assessed on a case by case basis as necessary. 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 intended to be protected

The use categories are identified in Part 1 – General as Types 1 – 10. This Guideline covers the application of reactive coatings to use types 4, 6 and 10.

2.3 Assumptions

The assumptions made are given in Part 1 "General" - clause 2.3

The provisions, test and assessment methods in this guideline, or referred to, have been written based on the assumed working life of the product for the intended use of 10 years. The provisions are based upon the current state of art and the available knowledge and experience.

An estimated working life of 25 years shall only be assumed in the case where the applicant can offer, in addition to the above, for examination by the Approval Body, sufficient documented proof to demonstrate the use of the reactive coating system for a period of 25 years in the environmental conditions claimed (see clause 2.2.2).

[1] These conditions apply for internal humidity class 5 in accordance with EN ISO 13788

3. TERMINOLOGY

3.1. Common terminology and abbreviations

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

3.2. Terminology specific to this Part 2 of the ETA-Guideline for Fire Protective Products

For the purpose of this ETA-Guideline Part 2 the following definitions apply:

Reactive coating system: Fire protective reactive coating systems normally comprise the primer, the reactive coating and the top coat. In some instances a reinforcing mesh is used.

Note 3: It is possible that a single coating may perform one or more of the functions described, which means that the “reactive coating system” comprises only the reactive coating.

Primer: a coating applied directly to a suitably prepared steel surface to provide corrosion protection and/or to act as an aid to the adhesion of the reactive coating.

Reactive coating: coating which is specially formulated to provide a chemical reaction upon heating such that the physical form changes and in so doing provides fire protection by thermal insulating and cooling effects

> **Intumescent layers** expand by foaming when exposed to heat in the conditions of a fire
>
> **Ablative layers** could slightly expand due to the formation of a char when exposed to fire. Energy will be consumed in fire conditions through chemical and/or physical processes creating the charred substance.

Topcoat: coating applied over the reactive coating as a protection against environmental degradation and/or for decorative purposes.

Reinforcing mesh: mesh of relatively small aperture size (e.g. metal, fibre glass) applied in close proximity or fixed to the substrate, which allows penetration of the reactive coating, to produce a good key.

Kit: For a definition of the term “kit” see EC Guidance Paper C. For kits based on reactive coatings the kit will be composed by the reactive coating product, and, at least, one of the other components (primer, topcoat and/or reinforcing mesh) of the reactive coating system. See also the foreword with the explanation of kits and “virtual” kits.

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”**.**

Required minimum thickness of intumescent layer: the dry film thickness of the intumescent layer given in the ETA is the required minimum thickness of the layer on site. Guidance for measuring the thickness and the allowable range is given in Annex H

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 Products based on reactive coatings shall be in accordance with Part 1 “General” – chapter 4 and with the following specific stipulations for this family of products.

4.1 ER 1: Mechanical resistance and stability

Not relevant

4.2. ER 2: Safety in case of fire

See Part 1 – General, Table 4.1

If there is a national requirement for a resistance to fire classification using the slow heating curve ("Inc-Slow" according to EN 13501-2; see also EN 13381-8:2010) the product shall be subjected to the appropriate test.

Note 4: See Annex G for the use of test data according to ENV 13381-4:2002.

4.3. ER 3: Hygiene, health and the environment

See Part 1 – General, Table 4.1

4.3.1 Air and/or water permeability

See Part 1 – General

4.3.2 Release of dangerous substances

In addition to European provisions, the existence of national restrictions concerning dangerous substances can be checked using the database of the European Commission, although this database is not complete and other national restrictions may exist.

4.4. ER 4: Safety in use

4.4.1 Mechanical resistance and stability

Not relevant

4.4.2 Resistance to impact/movement

Not relevant

4.4.3 Adhesion

Note 5: This requirement has been placed under clause 4.7.1 Serviceability, but it relates to other requirements as well, in particular to ER2 and ER4.

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 Aspects of durability, serviceability and identification

The performance of the fire protective products shall not change significantly during the working life. Therefore the properties on which the suitability and in particular the Fire resistance behaviour depend

shall not be significantly affected by ambient physico-chemical effects such as corrosion or degradation in particular caused by environmental conditions (e.g. moisture, chemical agents).

4.7.1 Serviceability

4.7.1.1 Adhesion

The reactive coating system shall adhere to the substrates, such that the system will have the required fire protective performance.

4.7.2 Durability

The performance of fire protective reactive coating systems 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. The reactive coating system shall be durable under service conditions, such as:

- Humidity: see clause 4.7.2.1
- Variations of temperature and relative humidity, rain and radiation of the sun: see clause 4.7.2.2
- Chemical attack: see clause 4.7.2.3
- Biological attack: see clause 4.7.2.4

4.7.2.1 Corrosion resistance

The reactive coating system shall not react adversely with the intended substrate(s) and where required the primer and/or the reactive coating shall provide corrosion protection to the substrate.

4.7.2.2 Behaviour under different environmental conditions

The fire behaviour of the reactive coating system shall not change significantly during the working life, if reactive coating systems are used in the defined use conditions. The ETA-Applicant shall claim durability of the reactive coating system according to the use categories in clause 2.2.2.

4.7.2.3 Resistance to chemicals

Reactive coating systems may or may not be influenced in their function by chemicals. For specific areas of application, where reactive coating systems may be exposed to chemicals, additional verifications may be required.

The extent of testing of resistance to chemicals depends on the ETA-applicant´s claims.

4.7.2.4 Resistance to biological attack

Reactive coatings may be influenced in their function by biological effects, i.e. mould growth 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 shall take place, taking into account the nature of the biological agent.

4.7.3 Identification

The materials used in the fire protective reactive coating system shall be identifiable as to their properties which have an influence on the ability of the reactive coating system to fulfil the Essential Requirement.

The determination of characteristics and properties of the product for identification purposes shall be as specified in the tests listed in clause 5.7.3.

5. SPECIFIC METHODS OF VERIFICATION

5.0 General

This Chapter refers to the verification methods used to determine the various aspects of performance of the product in relation to the requirements for the works (calculation, tests, engineering knowledge, site experience, etc.) as set out in chapter 4. The methods of verification given in Part 1 "General" - chapter 5 apply, except where modified or specified below (see table 5.1).

5.0.1 Sampling and Test Specimens

Where possible, samples of the product for all approval tests shall be taken at the manufacturing site (storage, production) and shall be representative of the reactive coating or reactive coating kit for which approval is being sought.

All samples for test specimens for each product shall be representative of the product placed onto the market. The sample shall be taken 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).

The specimens for approval tests shall as far as possible be prepared at the same time in order to minimize differences caused by variations in specimen preparation. This is in order to relate the characteristics of the material to the performance achieved.

Where relevant, the specimen substrate shall be a grade of steel (S designation) to the EN 10025-series (excluding S 185) of standards. Engineering grades (E designation) shall not be used. Where galvanized steel is used as substrate, EN ISO 1460 or EN ISO 1461 applies.

The surface of the steel used for the specimens shall reflect the surface conditions claimed by the ETA-Applicant, as specified in the application instructions for the product.

5.0.2 Conditioning of Tests Specimens and Test Conditions

The coating on the test specimens shall be applied and fully cured according to the ETA-applicant´s instructions.

