



**ASFP**  
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# **RED BOOK**

## **Fire-stopping**

## **Fire-stopping:**

**Linear joint seals, penetration seals & cavity barriers**

**4<sup>th</sup> Edition:**

**Association for Specialist Fire Protection**

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## FIRE AND YOUR LEGAL LIABILITY

Fire kills around 300 people and damage claims exceed £1 billion every year in the UK. That's why we must all play our part.

### Why is this of relevance to me?

If you are involved in the provision of fire protection, at any level, then you share liability for its usefulness and its operation when it's needed in a fire, and that liability will still be there in the event of a court case.

### I place the order; it is not my responsibility to install the works

If it is your responsibility to specify the materials and/or appoint the installation contractor it is also your responsibility to ensure that they can prove competency for the fire protection materials used, or the works to be carried out. It's no longer simply a duty of care or voluntary – it's a legal obligation under sections 5.3 and 5.4 of the Regulatory Reform (Fire Safety) Order 2005. Similar provisions also exist in equivalent legislation in Scotland and Ireland.

If you knowingly ignore advice that leads to a failure in the fire performance of any element of installed fire protection within a building, then you are likely to be found to be just as culpable as the deficient installer.

You also share liability for the provision of information required under Building Regulation 38 (formerly 16B) that tells the user of the building about the fire prevention measures provided in the building. The user needs this to make an effective risk assessment under the Regulatory Reform (Fire Safety) Order 2005 and national equivalents in Scotland and Ireland.

### I'm only installing what I'm contracted to do

If you are installing fire protection, then as with those specifying the materials and/or the contractor, you also have a legal obligation to ensure that the materials you install are adequate under sections 5.3 and 5.4 of the Regulatory Reform (Fire Safety) Order 2005 and national equivalents in Scotland and Ireland.

### What is expected of me?

In the event of fire, and deaths, a court will want to know how every fire protection system was designed and specified; the basis for selection of the installer; whether adequate time was provided for its installation; and whether there was adequate liaison between the different parties to ensure it was installed correctly. No ifs, no buts – it's all contained in the Construction, Design and Management Regulations 2015.

The CDM 2015 Regulations, enforced by Health and Safety Executive, concentrate on managing the risk, and the health and safety of all those who design, specify and build, those that use the building, those who maintain it and those that demolish it – cradle to grave.

**Be aware – the time to consider the above is before the event, not after it!**



## The Association for Specialist Fire Protection



The Association was formed in 1976, and currently represents UK manufacturers and contractors of specialist passive fire protection products, with associate members representing regulatory, certification, testing and consulting bodies. It seeks to increase awareness and understanding of the nature of fire and the various forms, functions and benefits provided by passive fire protection. It is willing to make available its specialist knowledge on all aspects of fire protection and can assist specifiers and main contractors in identifying products suitable for specific requirements, both in the UK and related overseas markets. The Association encourages experimental work related to passive fire protection and promotes consideration and discussion of all issues affecting the fire-stopping in buildings

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## The Fire Test Study Group (UK) Ltd (FTSG)



FTSG is a forum for technical discussions and liaisons between consulting fire test laboratories involved in producing test and assessment information for the purposes of building control.

The member laboratories are all UKAS Accredited for testing and the primary objective of the group is to ensure common technical interpretations of the fire test standards and a common approach to technical appraisals or assessments of products which may be made by the members within the terms of Approved Document B and national equivalents in Scotland and Ireland.

Members of the FTSG participate on all relevant BSI Committees, the equivalent CEN technical committees and are involved in the European Commission technical discussions on harmonization.

FTSG members support the publication of this edition of the “Red Book” as it provides specifiers and regulatory bodies with an independently validated comprehensive and concise guide to the performance of materials used to provide fire protection for the fire-stopping and sealing of penetrations in fire rated barriers.

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## European Association for Passive Fire Protection (EAPFP)



The European Association for Passive Fire Protection is dedicated to supporting manufacturers and installers of passive fire protection products across Europe. EAPFP coordinates technical and marketing activities between national fire protection organisations with an interest in passive fire protection and is the voice of the industry in CEN, Construction Products Europe and with the European Commission. The EAPFP has been in discussions with CEN and the European Commission in developing a mandate for CEN to develop harmonised product standards for fire-stopping and other products. Such standards would make CE marking mandatory in the EU. The ASFP is a founder member of the EAPFP.

## Acknowledgements

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# Fire-stopping: Linear joint seals, penetration seals & cavity barriers

## Foreword

We all depend on reliable fire resisting compartment walls and floors in buildings. However, weaknesses can easily arise at deficient fire-stopping or sealing within cavities, or wherever building services pass through compartment walls or floors. The reliability of effective firestopping systems is therefore of fundamental importance.

So, I am delighted to introduce you to this latest 4<sup>th</sup> issue of the ASFP 'Red Book' which has been designed to be the most up-to-date guide to the provision of proprietary materials and systems for the fire-stopping and sealing of penetrations and linear joint seals within fire separating elements. This document, which is cited in Approved Document B, the statutory guidance to the England and Wales Building Regulations, is the definitive guide to fire-stopping available

In the past, there were no formal British Standard fire test methods for linear joint seals or service penetration fire seals. This resulted in a collection of confusing and diverse marketing data which regulators and other end-users found difficult, if not impossible, to understand.

The 3<sup>rd</sup> edition of the Red Book raised the bar with the condition that all the products and systems listed in the data pages were third party certificated so that the test data was more relevant and the product would be more reliable than ever before. In addition, the format of the data sheets was revised to clearly define the applicable scope of performance and to make the selection of a suitable fire sealing or fire-stopping system more reliable than previous editions.

In this 4<sup>th</sup> edition of the 'Red Book' the product data sheets have been simplified and are now hyperlinked back to the relevant certification body website where a comprehensive certificate can now be downloaded. In this way, end users can be sure that they can get the most up to date information on the products concerned backed up with the authority of the certification body concerned. It also allows the inclusion of CE marked products in addition to those that hold voluntary third party certification. In the meantime, until the new Summary Data Sheets are produced, the existing product data sheets from the 3<sup>rd</sup> edition are included in this publication so that end users have a list of third party certificated fire-stopping products to choose from.

In this way, the end user can be sure that they are getting the most up to date information on the products concerned, backed up with the authority of the certification body. It also allows the inclusion of CE marked products in addition to those that hold voluntary third party certification.

Since the publication of the 3<sup>rd</sup> edition in 2009, widespread fire testing to BS EN standards and the introduction of the Construction Products Regulation is changing the way in which products are tested and assessed; and this edition of the 'Red Book' explains those changes. Manufacturers can now apply for a European Technical Assessment (ETA) which will allow them to CE mark their products for wider acceptance throughout the EU. Although neither CE marking, nor obtaining an ETA is mandatory under the Construction Products Regulation yet, such an approach constitutes 'best practice' and as such is supported by the ASFP.



Chris Johnson - UL  
Chairman ASFP TG3 Fire-stopping

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## Scope of publication

This publication addresses fire-stopping in buildings. In this publication, the term 'fire-stopping' incorporates linear joints seals, penetration seals & cavity barriers.

## Introduction

The concept of compartmentation means that buildings are divided up into manageable areas of risk to prevent the spread of smoke and fire, to allow occupants to escape and to provide access for fire fighters. Compartmentation only works if any imperfections in the building or breaches to walls or floors e.g. by services are adequately sealed. Such a process is generically known as fire-stopping and different types are required throughout buildings in a variety of locations including:

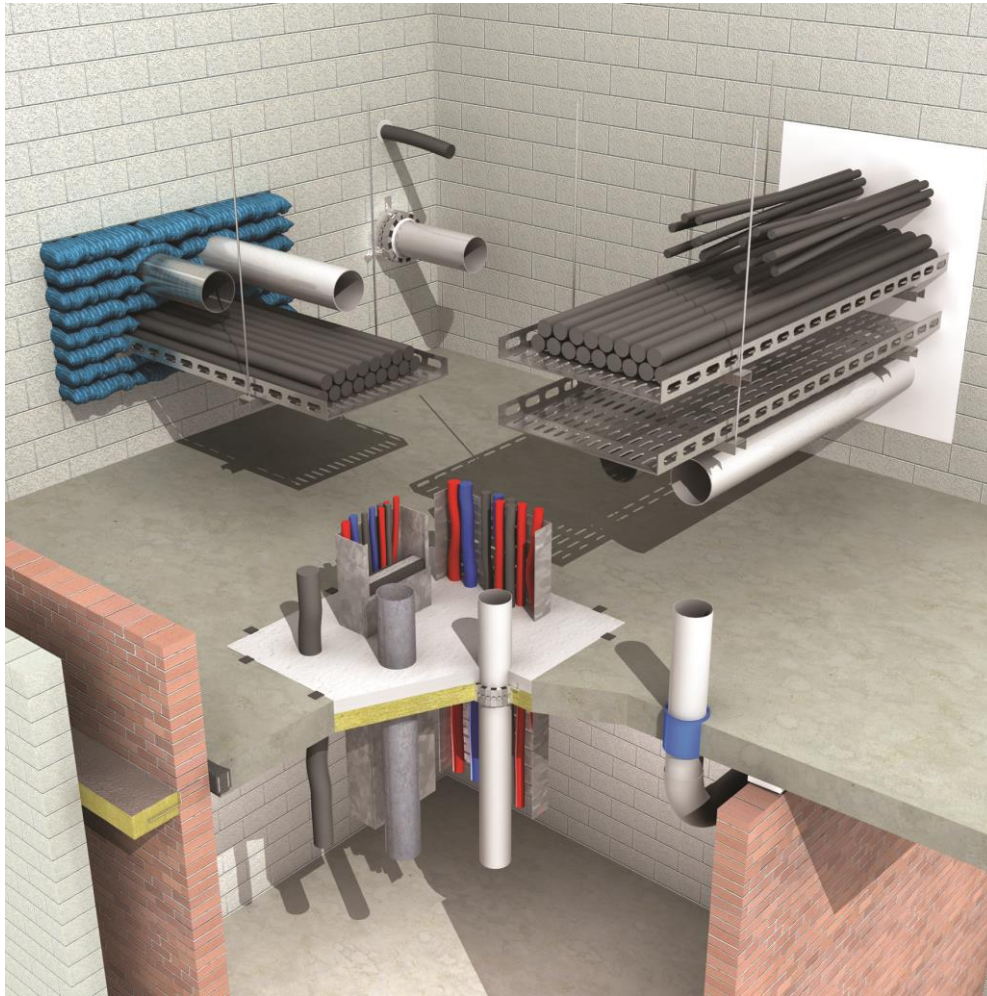
- **Penetration seals** – where services pass through fire separating elements and/or compartment walls or floors
- **Linear joint seals** – between fire resisting elements of building construction e.g. the junction between a wall and a ceiling
- **Small cavity barriers** – at imperfections in the building process e.g. at the junctions of walls/floors with cladding, between separating walls and a roof, over and between leaves of masonry walls etc.
- **Large cavity barriers** – e.g. to subdivide large roof spaces, under floor voids etc.
- **Open state cavity barriers** – between elements of a building and e.g. rain screen cladding where the cavity barrier is open in the cold state to allow for the free movement of air for ventilation. In a fire situation, the cavity barrier closes preventing the spread of fire.

This publication has been prepared by members of the ASFP and it documents the state-of-the-art with respect to the testing, certification and approval of products & systems for fire-stopping within buildings. It also provides a comprehensive guide to third party certificated and CE marked products which are manufactured and/or marketed by members of the ASFP.

ASFP listed product manufacturers and ASFP installers are committed to the highest quality in the provision and installation of firestopping products. Doing it the right way, first time around, will always be the most cost effective course of action

**In all cases, once a preliminary selection has been made, the user is strongly advised to contact the relevant manufacturer to ensure that appropriate specification enables best practice installation to be achieved.**

## 1. How to use this document



**Figure 1 – typical applications for fire-stopping systems**

Fire-stopping is used for sealing apertures and imperfections of fit, or design tolerance between fire resisting walls, floors and ceilings to restrict the passage of fire and smoke. Fire-stopping products should generally have at least the same fire resistance as the separating elements into which they are installed.

If you are involved in the specification, purchase, commissioning or maintenance of firestopping, this publication documents everything you need to know. You can use the publication as a reference document as required, or you can read the whole document if you wish to gain a full insight into the topic.

There are many types of fire-stopping, some purpose-made for specific applications. Figure 1 above illustrates the most common types which are described in more detail in Section 3. An understanding of the various properties of the different types of fire-stopping will enable correct selection of the most appropriate fire-stopping product/system.

- The main generic types of fire-stopping are described in Section 3
- How to select a suitable fire-stopping system is given in section 4
- Best practice guidance is covered in section 5
- Building Regulations and other requirements are given in section 6
- How fire-stopping is fire tested is considered in section 7
- CE marking and third party certification of fire-stopping are dealt with in sections 8 & 9 respectively
- Rules for acceptance of Summary Data Sheets are given in section 11.

## 2 Definitions

### **Ad-hoc test**

Test which has been performed to a non-standard procedure but which utilises the principles of fire resistance testing given in the relevant test method. The reports of such tests bear the following statement:

"This report covers a test which was conducted to a procedure which is not the subject of any British or European standard specification, but the test utilised the general principles of fire resistance testing given in [insert relevant test method]. Since fire tests are the subject of a continuing Standardisation process, and because existing standards are the subject of review and possible amendment and new interpretations, it is recommended that the report be referred back to the test laboratory to ensure that the methodology adopted and the results obtained remain valid in the light of the situation prevailing at that time."

### **Assessment (also referred to as appraisal or engineering judgement):**

An independent, technical appraisal of the likely performance of a component or element of construction used in a specific manner and end use application if it were to be subjected to a standard fire test.

### **Blank penetration seal**

A seal for an aperture through a separating element designed to maintain the integrity and insulation performance of the separating element for the duration of the specified fire resistance period without incorporating penetrating services.

### **Cavity barrier**

A non-loadbearing vertically or horizontally oriented element designed to provide fire separation within or at the edges of a concealed space (cavity). According to the requirements of relevant Regulations, the insulation requirement can be zero, less than or equal to the integrity requirement.

### **Compartment (fire)**

A building or part of a building, comprising one or more rooms, spaces or storeys, constructed to prevent the spread of fire to or from another part of the same building, or an adjoining building. Compartmentation subdivides the building into areas of manageable risk, to provide adequate means of escape, and to provide fire separation for adjoining buildings.

### **Construction joints**

Gaps designed into the construction of a building which requires a rigid or flexible seal to maintain the fire resistance of the structural element.

### **Concealed space**

A space in a building not normally accessible to the occupants where there may be development and/or spread of fire

### **Element of construction**

May occur as vertical walls or horizontal floors, each of which may contain a fire-stopping system

### **Escape route**

See Fire separating element below

### **European classifications**

A harmonised system of classifying the fire performance for construction products. Fire resisting elements such as walls, floors and fire-stopping tested to European Standards are classified according to EN 13501-2.

### **Fire barrier**

A non-loadbearing vertically or horizontally oriented element designed to provide fire separation within or at the edges of a concealed space e.g. in a roof. Unlike cavity barriers (above) Building Regulations normally require fire barriers to have the same insulation value and integrity value as that of the wall/floor in which they are mounted.

## Fire resistance (sometimes referred to as resistance to fire)

The ability of a component or construction to satisfy, for a stated period of time, the appropriate criteria specified in the relevant part of BS 476 or EN 1363. The following criteria are applied to fire-stopping.

### Integrity

The ability of a separating element, when exposed to fire on one side, to prevent the passage of flames and hot gases through and to prevent the occurrence of flames on the unexposed side.

### Insulation

The ability of a separating element, when exposed to fire on one side, to restrict the temperature rise on the unexposed face to below:

1. 140°C as an average value above ambient and/or
2. 180°C as a maximum value above ambient at any one point

## Fire safety engineering

The application of scientific and engineering principles, rules [codes], and expert judgement, based on an understanding of the phenomena and effects of fire and of the reaction and behaviour of people to fire, to protect people, property and the environment from the destructive effects of fire.

## Fire separating element

Fire resisting wall or floor enclosing a compartment, a protected escape route or a place of special fire hazard.

## Flexible wall

Lightweight plasterboard faced steel stud partition, defined in accordance with EN 1363-1 as:

Vertical supporting construction consisting of studs or joists, including boards/linings and optional insulation within the wall. The size of the tested flexible wall shall be minimum 3m in height and minimum 1.20m in width and contain minimum 1 vertical joint between the boards. The overall thickness, number of the gypsum board(s) and insulation should be as in the table below:

Intended fire resistance	Steel stud depth (mm)	Gypsum board type F according to EN 520		Insulation Mineral wool		Overall wall thickness (mm)
		Number of layers at each side	Thickness of Boards (mm)	Thickness (mm)	Density (kg/m <sup>3</sup> )	
EI30	44-55	1	12.5	40-50	30-60	69-80
EI60	44-55	2	12.5	40-50	30-60	94-105
EI90	44-55	2	12.5	40-50	85-115	94-105
EI120	62-70	2	15	60-70	85-115	122-130
According to EN 1363-1						

**Table 1: Construction of flexible walls from EN 1363-1: 2013**

Test results obtained with the standard flexible wall constructions may be applied to concrete or masonry elements of an overall thickness equal to or greater than that of the element used in the tests and a minimum density of 450kg/m<sup>3</sup>.

## Foam

Material, curing at room temperature, which increases its volume on application creating a cellular structure.

### Indicative Test

Report of a fire test, normally by letter only, which gives the data relevant to the test result but does not interpret those results against any classification requirements. A statement is included as follows:

"This (these) test result(s) relate to an investigation which utilised the test methodology given in (the relevant Standard); the full requirements of the Standard were not, however, complied with. The information is provided for the test sponsor's information only and should not be used to demonstrate performance against the Standard nor compliance with a regulatory requirement. The test was not conducted under the requirements of UKAS accreditation."

### Joint depth

The overall distance between the exposed and unexposed faces across the thickness of the separating element – see Figure 2A, B and C.

