EUROPEAN ASSESSMENT DOCUMENT

EAD 350865-00-1106

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FIRE RETARDANT PRODUCTS

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

Contents

1 SCOPE OF THE EAD

1.1 Description of the construction product

This EAD covers in situ applied paints, coatings, varnishes and surface impregnations intended to improve one or more of the reaction to fire performance characteristics of a surface of a construction product.

The following different types of coating material are covered by the EAD:

- paint and varnish (single or multilayer, primer / undercoat / top coat),
- intumescent (with or without top coating),
- encapsulation coating systems,
- surface treatments with liquids.

The fire retardant products covered by this EAD may consist of one or more different layers which can be combined in an assembled system. The ETA will cover at least one fire retardant layer and will include the specification of the other layers to enable the applied system to achieve the claimed fire performance.

This EAD is not applicable to:

- a fire retardant impregnated into a product and a paint or varnish applied to a product before that product is placed on the market (the fire performance of such a product is assessed in accordance with the relevant product Technical Specification),
- fire protective products for resistance to fire contribution (e.g. linear joint and gap seals covered by EAD 350141-00-1106, penetration seals covered by EAD 350454-00-1104, reactive coatings for steel elements covered by EAD 350402-00-1106 or renderings covered by EAD 350140-00-1106), which improve the fire resistance performance of elements to which they are applied,
- coatings and impregnations applied to textiles and cables.

The product is not covered by a harmonised European standard (hEN).

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

It is assumed that the product will be installed according to the manufacturer's instructions.

Note: the application conditions of the fire retardant are crucial to achieve the reaction to fire performance.

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

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

1.2.1 Intended use(s)

Fire retardant products are intended to be put on the market separately from the products or building elements to which they are intended to be applied. They are applied in situ.

Two applications are defined, since there are different fire tests for each one:

- construction products excluding floorings,
- floorings.

The following end use categories are defined in relation to environmental conditions:

- Type X: fire retardant products intended for all conditions (internal, semi-exposed and exposed),

- Type Y: fire retardant products intended for internal and semi-exposed conditions. Semi-exposed includes temperatures below zero, but no exposure to rain and limited exposure to UV (UV is not assessed),
- Type Z_1: fire retardant products intended for internal conditions (excluding temperatures below zero) with high humidity[1],
- Type Z_2: fire retardant products intended for internal conditions (excluding temperatures below zero) with humidity classes other than Z_1.

Note: Products for environmental use conditions type X can also be used for all other types without further assessment. Products for conditions type Y can also be used for type Z_1 and Z_2 without further assessment. Products for conditions type Z_1 can also be used for type Z_2 without further assessment.

1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of the fire retardant product for the intended use of 5 years when installed in the works (provided that the fire retardant product is subject to appropriate installation). These provisions are based upon the current state of the art and the available knowledge and experience.

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

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

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

1.3.1 Fire retardant product

A product supplied in liquid or in paste or powder form, that, when applied to a substrate, improves one or more of the reaction to fire performance characteristics of the substrate.

Note: Such products may have other defined performance not covered by the EAD.

1.3.2 Intumescent coating

A coating which is specifically formulated to provide a chemical reaction upon heating such that the physical form changes into an expanded foam, and in so doing provides protection to the underlying surfaces from fire.

1.3.3 Encapsulation coating system

A coating system which when applied completely encases a surface to a thickness of at least 1 mm.

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

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

1.3.4 Surface impregnation treatment (on site)

A product in liquid or paste form that, when applied to a substrate, penetrates below the surface and, on drying or curing, deposits substances that impart fire retardant properties to the substrate. The performance of such products depends on the combination of depth of penetration and amount (loading) of fire retardant substances deposited.

1.3.5 Topcoat

Material applied to the surface of the fire retardant coating as protection against environmental degradation and also for decorative purposes.

1.3.6 Exposed

Subject to extremes of temperature, UV light and rain.

1.3.7 Semi-exposed

Subject to extremes of temperature possibly in some areas to UV light but not to rain (UV not assessed).

1.3.8 Internal

Not subject to extremes of temperature, rain or UV light but may be exposed to high humidity.

1.3.9 Product family

Range of products within defined limits of variability of the product parameters and, if relevant, end use parameters, for which the reaction to fire classification remains unchanged (does not get worse).

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

All undated references to standards in this EAD are to be understood as references to dated versions listed in clause 4.

2.1 Essential characteristics of the product

Table 1 shows how the performance of the fire retardant product is assessed in relation to the essential characteristics.

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

No	Essential characteristic	Assessment method	Type of expression of product performance *(level, class, description)*
Basic Works Requirement 2: Safety in case of fire			
1	Reaction to fire	Clause 2.2.1	Class
2	Durability[3]	Clause 2.2.2	Description
3	Serviceability of floorings	Clause 2.2.3	Description
Basic Works Requirement 3: Hygiene, health and the environment			
4	Content, emission and/or release of dangerous substances	Clause 2.2.4	Description

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

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

The test and assessment methods prescribed by this EAD do not relate to the fire retardant product alone, but also to the products which are treated in situ with the fire retardant product. The application of the fire retardant product during the process of sampling and test specimens preparation, as well as the application control (e. g. determination of application rates), plays a fundamental role with regard to the performance to be determined.