Except where special 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.

The laboratory conditions at the start of fire testing shall be (20 ± 10) ^{o}C according to EN 1363-1.

5.0.3 Dry thickness of the reactive coating system

The dry film thickness of all layers of the reactive coating system shall be determined directly upon the test specimen, once the coating is fully dried. The thickness shall be measured using an instrument employing either the electro-magnetic induction principle or the eddy current principle with a probe contact diameter of at least 2,5 mm according to EN ISO 2808.

The measurements points shall be uniformly distributed over the surface of the test sample with a minimum number of 40 per m^2. For details of preparing and storing the test specimen, see A1 of Annex A of this guideline.

5.0.4 Assessment Approach for primers and top coats

5.0.4.1 General

Fire protective reactive coating systems normally comprise the primer, the reactive coating and the top coat. Some reactive coatings can be applied directly on the substrate without primer. The insulating efficiency tests for the ETA shall then be carried out without a primer. If, in practice there is a primer already on site the use of a primer can be accepted on the basis of an insulating efficiency test providing it is one of the generic categories from table 5.0 tested in accordance with Annex A.

For a reactive coating kit or reactive coating final assembly, consisting of one reactive layer and one or more primers and/or one or more top coats, both primers and top coats may be referred to specifically (by trade name and type) or generically (generic products or generic families, in case of primers).

Specific or generic products shall be specified in the ETA according to the available technical specifications (e.g. EN or ETA) or, when this 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 clause 5.0.4.2 shall be made.

5.0.4.2 Primer Evaluation

There are two options for assessing primers and covering primers in the ETA: generic types or specific primers

The most commonly used generic types of primer and their nominal thickness range are given in Table 5.0. Only one primer from a primer family is subjected to testing and primer types not covered by the generic types listed in Table 5.0 will be the subject of a separate evaluation in accordance with Annex A. If a primer is tested on uncoated steel but is intended to be used on galvanised steel as well, a separate evaluation on galvanised steel shall be made. In this case the maximum thickness shall not be more than 50% of the tested thickness.

Each generic primer group will be evaluated separately for both water borne and solvent borne materials. Solvent free materials will be classed in the same generic group as the solvent borne equivalent.

Table 5.0

Generic Primer Type	Maximum Approved Tested Thickness + (%)
Acrylic	50
Short/medium oil alkyd	50
Two component epoxy	50
Zinc rich epoxy (containing about 80% by mass of metallic zinc powder)	50
zinc silicate	50

In all cases the dry thickness of the primer shall not exceed the maximum dry thickness for each product as recommended by the manufacturer**.**

Where the primer contains zinc metal there may be a requirement to include a further tie coat or pre-treatment, in which case this shall be included in the system to be tested.
When a primer from any generic group is tested the generic approval will be limited to other primers in the group provided the thickness is within the tolerance given in Table 5.0. Any thicknesses below that tested shall be acceptable provided the lower thickness is not less than recommended by the manufacturer.
If no primer is used then the surface preparation shall be specified and tested in accordance with Annex A.
Compatibility testing carried out on steel panels or short columns will be acceptable for other ferrous substrates except stainless steel, which shall be evaluated separately in accordance with Annex A.

Primers not covered by the families identified above may be grouped in other families of primers based on the binder (e.g. oil alkyd, epoxy), carrier (organic solvent/water) and pigment (e. g. 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 the clauses 5.2 to 5.7 shall be carried out without a primer or with a primer chosen by the applicant. However, where the reactive coating system is intended to be used with more than one primer, an insulation efficiency test is necessary for the additional primers. Only one primer from a primer family is subjected to testing. The tests are valid for primers with the same carrier (water borne or solvent borne) and for a related similar thickness (a range of validity for tested dry film thickness shall be given).

Note 6: It is assumed that the result “pass” (see clause 6.7.2.2.1) within the insulation efficiency test is a basis for the assessment of a comparable behaviour in all other tests (e. g. fire resistance tests, durability test). For the “pass/fail”-criteria see clause 6.7.2.2.2.

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 reactive coating applicator to ensure that the primer is compatible with the reactive coating. 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 applied coating is not covered by the ETA.

5.0.4.3 Top coat Evaluation

All tests according to clause 5.7.2 shall be conducted without a top coat unless the ETA-applicant speci-

fies that the top coat is necessary to provide the required performance under the particular exposure conditions. In this case the reactive coating shall be tested with the specified top coat.

If the reactive coating system is claimed to be equally suitable with and without topcoat for environmental conditions types Z_1 and Z_2 the initial tests (clause 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 (this compatibility assessment might also be carried out by testing short columns –see Annex A). For determining the insulation efficiency after exposure, it is sufficient to perform the tests without topcoat. The top coat shall be specified in the ETA. The colour of the topcoat has no influence on the result of the durability assessment for types Z1 and Z2. Therefore there is no need to test different colours of the topcoat. 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.

Table 5.1: Relationship between ETAG paragraph on product performance, product characteristics and ETAG paragraph on verification method

ER	ETAG section on product performance	ETAG section on verification method of product characteristics
1	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 the environment 4.3.1 Air and/or water permeability 4.3.2 Release of dangerous substances	5.3 See Part 1 General 5.3.1 Not relevant 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	Not relevant Not relevant No specific verification but see 5.7.1 Serviceability
5	4.5 Protection against noise	5.5 See Part 1 General
6	4.6 Energy, economy and heat retention	5.6 See Part 1 General
	4.7 Durability, serviceability and identification 4.7.1 Serviceability 4.7.1.1 Adhesion 4.7.2 Durability 4.7.2.1 Corrosion resistance 4.7.2.2 Behaviour under different environmental conditions 4.7.2.3 Resistance to chemicals 4.7.2.4 Resistance to biological attack	5.7 Durability, serviceability and identification 5.7.1 Serviceability 5.7.1.1 Adhesion 5.7.2 Durability 5.7.2.1 Corrosion resistance 5.7.2.2 Behaviour under different environmental conditions 5.7.2.2.1 Initial test 5.7.2.2.2 Exposure conditions for Type Z_2: Reactive coating system intended for internal conditions 5.7.2.2.3 Exposure conditions for Type Z_1: Reactive coating system intended for internal conditions with high humidity 5.7.2.2.4 Exposure conditions for Type Y: Reactive coating system intended for internal and semi-exposed conditions 5.7.2.2.5 Exposure conditions for Type X: Reactive coating system intended for all conditions 5.7.2.3 Resistance to chemicals 5.7.2.4 Resistance to biological attack
	4.7.3 Identification	5.7.3 Identification

5.1 Mechanical resistance and stability

This Essential Requirement is not relevant for these products.

- [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.

5.2 Safety in case of fire

5.2.1 Reaction to fire

The reactive coating system shall be tested, using the test method(s) relevant for the corresponding reaction to fire class, in order to be classified according to EN 13501-1.
Guidance on mounting and fixing arrangements for tests in accordance with the test methods is given in Annex D of this document. If the reactive coating system is intended to be used with or without a top coat then both situations shall be tested.

