EAD **351281-00-1104**

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European Assessment Document for

Caps with intumescent inlay for recessed luminaires in fire-resistant suspended ceiling

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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) 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 caps with intumescent inlay for recessed luminaires in fire-resistant suspended ceilings (in the following referred to as caps with intumescent inlay), made of a steel sheet box (housing), an inlay (pre-fabricated element originally available as pastes, mortars, stoppers and putties) made of intumescent material for fire sealing and fire stopping purposes and a piece of non-combustible building board (see Figure 1.1.1).

The product concerned is manufactured, delivered and sold on the market as pre-assembled element.

Exposed to high temperatures in case of fire the intumescent material softens partially, the non-combustible building board falls down, largely sealing the installation opening of the recessed luminaire in the fire-resistant suspended ceiling. After that the intumescent material expands and creates foam which closes the remaining gaps, seals voids and cavities and restricts the passage of heat, smoke, flames or any combination of them this way.

The product is not covered by a harmonised European standard (hEN). EAD 350005-00-1104 does not apply, as the kit covered by EAD 350005-00-1104 does not comprise the piece of non-combustible building board and the steel sheet box (housing). Furthermore, the intended uses deviate and this EAD covers additionally the essential characteristic "content, emission and/or release of dangerous substances".

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 or (in absence of such instructions) according to the usual practice of the building professionals.

Relevant manufacturer's stipulations, e.g., with regard to the intended end use conditions, 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 as long as the details of the assessment methods as laid down in this EAD are respected.

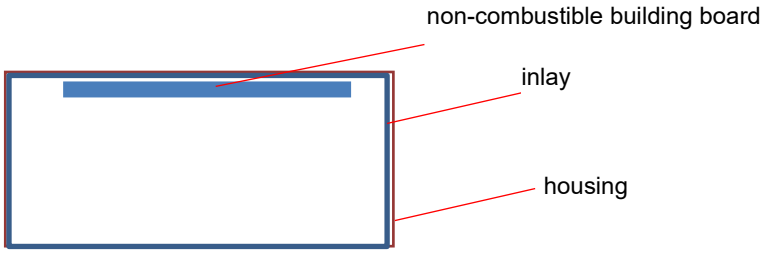


Figure 1.1.1: Cap with intumescent inlay (side view, see also Figure 1.2.1.1)

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

1.2.1 Intended use(s)

The product is intended to be used as an essential component with a fire protection effect in the penetration seal system for recessed luminaire in fire-resistant suspended ceilings that are subject to the fire requirements, as described in the following.

The intumescent component prevents and restricts the heat transmission and the propagation of fire by the formation and spread of foam (see section 1.1).

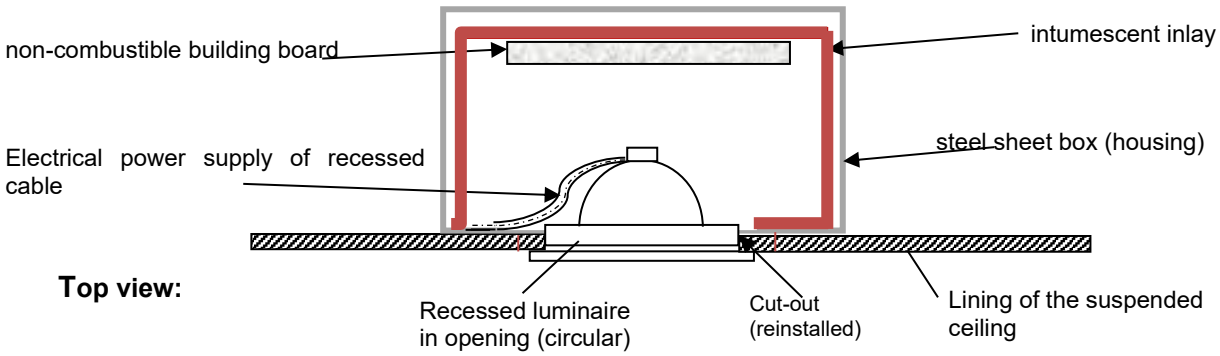
The penetration seal consists of the pre-assembled product described in 1.1, which is installed on the top of a suspended ceiling with metal substructure. The cap with intumescent inlay is installed as shown in Figure 1.2.1.1.

The product performance is closely linked to both the design of the penetration seal and the Manufacturer's Product Installation Instructions (MPII), both of which are selected according to the intended use of the penetration seal. Thus, the performance of the caps with intumescent inlay depends on the following conditions:

- the specification of all penetration seal components,
- the dimensions and description of preformed products (which components are installed in which position),
- the arrangement of the penetration seal components in the opening, on top of the separating element and/or on the services.

For the products covered by this EAD only type Z_2 in accordance with Annex B, clause B.1, is relevant.

Section:



Top view:

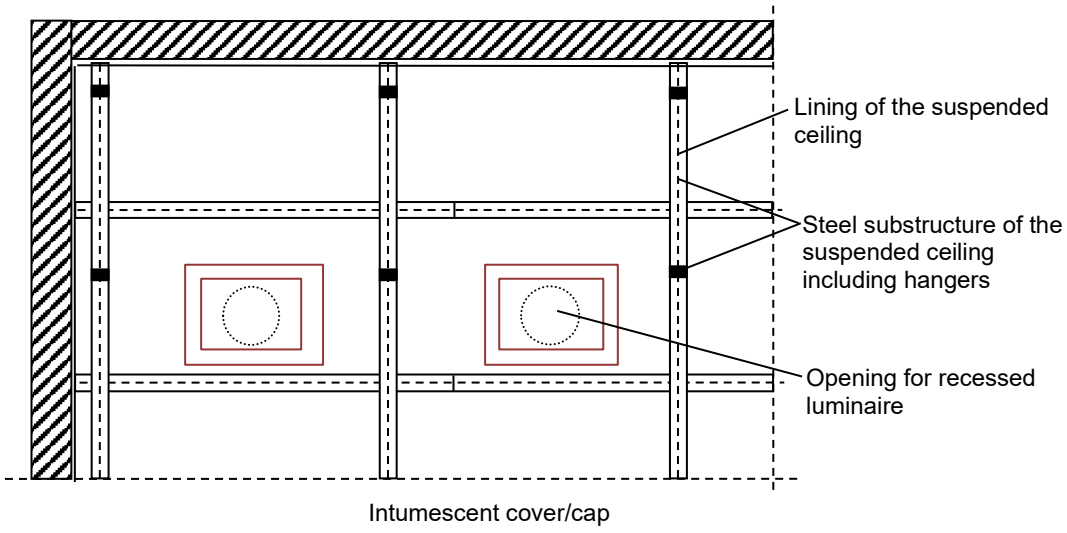


Figure 1.2.1.1: Penetration seal for recessed luminaire - installation in fire-resistant suspended ceilings: The product covered by this EAD is only the cap with intumescent inlay as described in 1.1. -The figure shows an example; also circular shapes are covered by this EAD.

Furthermore, the intended use scenario(s) describe(s) the situation(s) on site for which the penetration seal incorporating the product in accordance with this EAD is intended to be used. The intended use scenario(s) shall be defined by the type, structure (including for example thickness of linings or density) and thickness of the separating element, the distance to other apertures or cast-in components, the aperture form and size, the type(s) of the service(s) which penetrate the floor and their number and arrangement. A change of this/these situation(s) may have an influence on the performance of the penetration seal incorporating the product (see 2.2).

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 caps with intumescent inlay for the intended use of 10 years when installed in the works (provided that the caps with intumescent inlay are subject to appropriate installation (see 1.1)). 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[1].

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

1.3.1 Intumescent component

A preformed component made of an intumescent material.