The test specimens shall be prepared and controlled in such a way that –in addition to the test results according to the relevant test standard– the following information is available as basis for the assessment:

3 Durability assessment is only related to the reaction to fire performance.

a) description of the substrate (type, reaction to fire class, product standard – if possible),
b) measured values of thickness and density / weight per unit area of the substrate before commencing the application of the fire retardant product,
c) application rate of the fire retardant product (wet weight / coverage) and number of the coats,
d) description of the application process,
e) wet weight per unit area of the treated substrate measured directly after finishing of the application,
f) weight per unit area of the treated substrate after curing and before start of the conditioning, and
g) results of all measurements during the conditioning of the specimens until mass constancy is reached.

2.2.1 Reaction to fire

The fire retardant product (in combination with the product/substrate which is treated) shall be tested using the test methods relevant for the corresponding reaction to fire class according to EN 13501-1 and classified according to Commission Delegated Regulation (EU) No 2016/364 in connection with EN 13501-1.

The procedures for mounting and fixing the products for the specific test methods are given in Annex A. The test specimens shall be allowed to 'cure' for at least one week or as advised by the manufacturer and then conditioned to constant mass according to EN 13238, section 4.2.

2.2.2 Durability

Durability of fire performance is assessed by subjecting test specimens to fire tests in accordance with ISO 5660-1, then further specimens are subjected to ageing procedures then fire tested again to ISO 5660-1. All details of these procedures are given in Annex B. The test specimens shall be allowed to 'cure' for at least one week or as advised by the manufacturer and then conditioned to constant mass according to EN 13238, section 4.2.

After undergoing the ageing procedures, the averaged fire performance of the test specimens shall not deviate by more than the criteria provided in Table 2 from the averaged fire performance of those specimens which had not been subjected to ageing procedures.

Table 2 Durability of fire performance

Fire performance	**Building products excluding floorings**	**Floorings**
Test conditions: Heat flux	50 kW/m^2	30 kW/m^2
Assessment criteria: Rate of Heat Release (RHR) and Total Heat Release (THR)	Class B or B_{fl} products: $RHR_{30s,ave}$ ≤ 150 kW/m^2 during 600s after ignition and THR_{600s} increase < 20 % compared to testing before the exposure. Class C or C_{fl} products: $RHR_{30s,ave}$ ≤ 220 kW/m^2 during 600s after ignition and THR_{600s} increase < 20 % compared to testing before the exposure.	

2.2.3 Serviceability of floorings

This EAD does not include assessment methods related to the resistance to chemicals.

For floorings, the serviceability of the fire retardant product shall be tested to EN ISO 7784-2 which is a method for determining the abrasion resistance of a dry film of paint, varnish or related products using a rotating abrasive rubber wheel. Fire retardant floorings shall be abraded to the above method using a wheel with harsh abrasive action (for floorings resistant to pedestrian traffic) for 1000 cycles with a 1 kg applied load.

Note: The volume of pedestrian traffic represented relates to that which would be experienced in supermarkets, shopping centres, etc.

Ten square specimens of sides 100 (+0,-2) mm shall be prepared by applying the fire retardant coating to one face of a representative substrate. A central hole (diameter as specified in EN ISO 7784-2) shall be made in each of the specimens. Five of the specimens shall be subjected to the Taber Abrader Method specified above. Following this test, any dust shall be removed from the surface of the specimens.

The abraded and non-abraded specimens shall all be tested in accordance with ISO 5660-1. Details of these procedures are given in Annex B. The test specimens shall be allowed to 'cure' for at least one week or as advised by the manufacturer and then conditioned to constant mass according to EN 13238, section 4.2.

The central hole within all the specimens shall be filled with a Class A1 material (an appropriate product would be a sodium silicate paste). The specimens shall be placed within the specimen holder directly onto the ceramic fibre insulation, and a retaining frame placed over the specimen.

All specimens shall be conditioned to constant mass in accordance with EN 13238. The specimens shall be wrapped in aluminium foil and a ring of foil removed of the same diameter as the abraded area to expose the surface of the flooring. The conical heater on the ISO 5660-1 apparatus shall be set to give a heat output of 30 kW/m^2. The duration of the test shall be 12 minutes and the mean values calculated over a 10 minute period.

After being abraded, the averaged fire performance of the test specimens shall not deviate by more than the criteria provided in Table 3 from the averaged fire performance of those specimens which had not been subjected to the abrading procedures.

Table 3 Fire performance of floorings in service

Fire performance	**Floorings**
Test conditions: Heat flux	30 kW/m^2
Assessment criteria: Rate of Heat Release (RHR) and Total Heat Release (THR)	Class B_{fl} products: $RHR_{30s,ave}$ ≤ 150 kW/m^2 during 600s after ignition and THR_{600s} increase < 20 % compared to testing before abrading. Class C_{fl} products: $RHR_{30s,ave}$ ≤ 220 kW/m^2 during 600s after ignition and THR_{600s} increase < 20 % compared to testing before abrading.

2.2.4 Content, emission and/or release of dangerous substances

The performance of the product related to the emissions and/or release and, where appropriate, the content of dangerous substances will be assessed on the basis of the information provided by the manufacturer[4] after identifying the release scenarios (in accordance with EOTA TR 034) taking into account the intended use

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

The manufacturer is not obliged:

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

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

of the product and the Member States where the manufacturer intends his product to be made available on the market.

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

IA1: Product with direct contact to indoor air.