5.2.2 Fire Resistance

In order for an ETA to be issued for the reactive coating or reactive coating kit it shall be the subject of at least one fire resistance test and shall be classified according to EN 13501-2.
The method of application of water borne paints does not significantly affect the results so any method may be used but spray application is recommended. Solvent borne paints are more sensitive to the method of application and spray application shall be used unless the manufacturer specifies a different method which shall then be used.
If there is a national requirement for a resistance to fire classification using the slow heating curve ("Inc-Slow" according to EN 13501-2) the smouldering curve according to EN 1363-2 shall be used when the product is subjected to a resistance to fire test. The test method is described in EN 13381-8.
See Annex G for the use of test data according to ENV 13381-4.

Note 7: A proposed amendment to clause 10.3.2 of EN 13381-8:2010, states L*sup*/30 shall be reached in the range 500-600 ^{o}C. If this is not achieved after reaching 575 ^{o}C then the load shall be increased gradually and carefully until L*sup*/30 is reached. The temperature used shall be the mean of the bottom flange temperatures". Prior to publication of the amended version of EN 13381-8 it is recommended that ETA issuing bodies satisfy themselves that loaded beam test data provided in support of ETAs on the basis of this ETAG adequately demonstrates the stickability performance of the coating.

5.3 Hygiene, health and the environment

5.3.1 Air and/or water permeability

Not relevant

5.3.2 Release of dangerous substances

The product or kit shall comply with all relevant European and national provisions on dangerous substances applicable for the uses for which it is brought to the market. The EC database lists substances known to be regulated, but there may be other regulations as well, which need to be complied with.

5.4 Safety in use

5.4.1 Mechanical resistance and stability

Not relevant

5.4.2 Resistance to impact/movement

Not relevant

5.4.3 Adhesion

No specific verification method (but see clause 5.7.1 Serviceability)

5.5 Protection against noise

No specific verification method.

5.6 Energy economy and heat retention

No specific verification method.

5.7 Aspects of serviceability, durability and identification

5.7.1 Serviceability

5.7.1.1 Adhesion

No specific verification method.

Adhesion of the reactive coating system (primer, reactive coating layer with/without top coat) to the substrate (and cohesion of the system) is covered by testing the insulation efficiency (see clause 5.7.2.2.1).

5.7.2 Durability

5.7.2.1 Corrosion resistance

The tests according to clause 5.7.2.2 will serve to indicate whether the coating has an adverse effect on the primer and/or substrate and whether the reactive coating system provides corrosion protection to the substrate. The durability testing shall be carried out with the same reactive coating system used for the fire resistance tests.

5.7.2.2 Behaviour under different environmental conditions

The need to conduct each of the following tests is determined by the claimed use category related to environmental conditions for the reactive coating product or reactive coating kit (see clause 2.2.2 and table 5.7.2.2).

5.7.2.2.1 Initial test

The durability assessment is achieved through indirect testing, i.e. the measurement of insulating efficiency as a ‘proxy’ characteristic that is related to the fire protective behaviour of the reactive coating system. Durability is demonstrated by comparing “insulating efficiency” of initial test specimen (steel panels according to Annex A) and exposed specimen.

For preparation of test specimen, test procedure and test criteria see Annex A. The product or kit is assessed for a use category as claimed by the ETA-Applicant and therefore, the insulating efficiency on minimum 2 initial samples (clause 5.7.2.2.1) is compared with the insulating efficiency on minimum 2 weathered samples, in accordance with clauses 5.7.2.2.2, 5.7.2.2.3, 5.7.2.2.4 or 5.7.2.2.5. Table 5.2 specifies the tests and the number of tests depending on the possibilities for the different reactive coating systems.

Table 5.2: Minimum number of test specimens regarding the assessment approach for primer(s) and top coat(s) and the durability requirement (see clauses 5.0.4 and 5.7.2)

No	Required approval content	Tests according to clause	minimum number of specimens
1	Reactive coating systems without a primer or with one primer without top coat for type Z_2	5.7.2.2.1 5.7.2.2.2 (without top coat)	2 2
1a	Additional generic or specific primer(s)	5.7.2.2.1	+ 2 x n [1)]
1b	with top coat: (to test every claimed top coat)	5.7.2.2.1	+ 2 x m [2)]
2	Reactive coating systems without a primer or with one primer only with top coat for type Z_2	5.7.2.2.1 5.7.2.2.2	2 2
2a	Additional generic or specific primer(s)	5.7.2.2.1	+ 2 x n [1)]
2b	Additional top coat(s):	5.7.2.2.1	+ 2 x m [2)]
3	Reactive coating systems without a primer or with one primer without top coat for types Z_2 and Z_1	5.7.2.2.1 5.7.2.2.3 (without top coat)	2 2
3a	Additional generic or specific primer(s)	5.7.2.2.1	+ 2 x n [1)]
3b	with top coat (to test every claimed top coat)	5.7.2.2.1	+ 2 x m [2)]
4	Reactive coating systems without a primer or with one primer only with top coat for types Z_2 and Z_1	5.7.2.2.1 5.7.2.2.2	2 2
4a	Additional generic or specific primer(s)	5.7.2.2.1	+ 2 x n [1)]
4b	Additional top coat(s):	5.7.2.2.1	+ 2 x m [2)]
5	Reactive coating systems without a primer or with one primer with top coat for type Y (including types Z_1 and Z_2)	5.7.2.2.1 5.7.2.2.4	2 2
5a	Additional generic or specific primer(s)	5.7.2.2.1	+ 2 x n [1)]
5b	Additional top coat(s) (to test every top coat with only one colour)	5.7.2.2.1 5.7.2.2.4	+ 2 x m [2)] + 2 x m [2)]
6	Reactive coating systems without a primer or with one primer with top coat for type X (including types Y, Z_1 and Z_2)	5.7.2.2.1 5.7.2.2.5	2 2
6a	Additional generic or specific primer(s)	5.7.2.2.1	+ 2 x n [1)]
6b	Additional top coat(s) (to test every top coat with only one colour)	5.7.2.2.1 5.7.2.2.5	+ 2 x m [2)] + 2 x m [2)]

1) n = number of claimed generic or specific primers <u>in addition to</u> the one tested in number 1, 2, 3 or 4
2) m = number of claimed top coats and one colour (see clause 5.0.4.3)

5.7.2.2.2 Exposure conditions for type Z_2: Reactive coating system intended for internal conditions

The test specimen shall be placed in a vertical position into the test chamber and exposed to the following cycle:

- 4 h at (23 ± 3) °C and (80 ± 5) %RH
- 16 h at (40 ± 3) °C and (50 ± 5) %RH
- 4 h at (5 ± 3) °C and (50 ± 5) %RH

The product or kit shall be exposed to 21 cycles without interruption. After exposure the specimen shall be tested according to Annex A.

The chamber temperature change shall be at a rate of 1,5 K/min ± 0,5 K/min. During the period of temperature change the change of humidity is not controlled, but condensation shall be avoided. The duration of temperature change is included in the duration of the 16 h cycle.

5.7.2.2.3 Exposure conditions for type Z_1: Reactive coating system intended for internal conditions with high humidity

The test shall be carried out according to EN ISO 11503. The test cycle shall be repeated 21 times. After exposure the specimens shall be tested according to Annex A.

5.7.2.2.4 Exposure conditions for Type Y: Reactive coating system intended for internal and semi-exposed conditions

The test specimens shall be stored in a vertical position into the test chamber and exposed to the test conditions. The special requirements of the test method are described in Annex C. After exposure the specimens shall be tested according to Annex A.