### Joint width

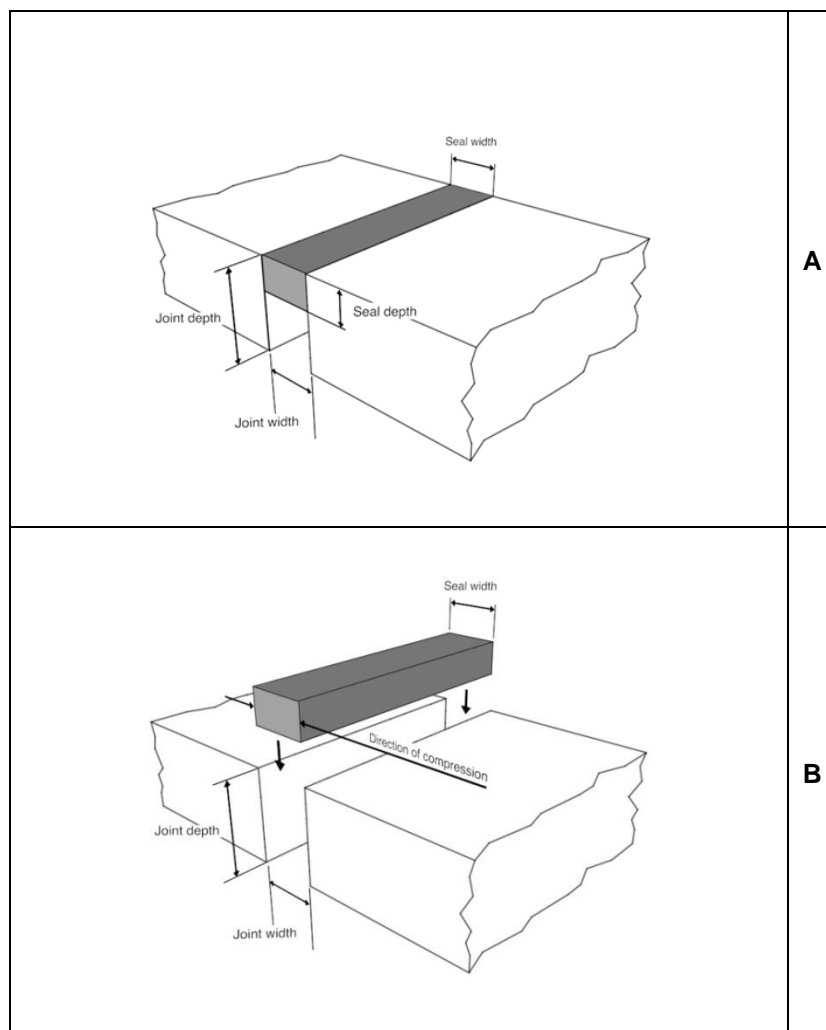
Distance between the two adjacent faces of the building element(s) – see Figure 2A, B and C.

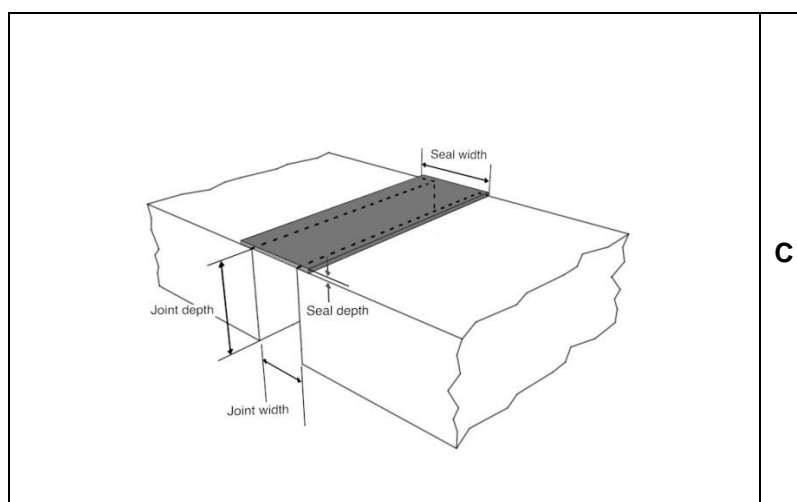
### Linear joint


Linear void having a length to width ratio of at least 10:1 within one or between two or more adjacent construction elements. NOTE that typical locations of linear joints include floors, the perimeter of floors, walls, ceilings and roofs.

### Linear joint seal

System designed to maintain the fire separating function and if relevant, to accommodate a specified degree of movement within the linear joint.





 = Linear joint seal

**Figure 2 – Definition of seal depth, joint depth and joint width for different types of seals**

### **Metal pipes type 1**

Metallic pipes and conduits of reaction to fire class A1 according to EN 13501-1 with a melting or decomposition point greater than 1000°C e.g. steel, cast iron, copper and copper alloys, nickel alloys. Included in this group are pipes with a coating, provided the overall reaction to fire class is minimum A2.

### **Metal pipes type 2**

Metallic pipes and conduits of reaction to fire class A1 or A2 according to EN 13501-1 with a melting or decomposition point equal to or less than 1000°C e.g. lead, aluminium and aluminium alloys

### **Mixed penetration seal**

A seal, that allows the installation of different types of services in a single opening

### **Modular system**

System comprising a steel frame into which elastomeric blocks are installed, compressed around the service.

### **Movement capability**

Maximum amount of movement the joint seal is able to tolerate as stated by the manufacturer or the sponsor, expressed as a percentage of the nominal width, without reduction of the intended fire performance.

### **Movement joint**

A joint between adjacent building elements or within a building element designed to accommodate a specified degree of movement such as deflection, thermal or seismic movement. In ETAG 026 Part 3 the maximum amount of movement the joint seal is able to tolerate expressed as a percentage of the nominal width. NOTE, only products with a capability of  $> \pm 7.5\%$  are considered to be suitable for movement joints.

### **Non-movement joint**

A joint between adjacent building elements or within a building element not designed to accommodate movement greater than  $\pm 7.5\%$  (such as those designed to accommodate construction tolerances or irregularities of fit).

### **Penetration**

The passage of one or more services through a fire separating element.

### Partial penetration

Service that does not completely pass through a fire separating element.

### Penetration seal

System used to maintain the fire resistance of a separating element at the position where there is provision for services to pass through the separating element.

### Pipe insulation

Figure 3 shows the terms used for the various purposes of pipe insulation.

- *Pipe insulation (local)* – pipe insulation that only extends a short distance either side of the seal
- *Pipe insulation (continued)* – pipe insulation that extends continuously either side of the seal
- *Pipe insulation (sustained)* – pipe insulation that passes through the seal
- *Pipe insulation (interrupted)* – pipe insulation that does not pass through the seal

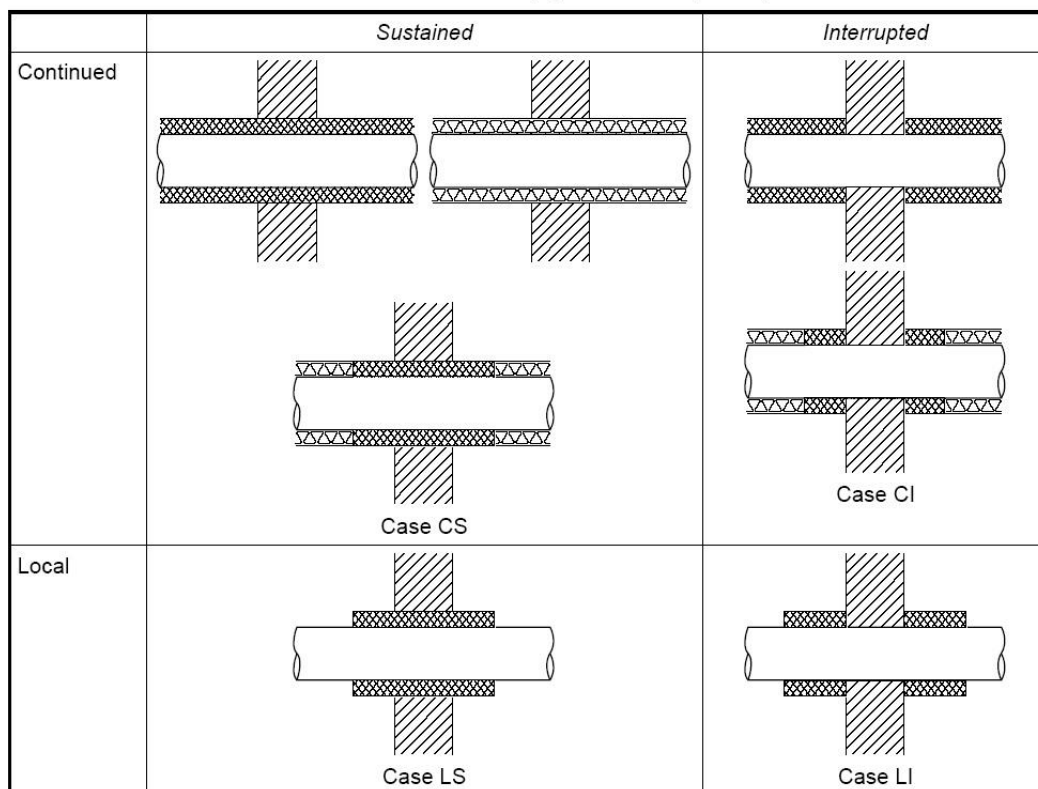


Figure 3 – Examples of purposes of pipe insulation

### Plastic pipes

Pipes made from thermoplastic or thermosetting polymeric materials including non-homogeneous materials e.g. glass fibre reinforced plastic pipes or layered pipes. They may be insulated or non-insulated. Such pipes cannot be classified to A1 or A2 according to EN 13501-1.

### Reaction to fire

The performance of a material in a fire with regard to its propensity to ignite, the amount and rate of heat released, spread of flame and smoke and toxic gases emitted.

Products and materials are classified for reaction to fire according to EN 13501-1.

**Reactive material:** The generic term for materials which react chemically or physically if exposed to heat generated by a fire. The term includes both intumescent and ablative materials.

### Rigid wall and floor

High density constructing element designed from block work, masonry or concrete with an overall density  $\geq 850\text{kg/m}^3$  with a thickness appropriate for the expected fire resistance period or a low density constructing element made from aerated concrete block, masonry or lintels with an overall density of  $(650 \pm 200) \text{kg/m}^3$  with a thickness appropriate for the expected fire resistance period.

#### **Seal depth**

The minimum distance between the exposed and unexposed surfaces of the seal (Figures 2A, B & C).

#### **Seal width**

In Figures 2A, B & C, the shortest dimension across the seal, whether between the joint or overlapping the joint, according to the following protocol:

For seals not requiring a compression fit – See Figure 2A

For seals requiring a compression fit – see Figure 2B

For seals designed to overlap the adjacent edges of the elements forming the joint – see Figure 2C.

#### **Overall seal width**

The overall width of the seal includes any fixings or overlap. This may differ from the joint width.

#### **Service**

Service such as a cable, cable tray, conduit, pipe (with or without insulation) or trunking.

#### **Service support construction**

Mechanical support provided in the form of clips, ties, hangers, ladder racks or trays, or any device designed to carry the load of the penetrating services.

Note: The service support construction does not include cable carriers.

#### **Standard Test**

The results of such a test are the subject of a full report in accordance with the Standard. The report will be comprehensive, with full details of the construction of the test specimen and the testing process.

#### **Supporting construction**

The wall, partition or floors within which the penetration seal is fitted.

**Trunking (from ETAG 026-2):** A metal or plastic casing designed to accommodate cables. Normally trunking is square or rectangular in section.

#### **Working clearances**

Distances between services or between services and the seal edge.

## 3 Generic types of fire-stopping & fire sealing systems

### 3.1 Coated stone wool batts/boards

#### Description

Coated stone wool for fire-stopping applications is typically supplied as batts or boards.

#### Areas of Use

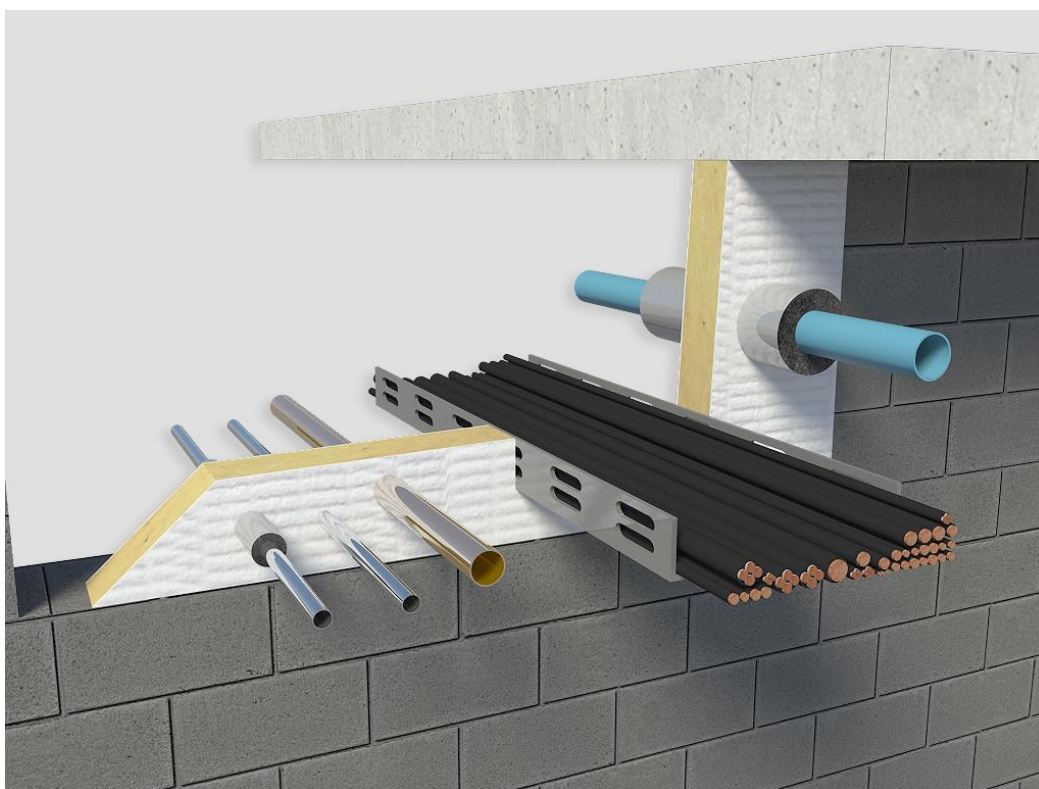
Coated stone wool batts can be used to fire-stop penetrations through compartment walls and floors and allow additional services to be readily installed as required. In certain circumstances, a structural support for the seal may be required – refer to manufacturers' recommendations. Additional provisions to satisfy load bearing requirements may also be required, particularly in the case of horizontal seals but should not be confused with the structural support that the seal may require. A separate loadbearing provision (e.g. steelwork and grating) should be provided in this case. Blank seals can also be installed, so that when services are required to penetrate a wall or floor, they can be quickly installed and the seal reinstated. Coated stone batts may be installed as a patress see clause 3.16.

#### Installation

Coated stone wool batts can be installed as pre-formed shapes or as standard batts for tailoring to fit openings. Batts can be friction fitted to the clean and dust free sides of the opening and around the penetrating services. A 'fire resistant' sealant that has been tested with the batt as part of a system is generally applied to all joints and to the raw edges of the slab. Some systems may require secondary support. This will vary from manufacturer to manufacturer.



Figure 4: Coated batt used for a vertical penetration seal



**Figure 5: Coated batt used for a vertical penetration seal**

## 3.2 Sealant/mastic coatings

### Description

Sealant or mastic (silicone, acrylic etc.) applied by a mastic gun or trowel applied into an opening and between/around penetrating services.

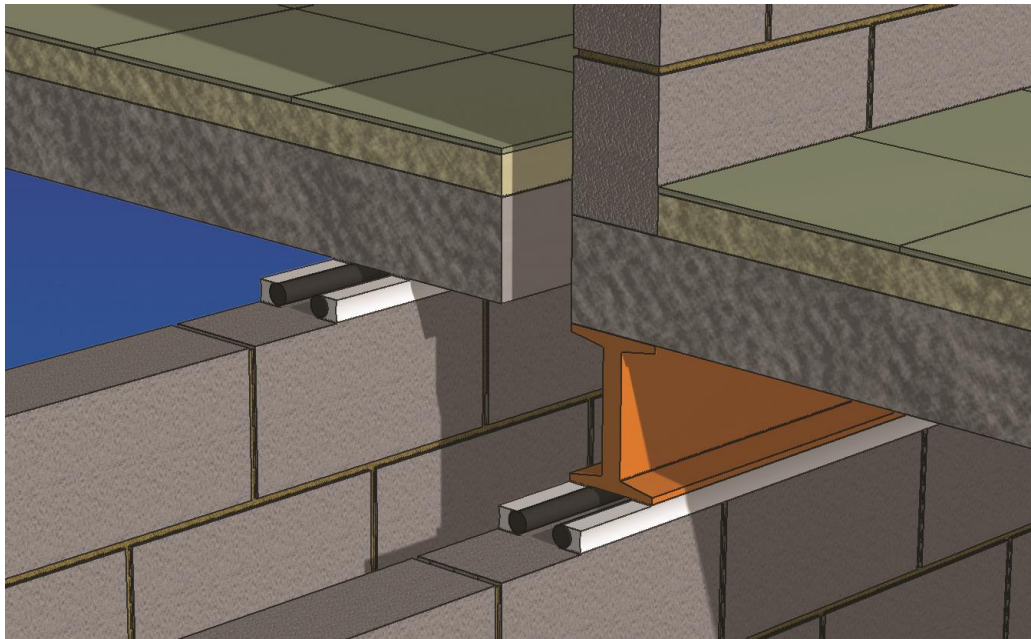
### Areas of Use

They may be used to seal around any penetrating services where testing indicates their suitability. They are also suitable when used in conjunction with coated batts/boards in all forms of fire resistant construction, where openings are small, where penetrations are complex and where there is imperfection of fit between building elements.