1.3.2 Intumescent material

The term describes a material which expands, creating foam, when exposed to heat in the case of fire and restricts the passage of heat, smoke, flames or any combination of them.

1.3.3 Expansion ratio

The expansion ratio is the quotient of the thickness of an expanded specimen of an intumescent material and the original thickness of the same specimen before exposure to high temperature.

1.3.4 Expansion pressure

The expansion pressure is the pressure exerted by an intumescent material as a result of intumescent activity.

1.3.5 Non-combustible

A non-combustible material is a material of class A1 in accordance with Commission Delegated Regulation (EU) No 2016/364 in connection with EN 13501-1[2].

1.3.6 Blank penetration seal

A seal without any penetrating services that seals an aperture in a separating element.

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[1] 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.

[2] All undated references to standards in this EAD are to be understood as reference to the dated versions listed in chapter 4.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 2.1.1 shows how the performance of the caps with intumescent inlay is assessed in relation to the essential characteristics.

Table 2.1.1 Essential characteristics of the cap with intumescent inlay 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
Basic Works Requirement 2: Safety in case of fire			
1	Reaction to fire	2.2.1	Class
2	Resistance to fire	2.2.2	Class
Basic Works Requirement 3: Hygiene, health and the environment			
3	Content, emission and/or release of dangerous substances	2.2.3	Level
Aspects of durability			
4	Durability	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 intended use scenario(s) describe(s) the situation(s) on site for which the penetration seal incorporating the product according to this EAD is intended to be used. The intended use scenario(s) shall be defined by the type, structure (including for example thickness of linings or density) and thickness of the separating element, the distance to other apertures or cast-in components, the aperture form and size, the type(s) of the service(s) which penetrate the floor and their number and arrangement. A change of this/these situation(s) may have an influence on the performance of the penetration seal incorporating the product (see 2.2). Therefore, in the ETA all necessary information related to all the above-mentioned conditions used for assessing the product shall be given.

Furthermore, the conditions for application, which have been taken into account for the assessment taking into account the climatic conditions of Type Z_2 (see Annex B), shall be given in the ETA.

2.2.1 Reaction to fire

The assessment of reaction fire is based on separate assessment of the components and the worst-performance component shall be considered as representative for the whole product. Thus, the components shall be assessed and the worst class achieved this way represents the reaction-to-fire class of the cap with intumescent inlay. One of the following options shall apply for each component:

a) The component of the caps with intumescent inlay is considered to satisfy the requirements of class A1 of the reaction-to-fire performance in accordance with Commission Decision 96/603/EC, as amended by Commission Decisions 2000/605/EC and 2003/424/EC[3], without the need for testing on the basis of it fulfilling the conditions set out in that Decision and its intended use being covered by that Decision.
   Therefore, when the conditions above are fulfilled, the performance of the component is class A1.

b) The component of the caps with intumescent inlay is considered to satisfy the requirements for the relevant class of the reaction-to-fire performance in accordance with an appropriate Commission CWFT[4] or CWT[5] Decision. The component shall be classified without the need for further testing on the basis of its conformity with the specification of the product detailed in that Decision and its intended end use being covered by that Decision.

c) In case neither a) nor b) applies: The component of the product shall be tested, using the conditioning and test method(s) relevant for the corresponding reaction-to-fire class according to EN 13501-1. The component shall be classified according to Commission Delegated Regulation (EU) No 2016/364 in connection with EN 13501-1. Annex B of EAD 350005-00-1104 shall be used for the specification of mounting and fixing provisions for testing the intumescent inlay.

2.2.2 Resistance to fire

The assessment methods covered by this clause are based on the assumption that all results of measurements for the insulation criterion (with thermocouples) and the integrity criterion (with gap gauge) according to sections 10 and 11 of EN 1366-3 shall fulfil the requirements of the assessed resistance to fire classification according to EN 13501-2 for the tested cap with intumescent inlay. The assessed fire resistance period shall be equivalent to the period from the beginning of the test to the time when the first thermocouple installed to the test specimen reaches the 180 K temperature rise.

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[3] OJ L 267, 19.10.1996, p. 23, OJ L 258, 12.10.2000, p. 36 and OJ L 144, 12.6.2003, p. 9

[4] CWFT = classified without further testing

[5] CWT = classified without testing

Example: The thermocouple on one cable of the test specimen exceeds the temperature rise of 180 K in the 70th minute. All other thermocouples had a temperature rise lower than 180 K up to the 96th minute. No integrity failure was observed. The resulting classification of the cable penetration seal as installed in the fire test is E 90, EI 60.
The cap with intumescent inlay shall be tested as part of a penetration seal for recessed luminaire installed in a suspended ceiling in order to be classified in accordance with EN 13501-2 using the test method of 1366-3. The specification of the penetration seal as well as of the suspended ceiling shall be given in the ETA together with the classification.

The intended use scenarios (see clause 1.2.1), e.g., the design of the suspended ceiling shall be clearly specified and given in the ETA as used for the assessment.

The test layout shall be as follows:
The ceiling construction as such is not covered by this document, nevertheless a ceiling construction with previously determined fire resistance class (higher than the expected fire resistance class of the cap with intumescent inlay) shall be used for the test.
Therefore, the penetration seal that contains the cap with intumescent inlay for recessed luminaire shall be installed in a suspended ceiling with a minimum size of 2000 mm x 4000 mm and a resistance to fire classification that equals at least to the classification of the penetration seal to be achieved. The suspended ceiling shall consist of a two-level steel substructure (see Figure 2.2.2.1).

The penetration seal installed in a suspended ceiling shall be tested from both sides: one test with fire from the upper side and one test with fire from the underside (see Figure 2.2.2.2).

For one size of the penetration seal two test specimens shall be installed in each of the before mentioned supporting construction: one with and one without recessed luminaire which shall always be presented together. If more than one size of the penetration seal is envisaged, each size shall be tested with recessed luminaire and in addition the largest envisaged size of the penetration seal shall be tested without recessed luminaire (blank penetration seal) in each of the before mentioned supporting construction.
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The resulting classification of a blank penetration seal shall not be used for a stand-alone classification but always be accompanied by the classification of the penetration seal including recessed luminaire. The lowest resulting classification of both installation situations shall be given in the ETA.
The assessment is only valid for the tested type and dimensions of the suspended ceiling, opening, seal components and services and to the arrangement of the seal components and the services in the opening. All penetration seal components and services (luminaire, cables) shall be clearly described in the ETA. For the cables the maximum diameter, the maximum number of conductors and the maximum conductor cross section shall be given. The assessed performance is only valid for what was tested (see 1.3.6).

In particular the following configuration shall be used in the fire tests:

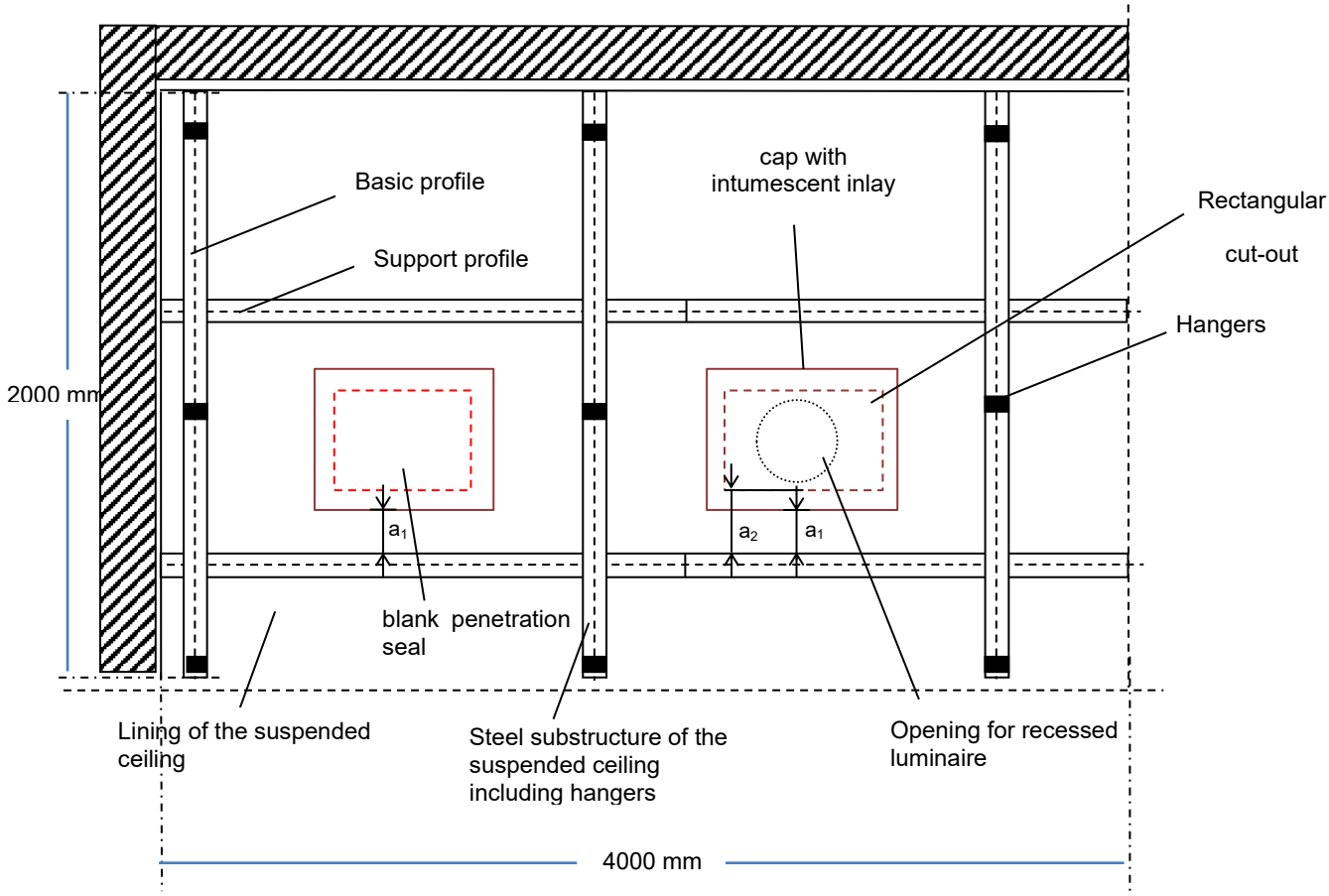


Figure 2.2.2.1: Top view (example); as described in figure 1.2.1.1 also circular shapes of the cap with intumescent inlay are covered by this EAD

In all cases the penetration seal shall be installed from the underside of the ceiling. First a rectangular opening shall be cut into the lining of the ceiling, having a minimum distance a2 as given in the (MPII) (a1 results from a2, because the cap with intumescent inlay is located symmetrically). The cut-out rectangular piece shall be kept for reinstallation.

The size of the opening depends on the size of the cap with intumescent inlay and shall be taken from the MPII. Then the cap with intumescent inlay shall be fed through the opening, be moved in position after installing the cables and be fixed by screws. For the insertion of a recessed luminaire a corresponding (to the form of the luminaire) opening shall be cut into the cut-out piece and the luminaire shall be fixed in the opening. The opening in the suspended ceiling shall be closed with the cut-out rectangular piece. The rectangular cut-out shall be screwed together with the cap with intumescent inlay. After that the gap between the suspended ceiling and the cut-out rectangular piece shall be closed with gypsum mortar.

For fire from the underside the substructure shall be fixed (using fixing methods required for the ceiling) to steel beams lying across the furnace opening on the furnace walls.

For fire from the upper side the substructure shall be fixed to the furnace ceiling. If the construction of the ceiling allows different distances of the steel profiles the maximum distance shall be used in the test.

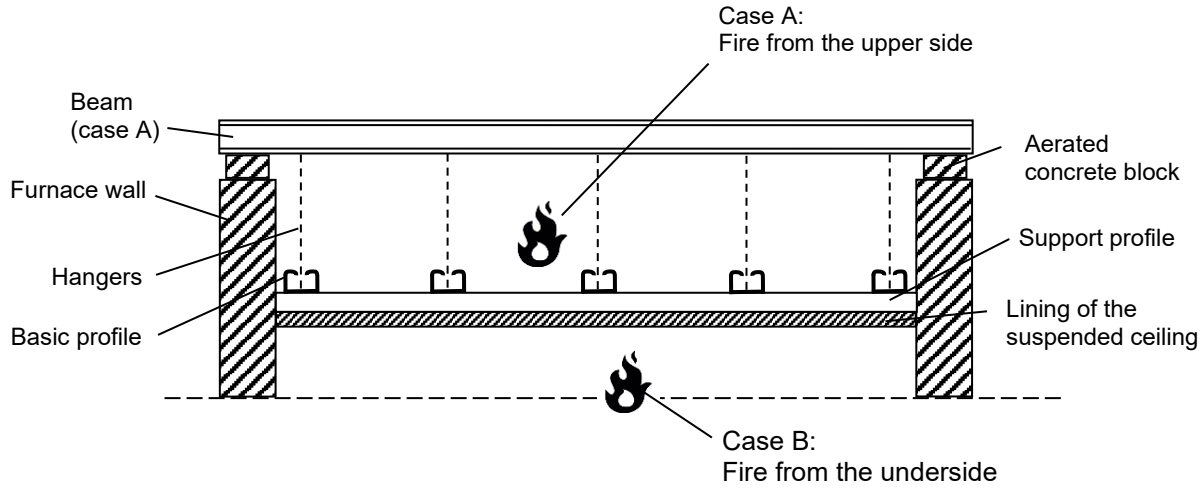
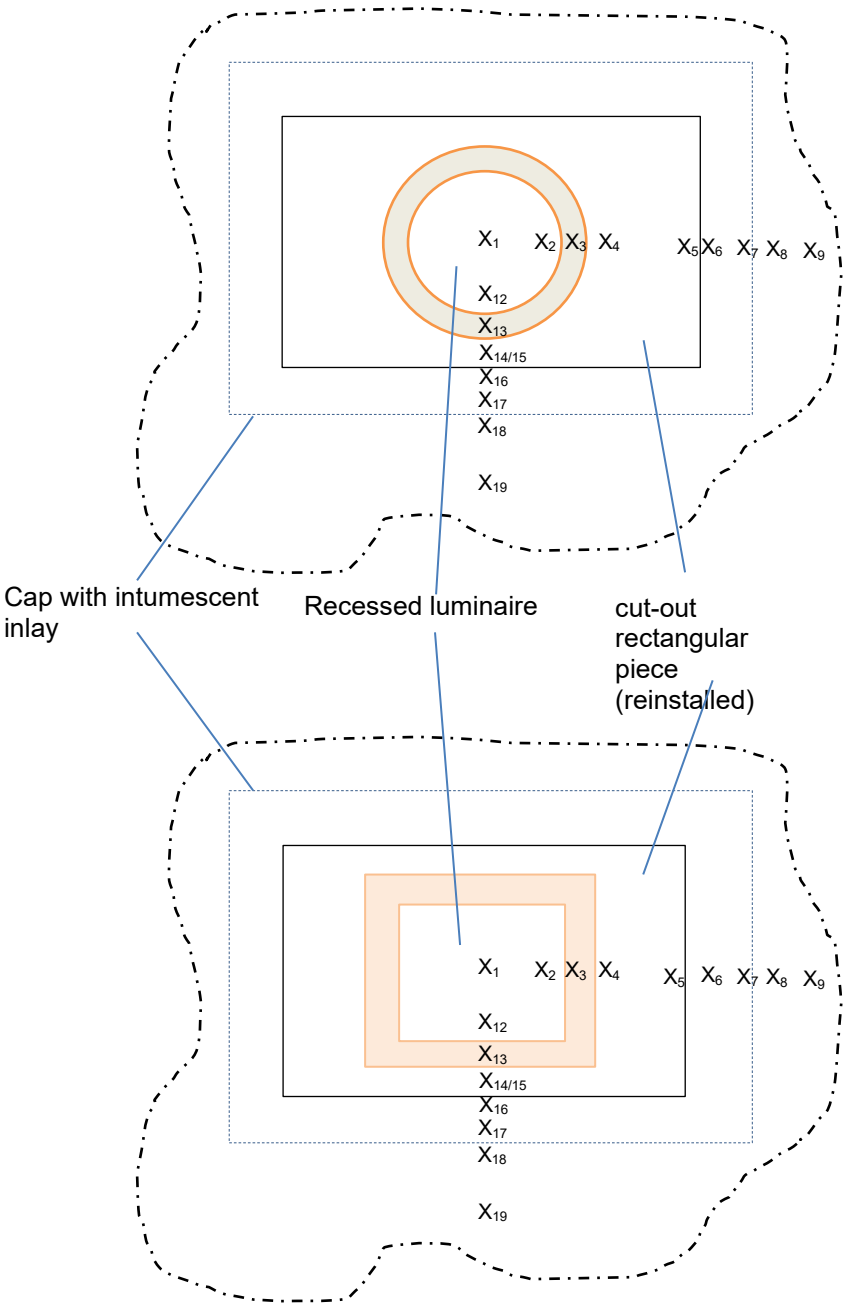