5.7.2.2.5 Exposure conditions for Type X: Reactive coating system intended for all conditions

The test specimens shall be stored in a vertical position into the test chamber and exposed to the test conditions. The principles of the test method are according to EN ISO 4892-3: 2006, table 4 cycle 3. After this exposure to UV and sprayed water the specimens shall be tested under special conditions as described in Annex B. After exposure the specimens shall be tested according to Annex A.

5.7.2.3 Resistance to chemicals

To determine chemical resistance, as claimed by the ETA-applicant, after subjecting (at least) two specimens to chemicals in accordance with EN ISO 2812-1, the test specimens shall be tested according to Annex A. The insulation efficiency after exposure to chemicals is compared with the insulation efficiency of the initial test (see clause 6.7.2.2.1).

5.7.2.4 Resistance to biological attack

See clause 4.7.2.4

5.7.3 Identification

Regardless of which option is chosen for the reactive coating or reactive coating kit (see Foreword) all components supplied by the manufacturer of the reactive coating system (primer, reactive layer and top coat) shall be clearly identified according to the following table 5.3.

Table 5.3: Testing for identification

Properties	Primers (if any)	Reactive coating	Top coat (if any)	Reinforcements (if any)
Technical data	x	x	x	x
Colour (visual verification)	x	x	x	
Density	x	x	x	
Non-volatile content	x	x	x	
Fingerprint according to Annex E or formulation (optional)		x		
Geometry				x

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

This Chapter details the performance requirements to be met by reactive coating systems (chapter 4) expressed as precise and measurable criteria (as far as possible and proportional to the importance of the risk) or qualitative terms, related to the products and their intended use, using the outcome of the verification methods (chapter 5).

6.1 Mechanical resistance and stability

This Essential Requirement is not relevant to fire protective products.

6.2 Safety in case of fire

6.2.1 Reaction to fire

The Fire Protective Products shall be classified in accordance with EN 13501-1

6.2.2 Fire resistance

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

Classification with respect to fire resistance is undertaken in accordance with EN 13501-2 and shall specify the protected elements. Classification can also be undertaken for cast iron on the basis of an assessment approach.

For reactive coating systems ‘No performance determined’ shall **not** be an option.

For tests with a smouldering fire curve the assessment criteria are given in EN 13501-2 and the test standards referenced therein.

6.3 Hygiene, health and the environment

6.3.1 Air and/or water permeability

Not relevant

6.3.2 Release of dangerous substances

See clause 5.3.2

6.4 Safety in use

6.4.1 Mechanical resistance and stability

Not relevant

6.4.2 Resistance to impact/movement

Not relevant

6.4.3 Adhesion

See clause 6.7.1.

6.5 Protection against Noise

No specific requirements.

6.6 Energy economy and heat retention

No specific requirements.

6.7 Aspects of serviceability, durability and identification

For all tests required in causes 5.7.1 and 5.7.2 the test result is a pass/fail criterion. No test results or threshold values (e. g. time to reach 500°C) are specified in the ETA.

6.7.1 Serviceability

6.7.1.1 Adhesion

No specific assessment (but see clause 6.7.2)

6.7.2 Durability

6.7.2.1 Corrosion Resistance

The result ”passed” in the tests according to clause 5.7.2.2 shall demonstrate sufficiently that the reactive coating has no adverse effect on the primer (if any) and that the reactive coating system provide corrosion protection to the substrate.

If ETA-applicants claim that their product or kit provides or contributes to the corrosion protection of the steel element it is intended to protect against fire, the product, or the kit component (or components together) shall be classified in accordance with EN ISO 12944-1.

6.7.2.2 Behaviour under different environmental conditions

6.7.2.2.1 Initial test

Durability is demonstrated by comparing the performance of unexposed test specimens with specimens exposed to artificial ageing. The insulation efficiency test is also used within the assessment approach for primers and top coats. The test method and the evaluation of the test results are described in Annex A. For the criteria for the test result “passed” see clause 6.7.2.2.2.

6.7.2.2.2 Criteria for exposure conditions for use categories Z_1, Z_2, Y and X

The test result is deemed “passed” when the mean time to achievement of the critical steel temperature (t_{500}) determined in the durability tests is not less than 85% of the time t_{500} (time to reach a steel temperature of 500°C) of the initial tests. To remove influences due to the variability of the thickness of the reactive coating, the relationship thickness/t_{500} may be assumed as linear. No single result of exposed specimens shall be less than 80% of the mean time t_{500} of the initial test.

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

These criteria for exposure conditions shall also be used for the evaluation of kits including primers and/or top coats when testing efficiency on panels (if testing on short columns, see Annex A).

6.7.2.3 Resistance to chemicals (optional test)

The assessment criteria shall be in accordance with clause 6.7.2.2.2.

6.7.2.4 Resistance to biological attack (optional test)

See clauses 4.7.2.4 and 7.1

6.7.3 Identification

The results of the identification tests according to clause 5.7.3 shall be kept in the files of the Approval Body.

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

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

7.1 Design of the works

See ETA-Guideline, Part 1.

Fire protective reactive coatings and kits shall be assessed under the presumption that the element being protected, the substrate, is suitable for the reactive coating 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.

Where steel structures have been previously primed, the primer shall be identified by both the generic description and the product name and shall be covered by the ETA.

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 insect or mammal 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 shall take place (see clause 4.7.2.4).

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

Proper water tightness of the building envelope, using appropriate design principles and details is 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 shall 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 the HVAC systems).

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

7.2 Transport and storage

The manufacturer has to give information for the transport and storage on an accompanying data sheet or on the containers. The ETA shall contain the basic principles of transport and storage (see clause 9).

As a minimum the following shall be addressed: storage temperature, way of storage (container, tank), the necessary information on minimum and maximum temperature for transport and storage. For flammable components or other potentially hazardous materials the instructions shall contain specific guidance on restrictions and/or conditions for handling, transport and storage.

7.3 Execution of the works

The manufacturer shall provide an installation guide for his product.

The installation guide shall give information about:

- List of suitable substrates
- Preparation of the surface of the construction (e. g. cleanliness, moisture)
- Method of application (e.g. spraying, painting, coating with special tools)
- Conditions of application (e.g. the temperature and humidity conditions before, during and after application)
- Necessary wet film thickness in relation to the dry thickness and measurement method
- The required minimum dry film thickness of the reactive coating for each section size and fire resistance period
- Period of time between the application of each component, taking account of exposure conditions
- Curing time of the system
- Approved top coat (if applicable)
- Equipment parameters
- Provisions to protect coatings intended for internal use, if temporarily exposed on site.

7.4 Maintenance and repair

The manufacturer of the reactive coating shall have readily available a procedure for the repair and maintenance of the reactive coating system.

Section three :

ATTESTATION OF CONFORMITY (AC)

8. EVALUATION 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

The ETA holder shall carry out all inspections and tests required by the factory production control system in order to maintain compliance with specification. This inspection and testing shall be applicable to the product and to all kit components as appropriate.

There are three options to deliver an ETA for reactive coating systems: Product, Kit or “Final assembly” (see FOREWORD).