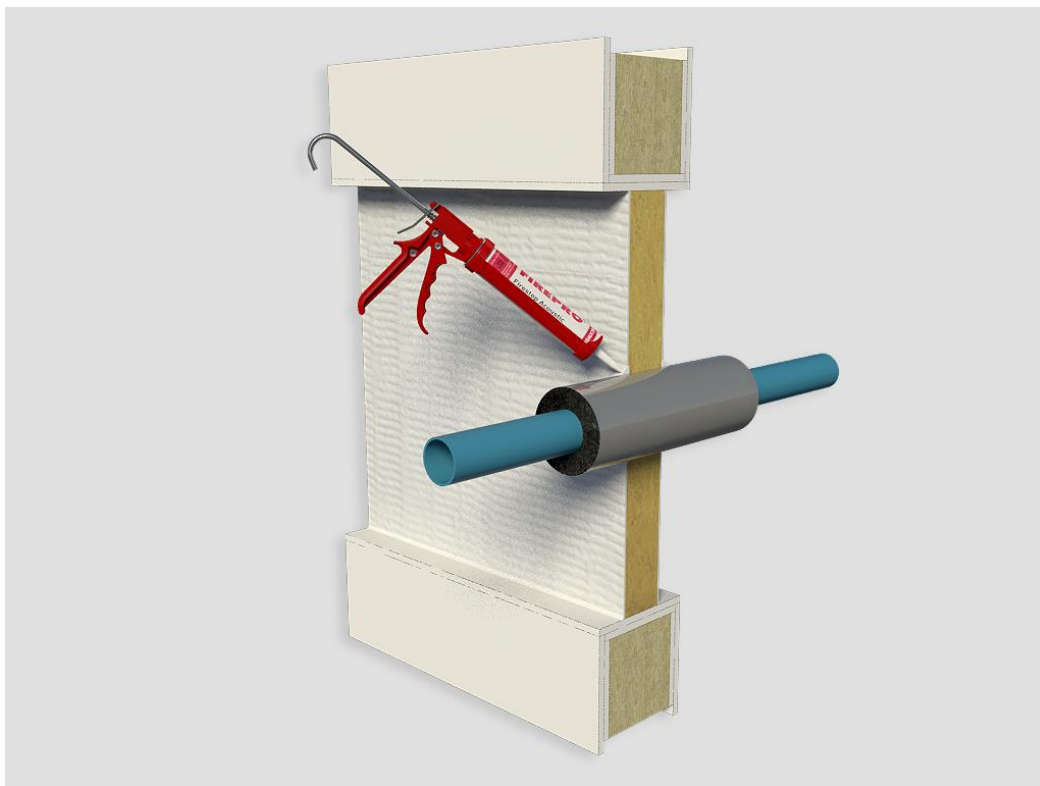
When used in linear joints where movement is expected, a sealant with the ability to accommodate the movement of the joint should be used so that a seal is maintained in service and during fire conditions. The movement capability should be assessed against ISO 11600 and fire resistance tested to EN 1366-4.

### Installation

Use of mastic guns or trowels is common, although for floor penetrations some materials can be poured using temporary or permanent damming boards and in some cases spray applied on site. Dusty/friable surfaces may need additional treatment prior to the application of the sealant/mastic – refer to manufacturer's instructions.



**Figure 6: Sealant/mastic used to seal joints between a masonry wall and steel beam and between a masonry wall and a concrete soffit**



**Figure 7: Sealant for a vertical penetration seal**



**Figure 8: Sealant used for a fire resisting linear joint seal**

### **3.3 Mortars (compound)**

#### **Description**

Gypsum or cementitious based powder blended with inorganic lightweight fillers, composite reinforcement and chemical modifiers. The compounds are mixed with water and placed around and between penetrating services giving a rigid seal with some products providing a loadbearing seal.

#### **Areas of Use**

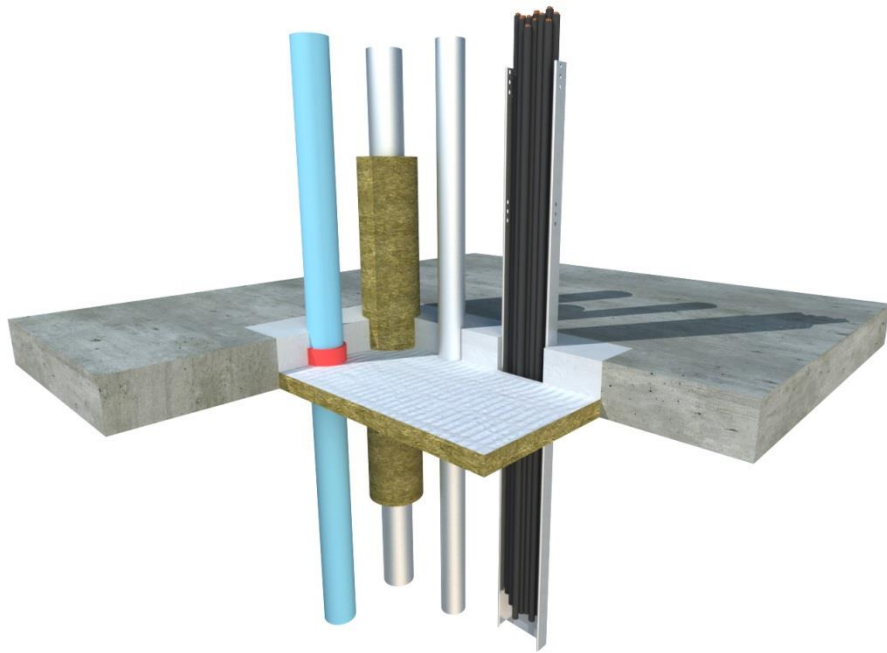
The systems can be used to fire-stop penetrations through concrete and masonry compartment wall and floor constructions although some can be used in conjunction with lightweight partitions or timber floors. In certain circumstances a supporting structure will be required – refer to manufacturers' instructions. Blank seals can also be installed, so that when services are required to penetrate a wall or floor, they can be quickly installed and the seal reinstated.

#### **Installation**

The mortar is mixed close to the opening. For large installations, some materials are capable of being pumped after mixing and in some cases a mechanical support system would be required.

In floor penetrations, a temporary or permanent damming board is normally used with the mortar poured in place. This will need to be able to carry the wet weight of compound.

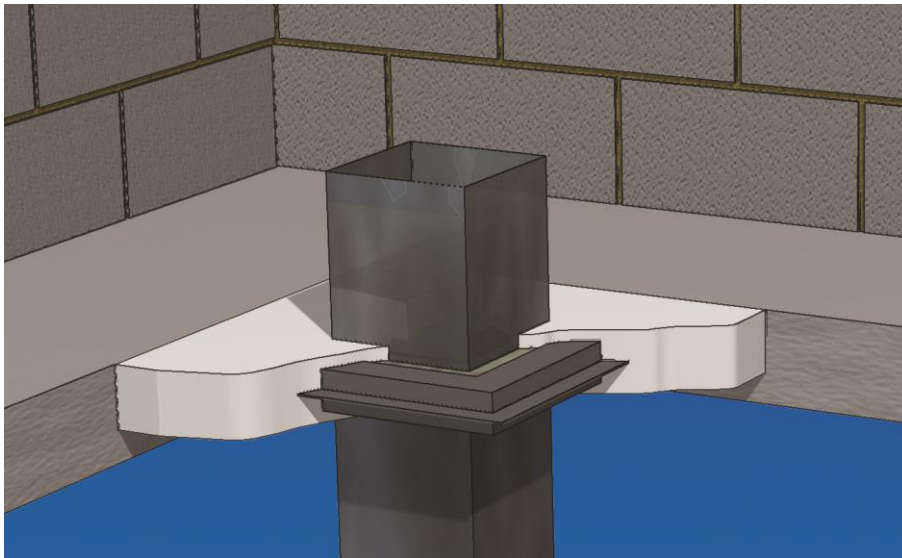
For wall penetrations, mortars are often trowelled using a single damming board or no damming board, dependent upon the opening size. Some mortars can be pre-formed into blocks so that wall seals can be built up with the same wet mortar to bind the blocks using masonry building techniques. Small penetrations can sometimes be made by trowelling the mortar into the opening without the use of a damming board.



**Figure 9: Mortar used in concrete floor**



**Figure 10: Mortar used in concrete floor**



**Figure 11: Mortar used in concrete floor. Note damper fitted with builder's frame (Specific test evidence of use with a duct fire test or damper fire test is required)**

### **3.4 Preformed elastomeric seals**

#### **Description**

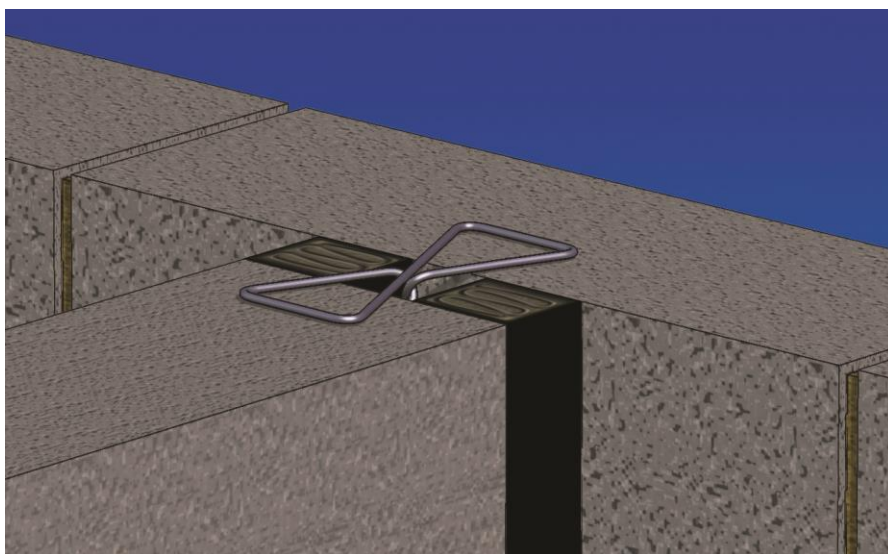
These are made from elastomeric foam, sometimes with reinforcing sheets on either side. The foam and/or the reinforcing sheets may be intumescent. These products are generally supplied in a strip form.

#### **Areas of Use**

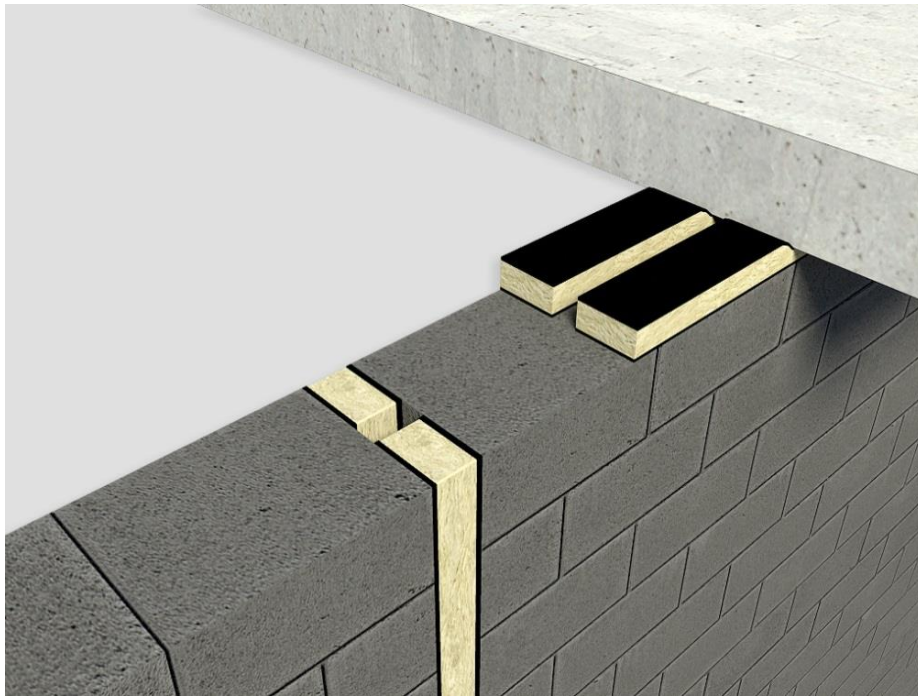
These products are generally used to seal the gap at a movement joint between two building elements, such as between a floor and a wall.

#### **Installation**

These products are fitted by compressing by hand and then by pushing into the gap which ensures they remain in place. It is important to ensure that the correct size seal is installed into the joint to allow expansion as well as contraction.



**Figure 12: Elastomeric seal used to seal between two masonry walls**



**Figure 13: Elastomeric seal used to seal expansion joints in a masonry wall and between a masonry wall and a concrete soffit**

### 3.5 Bags/pillows/cushions

#### **Description**

Bags/pillows or cushions are available in various sizes and shapes and are specified for use in temporary or permanent fire-stopping situations where services such as cables pass through walls and floors. Bags/pillows are made from special fabrics and enclose a filling material which often incorporates an intumescent material.

#### **Areas of Use**

Bags/pillows can be used wherever services, such as cables, penetrate a fire resistant element. Since they are easily removed, they are particularly useful where services are frequently re-routed, and can be used as temporary protection during construction work.

#### **Installation**

Bags/pillows must be placed into the opening(s) using the correct orientation, packing density and overlap (staggered joints), to achieve the desired fire resistance. For wall penetrations, bags/pillows are normally self-supporting, but large openings with few penetrating services may require a steel retaining mesh for support on both sides of the penetration. The size of mesh and method of fixing may affect the support of the bags/pillows and the manufacturers fixing specification must be adopted. Floor penetrations normally require a well anchored steel retaining mesh or basket to support the bags/pillows.



**Figure 14: Pillows used to provide temporary fire-stopping of a horizontal cable tray**



**Figure 15: Pillows used to provide temporary fire-stopping of a vertical cable tray**

### 3.6 Pipe closures

#### Description

Pipe closures are designed to preserve the integrity of a fire resistant compartment where various cross link plastic pipes (PEX), plastic pipes, plastic trunking, steel pipes with insulation or plastic pipes with insulation pass through floors or walls. Unlike metal or cable service penetrations, these service penetrations soften and collapse under heating, therefore some means of preventing the passage of fire is required. This is achieved by crushing the cross-section of the pipe or trunking.

There are variations in design of pipe closures. The three principal methods of pipe closure are **pipe collars**, **pipe wraps** and **high pressure exerting sealants**. All systems confine an intumescent compound which expands on exposure to fire, rapidly exerting pressure upon the pipe or, in some cases, insulation. The service penetrations, which will have softened due to the heat, collapse under this pressure creating a constriction. Some pipe closures incorporate a mechanical device which may or may not include an intumescent compound. Pipe collars incorporate an outer casing which acts as a restraint for the intumescent material, enabling the collar to be either surface fixed to the separating element or incorporated within it. Pipe wraps have no casing and hence must be located within the separating element, which acts as a restraint for the intumescent. High pressure exerting sealant is installed to a prescribed annular gap to a predetermined depth between the service penetration and the constructing element.

#### Areas of Use

Pipe collars, pipe wraps and high pressure exerting sealants can be used where plastic pipes (PEX), plastic pipes, plastic trunking, steel pipes with insulation or plastic pipes with insulation pass through fire resistant elements such as floors or walls.



Figure 16: Pipe closure used around plastic pipes passing through a wall



**Figure 17: Pipe collar used at soffit of concrete floor and against masonry walls**

**Installation: Pipe wraps**

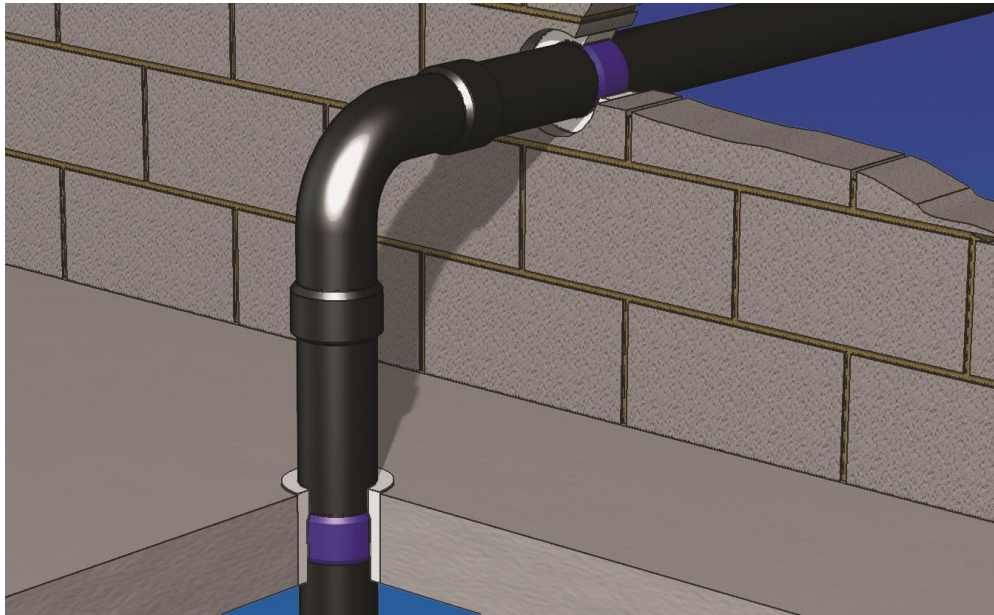
Pipe wraps are fitted into an oversize hole in the separating element, surrounding the pipe. If there is a fire risk on both sides of a compartment wall or floor two wraps may be required. The position of the pipe wrap within the wall or floor can be critical e.g. many pipe wraps for soil pipes passing through floors need to be positioned at the bottom of the opening in the floor to activate properly. Similarly, a pipe wrap tested in a rigid wall may not work when tested in a flexible wall without suitable framing out. Specifiers and installers should check that the supporting fire test evidence is applicable for the end use application envisaged.

**Installation: Pipe collars**

The normal method is to fit the collar to the wall or soffit/floor on the fire side, although some designs can be recessed into the structure or fitted on the non-risk side. If there is a fire risk on both sides of a compartment wall or soffit/floor, each side may require protection. It is essential that the method of securing the collar to the fire resistant element will not be compromised by the action of fire. Certain types of fixing components may not be suitable. Manufacturers fixing instructions must be followed.