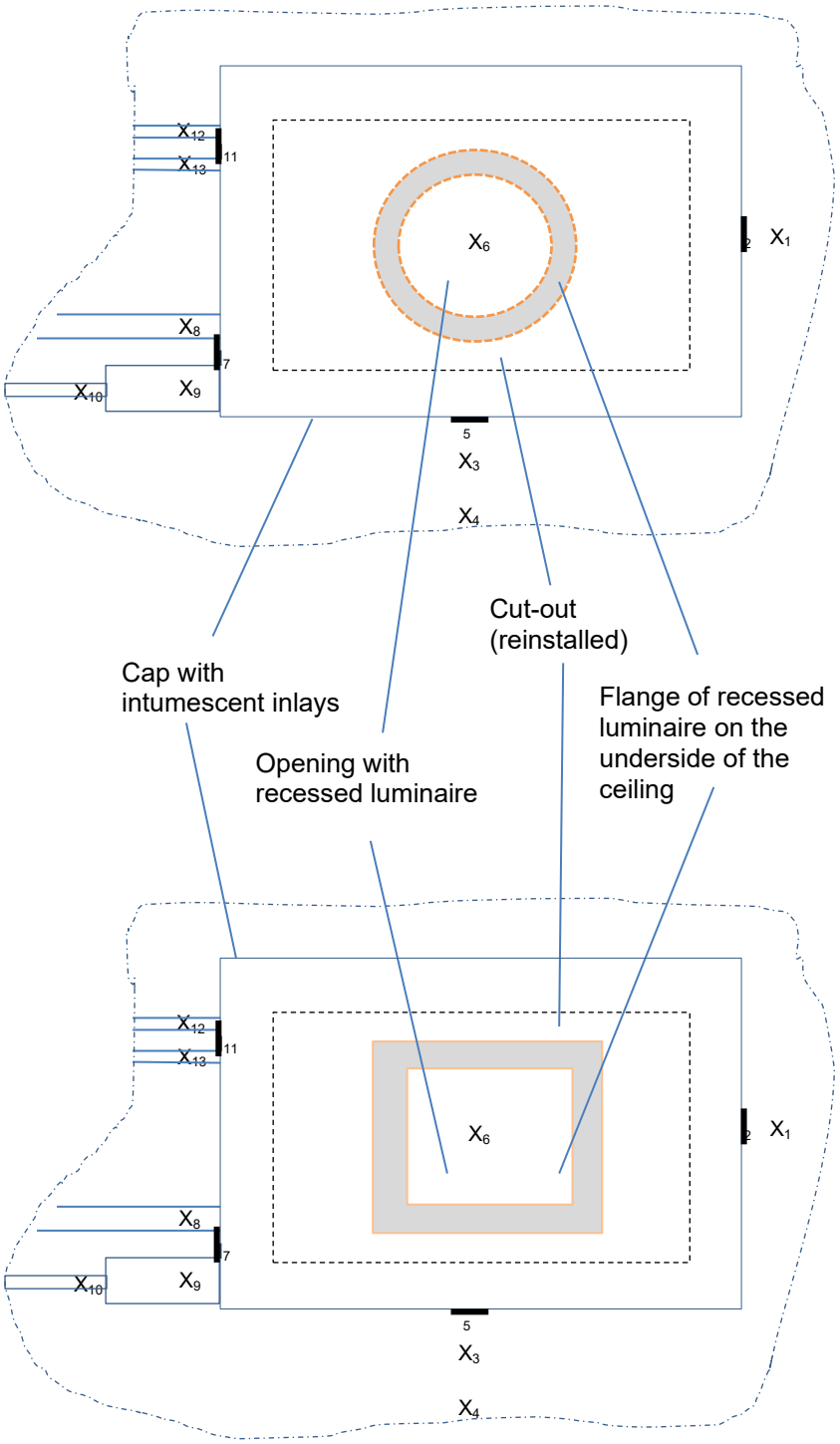
Figure 2.2.2.2: Standard configuration – Section (side view)

Figures 2.2.2.3 and 2.2.2.4 show how the thermocouples on the cold side shall be fixed to the specimens, with the luminaire positioned as shown.
For seals without luminaire and in case of fire from the upper side only thermocouples 1, 5, 15, 6, 16, 8, 18, 9 and 19 are necessary.



1: in the middle of the recessed luminaire
2: on the recessed luminaire 25 mm away from the flange
3: on the flange of the recessed luminaire
4: on the cut-out 25 mm away from the flange to the recessed luminaire
5: on the cut-out 25 mm away from the border to the lining of the suspended ceiling
6: on the lining of the suspended ceiling 25 mm away from the border to the cut-out
7: on the lining of the suspended ceiling below the cap with intumescent inlay 25 mm away from its border
8: on the lining of the suspended ceiling 25 mm away from the cap with intumescent inlay
9: on the lining of the suspended ceiling 100 mm away from the cap with intumescent inlay
12: on the recessed luminaire 25 mm away from the flange
13: on the flange of the recessed luminaire
14: on the cut-out 25 mm away from the flange of the recessed luminaire
15: on the cut-out 25 mm away from the border to the lining of the suspended ceiling
16: on the lining of the suspended ceiling 25 mm away from the border to the cut-out
17: on the lining of the suspended ceiling below the cap with intumescent inlay 25 mm away of its border
18: on the lining of the suspended ceiling 25 mm away from the cap with intumescent inlay
19: on the lining of the suspended ceiling 100 mm away from the cap with intumescent inlay

Figure 2.2.2.3: Position of thermocouples - Fire from the upper side (example); as described in figure 1.2.1.1 also circular shapes of the cap with intumescent inlay are covered by this EAD



1: at the short side of the cap with intumescent inlay on the suspended ceiling 25 mm away from the cap with intumescent inlay

2: on the short side of the cap with intumescent inlay 25 mm away from the border to the suspended ceiling