The routes for placing the reactive coating system on the market are:
- the ETA-holder manufacturers the product or all kit components
- the ETA-holder manufacturers some kit components and buys in other
- the ETA-holder does not manufacture anything, but places products or components manufactured by somebody else on the market in his own name.

In all cases, the ETA-holder´s FPC-system shall address appropriate conformity testing or inspection of the product or of all items in the kit to ensure consistency of performance of the reactive coating system. In the case where the product or all kit items are manufactured on the behalf of the ETA holder, the FPC shall address sample inspection of incoming material, process verification and testing the finished product. Where components are used which bear the CE marking, no further assessment of these components is needed for the purpose of this ETAG, provided that the manufacturer of the component declares all characteristics required for this ETAG. Components without the CE marking may be considered satisfactory without testing by the kit manufacturer provided that sufficient evidence can be given to show that the component is manufactured in a suitable way and of a constant quality.

Table 8.1 shows the properties that shall be controlled and minimum frequencies of control.

Table 8.1: Properties and minimum frequencies of control

No	Property	Relevant test method	Values (if any) and tolerances	Minimum frequency of tests
Reactive layer and reactive coating kit				
1	Incoming material	Declaration of conformity	manufacturer`s declaration,	Every delivery
2	Char depth (expansion ratio)	e. g. Cylinder test (see TR 024) or similar	manufacturer`s declaration, minimum value [1)]	Every batch
3	Insulating efficiency or any alternative test designed to ensure consistency of fire performance (to be agreed between the Approval Body, the Notified Body and the Manufacturer)	e. g. Annex A or similar	manufacturer`s declaration,	E[2]very 10th batch or at least once per month
4	Non-volatile content or density	e. g. EN ISO 3251		Every batch
5	Sag resistance		Declared values	Every batch
6	Viscosity	e. g. EN ISO 3219		Every batch
7	Raw material Check the test results of the supplier according to the specification of the manufacturer of raw material	Check the raw material supplier´s declared values against the manufacturer´s specification in FPC		Every delivery
8	Curing			Every batch
9	Pigment dispersion (fineness of the grind)			Every batch
Primer				
10	Raw material	Check the raw material supplier´s declared values against the manufacturer´s specification in FPC	Declared values	Every delivery
11	Viscosity	e. g. EN ISO 3219	manufacturer`s specification	Every batch
12	Non-volatile content	e. g. EN ISO 3251		Every batch
Top coat				
13	Raw material	Check the raw material supplier´s declared values against the manufacturer´s specification in FPC	Declared values	Every delivery
14	Pigment content colour		manufacturer`s specification	Every batch
15	Viscosity	e. g. EN ISO 3219		Every batch
16	Non-volatile content	e. g. EN ISO 3251		Every batch
Keying mesh				
17	Geometry	declaration of conformity	manufacturer`s specification	Every delivery

[1)] If the result of the test char depth is not sufficient in that case an insulating efficiency test shall be done

8.2.2 Tasks for the Notified Body

8.2.2.1 Initial type testing of the product

See Part 1 “General” - Clause 8.2.2.1.

2

8.2.2.2 Assessment of the factory production control system - initial inspection and continuing surveillance

See Part 1 “General” - Clause 8.2.3.1.

Subsequently continuing surveillance of factory production control is necessary to ensure continuing conformity with the ETA. The frequency of the surveillance shall be twice a year.

8.2.2.3 Certification of Conformity

The notified product certification body shall issue the Certification of Conformity of the product.

8.3 Documentation

See 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 (container, tank) of the reactive coating layer. For final assemblies, components other than the reactive layer shall not be CE marked. In cases of kits the CE Marking shall be on the container/tank or on the accompanying commercial documents, specifying explicitly that the CE Marking applies to a fire protective reactive coating kit.

For clarification see also “Foreword”

Example	explanation
CE xxxx	"CE"- marking Number of Notified Body
Any Company Rue du Producteur, 50 City Country xx xxxx-CPD-xxxx	Name and address of the manufacturer or his representative established in the EEA and of the plant where the product was manufactured Two last digits of year of affixing CE marking Number of EC certificate of conformity (where relevant)
ETA N° XX/XXXX ETAG 18, Parts 1 and 2 Fire Protective Product See ETA for relevant characteristics	ETA Number ETAG Reference Product name

Section four : ETA CONTENT

9. THE ETA CONTENT

9.1. The ETA-content.

The ETA-content is given in Part 1 "General" – clause 9

9.2. Additional information

Additional information shall be given regarding:

Area of Application
(use for beams and/or columns, 3- and/or 4-sided exposure to fire, minimum thickness of the dried layer of the reactive coating system as well as the minimum and the maximum thickness of the primer and of the topcoat for each primer family and each approved topcoat, application (sprayed, brushed), environment conditions, use on galvanized steel etc)
Special provisions for the components of the reactive coating systems (primers and/or top coats, if any)
Special provisions for the production, storage and transport
Special provisions for maintenance and repair

ANNEX A
Reactive coatings, reactive coating kits – initial test (Insulating Efficiency)

A1 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 to be tested shall be prepared in accordance with the manufacturers instructions for the fire protective system concerned. Specimens shall then be stored in an atmosphere ((23 ± 3) ºC and (50 ± 5) %RH for a period of time as specified by the manufacturer for drying.

After exposure to environment conditions, if any, the specimens shall be stored in an atmosphere (23 ± 3) ºC and (50 ± 5) %RH between the end of the exposure and the fire testing for a minimum of 1 week.

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

A2 Specimens

Testing different/additional primers, different/additional top coats, durability or for FPC the insulating efficiency test may be carried out with steel panels.
Alternatively, short columns can be used for testing compatibility of different/additional primers and for FPC purposes. For different/additional top coats short columns may be used for exposure types Z_1 and Z_2. They shall not be used for durability purposes for exposure types X and Y.

A2.1 Panels

The specimens shall consist of steel panels having a nominal thickness of 5 mm and a minimum size of 300 mm x 200 mm (see Note A.1). For every requirement a minimum of two specimens shall be tested.
The dry thickness of the coating shall be measured and recorded at a minimum of 40 per m^2 but at least 20 points for panels of 500 mm x 500 mm and at least 10 point for panels of 200 mm x 300 mm uniformly distributed points prior to testing.

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.

The primer and/or the topcoat used (if any) as part of the reactive coating system shall be applied at the dry film thickness that they would be used in practice.

The reactive coating shall be applied at (1000 ± 100) µm dry film thickness or the maximum thickness if the maximum thickness is lower. For epoxy coatings the dry film thickness shall be 2/3 of the maximum thickness.

Note A.1:
For tests according to the clauses 5.7.2.2.1, 5.7.2.2.2 and 5.7.2.2.3 it may be more convenient to use steel panels with a size of 500 mm x 500 mm (equal distribution of measurement points, usual in some countries etc.).

A2.2 I-section short columns

For the evaluation of different primers it is equally acceptable to carry out tests on short steel I-/H-sections of minimum height 500 mm comparing the reference result obtained for the primer used in the type testing with any new primer tested on the same section size at the same thickness of reactive coating as used for type testing.