**Figure 18: Suitable types of anchor for fixing collars**



**Figure 19: Intumescent wrap used to seal pipes in a masonry wall and a concrete floor**



**Figure 20: Pipe wrap fitted to pipe and being inserted in a concrete wall**

### **Installation: High Pressure Exerting Sealants**

High Pressure Exerting Sealants are installed into an oversize aperture in the separating element, surrounding the penetrating service. If there is a fire risk on both sides of a compartment wall or floor, HPE sealant may be required on both sides. The high pressure exerting sealant is installed to a prescribed annular gap to a predetermined depth between the service penetration and the constructing element. The backing material for these sealants should be checked before use to ensure they are approved. High pressure exerting sealants tested in a rigid wall may not work when tested in a flexible wall without suitable framing out. Specifiers and installers should check that the supporting fire test evidence is applicable for the end use application envisaged.

### Cautionary note – CPVC pipes

Care should be taken when fire-stopping around CPVC sprinkler pipes because there have been compatibility issues with some fire retardants and plasticisers in fire-stopping products reacting with the CPVC pipes and causing integral damage (fracture) to the pipes in the non-fire condition.

Some manufacturers of pipes carry a listing of tested and approved fire-stopping products. However, the best way to be sure is to use a third party certificated fire-stopping product that has been tested for compatibility by the manufacturer. Manufacturers of fire-stopping collars and other pipe closure will be able to advise on any compatibility issues.

## 3.7 Plugs/blocks

### Description

Plugs/blocks to fit around cables and pipes are formed from materials such as bonded vermiculite, mineral wool, gypsum or cementitious materials, polyurethane, modified rubber, etc. They can be rigid or flexible. Some fire-stopping plugs/blocks are inherently fire resistant, some rely on an intumescent coating, and some are manufactured using intumescent materials. Fire-stopping plugs/blocks are available in a variety of shapes and sizes. They are generally supplied as rectangular blocks for rectangular penetrations or cylindrical/conical for circular penetrations. Pre-formed trapezoidal plugs/blocks are available for sealing openings below profiled metal decking.

### Areas of Use

Plugs/blocks can be used for a wide variety of fire-stopping requirements. They can be used individually in small penetrations or in multiple layers for larger openings. They are useful where services require occasional re-routing.

### Installation

Fire-stopping plugs/blocks can be used individually where the penetration is small, or in multiple layers for larger openings. The various types can be loose laid, compression/friction fitted, or bonded together. Some types will require a fire resistant sealant to be applied along joints and interfaces. For circular penetrations, cylindrical or conical plugs/blocks can be used.

Some plugs/blocks, such as those based on calcium, potassium or sodium silicate, (e.g. bonded vermiculite plugs/blocks) may require additional protection in high humidity environments.

Specialist advice from manufacturers should be sought where these materials are to be used in combination with other fire-stopping materials.

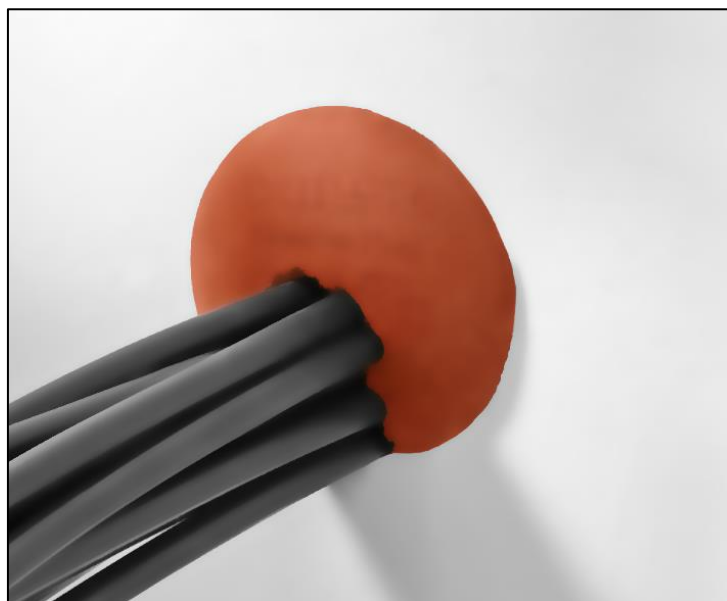
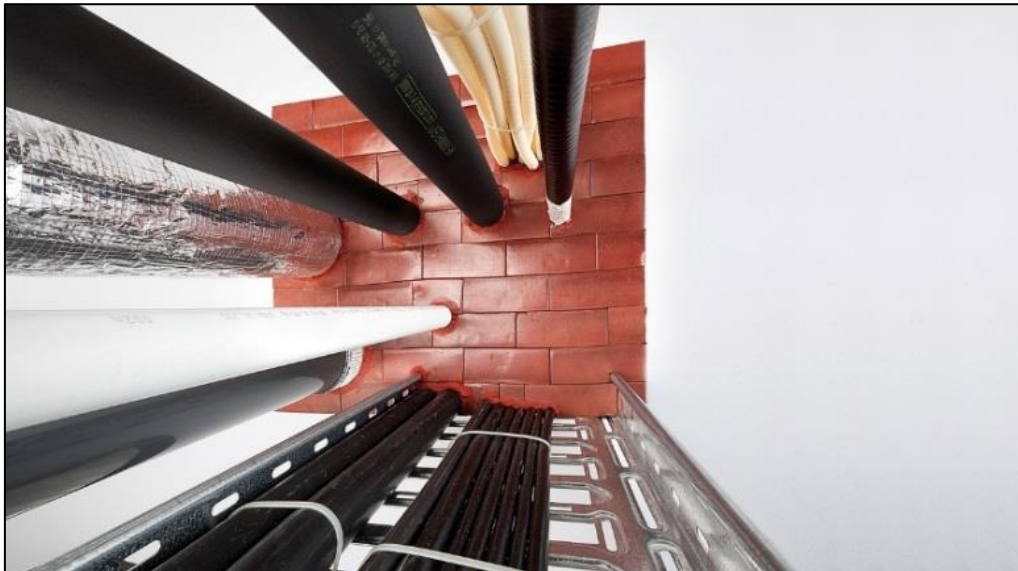


Figure 21: Intumescent pre-formed plug for cable seal

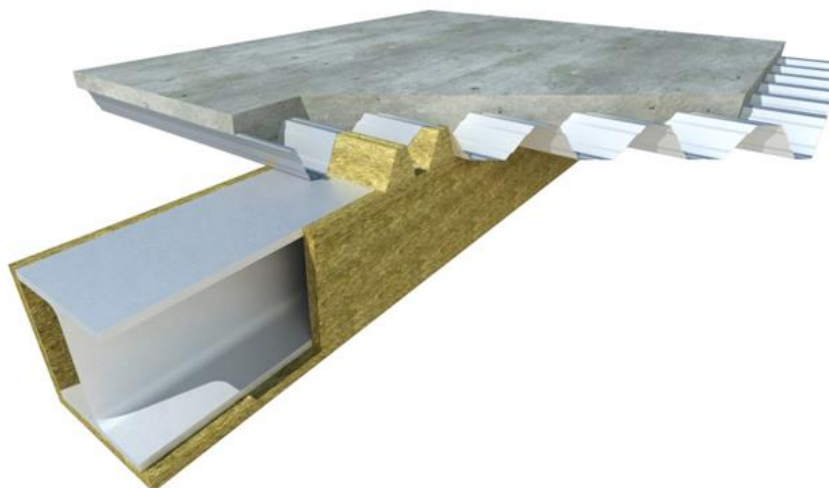


**Figure 22: Intumescent blocks in a service penetration through a wall**

### 3.8 Cavity barriers

Cavity barriers are defined as a construction, other than a smoke curtain, designed to close a concealed space, such as that in a cavity wall or ceiling void, against penetration of smoke or flame, or provided to restrict the movement of smoke or flame within such a space.

Cavity barriers require special attention from the designer. By their very nature they are usually hidden once installed and are therefore difficult to inspect after installation, handover and subsequently through the life of the building. However, the barrier will not become effective until it has been covered up and post-installation inspection could affect the usefulness of the cavity barrier by opening the works.



**Figure 23: Small cavity barriers as fire-stopping below a profiles metal deck**

### Description

Cavity barriers can be divided into two types: 'small' cavity barriers e.g. those used within the leaves of a masonry wall and 'large' cavity barriers which can be several metres high/wide which are used to divide large enclosed spaces e.g. in under floor voids and within roof spaces.

Small cavity barriers are usually made from stone wool slabs and strips or preformed elastomeric seals. Large cavity barriers are usually made from either non-combustible fabric such as glass or ceramic cloths or are fabricated e.g. from stone wool curtains.

### Areas of Use

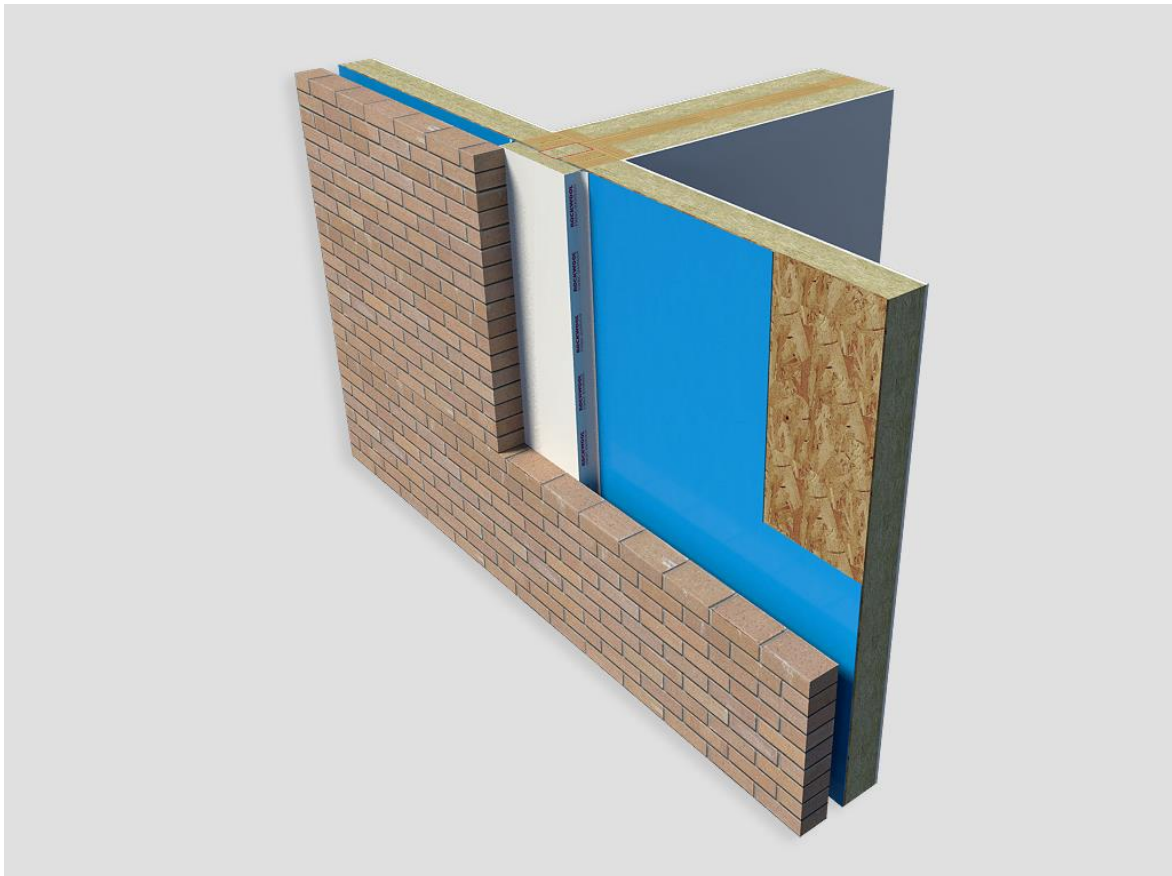
Cavity barriers are used: around window frames, within cavity walls (masonry and in timber frame constructions) in floor voids e.g. below raised floors, and in ceiling spaces and roof voids.

### Installation

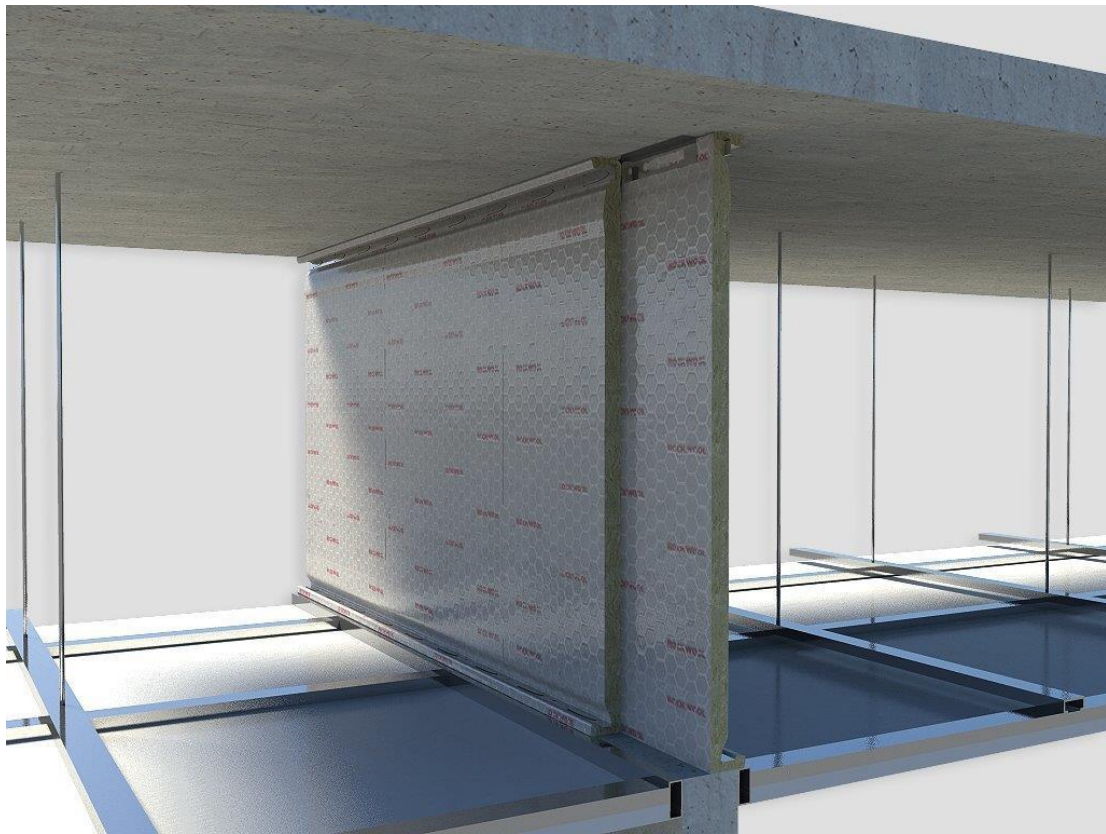
Particular care is required in the installation of some types of cavity barriers e.g. those within cavity walls because they will become inaccessible after installation and so cannot be inspected or maintained.

### Performance

Cavity barriers are only usually required to have 30 minutes integrity and 15 minutes insulation (different requirements may occur in Scotland, Wales and Ireland).



**Figure 24: Small cavity barriers as fire-stopping in fire-stopping in external wall cavity**



**Figure 25: large cavity barriers as fire-stopping in a suspended ceiling**

### 3.9 Open cavity barriers e.g. for rain-screen cladding

#### **Description**

Open cavity barriers such as those used in rain screen cladding systems are cavity barriers which are open to allow ventilation and drainage in the cold state, but which either close in a fire, or are inherently fire resisting providing fire separation in the cavity. They are usually made from stone wool slabs faced with aluminium foil together with a reactive component such as an intumescent which causes the seal to close in fire.

#### **Areas of Use**

Open cavity barriers are used in ventilated rain screen cladding, roof ventilation, eaves, within internal walls in buildings and other areas where ventilation is required in the cold state. As with ordinary sealed cavity barriers, they are not normally intended to act as fire separating elements which have higher requirements for fire resistance.

#### **Installation**

Particular care is required in the installation of some open cavity barriers as these are normally difficult to access after installation. For this reason, the use of specialist contractors is recommended.

#### **Performance**

Traditionally, open cavity barrier systems have been fire tested in an ad-hoc manner based on the fire exposure conditions of BS 476 Part 20 or EN1363-1 and/or load bearing or non-load bearing requirements of walls or floors according to BS 476 Parts 21 or 22 respectively.

More recently, the ASFP has published a fire test method (TGD 19 *Test method for open state cavity barriers*) for the comparative fire testing of open state cavity barriers. A variant of this has been put forward in CEN and it is intended that this will be correlated with large scale façade and cladding tests.

The ASFP recommends that the comparative fire resistance performance of open state cavity barriers is evaluated by TGD 19.