3 at the long side of the cap with intumescent inlay on the suspended ceiling 25 mm away from the cap with intumescent inlay

4: at the long side of the cap with intumescent inlay on the suspended ceiling 100 mm away from the cap with intumescent inlay

5: on the long side of the cap with intumescent inlay 25 mm away from the border to the suspended ceiling

6: on the top of the cap with intumescent inlay in the middle of the cap with intumescent inlay

7: on the cap with intumescent inlay 25 mm away from the cable entry into the cap with intumescent inlay

8: on the conduit (ø 20 mm) 25 mm away from the cap with intumescent inlay

9: on the conduit (ø 25 mm) 25 mm away from the cable entry into the cap with intumescent inlay

10: on the cable 25 mm away from the end of the conduit

11: on the cap with intumescent inlay 25 mm away from the entry of the cable into the cap with intumescent inlay

12: on the cable 25 mm away from the cap with intumescent inlay

13: on the cable 25 mm away from the cap with intumescent inlay

Figure 2.2.2.4: Position of thermocouples - Fire from the underside (example); as described in figure 1.2.1.1 also circular shapes of the cap with intumescent inlay are covered by this EAD

The furnace pressure of 20 Pa shall be measured in a distance of 100 mm from the surface (fire side) of the ceiling.

The penetration seals shall be tested in the same way that it will be used (2.2.2), and the test results shall be specified accordingly and given in the ETA, i.e., top side, bottom side or both.

2.2.3 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 shall be assessed on the basis of the information provided by the manufacturer[6] after identifying the release scenarios taking into account the intended use 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 are:

IA 1: Product with direct contact to indoor air[7]

IA 2: Product with indirect contact to indoor air (e.g., covered products) but possible impact on indoor air.[8]

2.2.3.1 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) shall be determined in accordance with EN 16516. The loading factor used for emission testing shall be 0,05 m^2/m^3.

The preparation of the test specimen shall be performed by using a representative sample of the product installed in accordance with the manufacturer's product installation instructions or in absence of such instructions the usual practice of the product installation. The size of the test specimen shall be chosen in consideration of the test chamber size and the intended loading factor (see above).

Once the test specimen has been produced, as described above, it shall immediately be placed in the emission test chamber. This time shall be considered the starting time of the emission test.

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

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

2.2.4 Durability

The durability of the product shall be assessed in accordance with Annex B.

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[6] The manufacturer may be asked to provide to the TAB the REACH related information which shall accompany the DoP (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
- 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, taking into account the installation conditions of the construction product and the release scenarios resulting from there.

Any information provided by the manufacturer regarding the chemical composition of the products is not to be distributed to EOTA, to other TABs or beyond.

[7] Scenario IA1 is applicable for products which are in contact with indoor air in a way that dangerous substances could be released directly out of the product.

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

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 Commission Decision 1999/454/EC, as amended by Commission Decision 2001/596/EC.

The system is 1 for any use except for uses subject to regulations on reaction to fire performance.

For uses subject to regulations on reaction to fire the applicable AVCP systems are 1, 3 or 4 depending on the conditions defined in the said Decision.

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 3.2.1.

The intention of the corner stones for the control plan for the manufacturer is especially the verification of constancy of the performance "resistance to fire" in an indirect way. It is assumed, that products which – for several defined characteristics – always show the same test results in the same test scenario are unchanged and would, therefore, lead to the same fire resistance if this would be tested. Therefore, it is not relevant which tests are chosen out of the section given in column three in the list below – if more than one method is provided – but it is necessary to use afterwards always the same method.

Table 3.2.1 Control plan for the manufacturer; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control[9]
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]					
Inlay					
1	Loss of mass on heating	3.4.1	see Control Plan	1	1/10 b
2	Dimensions (thickness/ other dimensions)	3.4.2	see Control Plan	3	1/b
3	Density	3.4.3	see Control Plan	1	1/b
4	Expansion ratio	3.4.4	see Control Plan	1	1/b
5	Expansion pressure	3.4.5	see Control Plan	1	1/b
Housing					
6	Thickness of steel sheet	3.4.2	see Control Plan	3	1/b
7	Thickness of Zn layer	Check of specification	see Control Plan	1	1/b
8	Thickness of protective coating	Check of specification	see Control Plan	1	1/b
9	Tensile strength of steel	Check of specification	see Control Plan	1	1/b
10	Dimensions[Error! Bookmark not defined.]	3.4.2	see Control Plan	1	1/b
Non-combustible board					
11	Density	EN 520	see Control Plan	1	1/h
12	Other properties in accordance with EN 520	EN 520	see Control Plan	1	1/h
Assembled product					
13	Content, emission and/or release of dangerous substances	2.2.3	See Control Plan	1	Once every 5 years or after product changes

[9] The abbreviations given stand for the frequency of tests: 1/b = once per batch, 1/10 b = once per 10 batches, 1/h = once per hour.
batch: The unit or quantity of production in a single complete production operation.

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 the caps with intumescent inlay are laid down in Table 3.3.1.

The intervention of the notified body for reaction to fire is only necessary for products/materials for which a clearly identifiable stage in the production process results in an improvement of the reaction to fire classification (e.g., an addition of fire retardants or a limiting of organic material).

Table 3.3.1 Control plan for the notified body; cornerstones

No	Subject/type of control	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					
1	Notified Body will ascertain that the factory production control with the staff and equipment are suitable to ensure a continuous and orderly manufacturing of the caps with intumescent inlay.	Verification of the complete FPC as described in the control plan agreed between the TAB and the manufacturer	According to Control plan	According to Control plan	When starting the production or a new line
Continuous surveillance, assessment and evaluation of factory production control					
2	The Notified Body will ascertain that the system of factory production control and the specified manufacturing process are maintained taking account of the control plan.	Verification of the controls carried out by the manufacturer as described in the control plan agreed between the TAB and the manufacturer with reference to the raw materials, to the process and to the product as indicated in Table 3.2.1	According to Control plan	According to Control plan	Twice a year

3.4 Special methods of control and testing used for the assessment and verification of constancy of performance

3.4.1 Loss of mass on heating

The caps with intumescent inlay shall be tested according to EN ISO 3451-1, subject to the following provisions: As "Loss on mass on heating" is a characteristic of a material, protective foils or coatings shall be removed, if at all possible. When the product is tested with a protective foil or coating this shall be recorded to ensure consistency with future tests.

The value shall be the mean value of at least 3 specimens.

3.4.2 Thickness and other dimensions

The thickness of plates, sheets, boards shall be measured by means of a suitable gauge to the nearest 0,1 mm on 3 specimens with the minimum size of 100 mm x 100 mm or with a minimum length of 500 mm in case of strips. Measurements shall be made in 5 symmetrically arranged positions (one in the centre and further 4 positions arranged symmetrically around the centre) with one reading at the centre of the sheets. The measuring equipment shall have an accuracy of 0,1 mm or 0,5 %.
If an appropriate standard exists that is more suitable for measuring the specific material, the equipment and tolerances shall be taken from that standard. For example, the standard that is suitable for gypsum plaster boards is EN 520.
Other dimensions shall be measured with an accuracy of 0,5% by means of a suitable gauge.

3.4.3 Density

The preferred unit of density is kg/m³.

The test shall be carried out at standard laboratory conditions (shall be conditioned at (23 ± 2) °C and (50 ± 5) % rh).
The density shall be calculated from the mass and the volume of the specimen. The mass of the specimen shall be assessed with an accuracy of 0,1 g. The dimensions shall be determined to the nearest mm either using a ruler when the product has a regular shape and the volume calculated, or the volume shall be determined by using a water displacement technique.
The following standards are applicable:

- for solid products EN 1015-10, EN 323 or ISO 9427, depending on the nature of the product,
- for prefabricated shapes EN 13470.