For each short I-/H-column there shall be a measurement station consisting of three thermocouples located at a distance of 250 mm from the top of the column, one thermocouple on the web and one on each flange. The thermocouples on the flanges shall each be fixed mid-way between

the toe of the flange and the web, the thermocouple on the web shall be fixed mid-way between the two flanges. In the case of short columns > 500 mm the thermocouples shall be in accordance with the requirements of clause 9.3.5 of EN 13381-8:2010.

To minimize heat transfer from the ends, the steel column sections shall be protected with insulation board or similar which at elevated temperatures is capable of providing equivalent or greater insulation than that of the fire protection material provided over the height of the column. The linear dimensions of the end protection shall be greater than the total overall dimensions of the fire protected steel section,

A minimum number of 16 measurements shall be taken spread over each measuring station. There shall be four measurement stations (in a distance of 100 mm, 200 mm, 300 mm and 400 mm from the top) or as indicated in Figures 3C for I or H short sections according to EN 13381-8:2010.
The thickness measurement stations shall be between 50 mm to 100 mm away from the temperature measurement stations on the surface of the test column.

A3 Test Procedure

A3.1 Panels

The panels may be tested individually or in one test. The panels shall be placed in the furnace either in a vertical or in a horizontal position such that the side without the reactive coating layer is not exposed to the fire.

The position shall not be mixed because the test results may vary depending on the position in the furnace

The panel shall be mounted in a frame which forms part of one side (wall or ceiling) of the furnace. The side with the coating system shall be faced to the fire side. The non-fire side shall be covered using vermiculite or calcium silicate boards with a minimum thickness of 5 mm with a bulk density of (475 ± 25) kg/m^3 or mineral wool (stone wool) with a bulk density of (110 ± 10) kg/m^3 (see A.1).

For each steel panel, a plate thermometer shall be placed in the middle of the panel, at a distance of 100 mm. The plate thermometer shall be oriented so that side ‘A’ faces the side walls of the furnace. The insulated parts shall face towards the panel. At the commencement of the test the hot junctions of these thermocouples shall be positioned and maintained throughout the test as specified in EN 1363-1.

Two thermocouples shall be attached to the non fire side of the smaller steel panels. These thermocouples shall be located close to the centre with a distance of 2 cm. The thermocouples shall be of the K type according to EN 1363-1 but without a copper disc and without insulation pad. The thermocouples shall be fixed to the back of the steel panels by welding (resistance spot welding). If 500 mm x 500 mm steel panels are used there shall be three thermocouples on the back in the free area of the steel panel: one in the centre and two in the centre of a quarter section (so that the three thermocouples build up a line).

The fire test is finished when the mean temperature of the two thermocouples reaches 500ºC.

A3.2 Short columns

The short column sections shall be supported vertically within the furnace, either installed to the soffit of the furnace cover slabs or stood, directly or on plinths, on the furnace floor.

In the case where short columns are included in the same furnace as a loaded beam or a loaded column and they are placed on the floor of the furnace, the furnace temperature in the region of each column section shall be measured using one plate thermometer placed, on one side of the column, at a distance of 0,5m from the base of column. These thermometers shall be placed as evenly as possible taking into account the location and number of test specimens.

The plate thermometers shall be oriented so that side ‘A’ faces the side walls of the furnace. The insulated parts shall face towards the column.
At the commencement of the test the hot junctions of these thermocouples shall be positioned and maintained throughout the test as specified in EN 1363-1.

Where the short columns are included in the same furnace as a loaded beam and they are fixed to the roof of the furnace the temperature shall be measured using the plate thermometers positioned in the region of the loaded beam test specimen, placed at locations at $^{1}/_{5}$, $^{2}/_{5}$, $^{3}/_{5}$ and $^{4}/_{5}$ of the heated length of the loaded beam, there being two plate thermometers at each location, one on each side of the beam.

A4 Test Report

The time to reach a mean temperature of 500 ºC shall be recorded (on the non-fire side of the steel panel) . For information purposes furthermore, adhesion of the char, char structure and char height shall be described in the test report.
In every case the insulating efficiency of the column under test shall be compared to that of an identical control short column.

A5 Assessment criteria

For insulating efficiency testing on panels, assessment criteria are given in clause 6.7.2.2.2.
For the alternative insulating efficiency testing on short columns, the test result shall not be less than 85% of the control short column. Where the result falls outside this criterion, additional 2 specimens may be tested and assessed. Both specimens shall fulfil the pass criterion (≥ 85%).

ANNEX B

Exposure condition type X

The specimens shall consist of steel panels having a nominal thickness of 5 mm and a minimum size of 300 mm x 200 mm. A minimum of two specimens shall be tested. The reactive coating shall be applied at (1000 ± 100) µm dry film thickness or the maximum thickness if the maximum thickness is lower. For epoxy coatings the dry film thickness shall be 2/3 of the maximum thickness.

The primer and/or the topcoat used (if any) as part of the reactive coating system shall be applied at the dry film thickness that they would be used in practice.

The specimens shall be exposed in a climate chamber to the conditions according to EN ISO 4892-3: 2006, table 4 cycle 3. The samples shall be subjected 112 cycles (= 28 days) without interruption.

The specimens shall then be visually assessed and after that exposed for 2 weeks (2 cycles) to the following procedure:

Day	Time			
	6 hours	6 hours	6 hours	6 hours
1. + 2.	20 °C ± 3°C, 95 % ± 5% R.H.	70 °C± 3°C, 20 % ± 5% R.H	20 °C± 3°C, 95 % ± 5% R.H	70°C ± 3°C, 20 % ± 5% R.H
3. + 4.	20 °C± 3°C, 95 % ± 5% R.H.	30 °C ± 3°C, 40 % ± 5% R.H.	40°C ± 3°C, 95 % ± 5% R.H.	30 °C ± 3°C, 40 % ± 5% R.H.
5. + 6 + 7	-20 °C ± 3°C,	40 °C ± 3°C, 95 % ± 5% R.H.	-20 °C ± 3°C,	40 °C ± 3°C, 95 % ± 5% R.H.

The chamber temperature change shall be at a rate of 1,5 K/min ± 0,5 K/min. During the period of temperature change the change of humidity is not controlled. The duration of temperature change is included in the duration of an exposure phase.

ANNEX C
Exposure condition type Y

The specimens shall consist of steel panels having a thickness of 5 mm and a minimum size of 300 mm x 200 mm. A minimum of two specimens shall be tested. The reactive coating shall be applied at (1000 ± 100) µm dry film thickness or the maximum thickness if the maximum thickness is lower. For epoxy coatings the dry film thickness shall be 2/3 of the maximum thickness.

The specimens shall be exposed for 2 weeks (2 cycles) to the following procedure:

Day	Time			
	6 hours	6 hours	6 hours	6 hours
1. + 2.	20 °C ± 3°C, 95 % ± 5% R.H.	70 °C± 3°C, 20 % ± 5% R.H	20 °C± 3°C, 95 % ± 5% R.H	70°C ± 3°C, 20 % ± 5% R.H
3. + 4.	20 °C± 3°C, 95 % ± 5% R.H.	30 °C ± 3°C, 40 % ± 5% R.H.	40°C ± 3°C, 95 % ± 5% R.H.	30 °C ± 3°C, 40 % ± 5% R.H.
5. + 6 + 7	-20 °C ± 3°C,	40 °C ± 3°C, 95 % ± 5% R.H.	-20 °C ± 3°C,	40 °C ± 3°C, 95 % ± 5% R.H.