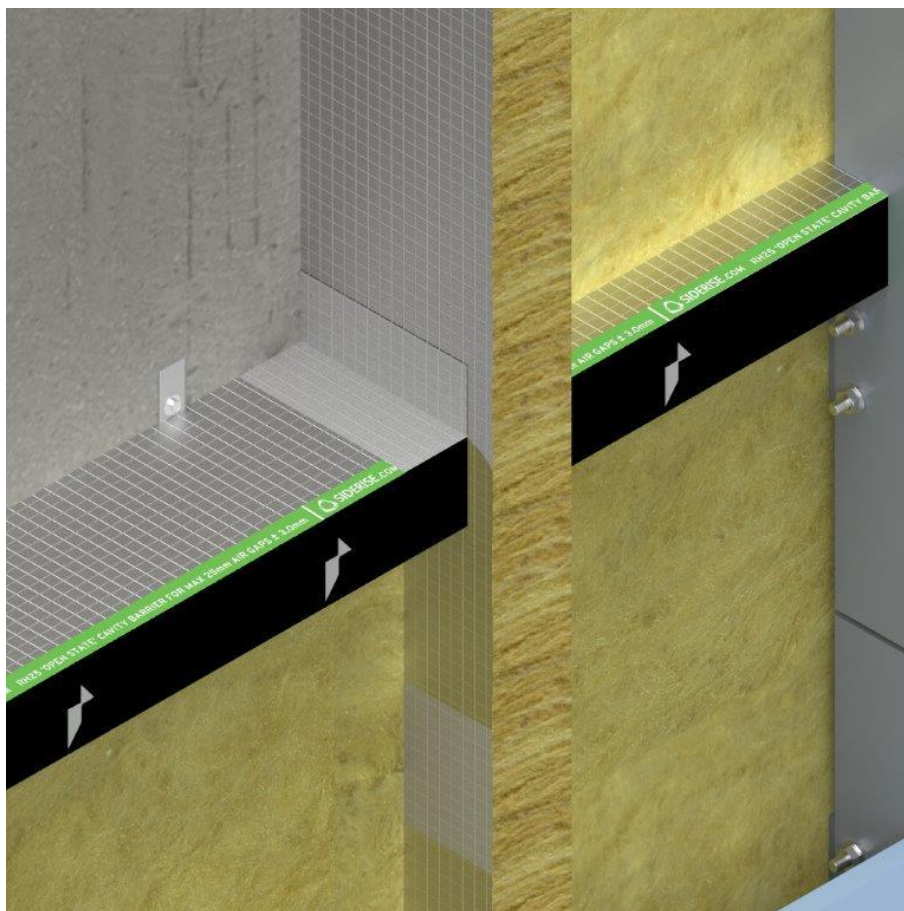


Figure 26 – Linear fire seal as fire-stopping to slab perimeter

### 3.10 Fire barriers

#### Description

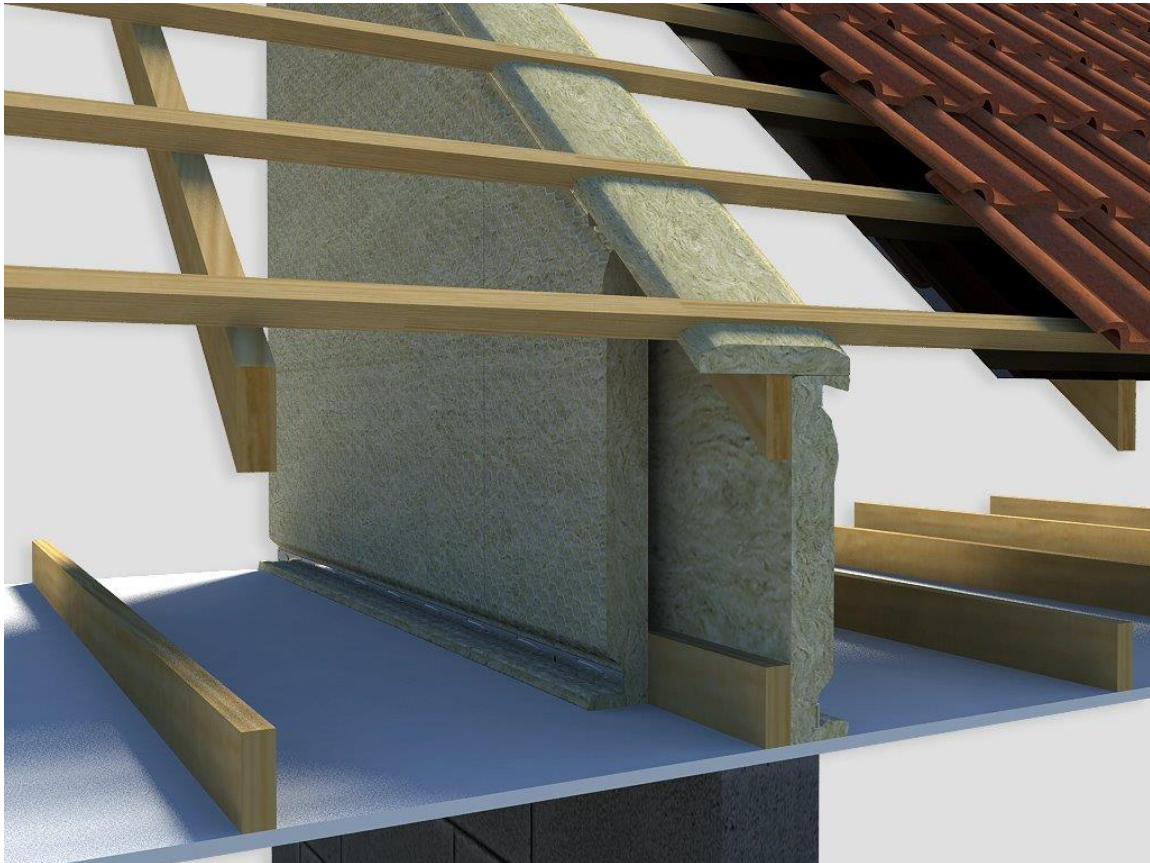
Fire barriers are large curtain type barriers which are usually constructed from either non-combustible fabric such as glass or ceramic cloths or are fabricated from stone wool curtains incorporating a reinforcing mesh.

#### Areas of Use

Although fire barriers can be used as large cavity barriers they are typically used to continue the compartment line of a fire resisting wall up to a roof or to the underside of a compartment floor. They are used to seal large openings, which commonly occur within roof spaces or ceiling voids and they must maintain the Integrity and Insulation rating of the wall that they are continuing.

#### Installation

Particular care is required in the installation of fire barriers e.g. those within timber roof spaces because in many cases they will require the protection of the supporting substrate. Fire barriers are usually hung as a curtain from a metal angle/frame system.



**Figure 27 – Large fire barrier**

#### **Performance**

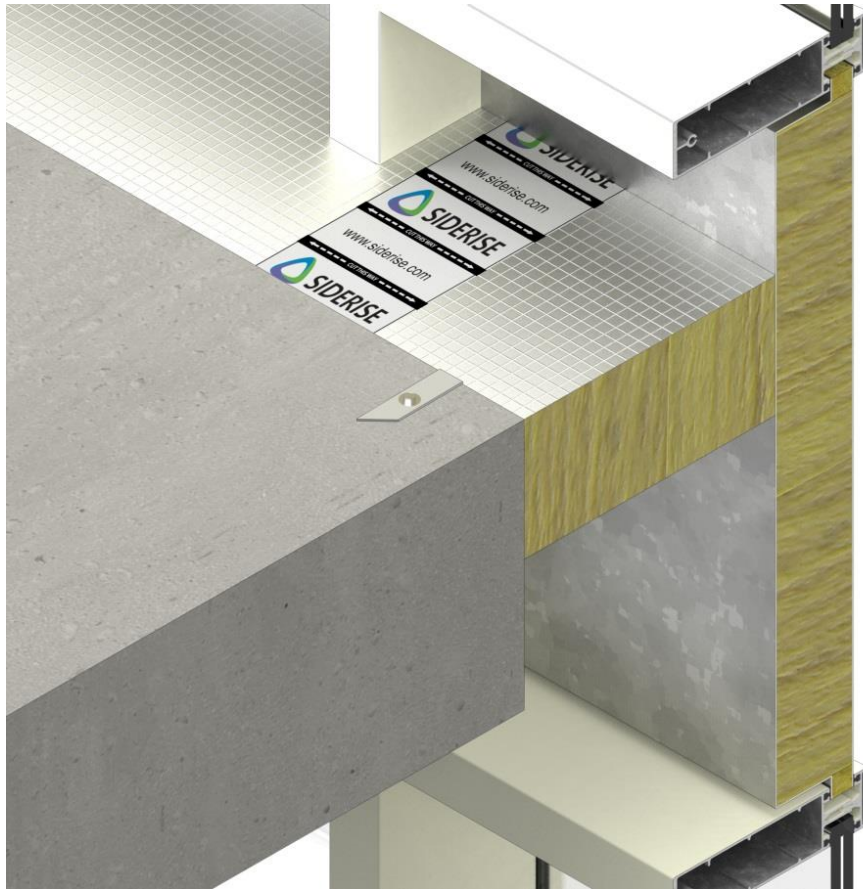
Fire barriers exceed the 30 minutes integrity and 15 minutes insulation required for cavity barriers (Different requirements may occur in Scotland or in Northern Ireland) and can offer up to 120 minutes integrity and insulation performance depending upon the substrate they are supported from.

#### **3.11 Curtain wall seals - fire-stopping at junctions of floors slabs**

These products are usually manufactured from stone wool used in conjunction with metal support systems and/or mastics/self-levelling or sprayed compounds to seal the gap between a floor slab and a curtain walling system. Throughout their lifetime these fire-stopping systems will have to withstand large amounts of movement due to dynamic loading of the superstructure, as well as the seismic and fire loads imposed on the curtain wall system. These deflections can be large in magnitude in comparison with the void dimension being sealed.

#### **Areas of Use**

Generally used between compartment floor slabs and curtain walling systems to maintain compartmentation.



**Figure 28 – Linear fire seal as fire-stopping to slab perimeter**



**Figure 29 – Sprayed linear fire seal as fire-stopping to slab perimeter**

## Installation

Curtain walling fire-stopping systems can be installed as pre-formed shapes or as standard sized products that are cut to shape onsite. The effectiveness of the fire-stop will depend on the ability of the curtain walling/cladding system to maintain the compression fit for the duration of the required fire resistance period. Unless the system is installed pre-compressed and can move to maintain compression, premature failure of the fire-stopping may occur.

Some systems require secondary support and/or the use of mastics/self-levelling or sprayed compounds. These requirements will vary from manufacturer to manufacturer.

## Performance

Edge of slab fire-stopping should only be used if tested to BS EN 1364-4 and within the field of application of the particular system, since the fire resistance periods obtained may vary from one curtain wall system to another. See 7.3.4 for more information.

## Classification of curtain wall fire-stopping

Curtain wall fire-stopping tested to BS EN1364-4 is classified into two curtain wall types;

- Curtain Wall Type A – Non fire rated curtain walling. This is only fire resisting in the spandrel zone i.e. it is a typical curtain walling system made from aluminium with no fire resistance
- Curtain Wall Type B – Fully Fire Rated Curtain Walling. This is a steel based or upgraded fire protected aluminium system

*Note: materials tested in Curtain Walling Type B cannot be utilised to assess performance for Curtain Walling Type A*

BS EN 13830: 2015: *Curtain walling — Product Standard*; is the harmonised product standard for curtain walling. (see 7.5 for more information on CE marking). The standard contains the following statement with regards to compartmentation

*“5.4 Fire propagation (to upper levels) Partial configuration of curtain walling kit shall be tested in accordance with EN 1364-4. Test results shall be classified in accordance with EN 13501-2”*

Reference should be made to ASFP Advisory Note 7: *Horizontal linear gap seals used in curtain walling system* <http://is.gd/I31BOH>

## 3.12 Stone wool mineral fibre slabs and strips

### Description

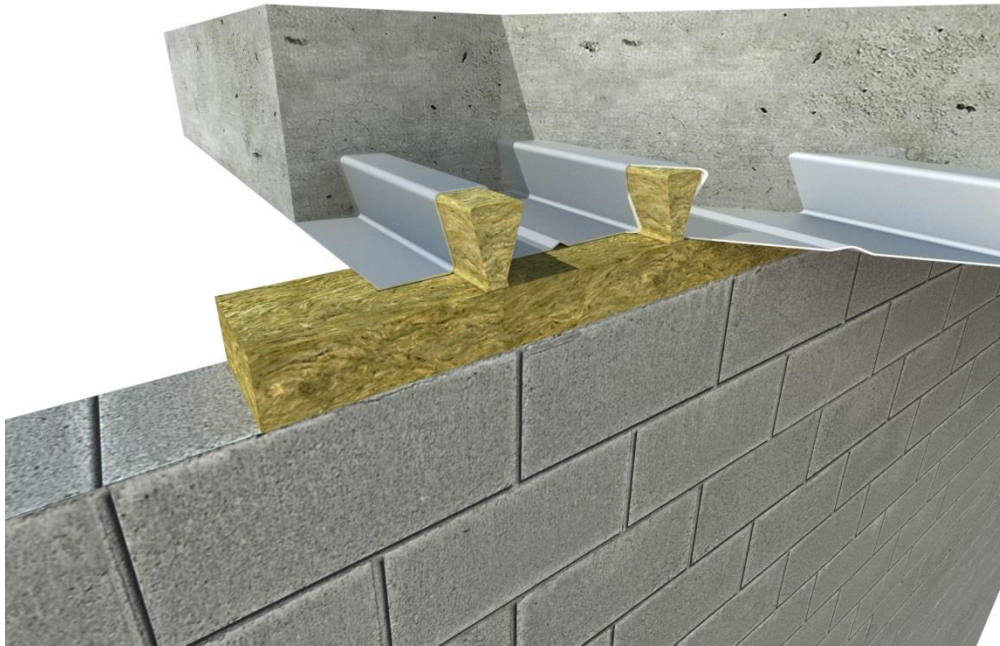
Stone wool products for fire-stopping are supplied in a number of forms; typically referred to as mats, batts, or pre-formed shapes.

### Areas of Use

Stone wool products are those that are manufactured for a specific purpose such as rain screen systems, cavity barriers, heads of walls, blank seals and penetration seals, as used for fire sealing of voids through compartment walls and floors.

### Installation

Stone wool products are installed as pre-formed shapes or components designed to carry a specific fire-stopping purpose. Some systems may require secondary support or fixing systems and further sealing or coating to maintain a resilient seal for long term movement e.g. deflection head joints. Refer to manufacturer's instructions.



**Figure 30: Mineral wool strips used for fire-stopping at the heads of walls**

### 3.13 Foam

#### **Description**

Foams can be divided into two types; silicone based foams and polyurethane (PU) based foams.

Silicone based and polyurethane fire-stopping foams are normally provided in two components which, when mixed together, cause the material to foam and increase its volume. The material cures at room temperature resulting in the formation of a highly resilient seal. Systems can be expected to prevent the passage of cold smoke, or halon gas where such use is permitted, and have good resistance to water, including flooding.

Polyurethane (PU) based foams are usually supplied in an aerosol can with a dispenser to guide and shape the resulting mix. The foam sets at room temperature to provide a seal capable of fitting around difficult to access constructions.

**Note:** It should be noted that one component aerosol applied polyurethane based foams may have a limited field of application for fire resistance and are generally not suitable for use in conjunction with metallic service penetrations, pipes or large or complex penetration seals.

Testing indicates they have a limited use for linear joint seals such as the gaps around door frames and small/simple penetration seals. Fire resistance periods are also generally less than those which can be achieved with silicone foams or other types of firestopping. It is essential that the designer, specifier and installer work within the limitations of the product concerned.

This warning is highlighted here in respect of aerosol applied PU foams due to the widespread abuse of such products where they are used in situations where their performance is not supported by appropriate and relevant testing.

Neither silicone nor PU foams, floor seals would be considered load bearing.

Reference should be made to ASFP Advisory Note – *PU data sheet*. <http://is.gd/I31BOH>

The ASFP has also produced a video highlighting the misuse of PU foam seals, available on the ASFP website.

### **Area of Use**

Suitable for the fire-stopping of service openings through compartment walls and floors, particularly where access is difficult and where there are complex spaces between groups of services.

### **Installation**

Metered mixing is essential and reaction times will vary. Some manufacturers supply these as easily dispensed pre metered self-mixing cartridges. In the case of aerosol PU foams, this is provided by the aerosol can.

Manufacturer's instructions must be referred to, ensuring the correct installation of the seal. Temporary or permanent damming boards may need to be used to contain the expanding mixture. Where permanent damming boards are used their presence must not adversely affect the fire performance of the finished seal and specialist advice should be sought.



**Figure 31: 2-component Polyurethane fire-stop foams correctly used for penetration seals**



**Figure 32: Silicone fire-stop foams correctly used for penetration seals**

### 3.14 Cable transits and sleeves

#### Description

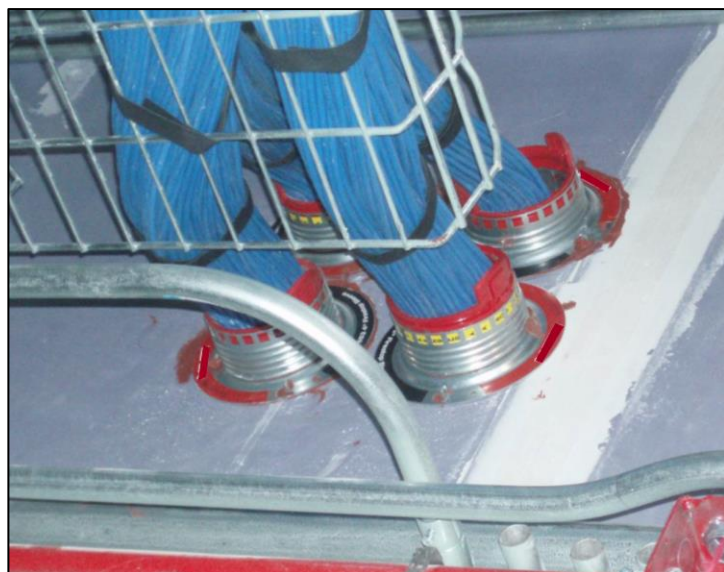
These are preformed firestopping units that can easily facilitate the removal, replacement and addition of cables at any future point. Some of these systems are made in such a way that they have explosion and blast resistance properties as well as high water table resistance.

#### Areas of Use

In walls or floors where cables have to be moved, changed or replaced on a regular basis without disturbing or damaging the fire resistant properties of the fire-stop seal and therefore the building element. They are particularly invaluable in active working environments where shut downs to replace and reinstate traditional fire-stop would be inconvenient and disruptive.

#### Installation

These are generally mechanically assembled and fixed into openings. They are opened and closed with a simple hand action or are assembled using pre-made sealing units. Refer to manufacturer's instructions.