IA2: Product with indirect contact to indoor air (e.g. covered products) but possible impact on indoor air.

S/W2: Product with indirect contact to soil, ground- and surface water.

2.2.4.1 SVOC and VOC

For the intended use covered by the release scenarios IA1 and IA2 semi-volatile organic compounds (SVOC) and volatile organic compounds (VOC) are to be determined in accordance with EN 16516.

The loading factor to be used for emission testing can be taken from the following table.

Table 4 Loading factor L, depending on the product type (in accordance with EN 16516)

Intended use	Loading factor [m^2/m^3]
Walls	1,0
Floor, ceiling	0,4
Small surfaces e.g. door, window, heating system	0,05
Very small surfaces, e.g. sealants	0,007

The preparation of the test specimen is performed on an inert substrate (glass or stainless steel) or an appropriate substrate being representative for soaking substrates in end-use applications. The test specimens shall be allowed to 'cure' for at least one week or as advised by the manufacturer and then, if necessary, immediately conditioned according to EN 16516 to enable the specimens to acquire properties representing in end-use conditions. This conditioning (duration, temperature and humidity) will depend on the chemical nature of the product, as defined in the manufacturer's instructions and in his additional information to the TAB, and will be stated in the ETA.

The coating shall be carried out exactly in accordance with the manufacturer's specifications. Environmental conditions and drying time have to be reported. Cross contaminations shall be avoided.

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

The product performance shall be expressed in [mg/m^3 or $\mu g/m^3$] and stated in the ETA.

2.2.4.2 Leachable substances

For the intended use covered by the release scenario S/W2, the leachable substances are to be determined in accordance with CEN/TS 16637-2:2014.

A leaching test with subsequent eluate analysis must take place, each in duplicate. Leaching tests of the fire retardant product, in end use conditions as specified by the manufacturer, are to be performed according to CEN/TS 16637-2:2014. The leachant shall be pH-neutral demineralised water and the ratio of liquid volume to surface area must be (25 ± 5) l/m^2.

The fire retardant product applied to the substrate must be tested. The edges are not sealed. The cut edges of test specimen exposed to the eluent should be included in the calculation as a leachable area.

In eluates of "6 hours" and "64 days", the following biological tests shall be conducted:

- Acute toxicity test with Daphnia magna Straus according to EN ISO 6341.
- Toxicity test with algae according to ISO 15799.
- Luminescent bacteria test according to EN ISO 11348-1, EN ISO 11348-2 or EN ISO 11348-3.
- For each biological test, EC20-values shall be determined for dilution ratios 1:2, 1:4, 1:6, 1:8 and 1:16.

If the parameter TOC is higher than 10 mg/l, the following biological tests shall be conducted with the eluates of "6 hours" and/or "64 days" eluates:

- Biological degradation according to OECD Test Guideline 301 part A, B or E.

Determined toxicity in biological tests must be expressed as EC20-values for each dilution ratio. Maximum determined biological degradability must be expressed as "…% within …hours/days". The respective test methods for analysis must be specified.

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

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

For the products covered by this EAD the applicable European legal act is: Decision 1999/454/EC as amended by Decision 2001/596/EC.

The system is: 1.

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 5.

Table 5 Control plan for the manufacturer; cornerstones

No	Subject/type of control *(product, raw/constituent material, component - indicating characteristic concerned)*	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC)					
1	Percentage solids	EN ISO 3251	Control Plan	[1]	Every batch
2	Viscosity	EN ISO 2884, EN ISO 3219	Control Plan	[1]	Every batch
3	Density	EN ISO 2811-1	Control Plan	[1]	Every batch
4	Sag resistance	EN ISO 16862	Control Plan	[1]	Every batch
5	Ash content	EN ISO 14680-2, EN ISO 3451-1	Control Plan	[1]	Every batch
6	Drying	EN ISO 9117-3 (surface), EN ISO 9117-1 (through dry)	Control Plan	[1]	Every batch
7	Brightness (gloss)	EN ISO 2813	Control Plan	[1]	Every batch
8	pH	ISO 19396-1 or ISO 19396-2	Control Plan	[1]	Every batch
9	Abrasion	ISO 7784-2 CS17 wheel for 1000 cycles with a 1 kg applied load	For floorings. Control Plan	[1]	Every 10 batches or at least once per month
10	Reaction to fire	3.4	Control Plan	[1]	Every batch
11		ISO 5660-1 or EN 13823	Control Plan	[2]	Once per year

[1] The final number of specimens is to be defined in the Control Plan.

[2] For the control method according to EN 13823, the minimum number of samples is 1 (indicative SBI).

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance for fire retardant products are laid down in Table 6.