The chamber temperature change shall be at a rate of 1,5 K/min ± 0,5 K/min. During the period of temperature change the change of humidity is not controlled. The duration of temperature change is included in the duration of an exposure phase.

ANNEX D
Reaction to fire test

I. Testing according to EN 13823: Reaction to fire tests for building products – Building products excluding floorings exposed to thermal attack by a single burning item

Dimensions of the test rig

Both wings for the SBI tests shall be set up freestanding with a distance of 80 mm in front of the backing board. During the manufacture for the SBI test each sample wing is to be manufactured individually. Assembly of both sample wings shall only be performed on the sample trolley of the SBI testing device. The two wings shall be fixed by a L-steel profile which is screwed to the wings.

Test specimen
Reactive fire protection systems shall be tested applied on a steel substrate of a thickness of at least 2 mm. The surface of the steel plate shall be prepared in accordance with the manufacturer's instructions and recommendations – it could e.g. be sandblasted, shot-blasted, grit-blasted, high-pressure washed, manually prepared or any other. If there is no instruction or recommendation the surface shall be sandblasted.
For testing according to EN 13823 the reactive coating systems with primer, reactive component and with top coat shall be tested.

The set-up shall be tested with all assessed (see 5.0.4) top coats or, if known, with the top coat of which the most unfavourable result is to be expected (e.g. on the basis of formula data, of already existing experience in testing or on the basis of the heat value determination (PCS-value)). To get all possible colours of the top coat a black and red topcoat shall be tested. If the system in practice is used without top coat the test according to EN 13823 shall be done without top coat.

The set-up shall be tested with all assessed (see 5.0.4) primer families or, if known, with the primer of which the most unfavourable result is to be expected (e.g. on the basis of formula data, of already existing experience in testing or on the basis of the heat value determination (PCS-value)). If the system in practice is used without primer the test according to EN 13823 shall be done without primer.
Reactive coating systems shall be tested with the maximum application quantity. Prior to performing the test the samples shall be conditioned in accordance with EN 13238. The dry thickness of the coating shall be measured and recorded at least 20 points for panels of 500 mm x 500 mm and at least 10 point for panels of 200 mm x 300 mm uniformly distributed points prior to testing. For the method see section 5.0.3.

The result of the tests executed in the SBI following the stipulations stated above applies to all application quantities smaller than or equal to the application quantity tested including all top coats and primers on steel substrates with a thickness ≥ 2 mm in the practical application

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

Reactive fire protection systems shall be tested applied on a steel substrate with a thickness of at least 2 mm.
Prior to performing the test the samples shall be conditioned in accordance with EN 13238.

The reactive fire protection system shall be tested with its largest possible application quantity on two samples each with edge and surface flaming. Four more samples shall be tested with the more critical flaming (edge or surface flaming). For products of Class E, 15 seconds exposure shall be used; for products of Class D or above, 30 seconds exposure shall be used.

The set-up shall be tested with all assessed (see 5.0.4) top coats or, if known, with the top coat of which the most unfavourable result is to be expected (e.g. on the basis of formula data, of already existing experience in testing or on the basis of the heat value determination (PCS-value)). To get all possible colours of the top coat a black and red topcoat shall be tested. If the system in practice is used without top coat the test according to EN ISO 11925-2 shall be done without top coat.

The set-up shall be tested with all assessed (see clause 5.0.4) primer families or, if known, with the pri-

mer of which the most unfavourable result is to be expected (e.g. on the basis of formula data, of already existing experience in testing or on the basis of the heat value determination (PCS-value)). If the system in practice is used without primer the test according to EN ISO 11925-2 shall be done without primer.

The result of the tests according to EN ISO 11925-2 applies to all reactive coating systems tested with application quantities smaller than or equal to the application quantity tested including all primers and top coats taken into account for testing on steel substrates with a thickness ≥ 2 mm in the practical application.

III. Testing according to EN ISO 1716 and EN ISO 1182 (if relevant for reactive fire protection systems)

The preparation of the sample and the execution of the test shall be performed in accordance with the stipulations in the standards EN ISO 1716 and EN ISO 1182.

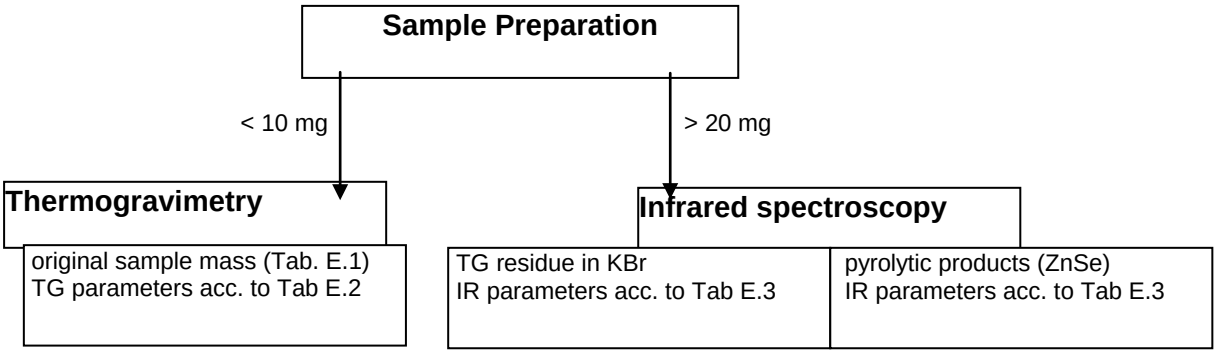
The complete number of specimens with each chemical composition and considering all possible surface coatings is to be tested.

ANNEX E

Reactive Coatings – Determination of identification characteristics

In addition to the determination of physical-chemical data the identification test of fire protective coatings is performed by combining infrared spectrum with thermal analysis of the dried reactive coating.

Scheme of analysis:



SAMPLE PREPARATION

An identical preparation of the samples shall be provided for the thermoanalytical analyses (TG) and infrared-spectroscopy analyses (IR):

- Separation of a representative part quantity (ideally ca. 1g, at least ca. 30 mg) e.g. by means of a scalpel from the fire protective mass
- In the case of a highly heterogeneous sample composition: homogenizing by grinding up in a pot mill or in a mortar – in the case of reaction resin-bound materials, if necessary, by using liquid nitrogen. The required quantity of original sample's mass is then taken from the homogenized mass.
- TG: Original sample's mass without further treatment directly into the sample crucible according to Table E.1: analysis parameter Table E.2.
- IR: Pyrolysis or KBr method according to instructions, analysis parameters Table E.3.

The quantity size of the original sample's mass used for the TG may only be chosen such that an increase in volume occurring with some materials during the process of analysis does not lead under any circumstances to sample components escaping from the sample receptacle.