**Figure 33 Examples of firestopping cable sleeve and transit**

### 3.15 Ductwork and damper penetration sealing systems

The fire performance of fire resisting and smoke extraction ducts and fire or smoke control damper systems and their associated penetration seals is determined by fire tests particular to those products, not to EN 1366-3 (penetration seals fire test). These fire tests include a specified fire-stopping system and significant provisions for supporting the duct or damper being tested. These should not be replaced by other systems in practice, unless additional information justifies the change. Penetration sealing systems for cables and pipes are not suitable for ducts and dampers unless proven by test. The applicable fire tests are BS 476: Part 24 for fire resisting and smoke extraction duct and EN 1366, Fire resistance tests for service installations:

- Part 1: Ventilation ducts;
- Part 2: Fire dampers;
- Part 5: Service ducts and shafts
- Part 8: Smoke extraction ducts
- Part 9: Single compartment smoke extraction ducts
- Part 10: Smoke control dampers
- Part 12: Non-mechanical fire barriers

It should also be noted that to satisfy both criteria for fire resistance (integrity and insulation) ductwork needs to be insulated to prevent heat transmission through the fire-stop seal.

It is important that the dampers are appropriately supported and restrained back to the building element or adjacent structure through which it penetrates in a manner that maintains the support and restraint function in a fire condition. Dampers must also be in line with the building element unless the manufacturer has test data to the relevant part of EN 1366 that permits an 'out of line' installation.



**Figure 34: Fire damper fitted with expansion frame being sealed in floor opening with fire rated mortar.  
Note- damper in line with floor**

Mixed penetrations (ducts, dampers, pipes and cables in the same opening) should also be avoided wherever possible. It is known that heat from a duct penetration and movement due to expansion adversely affects the fire resistance of other services. The method of testing for ductwork is to a different standard than that for other service penetrations. Therefore a mixed penetration cannot be validated by test in the strict sense of the term. In the event of a mixed penetration, advice and design of a suitable seal

should be sought from a UKAS accredited laboratory, a suitably qualified fire consultant or a fire engineer with experience of mixed penetrations.

### 3.16 Partial penetration fire-stopping devices/systems

#### Description

The fire resistance of separating elements may be compromised by the addition of ‘partial penetrations’ such as down-lighters, electrical sockets and switches, and sound systems. In fire conditions, a premature failure may occur due to the fittings permitting a more rapid ingress of heat into the cavity of the wall, partition, floor or ceiling.

Partial penetration fire-stopping devices are used to prevent the passage of fire through part of the separating element and usually comprise electrical socket box inserts, putty pads, intumescent pads, down-lighter covers, fire protection hoods / boxes, conduit fillers, etc.

Whatever system is used, it is vital that it has been demonstrated by test and/or assessment so that the overall fire performance of the wall, partition, floor or ceiling will not be compromised.

#### Areas of use

Where a service penetrates one part of a separating element but does not exit on the other side, a device will be required to prevent the passage of fire through or around that service.

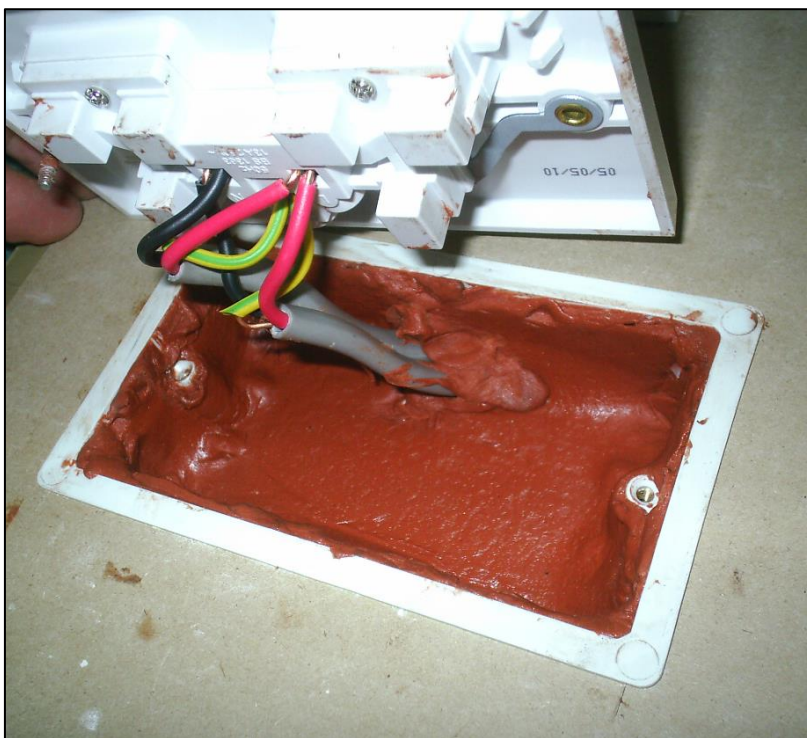
#### Performance

At the time of writing, partial penetration systems are fire tested in an ad-hoc manner based on the fire exposure conditions of BS 476 Part 20/EN 1363-1 and/or load bearing or non-load bearing requirements of walls or floors according to BS 476 Parts 21 or 22/EN 1365-2 respectively. A fire test is being developed specifically for partial penetrations and this will be put forward to CEN at the appropriate time.

In the meantime, the ASFP recommends that designers and installers request the test and assessment evidence from the manufacturer that supports the use of their product in the relevant separating element. The supporting evidence must consider all factors which may influence the overall fire performance of the wall, partition, ceiling or floor, as referred to above, such as the type of outlet its position relative to the floor and of the wall construction (e.g. timber, metal framing).



**Figure 35: Intumescent putty pad to fire-stop electrical outlet – being installed**



**Figure 36: Intumescent putty pad to fire-stop electrical outlet – completed**

### **3.17 Patressing**

#### **Description**

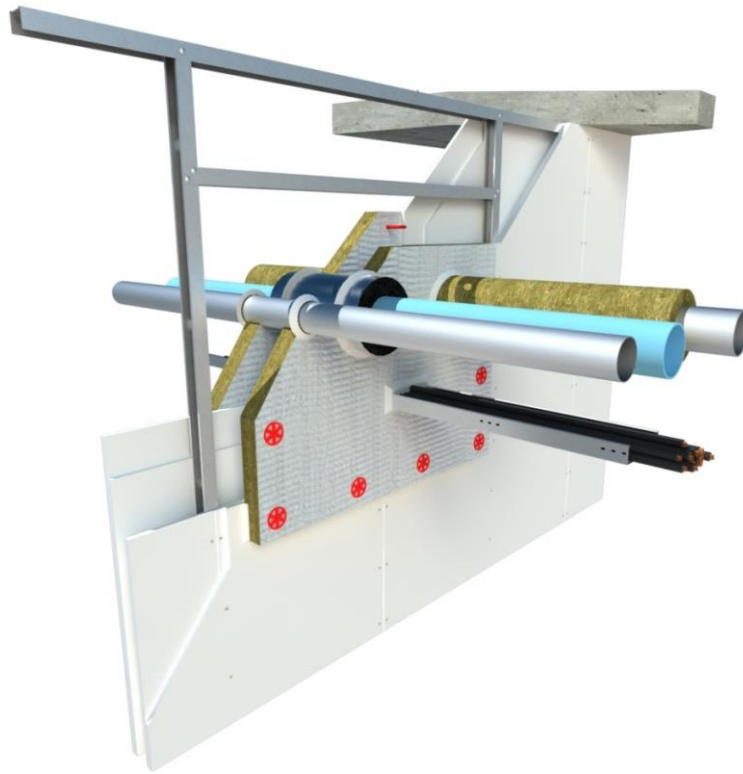
Patressing is the application of penetration sealing systems e.g. for cables and pipes onto the face of the separating element rather than within the thickness of it. Patressing is usually used where it is impossible or impractical to install a penetration sealing system in the normal way and is often installed on an ad-hoc basis. There are some tested and approved patressing products that are fixed in place around cables. Patressing sealing systems include batt and mastic systems and patressing devices.

#### **Areas of use**

Patressing is used where it is impossible or impractical to install a penetration sealing system in the normal way within the thickness of the separating element (wall, floor, partition, ceiling).

#### **Installation**

Patressing tends to be used on an ad-hoc basis by installers where the normal installation methods cannot be used unless a manufacturer has testing and approvals for a patress detail or device. It is important to ensure that such an installation method is covered by appropriate fire test data from the manufacturer or the installer and/or suitable technical advice in the form of engineering judgements are sought from the manufacturer. It is recommended that only specialist installers are permitted to use patressing.



**Figure 37: Fire-stop patressing for service penetrations**

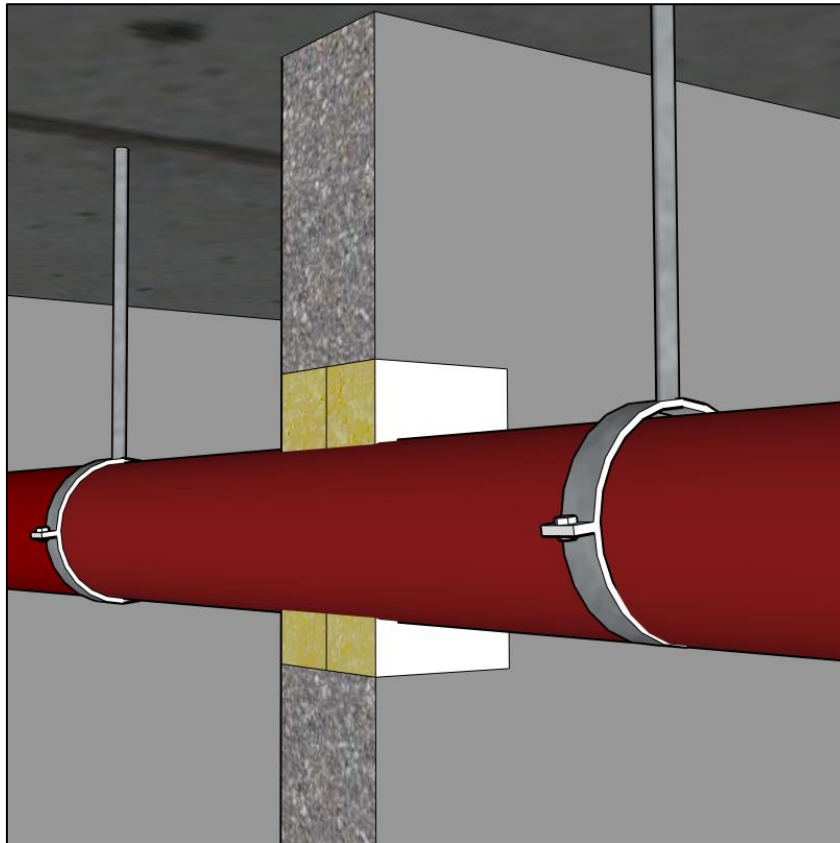
### 3.18 Service supports

The many services in a building require adequate support and sometimes restraint so that they are safely installed to prevent collapse in fire. This can occur when a service support fails and the collapse or movement of the service applies undue load and stress on the fire-stop seal. This in turn may cause premature damage to the fire-stop which then may not be able to maintain the required fire resistance.

Consequently, the service supports should be designed so that they can support the service in fire. This not only assists the fire-stop in its function but also prevents the blockage of escape routes and hindrance of the emergency services.

Suitable fire tested and fire rated anchors along with fire rated installation systems (e.g. formed metal channels) should be sought out and used. Some types of anchors e.g. plastic plugs and ties are not suitable for some services e.g. cables unless proven by test.

The service support centres should be as fire tested or assessed otherwise the services might collapse or distort and cause the fire-stop seal to fail prematurely. Reference should be made to ASFP Advisory Note 8: *Issues surrounding service support centres* <http://is.gd/I31BOH> .



**Figure 38: Illustration of service supported adjacent to fire-stop seal**



**Figure 39: Example of fire rated service supports**

### 3.19 Loadbearing seals

Service openings in floors can be subject to foot traffic especially so in the case of service risers where access is required for regular maintenance of the services. Therefore the fire-stop seal (invariably a mortar compound) needs to provide resistance to these applied loads. It is possible to use non-loadbearing materials but a suitable loadbearing platform (usually consisting of secondary steel work and grating) is required. However, some fire-stopping materials can bear loads enough to negate the need for extra support.

Table 1 of PD 6688-1-1:2011 gives the appropriate load action that could be applied to riser seals is to be found:

Examples of specific Use	$q_k$ (kN/m <sup>2</sup> )	$Q_k$ (kN)
Work rooms (light industrial (without storage))	2.5	1,8

**Table 2: Load actions/factors from Eurocodes EN 1991-1-1: 2002**

All wet-applied fire-stopping systems will take time to cure and harden before the permitted load can be tolerated. During the curing time, the installer shall display suitable warning signage and temporary barriers to prevent accidental access onto the horizontal surface and to avoid risk of injury. Any such loading could also be detrimental to the fire performance of the seal. Advice on the suitability and the design of a load bearing riser seal should be referred to the manufacturer.

The ASFP does not recommend the practice of using large non-loadbearing seals e.g. batt systems and then preventing access to the seal using barriers and warnings signs. It is far better to use loadbearing seals or limit the size of any non-load-bearing seals to e.g. 200mm x 200mm.

Reference should be made to ASFP Advisory Note 1– *Safe use of horizontal fire-stopping*.  
<http://is.gd/I31BOH>

## 4 SELECTING A SUITABLE FIRE-STOPPING SYSTEM

### 4.1 Design and specification of fire-stopping

A fire strategy can employ different techniques to achieve an optimum solution for a building and its occupants. Increasingly the complexity of the built environment means an element of fire engineering is used. But whether a prescriptive method of design (simple compliance with statutory guidance document such as AD-B or its national equivalents in Scotland, Wales and Ireland) or a performance based design is used (fire engineering type approach) the need for compartmentation to prevent the spread of fire and smoke is still a basic necessity. In fact, several of the performance based methods base their calculations on the assumption that building elements are sealed and are imperforate. Therefore, the need for firestopping in a building can be seen to be vital. Further considerations on design are given in 5.1.

Choosing the most appropriate product is a relatively straightforward process, requiring a crosscheck of manufacturer's data to ensure the correct product with the appropriate testing is specified for each application. The critical points to consider are given in 4.2 below.

Once selected, listing the fire-stop products in a specification is required not only for installation but also to ensure correct pricing at the tender stage of the project. Specifications can easily be compiled using various tools such as National Building Specification (NBS) and manufacturers' specification clauses.

These along with standard details that manufacturers supply can ensure that correct firestopping, correctly specified is used. By further specifying that the installation be carried out by a third party certificated specialist contractor means that compliance is achieved as well as meeting insurers requirements.

Reference should also be made to:

ASFP publication *Ensuring Best Practice for Passive Fire Protection in Buildings*, Edition 2,  
<http://is.gd/t9V42f>

ASFP TGD 17 *Code of Practice for the installation and inspection of fire-stopping systems in buildings* <http://is.gd/FCjaV1>

### 4.2 Criteria for selection of the fire-stopping product/system

In order to ensure the correct type of fire-stopping is specified and installed, there are a number of key questions that need to be addressed before a final selection can be made. These include:-

- a) Is the fire-stopping to be used in a wall or a floor, or a junction between fire-separating elements?
- b) If it is a floor, is it required to be loadbearing?
- c) What fire resistance period is required?
- d) How big is the gap or the opening?
- e) Does the fire-stopping have to cater for movement in the fire separating element?
- f) What kind and type of services, if any, are penetrating the construction at the opening?
- g) How many services are there?
- h) What size is each service?
- i) How close are the services positioned to each other?
- j) How close are the services positioned to the edge of the opening?
- k) Is the fire-stopping system suitable for use with the intended elements of construction?
- l) Is installation accessible for the particular type of service and firestopping being considered?
- m) Is the seal required to have acoustic, air tightness or water resistance properties?
- n) Is it required to have a particular reaction to fire performance?
- o) Is it required to have particular electrical resistance characteristics?

The answers to the key questions above will help the user decide which type of fire-stopping system to use. Each particular product will have specific characteristics that lend it to particular end-use applications.

The relevance of the criteria must be assessed for each application and for selection of each fire-stopping product, taking note of any limitations of use for the relevance of the fire test evidence available.

### **4.3 Scope of application of manufacturer's data sheets**

The answers to the key questions in 4.2 will help the user decide which type of fire-stopping system to use. The product summaries in Section 3 can only give a generic overview for a family of products. Each particular product will have specific characteristics that allow it to be used in a defined scope of application.

The relevance of the criteria listed in 4.1 must be assessed for each application and for selection of each fire-stopping product, taking note of any limitations of use for the relevance of the fire test data and the fire resistance classification available.

In order to complete the selection of an appropriate product, confirmation should be obtained from the manufacturer and the published information

## 5 BEST PRACTICE

This section gives guidance on the best practice to be employed when designing, specifying, installing and maintaining fire-stopping in buildings.

The ASFP publication, *Ensuring Best Practice for Passive Fire Protection in Buildings*, Edition 2 describes in detail best practice to be followed from a project's inception through design, build and commissioning to providing information for maintenance and for facilities managers. It was written specifically to encourage a 'cradle to grave' approach in the provision of passive fire protection in buildings. The guide includes essential recommendations to be followed and has dedicated sections on fire-stopping, penetration seals, linear joint seals and cavity barriers. It can be downloaded from <http://is.gd/t9V42f>.



The ASFP has also produced an *On-site guide to installing fire-stopping* which is aimed at those installing fire-stopping. The document is pictorially based and provides practical advice including; general guidance on site conditions and typical pre-installation checks, as well as offering detailed advice on best practice for the installation of products in particular types of application. The document can be downloaded from <https://is.gd/bv3Qu0>.

### 5.1 Recommendation on design of fire-stopping installations

#### 5.1.1 General

Fire-stopping requires special attention from the designer because it is frequently hidden once installed and is therefore difficult to inspect after installation, handover and subsequently through the life of the building. However, it is often not considered early enough, often as a result of a 'design and build' type approach; with the result that layout of the compartmentation with respect to services is not considered until it is too late. This results in services and their associated firestopping and supports installed: in the wrong place, too close to each other, too close to adjacent walls/floors and in locations where correct firestopping is almost impossible e.g. because of limited access. This in turn means the firestopping contractor often has to design something 'on the hoof' and use techniques such as patressing which may not be covered by the fire test data for the product. If adequate provision was given to the design of the division earlier on in the construction process, these problems would be avoided.

The ASFP publication *Ensuring Best Practice for Passive Fire Protection in Buildings*, Edition 2 gives guidance on when the design of fire-stopping and other passive fire protection products should be considered in the construction process and on who is responsible for it.