Table 6 Control plan for the notified body; cornerstones

No	Subject/type of control *(product, raw/constituent material, component - indicating characteristic concerned)*	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control *(for system 1)*					
1	The notified body shall verify the ability of the manufacturer for manufacturing the product in accordance with the control plan. In particular the following items shall be appropriately considered - personnel and equipment - the suitability of the factory production control established by the manufacturer - full implementation of the prescribed test plan Special attention should be paid to the control of the composition and to those characteristics of the finished product related to the reaction to fire performance (e.g. result of fingerprinting tests, cf. cl. 3.4), as defined in the Control Plan depending on the product nature.	As defined in the control plan	As defined in the control plan	As defined in the control plan	When starting the production process, after its modification and when starting a new production line
Continuous surveillance, assessment and evaluation of factory production control *(for system 1)*					
2	It shall be verified that the system of factory production control and the specified manufacturing process are maintained in accordance with the control plan. In particular the following should be dealt with - inspection of factory, of the production of the product and of the facilities for factory production control - evaluation of the documents concerning factory production control - issuing a report of surveillance Special attention should be paid to the control of the composition and to those characteristics of the finished product related to the reaction to fire performance (e.g. results of fingerprinting tests, cf. cl. 3.4), as defined in the Control Plan depending on the product nature.	As defined in the control plan	As defined in the control plan	As defined in the control plan	Twice a year [1]

[1] Frequency can be reduced if the Notified Body confirms that production and FPC are in accordance with the Control Plan and the constancy of performance is maintained. Frequency can also be increased in the case that the outcome of the inspections is not satisfactory.

3.4 Special method of control and testing used for verifying the constancy of performance

Reaction to fire is a material characteristic[5] depending on the chemical composition. Identic chemical composition generates the same product properties determining the reaction to fire and, therefore, controlling that the product composition is not changed, it can be verified that the performance of the product remains constant. By doing so, a direct control of reaction to fire is only necessary once per year.

The Fingerprinting methods given in 3.4.1 provide accurate graphs of a specific composition, without showing the product formulation. Test results must comply with the initial data established in the control plan. If deviations are detected, classification must be checked.

3.4.1 Fingerprinting methods for verifying the constancy of performance

3.4.1.1 General

The fire protective product shall be tested by combining the infrared spectrum and the thermal analysis of the dried product.

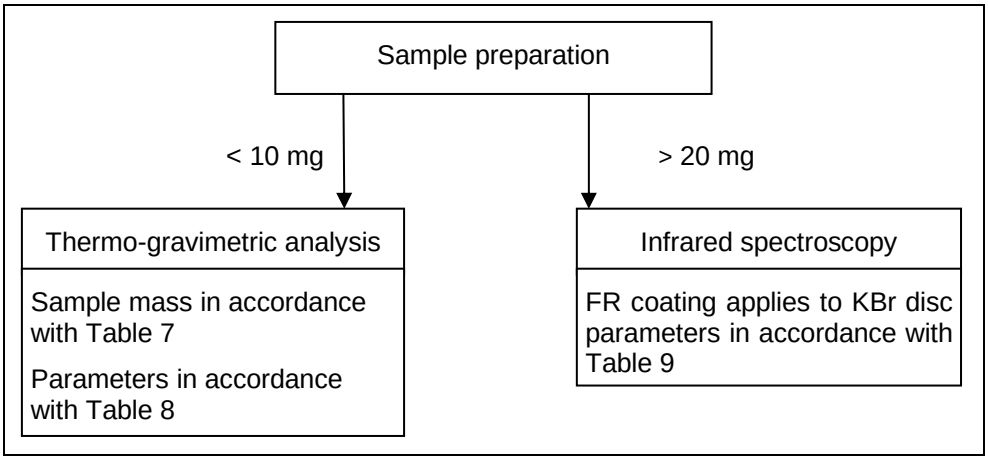

Figure 1: Scheme of analysis.

3.4.1.2 Sample preparation

An identical preparation of the samples shall be provided for the thermo-analytical and infrared spectroscopy analyses:

- Separation of a representative quantity of fire retardant product (ideally approximately 1 g but not less than 30 mg). This can be achieved for example, by means of a scalpel from the applied and dried fire retardant coating component. In order to dry the fire retardant product, pour some of the product into a small Petri dish and place in a warm atmosphere or apply to a sheet of glass and allow to dry as appropriate.
- In the case of a highly heterogeneous sample composition: homogenize the sample by grinding in a mill or mortar. The required quantity of sample is then taken from the homogenized mass.
- TG: Sample, without any further treatment is placed directly into the sample crucible according to Table 7. The results shall be analysed in accordance with Table 8.
- IR: KBr method. The results shall be analysed in accordance with Table 9.

[5] Other factors have an influence on the reaction to performance (such as the characteristics of the substrate on which the fire retardant is applied or the product application process). However, these factors are not object of the AVCP under EAD 350865-00-1106.

The sample mass used for the thermo-gravimetric analysis shall be chosen such that any increase in volume occurring with some fire retardant materials during the process of analysis does not lead, under any circumstances, to sample components escaping from the sample receptacle.

Table 7 Maximum sample mass recommended as a function of the size of sample receptacle

Receptacle size (µl)	40	70	300	900
Max. quantity of original sample mass (mg)	3	4	10	30

3.4.1.3 Parameters for thermo-gravimetric analysis of fire retardant products

The parameters given in Table 8 shall be used for the thermo-gravimetric analysis of fire retardant products.

Table 8 TG parameters for the analysis of fire retardant products

Crucible	Standard Alox crucible with perforated lid
Original sample mass	See Table 7
Cleansing gas / flow	Nitrogen, 50 ml/min
Range of temperature	50 °C – 800 °C
Rate of heating	10 K/min
Graphical representation	Both TG and DTG curve

3.4.1.4 Infrared Spectroscopy

3.4.1.4.1 General

The following method is recommended to qualify the chemical nature of the fire retardant product. The parameters for the infrared analysis are given in Table 9.

3.4.1.4.2 Infrared spectroscopy of the fire retardant product film

Apply a thin coating of the fire retardant coating to a KBr disc producing a thin film. The coated KBr disc is run directly against an identical but blank KBr disc in the reference sample position.