3.4.4 Expansion ratio

The expansion ratio is measured according to Annex A.1.

3.4.5 Expansion pressure

The expansion pressure is measured according to Annex A.2.

4 REFERENCE DOCUMENTS

EAD 350005-00-1104	Intumescent products for fire and fir stopping purposes
EN 323:1993	Wood-based panels – Determination of density
EN 520:2004+A1:2009	Gypsum plasterboards – Definitions, requirements and test methods
EN 1015-10:1999+A1:2006	Methods of test for mortar for masonry – Part 10: Determination of dry bulk density of hardened mortar
EN 1366-3:2021	Fire resistance tests for service installations – Part 3: Penetration seals
EN 10216-5:2021	Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 5: Stainless steel tubes
EN 13501-1:2018	Fire classification of construction products and building elements – Classification using test data from reaction to fire tests
EN 13501-2:2023	Fire classification of construction products and building elements - Part 2: Classification using data from fire resistance and/or smoke control tests, excluding ventilation services
EN 16516:2017+A1:2020	Construction products: Assessment of release of dangerous substances - Determination of emissions into indoor air
EN ISO 3451-1:2019	Plastics – Determination of ash – Part 1: General methods (ISO 3451-1:2019)
ISO 9427:2003	Wood-based panels – Determination of density

Annex A: Expansion ratio and expansion pressure

A.1 Expansion ratio

The expansion ratio shall be determined on at least 6 specimens to assess the ability of the material to create foam in the event of fire. The mean value and the standard deviation shall be recorded in the test report.

The original thickness of the dried specimen shall be measured according to 3.4.2.

The thickness shall be determined after expansion. If the expansion of the material is not uniform, the thickness after expansion shall be determined from the average value of the maximum and minimum thickness.

An example of suitable equipment and apparatus for determining the expansion ratio are shown hereafter.

Other equipment or methods are acceptable provided the results are reproducible.[10]

A.1.1 Test procedures for determining the expansion ratio

A.1.1.1 General

The aim of this assessment is to compare a product which has been exposed to fire with an unexposed product in terms of changes caused by the exposure.

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

Examples of suitable apparatus and equipment to determine the foam height are shown in figure A.1.1.3.2.1.

This apparatus can be used with or without a top load depending on the intensity of reaction.

If the specific intumescent material is manufactured of more than one nominal thickness or more than one nominal density, the maximum thickness/density and the minimum thickness/density shall be tested.

Pastes, mortars, stoppers and putties shall be tested with a maximum thickness of approximately 5 mm and coating materials with a thickness of approximately 2 mm.

A.1.1.2 Determination of the suitable test temperature

The test temperature required for the determination of the foam height of a specific intumescent material shall be determined in pre-tests.

In order to find out the appropriate test temperature for the specific intumescent material, the temperature in the oven shall be increased in steps of 50K (300°C, 350°C, 400°C, 450°C etc.). Leave the specimens in the oven until the material has completely reacted. A specimen is considered completely reacted when the foam height reaches and maintains a maximum at the test temperature.

The duration of the test depends on the intumescent capacity of the material and can differ at different temperatures. Normally 30 minutes are considered as suitable. The duration may be increased if the maximum foam height is not reached in 30 minutes. The same duration shall be used for the test series of all temperatures.

It will be helpful to create an expansion-time-temperature curve. The relationship between foam height and test temperature may be visualized for a set test duration by plotting maximum foam height (y-axis) against

[10] To achieve a reproducible result the test parameters, e.g., temperature, duration, mass of the weight on top of the specimen, if relevant, etc. shall be selected appropriately and shall be recorded.

test temperature (x-axis). The complete reaction corresponds to the lowest temperature at which a maximum (or plateau at the maximum value) is observed on this curve.

The determined test temperature and the relating time of exposure to heat shall be recorded and shall be used for all further tests for determining the foam height of this specific material.

A.1.1.3 Test methods using the device of figure A.1.1.3.2.1

A.1.1.3.1 Preparation of the specimens

At least six circular specimens of a diameter corresponding to the inner diameter of the specimen holder with a tolerance of ± 0,5 mm shall be cut out of the intumescent material. The thickness of the specimen shall be measured 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 shall be recorded together with the standard deviation.
If necessary, the thickness of the specimens may be reduced such that the foam height does not exceed the height of the specimen holder. Such handling shall be recorded.

A.1.1.3.2 Test device

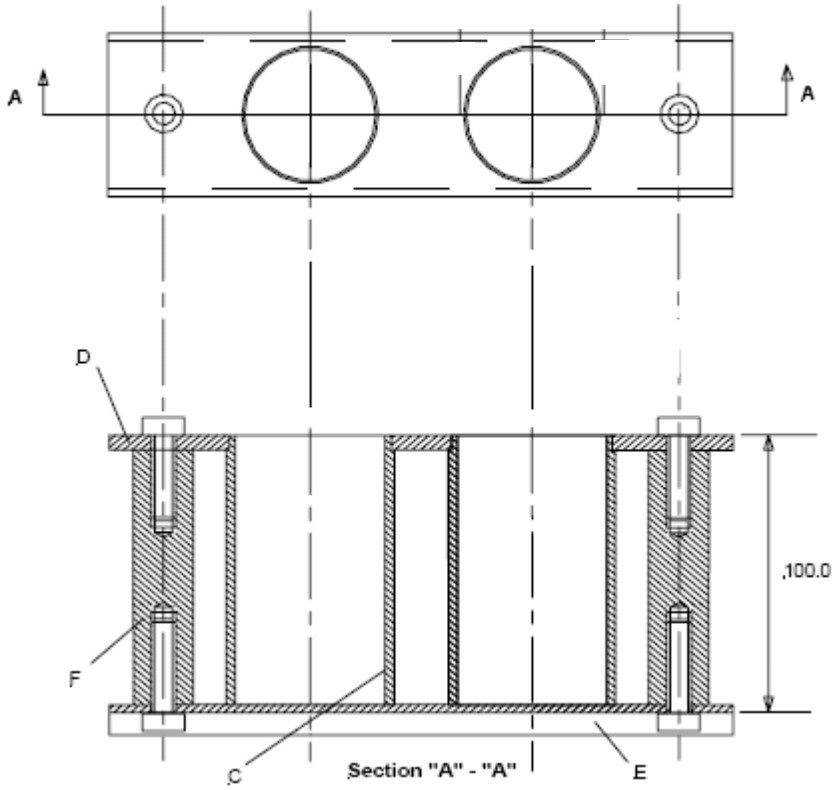

Figure A.1.1.3.2.1: Test device

Key

Pipes: according to EN 10216-5, wall thickness 2 mm
C specimen holder
D upper frame
E lower frame
F spacer bar

A.1.1.3.3 Test procedure

A temperature-controlled muffle oven capable of reaching a stable temperature of at least 600°C is required. The oven must be preheated to the required stable temperature resulting from the test in A.1.1.2. The specimen will then be placed in the specimen holder of the test device (figure A.1.1.3.2.1). The test device should be placed quickly (to minimise heat loss) in the centre of the muffle oven at the required temperature for a defined duration. The test temperature should be re-established within five minutes in the oven. The test device shall be removed from the oven as soon as reasonably practicable after the test, while wearing protective clothing and gloves. The foam height will be determined within five minutes of the specimens being removed from the oven (In order to preserve the foaming results, the specimen can only be removed from the oven after it has cooled, i.e., it is no longer soft or malleable!).

This can be achieved using the device of figure A.1.1.3.2.1 and either Method 1 or Method 2, as described below.

The aim is to have a method that can be used to compare a product which has been exposed to fire with an unexposed product in terms of changes caused by the exposure.