#### 5.1.2 Mixed penetrations

Another reason why design is so important to consider at an early stage is to avoid situations where designers put all the services e.g. HVAC equipment, cables and pipes through one opening. Such 'mixed penetrations' should be avoided because the heat from a duct penetration and movement due to expansion adversely affects the fire resistance of other penetration seals. The method of testing for ductwork is to a different standard than that for other service penetrations. Therefore a mixed penetration cannot be validated by test in the strict sense of the term. In the event of a mixed penetration, advice and design of a suitable seal should be sought from a fire engineer with experience of mixed penetrations.

## 5.2 Recommendations on who can undertake fire-stopping

Unless clearly defined, the task of installing specialist fire-stopping systems is often given to an inexperienced and/or inappropriate sub-contractor. For example, where fire-stopping is needed behind a cladding system at floor level, the responsibility may fall to the floor installer or the cladding contractor. Those who carry out the task must have the necessary expertise. The requirements and responsibilities for the provision of fire-stopping must be clearly stated in the contract(s). Proprietary systems must be designed in accordance with manufacturer's printed instructions.



Recommendations on the provision of fire-stopping and on the competence of those installing it are given in AD-B. The ASFP recommends that fire-stopping should only be undertaken by contractors holding the relevant third party certification. See also clause 8.

Further information on the installation and inspection of fire-stopping can be found in ASFP TGD 17 *Code of practice for the installation and inspection of fire-stopping systems in buildings* <http://is.gd/FCjaV1>.

## 5.3 Recommendations for the specifier

Advice should be sought from both the manufacturer and the specialist contractor at the earliest possible opportunity regarding the programming, installation sequence, and suitability before specifying a particular fire-stopping and/or penetration sealing system.

A number of parties may have reasonable claim to influence the specification including the building owner, occupier, architect, insurers, fire safety engineer, main contractor and/or fire protection contractor. The number of interested parties can give rise to problems not least because they are rarely involved at the same time. Consequently, a specification drawn up by the architect implementing a certain fire safety strategy may subsequently be changed by others. This is a necessary part of the process but there is the potential for specifications to be inadequate or to compromise the requirements of the original fire safety strategy. It is therefore recommended that only a limited and controlled number of parties be authorised to change the specification and that any changes to the specification be carefully monitored and recorded. It may be appropriate in the event of a large number of changes to a specification to have the amended design checked by a competent third party.

It is recommended that this check should ensure:

- a) The correct location of the fire-stopping and penetration seals
- b) That the proposed fire resistance periods are appropriate given the changes to the design
- c) That the systems specified are appropriate for their end-use
- d) That the systems specified have appropriate test reports/assessments showing them to be fit for purpose.
- e) That adequate documentation is available for the subsequent building managers so that they may inspect and maintain the fire-stopping and penetration sealing systems.

## 5.4 Recommendations for the main contractor/installation contractor

The placing of sub-contracts is a vital element in the installation of fire-stopping and the main contractor should have in mind his legal responsibility to ensure that all such work is correctly undertaken. It should not be assumed that responsibility in the event of failure can automatically be passed to a sub-contractor.

In some cases, installing fire-stopping has been included in the scope of work for each service trade contractor. This approach can raise problems because of interface between trades and sometimes the installation has been left to inadequately trained personnel. A preferred approach, which has proved successful, is to remove the installation of the fire-stopping and/or penetration sealing systems from the

scope of work of the service trades and appoint a competent specialist contractor to carry out all this work throughout the project.

The main contractor can identify competent contractors for the work concerned from recognised third party certification schemes. Approved Document B of the Building Regulations of England and Wales and national equivalents in Scotland and Ireland recognise the benefits in confidence and reliability obtained by the use of contractors that are members of such schemes.

If a manufacturer's system has been specified, advice should be obtained from them with regard to approved or recommended installers. The scope of work should include a requirement that the contractor carry out inspection of work in progress and when completed. This may include a requirement that the contractor employs an approved third party independent inspector, whose reports will be issued to the main contractor.

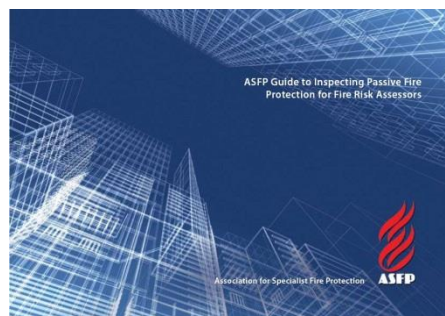
After inspection has been completed by a suitably qualified individual, and the installation approved, a label bearing the date, type of installation and manufacturer and/or contractor details should be fitted to the finished fire-stopping installation in order that expert advice may be obtained in the event of damage or change to the system.

Further information on the installation and inspection of fire-stopping can be found in ASFP TGD 17 *Code of practice for the installation and inspection of fire-stopping systems in buildings* <http://is.gd/FCjaV1>.

## 5.5 Recommendations for the building owner

Modern commercial and public buildings are dynamic environments in which change is frequent and this can affect the installed fire protection systems. In particular, building services are the principal cause of breaches in fire barriers, e.g. the running of cable when a newly networked computer system is installed. These breaches in fire-resisting elements in the event of a fire may give rise to uncontrolled spread of fire.

Building owners (and their agents) and/or the Responsible Person under the Regulatory Reform (Fire Safety) Order 2005 (Fire Safety) Order 2005 (and national equivalents in Scotland, Wales and Ireland) are responsible for the maintenance of fire-stopping systems within the building and this should form part of the risk assessment carried out under these regulations. Similar provisions apply in Scotland and Ireland. The ASFP publication: *Guide to inspecting passive fire protection for fire risk assessors* gives detailed information on how to inspect passive fire protection to be able to adequately undertake a risk assessment under those regulations. <http://is.gd/eUAABM>



## 5.6 Recommendations on Inspection,

Product manufacturers are required to provide information for inspection, maintenance and repair of their products in accordance with the requirements of Building Regulation 38 – See Appendix G Approved Document B – Fire Safety.

In particular, it is good practice to inspect frequently to ensure that inappropriate unauthorised modifications have not been made. Where modification occurs for the addition or removal of services, the fire penetration seal must be reinstated within the permitted field of application of the sealing system.

Some fire-stopping and fire sealing systems may deteriorate under adverse environmental conditions, such as extremes of temperature or condensation, and may require replacement if exposed. Periodic inspection and repair can ensure longevity and performance in fire



ASFP Technical Guidance Document - TGD 17  
Code of practice for the installation and inspection of fire stopping systems in buildings:  
Linear joint seals, penetration seals, seal cavity barriers

Further information on the installation and inspection of fire-stopping can be found in ASFP TGD 17 *Code of practice for the installation and inspection of fire-stopping systems in buildings* <http://is.gd/FCjaV1>.

## 5.7 Recommendations on maintenance, and repair

Where firestopping has been damaged, or new services installed or old ones removed, it is vital to establish the make and type of fire-stopping. This is to ensure that compatible or 'like for like' systems are used in the repair and reinstatement. Mixing of fire-stopping materials and products even from the same manufacturer must be avoided unless test data is available to demonstrate that the original design fire resistance can be achieved. If this is not possible, it is recommended that replacement of the complete seal is undertaken to ensure compliance with fire resistance requirements. It is advised if services are being changed on a regular basis a reusable type of fire-stopping is used.

Reference should be made to ASFP Advisory Note 6 *Use of fire-stopping components from different manufacturers/systems* <http://is.gd/l31BOH>

If any fire-stopping, is removed or altered e.g. by the follow-on trades, there is a liability on the Responsible Person under the Regulatory Reform (Fire Safety) Order to reinstate it properly afterwards. That responsibility also extends to those who specify and those who install such fire systems. Similar provisions exist in Scotland and Ireland. Any maintenance or repairs should be made by a third party certificated contractor in conjunction with the manufacturer's recommendations

## 5.8 Recommendations on fire-stopping of combustible pipes ID 40mm or less

Section 7 of the statutory guidance to the Building Regulations in England & Wales, Approved Document B, vol. 1 for dwelling houses, and section 10 of vol. 2, for buildings other than dwelling houses, provides specific guidance with respect to combustible pipes with an internal diameter of 40 mm or less.

This guidance requires that combustible pipes of 40mm internal diameter or smaller, which pass through fire-separating elements (unless the pipe is in a protected shaft), should meet the appropriate provisions in alternatives A, B or C below:

- **Alternative A:**  
Provide a proprietary sealing system which has been shown by test to maintain the fire resistance of the wall, floor or cavity barrier.
- **Alternative B:**  
Where a proprietary sealing system is not used, fire-stopping may be used around the pipe, keeping the opening as small as possible.
- **Alternative C: (only applicable to uPVC)**  
The pipe may be used with a sleeving of non-combustible pipe passing through the separating element and not less than 1000mm long on both faces (diagram not reproduced here).

Although this guidance therefore does not specifically require the use of proprietary firestopping systems (Alternative B), it also does not provide any detailed guidance with respect to which non-proprietary systems will be suited to the varied types of construction used as separating elements, or the various different combustible pipe materials, all of which can act quite differently in a fire. Additionally no consideration is given to the effect of multiple combustible pipes within the same aperture or within separate apertures but close proximity within the separating element.

To select a non-proprietary system capable of reinstating the fire resistance of the separating element, may therefore require expertise in construction, plastics, fire and the selected system materials.

Consequently, the ASFP recommends the use of proprietary firestopping systems, as per Alternative A. This represents the most robust solution, as many proprietary systems which have been specifically designed for

this application exist and these systems should have appropriate test evidence and/or certification, with a field of application which can easily be understood and interpreted by the installer.

## 6 REGULATIONS & REQUIREMENTS

### 6.1 Introduction

Fire protection is intended to preserve life and property. Effective fire-stopping in fire resisting separating elements plays a critical role in containing a fire at its source, thereby reducing its effect on the primary building structure. The degree of spread is controlled by creating fire-resisting compartments which subdivide the building. However, a major threat from fire in most building structures occurs where concealed cavities between fire-separating walls and floors are interlinked. It is therefore essential that all openings and gaps are fire-stopped to restrict lateral and vertical fire spread and to achieve the required degree of containment. Failure to do so may cause fire to spread uninterrupted in cavities and penetrations in a building.

Mechanical and electrical services by necessity, breach compartment walls and floors allowing failure of integrity and insulation to occur where gaps around services have not been adequately fire-stopped. Fire-stopping products must be able to provide sufficient insulation to the penetrating services, in order to reduce the temperature rise along conductive materials, in accordance with the required insulation criteria of the fire separating element. The movement of smoke is also often an under-rated feature of fires, and needs to be carefully considered when specifying fire-stopping constructions.



### 6.2 Building Regulations

Building Regulations in the UK and the Republic of Ireland are applicable to most building work that is undertaken. The Regulations for England and Wales are functional and deal with life safety standards for design and building work in the construction of domestic, commercial and industrial buildings. The regulatory systems in Scotland Northern Ireland and the Republic of Ireland are different.

Country	England	Wales	Scotland	N Ireland	Ireland
<b>Building Regulations</b>	Building Regulations 2010	Building Regulations 2010	Building (Scotland) Regulations 2006	Building Regulations (N Ireland) 2000	Building Control Regulations 1991, 1997 – 2011. Building Control (Amendment) Regulations 2014
<b>Statutory or Supporting Guidance docs</b>	Approved Document – B 2007 <a href="http://is.gd/BVG4MS">http://is.gd/BVG4MS</a>	Approved Document – B 2007 (inc 2010 & 2016 amendments) <a href="http://is.gd/DjxxNx">http://is.gd/DjxxNx</a>	Technical Handbook 2013 <a href="http://is.gd/k9dVVq">http://is.gd/k9dVVq</a>	Technical Booklet E 2012 <a href="http://is.gd/8RCBtB">http://is.gd/8RCBtB</a>	Technical Guidance Document B 2006 (new TGD-B expected 2016)
<b>Building Regulation 38 or equivalent</b>	Yes	Yes	No**	No	Fire Services Acts 1981 and 2003
<b>CDM regulations or equivalent</b>	2015	2015	2015	2007	No

**Table 3: Summary of the applicable legislation and appropriate statutory guidance documents for fire safety in the UK and Ireland.**

\*No specific reference found

\*\*although Scottish Building Standards Officers can apply 'continuing requirements' and fire safety design documents are part of those. In addition the Scottish Executive is considering an equivalent to Regulation 38.

## 6.2.1 Specific clause relating to fire-stopping in statutory guidance documents

Approved Document B (England clause 10.2) and Wales (clause 11.2) states:

*"If a fire separating element is to be effective, then every joint, or imperfection of fit, or opening to allow services to pass through the element, should be adequately protected by sealing or fire-stopping so that the fire resistance of the element is not impaired"*

Section 10.17 (England) and 11.17 (Wales) add the requirement that:

- a. *"Joints between fire separating elements should be fire-stopped; and*
- b. *all openings for pipes, ducts, conduits or cables to pass through any part of a fire separating element should be:*
  - i. *kept as few in number as possible and*
  - ii. *kept as small as practical*
  - iii. *fire-stopped (which in the case of a pipe or duct, should allow for thermal movement)"*

Section 2.4 of Scottish Technical Handbook 2015 contains the following mandatory standard:

*"Every building must be designed and constructed in such a way that in the event of an outbreak of fire within the building, the unseen spread of fire and smoke within concealed spaces in its structure and fabric is inhibited."*

Section 2.1.14 also contains the following statement:

*"Fire-stopping may be necessary to close an imperfection of fit or design tolerance between construction elements and components, service openings and ventilation ducts. Proprietary fire-stopping products including intumescent products, should be tested to demonstrate their ability to maintain the appropriate fire resistance under the conditions appropriate to their end use"*

Section 4.45 of Northern Technical Booklet E states:

*"In addition to any other provision in this Technical Booklet for fire-stopping, fire-stopping should be provided at –*  
*(a) all joints and imperfections of fit between elements which serve as a barrier to the passage of fire; and*  
*(b) all openings for pipes, ducts, cables, conduits or trays which pass through any fire separating element, and such openings should be –*  
*(i) as few in number as possible; and*  
*(ii) as small as is practicable.*

And under 4.6 Provision of cavity barriers:

*"To restrict the spread of smoke and flame through concealed spaces in the construction of a building, cavity barriers should be provided.....*  
*(i) at the intersection of fire-resisting construction and an element containing a cavity as shown in Diagram 4.4; and*  
*(ii) as set out in Table 4.6 for the appropriate purpose group of the building and the specified locations."*

Section 3.4 of Ireland Technical Guidance Document B contains the following statement:

*"If an element that is intended to provide fire separation (i.e. it has requirements for fire resistance in terms of integrity and insulation) is to be effective, then every joint, or imperfection of fit, or opening to allow services to pass through the element, should be adequately protected by sealing or fire-stopping so that the fire resistance of the element is not impaired".*

## 6.3 Building Regulation 38 (England & Wales)

If a building was constructed after April 2007, Regulation 38 (formerly 16b) of the Building Regulations applies in England and Wales. This requires that sufficient fire safety information be provided for persons to operate and maintain the building in reasonable safety. An overview of what information is required in terms of PFP measures is provided in the Annex G of Approved Document B Volume 2: Fire Safety (English and Welsh versions). The information, which should have been passed on by the main contractor in compliance with Regulation 38 is vital to ensure that an appropriate and effective Fire Risk Assessment under the Regulatory Reform (Fire Safety) Order can be undertaken (see 6.4.2).

Such information, whether arising from the CDM Regulations or Regulation 38 will include details of fire-resisting construction on escape routes, fire compartmentation and other PFP information specified to satisfy AD-B and should include the fire test and assessment reports and any third party certification.

## 6.4 Other Regulations

### 6.4.1 Construction (Design and Management) Regulations 2015

The Construction (Design and Management) Regulations 2007 were revised in 2015. Whilst mainly aimed at clients, designers and contractors, manufacturers of construction products also have obligations under these Regulations:

Manufacturers supplying standardised products for use in any construction project are not designers; however, the person who selects the product is a designer and must take account of health and safety issues arising from the installation and use of those products. In a situation where a product is required to be purpose built (bespoke), then the person who prepares the specification or drawings is a designer and so is the manufacturer if he develops the specification into a detailed design. The connection is that the designer's decisions can affect the health and safety of workers and others who will construct, maintain, repair, clean, refurbish and eventually demolish the building or structure, as well as those who will use it as a completed workplace.



Further information can be obtained from CDM2015 Principles in Practice, Industry Guidance for Designers published by CITB which can be downloaded [here](#). Note that this is still draft guidance which is subject to change. Further Industry Guidance publications include guidance for Contractors (download [here](#)), Principal Contractors (download [here](#)), Workers (download [here](#)) and the new role of Principal Designers (download [here](#)). The existing role of CDM Co-ordinator is not taken forward with the new Regulations.

In addition to the above guidance, the HSE has published *Draft Guidance on The Construction (Design and Management) Regulations 2015* which provides draft Legal (L) Series guidance on the legal requirements of the Regulation. A copy of this publication can be downloaded [here](#).

For the first time, all the above will now apply to domestic client projects, although the client duties will normally be transferred to the contractor or principal contractor, or if the client wishes to make a specific appointment, the designer.

The ASFP will be producing a short guide to the 2015 CDM regulations.

### 6.4.2 Risk based fire safety legislation

The move within regulatory guidance from prescriptive rules to performance-based designs and risk assessment during occupation puts greater responsibility for safety onto building owners or occupiers. The establishment of the 'Responsible Person' under the RR(FS)O (and national equivalents in Scotland and

Ireland) means that those who are responsible for the operation of a business within a building need to be aware of their responsibilities which include the installation and maintenance of passive fire protection systems.

*The Responsible Person is the employer, where there is one, and where there is not it will be the person responsible for the activity undertaken on the premises which might give rise to a risk to those present. It includes;*

- a) *the employer in relation to any workplace which is to any extent under his control;*
- b) *in relation to any premises where there is no employer:*
  - i *the person (whether the occupier or owner of the premises or not) who has the overall management of the premises; or*
  - ii *where there is no one with overall management responsibility, the occupier of the premises; or*
  - iii *where neither (i) or (ii) apply, the owner of the premises*

A brief summary of the appropriate legislation is given in the table below.