Table 9 IR parameters for the analysis of fire protective materials

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

It is possible to combine these two methods of analysis by carrying out an infrared analysis of the TGA residue. In this instance, a KBr disc shall be formed using a homogenized mix of residue and KBr.

3.4.2 Expansion ratio

If the product assessed is an intumescent coating, the infrared spectroscopy can be replaced by the control of the expansion ratio.

The expansion ratio shall be determined on at least 3 specimens to verify the ability of the material to create a foam/char in the event of fire. The test specimens consist of steel sheet discs of minimum diameter 50 mm, coated with the intumescent coating at a defined dry film thickness, that shall be measured according to EN ISO 2808 at the centre of the specimen and at four symmetrically placed points approximately 10 mm from the edge of the specimen.

The principle of testing the expansion ratio is to expose an intumescent material to a certain temperature for a certain duration, restrict the expansion to one direction, measure the final thickness after expansion (foam height) and express it in relation to the original thickness before heat exposure.

The specimens shall be placed into a test device (e.g. a pipe according to EN 10216-5, wall thickness 2 mm) and introduced during 30 minutes into a temperature controlled muffle oven, pre-heated to 500ºC (or another determined temperature appropriate for the intumescent coating).

Following the heat exposure, the final thickness shall be determined after expansion with an accuracy of 0,1 mm at the centre of the disc and at four symmetrically placed positions ca. 10 mm from the edge of the specimen. The mean value should be recorded together with the standard deviation.

The expansion ratio is the relation between the final thickness (foam height) and the original dry film thickness.

4 REFERENCE DOCUMENTS

EN 13238:2010	Reaction to fire tests for building products - Conditioning procedures and general rules for selection of substrates
EN 13501-1:2018	Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests
EN 13823:2010 +A1:2014	Reaction to fire tests for building products - Building products excluding floorings exposed to the thermal attack by a single burning item
EN 16516:2017	Construction products: Assessment of release of dangerous substances - Determination of emissions into indoor air
EN 520:2004+A1:2009	Gypsum plasterboards - Definitions, requirements and test methods
EN ISO 11925-2:2010 /AC:2011	Reaction to fire tests - Ignitability of products subjected to direct impingement of flame - Part 2: Single-flame source test
EN ISO 13788:2012	Hygrothermal performance of building components and building elements - Internal surface temperature to avoid critical surface humidity and interstitial condensation - Calculation methods
EN ISO 14680-2:2006	Paints and varnishes - Determination of pigment content - Part 2: Ashing method
EN ISO 16862:2006	Paints and varnishes - Evaluation of sag resistance
EN ISO 2811-1:2016	Paints and varnishes - Determination of density - Part 1: Pycnometer method
EN ISO 2813:2014	Paints and varnishes - Determination of gloss value at 20°, 60° and 85°
EN ISO 2884-1-2:2006	Paints and varnishes - Determination of viscosity using rotary viscometers
EN ISO 3219:1994	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 3251:2008	Paints, varnishes and plastics - Determination of non-volatile-matter content
EN ISO 3451-1:2008	Plastics - Determination of ash - Part 1: General methods
EN ISO 7784-2:2016	Paints and varnishes - Determination of resistance to abrasion - Part 2: Method with abrasive rubber wheels and rotating test specimen
EN ISO 9117-1:2009	Paints and varnishes - Drying tests - Part 1: Determination of through-dry state and through-dry time
EN ISO 9117-3:2010	Paints and varnishes - Drying tests - Part 3: Surface-drying test using ballotini
EN ISO 9239-1:2010	Reaction to fire tests for floorings - Part 1: Determination of the burning behaviour using a radiant heat source
EOTA TR 034	General BWR3 Checklist for EADs/ETAs - Dangerous substances. October 2015.
ISO 19396-1:2017	Paints and varnishes - Determination of pH value - Part 1: pH electrodes with glass membrane.
ISO 19396-2:2017	Paints and varnishes - Determination of pH value - Part 2: pH electrodes with ISFET technology.
ISO 5660-1:2015	Fire tests - Reaction to fire - Part 1: Rate of heat release from building products - (Cone calorimeter method)

ANNEX A – MOUNTING AND FIXING FOR REACTION TO FIRE TESTS

A.1 Substrates

A.1.1 General

Three substrates are identified for testing purposes:

- pre-coated (not defined in EN 13238),
- timber based e.g. particleboard or plywood (as defined in EN 13238) or end use specific,
- end use substrate with a defined fire performance as previously tested (representative only of itself).

A.1.2 Pre-coated substrate

When the fire retardant coating is applied on previous existing coatings, without removing them, this has been recognised as a potential fire hazard and a pre-coated multilayer substrate can be used to provide an end use behaviour which gives rapid fire growth. Surface coatings shall be applied to this type of substrate which are intended to upgrade this fire performance.

A multilayer pre-coated substrate is representative of coated surfaces of concrete, brick, breezeblock, and other masonry, plaster, paper-faced and skimmed plasterboard. It is not representative of coated combustible substrates.

A typical pre-coated substrate could consist of 10 layers of assorted types of paint on 12,5 mm thick paper-faced plasterboard. This substrate has Class F performance according to EN 13501-1 due to the very rapid surface flame spread and immediate release of heat and its ease of ignition.