Method 1 is more accurate and more suitable for specimens that expand by different amounts in width and height, while method 2 is practical, flexible and particularly suitable for complex or non-practical geometries or dimensions.

Method 1 is the reference method.

Method 1:

For this method circular weights (5g, 10g, 20g, 50g, 100g etc.) of a diameter corresponding to the specimen holder shall be put on top of the specimen before testing. After exposure to heat the height of the lower surface of the lifted weight shall be equated with the foam height.

Method 2:

In these tests no weights shall be used and the foam will expand freely in one direction in the specimen holder. After the heat exposure the measurements shall be carried out at five points symmetrically arranged with one central as done before testing (see A.1.1.3.1).

For both methods the mean value of the measurement represents the "maximum foam height" at a certain temperature after a certain time of heat exposure. Minor voids or cavities within the structure of the foamed specimens shall not be taken into consideration.
The expansion ratio is the quotient of the mean value of thickness (see 3.4.2) of an expanded specimen of the intumescent specimen divided by the mean value of the original thickness of the same specimen before expansion.

A.2 Expansion pressure

The expansion pressure shall be determined on at least six specimens. The following test procedure can be used to assess the expansion pressure that a material develops during foam formation. The mean value and standard deviation shall be recorded.

A.2.1 Test procedures for determining the expansion pressure

A.2.1.1 General

Examples of suitable apparatus and equipment to determine the expansion pressure of an intumescent material are shown in Figures A.2.1.2.1.1 and A.2.1.3.1.1.

If the specific intumescent material is manufactured of more than one thickness or more than one density, the maximum thickness/density and the minimum thickness/density shall be tested.

Pastes, mortars, stoppers and putties shall be tested with a maximum thickness of 5 mm, coating materials of a thickness of approximately 2 mm.

A.2.1.2 Test method using the device of figure A.2.1.2.1.1

A.2.1.2.1 Test device

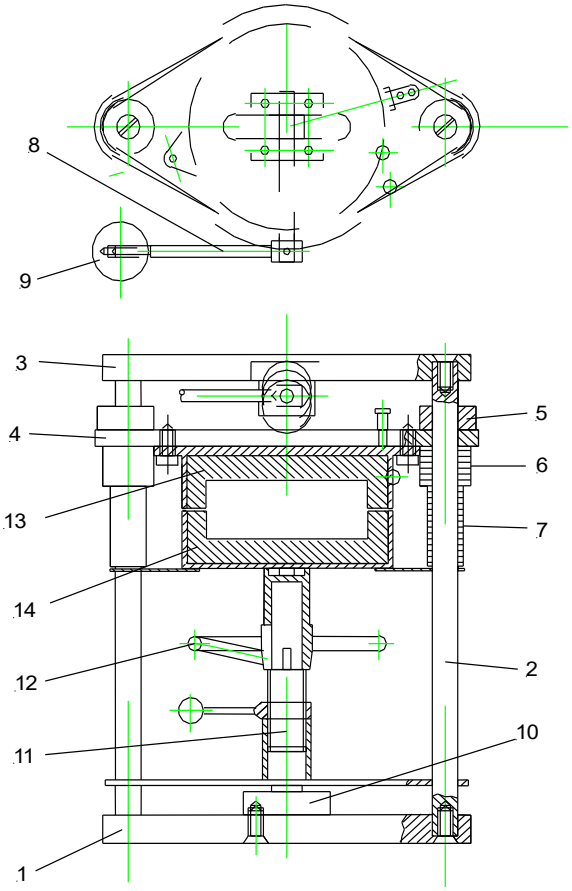

Figure A.2.1.2.1.1: Test device

	Key				
1	base plate	6	guide system	11	spindle
2	pillars	7	guide system	12	hand wheel
3	pressure plate	8	lever	13	heated upper pressure receptor
4	top plate	9	lever	14	heated lower pressure receptor
5	guide system	10	force transducer		

A.2.1.2.2 Preparation of the specimens

At least 6 circular specimens of a diameter of at least 50 mm (corresponding to diameter of the used steel ring) with a tolerance of ± 0,5 mm[11] shall be cut out of the intumescent material. The thickness of the specimen shall be measured with an accuracy of ± 0,1 mm at the centre of the disc and at four symmetrically

[11] The specimen shall be as large as possible to reduce the edge influences, but the actual size will depend on the apparatus (e.g., ring size).

placed points approximately 10 mm from the edge of the specimen. The mean value shall be recorded with the standard deviation.

For intumescent materials being tested in the ring necessarily (e.g., pastes, powder, granules) the weight of the specimens shall be determined.

A.2.1.2.3 Test procedure

The measuring device for determining the expansion pressure, acting at given temperatures by an intumescent material, is built into a frame consisting of a base plate (1), two pillars (2) and a pressure plate (3).

The heated upper pressure receptor (13) is rigid during the test but can be swung out for cleaning purposes. It is connected with the frame through a guide system (5, 6, 7). In order to enable the specimens to be quickly inserted, the top plate can be adjusted in height by 15 mm by means of the lever (8, 9).

The heated lower pressure receptor (14) transmits the force occurring during the test via a transmission device to the force transducer (10) mounted on the base plate.

The transmission device has a hand wheel adjustment that allows specimen thickness of up to 32 mm. The spindle (11) serves as a locking device for the mechanism.

Preparation of the test device

In the neutral/zero position of the heating plates a pre-pressure of approximately 60 N shall exist. The starting positions for the heating plates required for the test and the appropriate spacing between them shall be established by measurement. The setting will take into account the thickness of the specimen.

The heating plates shall be spaced 1 mm greater than the height of the steel ring in use to avoid pre-pressuring the specimen and to compensate for uneven foaming at the beginning of the test.

Test method 1: Testing without lateral restriction

The specimens shall be placed centrally between the two aluminium foils into the apparatus according to figure A.2.1.2.1.1.

Note
This method (1) is not applicable for powders and granules.

Test method 2: Testing with lateral restriction

The specimens shall be placed into two steel rings, which are adjusted to the size of the specimen to be tested. The internal diameter of steel rings made of stainless steel shall have a tolerance of + 0,2/ - 0 mm.

If possible, the steel rings shall have a web height of 4 mm or 9 mm (tolerance + 0,1 / - 0 mm). The specimens will then have a maximum height of 5 mm or 10 mm, respectively.

The specimen shall be placed into the apparatus according to figure A.2.1.2.1.1 in the steel ring centrally between two aluminum foils (50µm thick).

Note
For testing specimens placed in a steel restraining ring, the heating receptors shall be spaced at a distance exceeding 1 mm from the web height of the ring.

A.2.1.2.4 Measurement of the expansion pressure and evaluation of the results

The expansion pressure [N/mm^2], temperature and time elapsed shall continuously be recorded. The test shall be performed until the maximum pressure (measured pressure at maximum expansion) is clearly exceeded, but no longer than 10 min.
The maximum expansion pressure for each specimen thickness shall be recorded.
The results shall be recorded to assess the product's performance.

Note

For some intumescent materials, tested according to method 2, the test results may show a significant relationship between the weight of the specimen and the expansion pressure.