Table E.1: **Maximum quantity of original sample 's mass recommended as a function of the size of sample receptacle.**

receptacle size / µl	40	70	300	900
max. quantity of original sample's mass/ mg	3	4	10	30

Table E.2: TG parameters for the analysis of fire protective materials

Crucible	standard Alox crucible with perforated lid
Mass of the original sample	see Table E.1
Cleansing gas / Flow	nitrogen / 50 ml/min
Range of temperature	50 – 800 °C
Rate of heating	10 K/min
Graphical representation	both TG and DTG curve

INFRARED SPECTROSCOPY (IR)

Pyrolysis

1. A typical piece of the sample material (approx. 20 – 50 mg, if necessary, reduced to powder) is placed in the lower part of a dry mini-format test tube (8 mm x 70 mm)
2. The tube is covered at its outer upper end with a 1 cm wide filter paper collar wetted with cold water, which is fixed by means of a test tube clamp.
3. The test tube is held with its bottom into a Bunsen flame, which is preferably carried out underneath the exhaust. The test tube remains in the flame (if necessary, turn in and out) until pyrolysis of the sample. The developing steams condensate at the inner side of the test tube edge in the area of paper collar.
4. The condensate is taken with a clean glass rod and uniformly applied directly on a ZnSe crystal. The spectrum is recorded with the parameters according to Table E.3 as reference against an empty crystal.

KBr method

1. 300 mg KBr powder (“spectroscopy grade”) are homogenized with the residue from the TG analysis (maximum 1 mg) e.g. in an agate mortar.
2. The powder is processed in known manner to KBr pressed piece. The inner space of the press total shall be evacuated for 1 to 2 minutes before pressing is done, in order to eliminate air and humidity.
3. The KBr pressed piece is directly analysed at the spectroscope against an identical but empty KBr pressed piece in the reference sample position.

Table E.3: IR parameters for the analysis of fire protective materials

Range of wave number	4000 – 600 cm^{-1}
Dispersion	< 4 cm^{-1}

ANNEX F
List of reference documents

Product specifications

EN 10025-1:	Hot rolled products of structural steels - General technical delivery conditions
EN 10025-2:	Hot rolled products of structural steels - Technical delivery conditions for non-alloy structural steels
EN 10025-3:	Hot rolled products of structural steels - Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels
EN 10025-4:	Hot rolled products of structural steels - Technical delivery conditions for thermo-mechanical rolled weldable fine grain structural steels
EN 10025-5:	Hot rolled products of structural steels - Technical delivery conditions for structural steels with improved atmospheric corrosion resistance
EN 10025-6:	Hot rolled products of structural steels - Technical delivery conditions for flat products of high yield strength structural steels in the quenched and tempered condition
EN ISO 1460:	Metallic coatings – Hot dip galvanized coatings on ferrous materials – Gravimetric determination of the mass per unit area.
EN ISO 1461:	Metallic coatings - Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods.

Test methods and classification standards

EN 1363-1:	Fire Resistance – General Requirements.
EN 1363-2:	Fire Resistance Tests – Part 2: Alternative and Additional Procedures
ENV 13381-4:2002	Test methods for determining the contribution to the fire resistance of structural members, Part 4: Applied passive protection products to steel members
prEN 13381-4:2009	Test methods for determining the contribution to the fire resistance of structural members, Part 4: Applied passive protection products to steel members
EN 13381-8:2010	Test methods for determining the contribution to the fire resistance of structural members – Part 8: Applied reactive protection to steel members
EN 13501-1:	Fire classification of construction products and building elements – Part 1: Classification using test data from reaction to fire tests
EN 13501-2:	Fire classification of construction products and building elements – Part 2: Classification using test data from fire resistance tests
EN 13238	Reaction to fire tests for building products – Conditioning procedures and general rules for selection of substrates
EN 13823	Reaction to fire tests for building products – Building products excluding floorings exposed to the thermal attack by a single burning item
EN ISO 1182	Reaction to fire tests for building products – Non-combustibility tests
EN ISO 1716	Reaction to fire tests for building products – Determination of the heat of combustion
EN ISO 2808	Paints and varnishes – Determination of film thickness
EN ISO 2812-1:	Paints and varnishes – Determination of resistance to liquids Part 1: General methods
EN ISO 3219	Plastics – Polymers/resins in the liquid state or as emulsions or dispersions – Determination of viscosity using a rotational viscometer with defined shear rate
EN ISO 3251	Paints, varnishes and plastics – Determination of non-volatile matter content
EN ISO 4892-3:2006	Plastics – Methods of exposure to laboratory light sources – Part 3: Fluorescent UV lamps
EN ISO 11925-2	Reaction to fire tests for building products – Part 2: Ignitability when subjected to direct impingement of flame
EN ISO 11503	Paints and varnishes – Determination of resistance to humidity (intermittent condensation)
EN ISO 12944-1:1998	Paints and varnishes – Corrosion protection of steel structures by protective paint systems; Part 1: general introduction
EN ISO 13788	Hygrothermal performance of building components and building elements – Internal surface temperature to avoid critical surface humidity and interstitial condensation – Calculation method

ISO 7724-1	Paints and varnishes – Colorimetry; Part 1: Principles
ISO 7724-2	Paints and varnishes – Colorimetry; Part 2: Colour measurement

ANNEX G

Guidance for use of test data reached according to the obsolete ENV 13381-4:2002 for an assessment according to EN 13381-8:2010

This Annex G gives guidance for the use of test data carried out according to ENV 13381-4:2002 in an assessment according to EN 13381-8:2010 Test results from ENV 13381-4:2002 can be used within an assessment of performance to EN 13381-8:2010, if there are sufficient data points provided by ENV 13381-4:2002 testing. If not, then additional testing will be required. The ENV 13381-4:2002 results shall be subject to the adoption of the following review process

Step 1 The thermal data from the ENV 13381-4:2002 testing shall be re analysed in its entirety.

Step 2 The data shall then be corrected in accordance with Annex D of EN 13381-8:2010.

Step 3 Select the desired assessment method and assess the data ensuring that the analysis complies with the Criteria for Acceptability required by EN 13381-8:2010.

Step 4 Ensure that any extensions of the resulting assessment comply with the requirements of EN 13381-8:2010

Step 5 If the scope of the ENV 13381-4:2002 tests includes hollow columns then the additional testing of a loaded hollow column and short columns shall be carried out in accordance with the requirements of EN 13381-8:2010 before assessment can be carried out.

Step 6 If the scope is to be extended further beyond the original ENV 13381-4:2002 testing then any additional tests shall be carried out in accordance with the test specimen requirements of Table 6.6.1 of EN 13381-8:2010 and all the data shall be used for assessment. The number of short sections shall comply with the requirements of EN 13381-8:2010.

ANNEX H

Guidance for the measurement of the dry film thickness of the intumescent layer and the limits on site

The coating thickness acceptance criteria shall be as follows, based on the required thickness stated in the schedule of thickness, being a nominal value:

1) The mean dry film thickness applied to each element shall be greater than or equal to the specified nominal value.
2) The mean of the measured dry film thickness on any face of any member shall not be less than 80% of the specified nominal value
3) Dry film thickness values less than 80% of the specified nominal value are acceptable, provided that such values are isolated and that no more than 10% of the readings on a member are less than 80% of the specified nominal value.

   Where any single thickness reading is found to be less than 80% of the specified nominal value, a further two, or where possible three, readings shall be taken within 150 mm to 300 mm of the low reading. The initial reading may be considered isolated if all the additional readings are at least 80% of the specified nominal value. If one or more of the additional readings are less than 80% of the specified nominal value, further readings shall be made to determine the extent of the area of under thickness.
4) All dry film thicknesses shall be at least 50% of the nominal value