Table A.1 Typical specification of standard multilayer painted substrate

Type of substrate	Gypsum plasterboard with a density of 700 kg/m^3 ± 100 kg/m^3 with paper facing of 200 g/m^2 ± 20 g/m^2 in accordance with EN 520 type A
Thickness of substrate	12,5 mm ± 0,5 mm
Typical performance to EN 13823	2500 W/s < FIGRA$_{0,4MJ}$ < 3500 W/s 4 MJ < THR600s < 8 MJ 50 m^2/s^2 < SMOGRA < 120 m^2/s^2 50 m^2 < TSP600s < 80 m^2
Typical performance to EN ISO 11925-2	Flame spread > 150 mm during 15 s after flame application

The board consists of ten layers of paint each applied individually and within a defined time period of 7 days during which each individual paint layer dries and cures to ensure absolute individuality of layers. Table A.2 provides a description of the paint used for each layer of the substrate which when produced will give the defined characteristics.

Table A.2 Paint layers for multilayer painted substrate

Coat No.	Description of material	Type	Wet application rate (g/m²)
1	Stabiliser	Cellulose based	230 – 240
2	Gloss paint	Cellulose based	230 – 240
3	Undercoat	Cellulose based	230 – 240
4	2 pack lacquer	Polyurethane based	230 – 240
5	Gloss paint	Oil based	115 – 120
6	Gloss paint	Oil based	115 – 120
7	2 pack lacquer	Polyurethane based	230 – 240
8	Isolator	Cellulose based	230 – 240
9	Gloss paint	Cellulose based	230 – 240
10	Gloss paint	Cellulose based	230 – 240

A.2 General guidance on preparing test specimens

The test specimen shall fully represent the end use coating system utilising all the envisaged components in the end use condition as specified by the manufacturer.

Each different coating system, as placed on the market, requires testing following the manufacturer's instructions. The assembly including corner details (for the SBI test) shall be as specified by the manufacturer and in accordance with the end use conditions.

Influences of different colours of coatings can be determined by performing tests on the lightest and darkest colour, and the deepest red (e.g. CIELAB 40.51, 59.28, 47.98; RGB 184, 29, 19; Munsell ref. 7.5R 4/13; RAL 3020; or BS04E56).

Where formulations are identical but simply carry a different label and can be identified as being of the same formula from a factory audit, duplicate testing is not required.

Where the coating system may be used on different substrates, the general rules for the selection of substrates given in EN 13283, section 5, shall be applied. The coating shall be applied only to the surface of the substrate and to all edges.

A.3 Mounting and fixing procedures for testing to EN 13823

The test rig consists of a corner with a long (1,0 m) and a short (0,5 m) wing. The dimensions of the test specimens shall be as follows.