A.2.1.3 Method 3 using the device in figure A.2.1.3.1.1

A.2.1.3.1 Test device

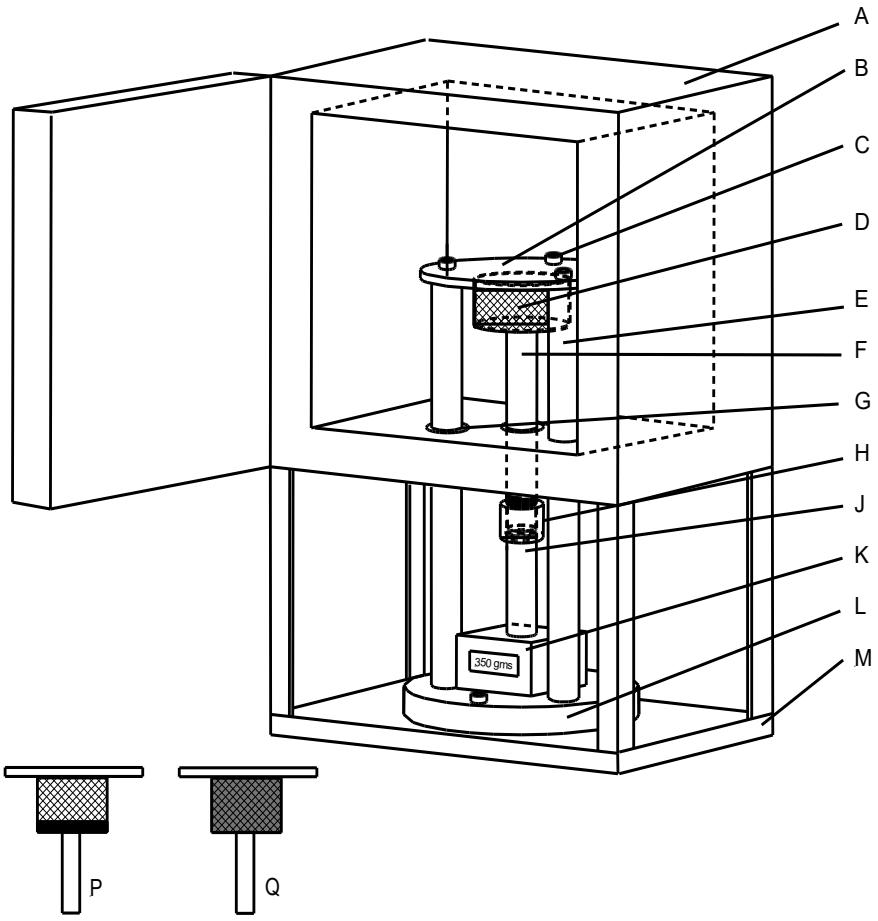

Figure A.2.1.3.1.1: Test device

	Key				
A	Muffle furnace	F	Ceramic reaction bar	L	Base plate
B	Reaction plate	G	Ceramic fibre heat seal	M	Furnace support frame
C	Set screw	H	Threaded adjustment collar	P	Specimen containing die with intumescent material ready for test
D	Sample containing die	J	Spacer bar	Q	Specimen containing die with material expanded up to reaction plate
E	Ceramic tension bars	K	Piezo-resistive force sensor		

A.2.1.3.2 Test procedure

The test procedure is based on the principle of measurement of the range of expansion pressures at a fixed volume of expansion.

The test shall be conducted under normal laboratory conditions.

A specimen of chosen thickness shall be cut to a size corresponding to the internal dimensions of the specimen containing die (D) +0,0/ – 0,5 mm.

A specimen containing die shall be selected that has an internal height that will allow the required ratio of expansion of the specimen, e.g., specimen thickness 4,0 mm in a containing die of internal height of 20,0 mm will limit the expansion ratio to 5:1.

The specimen shall be placed into the specimen containing die as shown in (P) and the reaction plate (B) shall be secured above the specimen containing die using set screws (C), but preloading the Piezo-resistive force sensor (K) shall be avoided by winding the threaded adjustment collar (H) to give a slight clearance between the reaction plate and the specimen containing die.

The Piezo-resistive force sensor shall be set to zero by initially finely adjusting the collar to give a small reading on the sensor and then winding back until the sensor just registers zero.

The muffle furnace door shall be closed and the furnace (A) shall be heated to the determined temperature.

The time when heating commences shall be recorded.

The time and temperature that the specimen activates shall be recorded.

The time and temperature at which a positive force is registered by the sensor shall be recorded.

Subsequently pressures and temperatures shall be recorded at intervals of 2 minutes.

A.2.1.3.3 Test results

From the recordings a chart shall be produced indicating pressure and temperature on the ‘Y’ axis versus time elapsed on the ‘X’ axis.

Comparing charts of identical specimen tests provides evidence of consistency in the furnace heating curve. Where the heating regime is consistent, the charts show the range of pressure characteristics of a given material at a predetermined expansion ratio.

The expansion ratio may be varied by using specimens containing dies of different heights.

ANNEX B: Durability tests

B.1 General stipulations

The durability of reactive materials may change significantly when exposed to specific conditions. This change may result in a product not achieving the expected performance. This indicates that the product probably does not meet the required resistance to the intended application conditions.

Where a product is not subject to further processing (e.g., external protection or encapsulation) to achieve its final form, it shall be tested for durability in accordance with the guidance in this document.

The following types of final intended use conditions are considered to be relevant for reactive materials, components and products:

Type X: intended for use at conditions exposed to weathering

Type Y_1: intended for use at temperatures below 0°C with exposure to UV but no exposure to rain

Type Y_2: intended for use at temperatures temporarily below 0°C, but with no exposure to rain nor UV

Type Z_1: intended for use at internal conditions with high humidity (permanent, changing, or temporary condensation), excluding temperatures below 0°C

Type Z_2: intended for use at internal conditions with humidity classes other than Z_1, excluding temperatures below 0°C.

For the products covered by this EAD only type Z_2 is relevant.

B.2 Testing and assessing of durability

B.2.1 General

The principle of the durability tests in this case is to check whether the expansion ratio and/or expansion pressure of the product will change during exposure to defined conditions.
The results of the tests on unexposed and exposed specimens shall be compared. This means that the specimens used for the exposure tests shall be of the same quality as those used for the tests on unexposed specimens. All specimens shall therefore be taken from the same sample or, at the very least, from the same charge.

The evaluation "no essential change in performance" shall be given if the mean value of the tested property of the exposed specimen does not deviate more than ± 15 % of the mean value of the initial test (unexposed specimens). Furthermore, the individual result of the exposed specimens shall not be less than 80 % of the mean value of the test results of the unexposed specimens.

If the result falls outside these criteria, additional 4 specimens of the same sample shall be exposed, tested and assessed. In this case all four additional specimens are supposed to meet the above criterion "no essential change in performance". Otherwise, it shall be stated in the ETA that there was an essential change in the performance after this test.

B.2.2 Preparation and conditioning of specimens

All specimens shall be prepared as intended in practice (curing and curing period, exposure with protection as intended etc.). The type of protection, if any, shall be recorded.

The specimens shall be supported on racks or special devices (made of an inert material) to place them in the test chamber, in a vertical position and 20 mm from each other. The size of the specimen shall be sufficient for at least 3 samples for every durability test and every option model (e.g., thinnest/thickest variation of thickness) and product variation.

Before and after environmental exposure the specimen shall be conditioned at a temperature of (23 ± 3) °C and a relative humidity of (50 ± 5) % RH

Before and after exposure the specimens shall be weighed. The change of weight, if any, shall be recorded.

After exposure and before testing the specimens shall be maintained in conditions of a temperature of

(23 ± 3) °C and a relative humidity of (50 ± 5) % RH.

B.2.3 Exposure testing for durability Type Z_2

For this test the specimens shall be cut out from a sample before exposure. The specimens shall be of the same dimensions and size as required for the durability tests.

At least 3 specimens are required for each durability test (e.g., expansion ratio or expansion pressure after exposure) and shall be stored in a vertical position in an environmental chamber for 21 days and exposed to the following cycle:

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

This test shall be repeated for 21 cycles without interruption.

After exposure, the specimens shall be used to determine, e.g., the expansion ratio and/or expansion pressure. These results shall then be used to compare non-exposed and exposed specimens according to B.2.1.