Table A.3 EN 13823 test specimen dimensions

Wing	Length (mm)	Height (mm)
Short	495	1500
Long	1000	1500

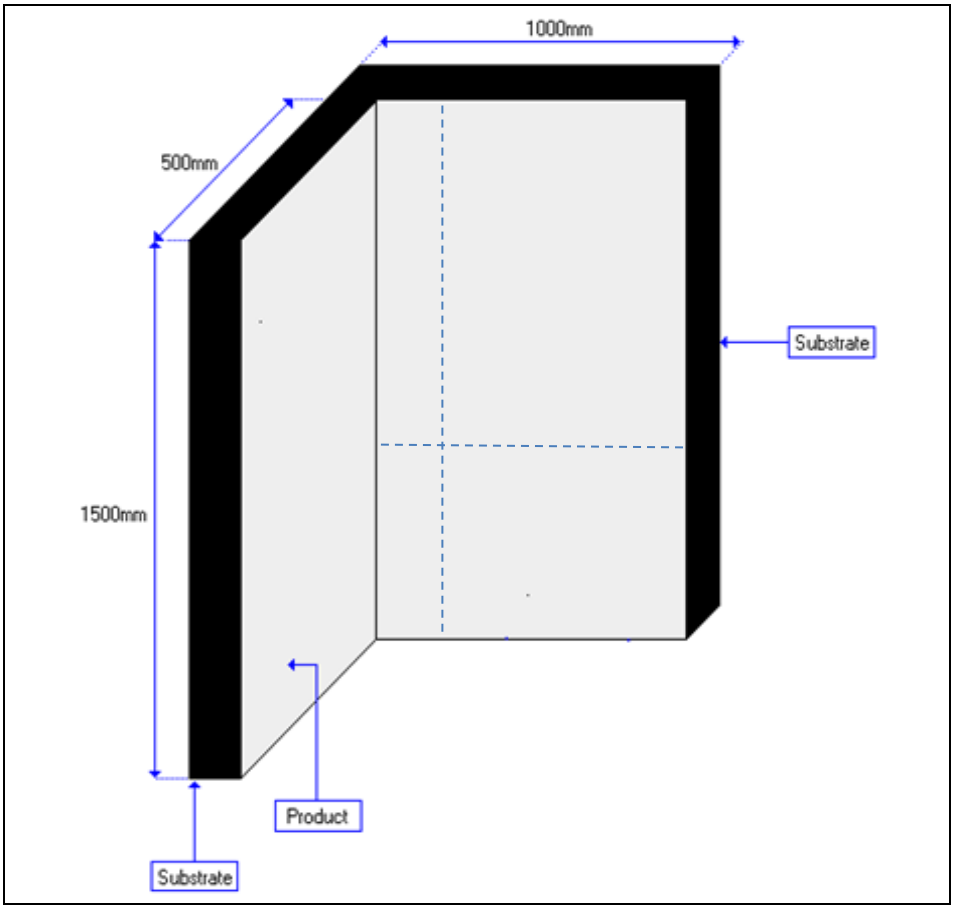

Figure A.1 Schematic arrangement in EN 13823

When testing to EN 13823, the test assembly shall be representative of end use conditions. The first 200 mm depth in the end use assembly are important and can affect the fire performance of surface coatings. It is therefore necessary that the assembly upon which surface coatings will be used is considered when determining the mounting and fixing conditions for fire tests to EN 13823. Under end use conditions, a number of different substrates may be found, the most common of which are plasterboard, concrete and wood (of several different types). The rules specified in EN 13238 shall apply. None of these substrates relates to previously painted substrates, which will need to be addressed separately.

The mounting and fixing of the fire retardant coatings shall therefore take these rules into consideration and the test specimen shall consist of the coating system applied to the chosen substrate which for A1 and A2 substrates shall be placed directly against the backing board. The panels shall be prepared separately and butt jointed together. Vertical and horizontal joints are not necessary. The coatings shall be applied to the front surface and to the edges of the chosen substrate.

In the case that the substrate to which the fire retardant is applied may have joints in end use conditions, joints will be included in the substrate to be tested according to the specification given in EN 13823, clause 5.2. The tested joint width will be the maximum joint width for which the obtained results are valid.

It should also be noted that the substrates may in end use conditions have an air gap immediately behind and this shall be taken into account when testing as the air gap may influence the burning behaviour of the assembly. If a ventilated air gap is used in the test, the result is also valid for a non-ventilated air gap.

The choice of the substrate is for the manufacturer with the advice and guidance of the TAB. This will have a direct bearing on the end use application of the product.

A.4 Mounting and fixing procedures for testing to EN ISO 11925-2

When testing to EN 11925-2, the substrate upon which the surface coating is applied can affect the coating's fire performance. It is therefore necessary that the substrate used is representative of the worst case substrate upon which the surface coating may be found. According to the rules specified in EN 13238, if a particle board is used then the test results apply to all wood, and any A1 or A2 substrate, of 75 % of density of the particleboard and above and thicknesses which are identical or greater. If plasterboard is used then this applies to all A1 and A2 substrates but not wood.

The choice of the substrate is for the manufacturer and the TAB to agree. This will have a direct bearing on the end use application of the product. The substrate for this test shall be that also used in the EN 13823 or the EN ISO 9239-1 test.

The substrate shall be (250 +0,-2) mm long by (90 +0,-1) mm wide. The coating shall be applied to the front face and to all sides of the substrate. No backing board is required by this test. The EN ISO 11925-2 test shall be conducted using surface application only.

A.5 Mounting and fixing procedures for testing to EN 9239-1

When testing to EN ISO 9239-1, the test assembly shall be representative of end use conditions. The first 100 mm depth in the end use assembly are important and can affect the fire performance of surface coatings. It is therefore necessary that the assembly upon which surface coatings will be used is considered when determining the mounting and fixing conditions for fire tests to EN ISO 9239-1. Under end use conditions, a number of different substrates may be found, the most common of which are concrete and wood (of several different types). The rules specified in EN 13238 shall apply. None of these substrates relates to previously painted substrates, which will need to be addressed separately in accordance with the provisions given in section A.1 of this Annex.

The mounting and fixing of the fire retardant coatings shall therefore take these rules into consideration and the test specimen shall consist of a coating system applied to the chosen substrate. Three specimens of (1050 ± 5) mm × (230 ± 5) mm shall be prepared, the coatings shall be applied to the front surface and to the edges of the chosen substrate.

A.6 End use application rules

A.6.1 General

The manner in which the product is tested has a direct consequence upon the manner in which the product or product family may be classified and used within a building construction. When determining the testing programme, all aspects of the product in terms of its own parameters and its end use parameters need to be considered. For fire retardant products, the following provides guidance on the potential end use application rules which may apply dependant on the testing programme undertaken. If different classifications are obtained, additional testing shall be conducted to redefine the product family to which a single classification applies.

A.6.2 Influence of colour

If the tests conducted on the darkest and lightest colours, and the deepest red (e.g. CIELAB 40.51, 59.28, 47.98; RGB 184, 29, 19; Munsell ref. 7.5R 4/13; RAL 3020; or BS04E56), yield the same classification, that classification will apply to all colours. If a red pigmented product is not part of the range of colours for a particular product family, the intermediate test shall be conducted on the product containing the highest organic content.

A.6.3 Influence of substrate

The substrate used to support the surface coating system in the reaction to fire tests determines the type of substrate, according to EN 13238, to which the fire retardant coating system may be applied in end use.

A.6.4 Influence of coating application rates

If the coating may be applied at varying application rates, and tests conducted on the minimum and maximum quantities applied yield the same classification, that classification will apply to all the intermediate coating application rates.

A.6.5 Influence of air gap

If the product is tested with a ventilated cavity the results shall apply to both open and closed cavities and to situations where there is no air gap in end use configurations.

A.6.6 Influence other variables

Other variable parameters, such as organic content, may be addressed in a similar manner to the above.

ANNEX B – ASSESSMENT OF DURABILITY OF FIRE PERFORMANCE

B.1 General

The durability of fire retardant products depends from the conditions in service such as:

- variations in temperature,
- variations of relative humidity, rain,
- radiation from the sun (UV exposure).

With reference to the end use categories defined in 1.2.1, the weathering conditions in Table B.1 shall be used.

Table B.1 Weathering conditions for end use categories

End use condition	**X**	**Y**	**Z_1**	**Z_2**
Weathering conditions	T H R UV	T H	T H	T H
T = temperature, H = humidity, R = rain, UV = ultra violet.				

B.2 Specimen preparation

The fire retardant coating shall be applied to one face of a representative substrate. The coated substrate shall be cut to provide at least 10 specimens. The specimens shall be square, the sides having a dimension of (100 +0,-2) mm. Five of these specimens shall be subjected to tests in accordance with B.4 and a further five specimens shall be subjected to environmental conditioning cycles.

The specimens shall be protected by suitable means such that only a square area of sides (95 +0,-2) mm on the coated surface is exposed and all other faces are covered and water penetration into the substrate is prevented. One method by which this may be achieved is for the specimens to be wrapped first in a polyethylene film and then in aluminium foil. The edges of the aluminium foil on the face of the specimen can then be adhered to the face of the specimen using aluminized tape. Another method would be to use a fabricated container which could be sealed on closure and which has a number of square openings (95 +0,-2) mm which when specimens are placed behind them also seal to expose only the face of the specimen to the environment of the weathering machine. For timber substrates, an alternative approach has been found suitable. The edges of the wood shall be sealed with a thin coat of alkyd primer and a thick coat of silicon sealant.

B.3 Environmental conditioning cycles

The environmental conditioning cabinet used to artificially age the specimens with fire retardant coatings shall be capable of exposing only one face of the specimen to the conditioning cycles and to any wetting which may be required, protecting the other faces, see B.2. This is an essential characteristic since the unexposed substrate upon which the coating is being assessed shall be protected from the wetting and high humidity conditions which occur during the conditioning cycles.

The environmental conditioning cycles for each of the end use conditions shall be as detailed below.

Upon completion of all the prescribed exposures below, the specimens shall be conditioned to constant mass in accordance with EN 13238 and then fire tested according toB.4.

B.3.1 Type X category

The specimens shall be exposed in a climate chamber to the following weathering conditions:

a. Subject the specimen to the exposure cycle described for Type Y category for 48 hours.

b. Subject the specimen to a 24 h exposure cycle consisting of 4 h wetting, 4 h drying, 4 h wetting, 4 h drying, and 8 h rest. Repeat this cycle for a total of 1000 h (6 weeks).

c. Apply water in a moderately fine spray uniformly over the exposed specimen surface at a rate of (12 ± 0,8) l/(min·m^2) of specimen surface. The temperature shall not exceed 32 °C.

d. Dry at a temperature of (63 ± 3) °C, with this temperature attained within 15 min from the start of drying. The controlling temperature shall be the air temperature 2,5 cm above the specimen surface. Obtain the temperature by bare thermocouples or other temperature sensors which are protected from the direct radiation of the lamps by a shield not larger than 13 cm^2. Accompany drying with air movement directed across the face of the specimen at a rate of at least 7,6 m/min. Exposure to the ultraviolet sunlamps shall be continuous throughout the drying period.

e. At the start of next cycle, change the position of the specimens within the exposure rig so that each specimen occupies approximately an equal number of cycles in each location used.

B.3.2 Type Y category

The specimens shall be exposed in a climate chamber to the following weathering conditions:

- 8 hours at 27 ± 2 °C and 90 ± 5 % RH
- 16 hours at 23 ± 2 °C and 50 ± 3 % RH
- 8 hours at -20 ± 2 °C, dry
- 16 hours at 23 ± 2 °C and 50 ± 3 % RH

The cycle shall be repeated 10 times without interruption.

B.3.3 Type Z_1 category

The specimens shall be exposed in a climate chamber to the following weathering conditions:

- 8 hours at 27 ± 2 °C and 90 ± 5 % RH
- 16 hours at 23 ± 2 °C and 50 ± 3 % RH

The cycle shall be repeated 10 times without interruption.

B.3.4 Type Z_2 category

The specimens shall be exposed in a climate chamber to the following weathering conditions:

- 8 hours at 25 ± 2 °C and 70 ± 5 % RH
- 16 hours at 23 ± 2 °C and 50 ± 3 % RH

The cycle shall be repeated 10 times without interruption.

B.4 Determination of fire behaviour

Five specimens shall be subjected to fire test without environmental conditioning and five further specimens shall be subjected to fire test following environmental conditioning in accordance with the relevant section of B.3.

The specimens shall all be tested in accordance with ISO 5660-1. All specimens shall be conditioned to constant mass in accordance with EN 13238. The specimens shall be placed within the specimen holder directly onto the ceramic fibre insulation, and a retaining frame placed over the specimen. Specimens showing intumescent properties shall be tested either using the wire grid as specified in ISO 5660-1, or using the procedure for intumescent products detailed in ISO 5660-1.

The conical heater on the ISO 5660-1 apparatus shall be set to give a heat output of 50 kW/m^2 for wall and ceiling systems and 30 kW/m^2 for flooring systems. The duration of the test shall be 12 minutes and the averaged values calculated over a 10 minute period.