Country	England & Wales	Scotland	N Ireland	Ireland
<b>Relevant Act</b>	Regulatory Reform (Fire Safety) Order (FSO)	Fire Safety (Scotland) Regulations & Fire Scotland Act	Fire and Rescue Services (Northern Ireland) Order 2006	General Application Regulations 2007 under the Safety, Health and Welfare at Work Act 2005. Fire Services Acts 1981 & 2003
<b>Person responsible</b>	Responsible Person	Duty holder	Appropriate Person	Responsible Person (Employer/landlord)
<b>Person to do risk assessment</b>	Responsible or Competent person	Responsible or Competent person	Responsible or Competent Person	Responsible or Competent person
<b>People affected in building</b>	Relevant persons	Relevant Persons	Relevant Persons	Employees and persons connected with the workplace

**Table 4: Summary of the applicable legislation pertaining to fire risk assessments in the UK and Ireland.**

### 6.4.3 Guidance documents for risk based fire safety legislation

The Department for Communities and Local Government (CLG) has published a series of guides which introduce employers, managers, occupiers and owners to the new fire safety regime as it affects a variety of types of premises, under the generic title 'Fire safety risk assessment'. Documents can be downloaded from: <http://is.gd/hB1U1h>.

Other general supporting documents can be found in section 10.

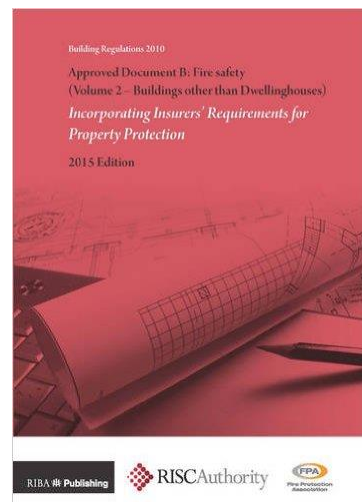


#### 6.4.4 Insurers' requirements

Insurers' requirements for the protection of property may be higher than those required for life safety. Business continuity is also a consideration which can lead to higher specification of passive fire protection.

Useful information can be found at [www.riscauthority.co.uk](http://www.riscauthority.co.uk) including free downloads of relevant documentation including:

- *Insurers' version of England Approved Document B* <http://is.gd/wm9XjE>
- *BDM2 - Fire protection of buildings - Core Document – Compartmentation* <http://is.gd/dxDsAl>
- *BDM6 - Fire protection of buildings - Core Document - Protection of openings and service penetrations from fire* <http://is.gd/HutrbG>
  - a) 'Essential principles'
  - b) 'Design Guide for the protection of buildings - Protection of openings and service penetrations from fire'



## 7 Fire testing, assessment and classification

The fire performance of passive fire protection products is evaluated primarily by fire tests undertaken to British and European standards. Manufacturers undertake tests at specialist fire test laboratories to satisfy the requirements of Building Regulations, but also for a variety of other reasons including obtaining market advantage, developing new products, in support of CE marking and for third party certification. This section explains the various processes from fire testing, through assessment (expert judgement), classification, CE marking through to third party certification.

### 7.1 The stages of a fire, 'reaction to fire' and 'fire resistance'

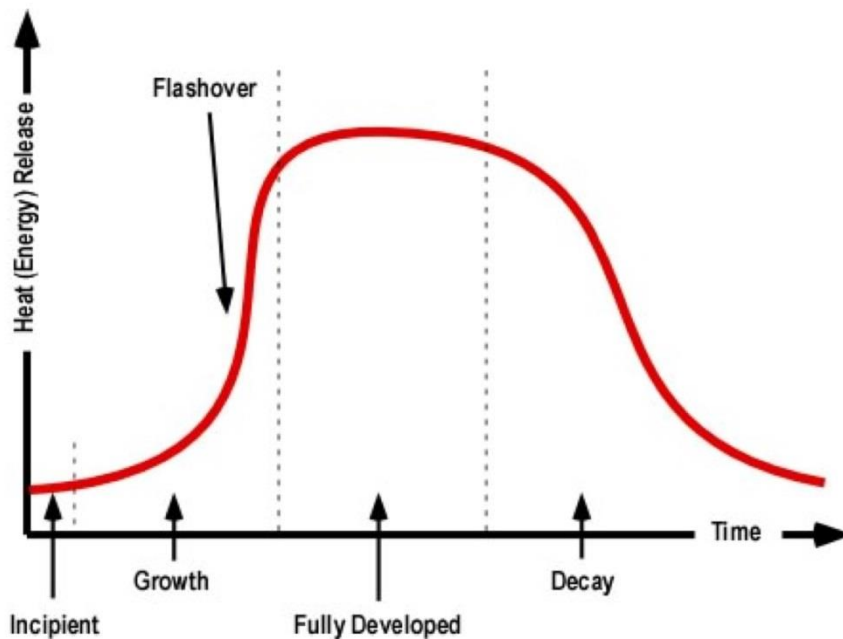


Figure 40: Stages of development of fire in a compartment

Fire occurs when a combustible material is ignited in the presence of oxygen/air which supports the combustion and allows the fire to grow. The stages of a fire in a compartment can be

The rate of fire growth will depend on the combustibility of the item first ignited and the other materials in contact with, or in the vicinity of, the ignited material, such that fire spread could occur through conductivity of heat, convection of heat, or radiation of heat. This is the growth phase.

When the temperature of the enclosure containing the ignited contents in a small room reaches around 600°C, the condition known as flashover will occur, sometimes suddenly, such that all other combustibles in the enclosure will also ignite and release energy through combustion along with smoke and the toxic products of combustion. This is accompanied by a rapid increase in temperature.

The fire temperature will grow further if further combustible material is available in a ventilated space. Otherwise the fire will peak in the fully developed phase and then die back, usually due to lack of fuel. If the oxygen required for combustion is inadequate then combustion will reduce to smouldering level and finally cease. This does not necessarily mean the end of the danger. A smouldering fuel bed can explosively reignite with the influx of a fresh supply of oxygen. This is a phenomenon known as *backdraught* and can result in fatal consequences for firefighters especially. It also means that the fire can return to a fully developed stage.

The duration of any fire is dependent of the amount of combustible organic material available to burn.

### 7.1.1 Reaction to fire

Reaction to fire is the term used to describe the behaviour of materials and products during the incipient and growth stages of a fire. The reaction to fire characteristics of a material can be measured using a variety of fire tests. These include:

- Ignitability
- Spread of flame over its surface,
- Amount and rate of heat released,
- Amount of smoke produced
- Production of burning droplets
- Amount and toxicity of effluent gasses emitted.

Because such fire exposures (tests) are intended to model the ignition and growth stages of a fire they are described as 'pre-flashover' condition. There are British and European standard tests for Reaction to fire both are given visible recognition in the statutory guidance documents to UK Building Regulations such as Approved Document B.



Figure 41: EN 13823 SBI test

However, if the material under consideration is CE marked, then only the European test can be used to create the resulting 'Euroclass'

### 7.1.2 Fire resistance



Figure 42: Pillow penetration seal installed for fire testing

'Fire resistance' or 'resistance to fire' is the terminology used to measure by test the time that a wall or floor can resist the passage of fire from one side to another as measured by [a] integrity – ability to resist the passage of fire and [b] insulation – ability to restrict the temperature rise of the unexposed face to predetermined levels. Fire resistance is primarily associated with the performance of walls or floors when

the fire has reached its fully developed condition. The fire exposure in fire resistance tests is intended to represent a fully developed fire and hence the exposure models the 'post-flashover' condition.

As with reaction to fire, both British and European fire resistance standard tests are given visible recognition in the statutory guidance documents to UK Building Regulations such as Approved Document B. However, if the material under consideration is CE marked, then only the European test can be used to create the resulting 'Euroclass'.

Most fire-stopping systems are only required to have a fire resistance performance, but in some cases a reaction to fire classification is required in addition.

## 7.2 Historical fire testing of fire-stopping in the UK

Due to the historical absence of dedicated British Standard fire tests for fire-stopping, 'ad hoc' or 'indicative tests' have often been used to demonstrate the fire performance of fire-stopping products and systems. These are subject to widely varying interpretations and this can inevitably lead to confusion for the specifier, specialist fire protection contractor, building control personnel and other end users. It may also lead to fire-stopping installations that are unable to provide the required standard of protection.

Some less than scrupulous manufacturers have also used the confusion over ad-hoc and indicative tests to place products on the market that have not been adequately tested and, if were so tested, would probably not achieve the required performance.

Because of the uncertainty over ad-hoc and indicative fire testing following the principles of British standard fire resistance tests, the ASFP recommends that either EN fire test data is required or, alternatively, that the product in question is third party certificated by a UKAS-accredited certification body (see section 8). An independent third party certification body will be able to verify the claims of performance made against ad-hoc and indicative standards and give the end-user confidence that the product will perform in the manner required and expected.

The ASFP has published an Advisory Note on Indicative or Ad-hoc tests which explains their limitations and the course of action that should be followed if one is presented with a report that is not a full test to the appropriate standard. <http://is.gd/I31BOH>



## 7.3 European fire test methods

Several European test methods are now used for evaluating the fire resistance of fire-stopping products to support CE marking under the Construction Products Regulation. These standards replace the 'ad-hoc' and 'indicative' test methods that follow the principles of British Standards used previously. They are far more sophisticated and end-users can be sure that fire-stopping that satisfies these European tests will have been more extensively and comprehensively evaluated than those tested under ad-hoc methods following British standards.

### 7.3.1 BS EN 1366: Part 3: Fire resistance tests for service installations: penetration seals

This standard provides a fire test method for evaluating the performance of fire sealing products such as pipe closure devices, cable supporting systems (trays and ladders) and non-combustible pipe sealing systems; wherever services pass through fire resisting walls and floors. The end-use situation is modelled with the addition of weights to simulate a continuous run of service away from the seal.

The standard also contains a number of 'standard configurations' of penetration sealing systems to cover a wide variety of end-use applications. These allow manufacturers to be able reduce the amount of testing that would otherwise be required.

For example, for testing penetration seals used for plastic and metal pipes, the standard contains suggested test configurations that best model the end-use condition.

Intended use of pipe		Pipe-end condition	
		inside the furnace	outside the furnace
Rainwater pipe		uncapped	uncapped
Sewage pipe	Ventilated	uncapped	uncapped
	Unventilated	uncapped	capped
Gas, drinking water, heating water pipe		uncapped	capped

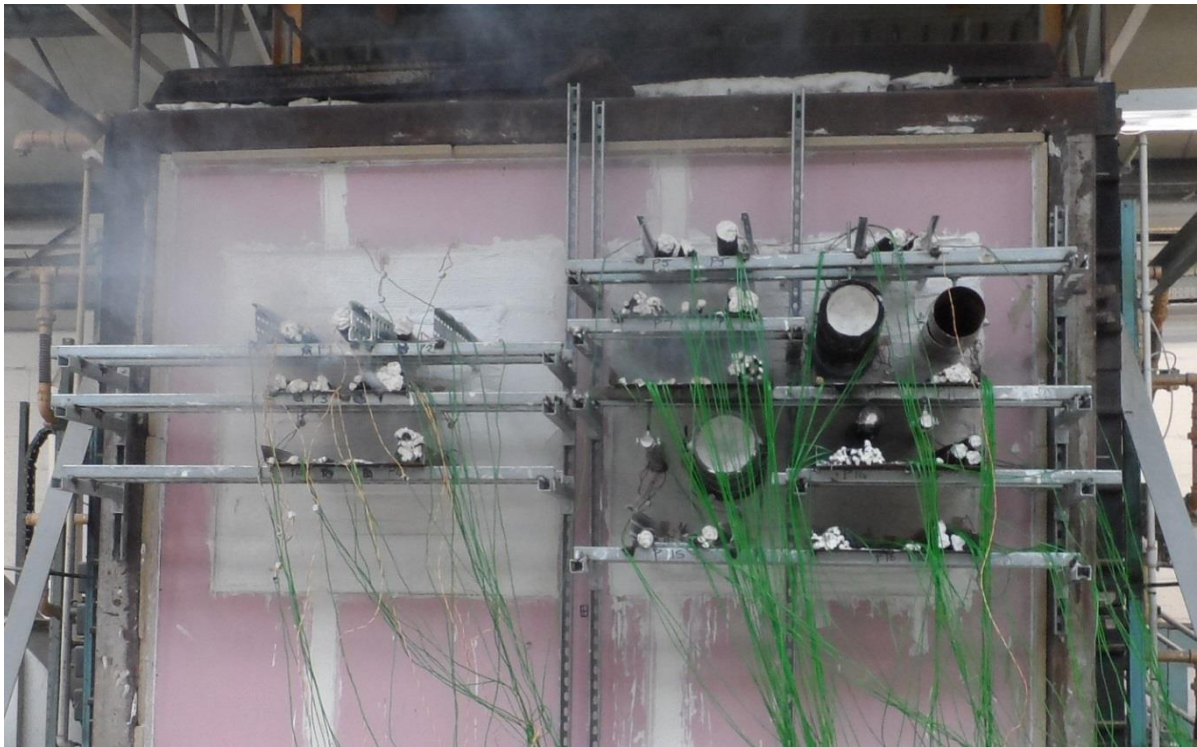
**Table 5: Plastic pipe configuration versus intended use (BS EN 1366-3:2009)**

Metal pipes would normally be capped inside the furnace at all times as they will not melt like plastic pipes. However, this depends on their supporting system. If the pipes are supported by non-fire resisting supports then failure of the supports may result in an open pipe situation which is considered in table 6 below

Use of pipe	Pipe-end condition	
	inside the furnace	outside the furnace
Supported by fire rated <sup>a</sup> suspension system	capped	uncapped
Supported by non fire rated suspension system	uncapped	capped
Waste disposal shafts made from pipes	uncapped	capped
<sup>a</sup> Shown by test or calculation (e.g. Eurocodes).		

**Table 6: Metal pipe configuration versus intended use (BS EN 1366-3:2009)**

The standard contains many other items to be considered by a manufacturer before embarking on a test programme. A correctly designed test specimen will give a manufacturer the greatest field of application (widest applicability) of the test result. Test specimens and programmes should be designed to give the widest applicability taking into account the direct application rules (7.3.4) and extended application (7.3.5).



**Figure 43: Batt and mastic penetration seals installed being fire tested**

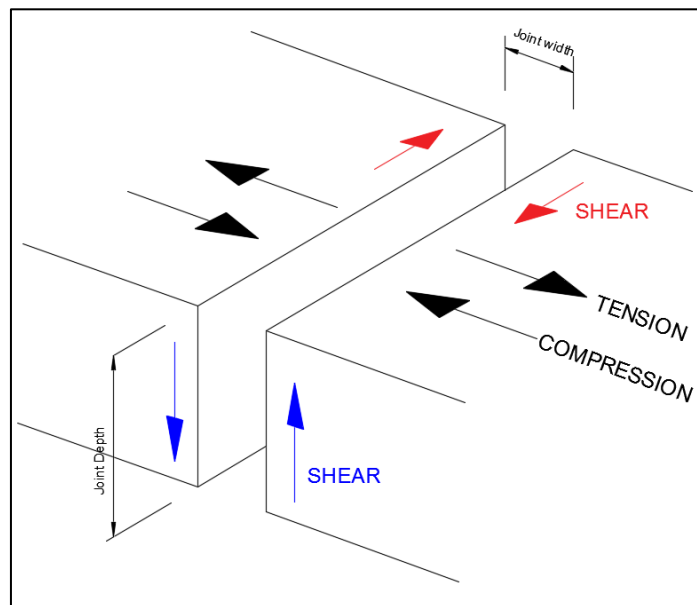
### **7.3.2 BS EN 1366: Part 4: Fire resistance tests for service installations: linear joint seals**

This standard provides a fire test method for evaluating the performance of fire sealing products used between two elements of construction; such as the junction between a wall and a floor, or around a door frame between the frame and the surrounding wall etc.



**Figure 44: Linear joint seal installed for fire testing**

The fire test standard also considers the effect of movement on the seals. When a manufacturer claims that the seal can tolerate a certain degree of movement and still retain its fire resistant properties this can be proven by using the test methodology outlined in the product standard and the fire test standard. Claims for movement capability cannot exceed  $\pm 7.5\%$  of the seal width, without further dynamic testing.



**Figure 44: Different directions of movement capability of linear joint seals**

Methods for determination of other properties, including movement capability of fire-stopping systems is given in ETAG 026 Part 3 Annex B Section 13 of that standard document.

As with penetrations seals, the test standard contains other items to be considered by a manufacturer before embarking on a test programme. A correctly designed test specimen will give a manufacturer the greatest field of application (widest applicability) of the test result. Test specimens and programmes should be designed to give the widest applicability taking into account the direct application rules (7.3.4) and extended application (7.3.5).

#### **7.3.4 BS EN 1364: Part 3: Fire resistance tests for non-loadbearing elements. Curtain walling. Full configuration (complete assembly) and BS EN 1364: Part 4 Part configuration**

These two fire test methods are tests of curtain walling systems rather than tests of fire-stopping.

In EN 1364: Part 3 (full configuration), a representative sample of a whole curtain wall assembly is fire tested in a fire resistance furnace. This will include all the major components e.g. the floor slab, glazing, spandrel panel etc. together with the perimeter fire seal and/or any other fire-stopping to be evaluated.

In EN 1364: Part 4 (part configuration), a representative sample of an individual component, or a small section of a curtain walling containing a limited number of components is fire tested in a fire resistance furnace. This will include some components e.g. the floor slab, glazing, spandrel panel etc. together with the perimeter fire seal and/or any other fire-stopping to be evaluated.

Tests of perimeter seals for floor slabs may be undertaken to either of these parts of EN 1364 – see 3.10.

All the fire test methods listed above use the principles contained within EN 1363: Part 1: 2013: *Fire resistance tests – Part 1: General requirements*. EN 1363: Part 1: 2013 is the European equivalent of BS 476: Part 20: 1987.



Figure 45: EN 1364-4 Curtain wall (part configuration) being prepared for fire testing

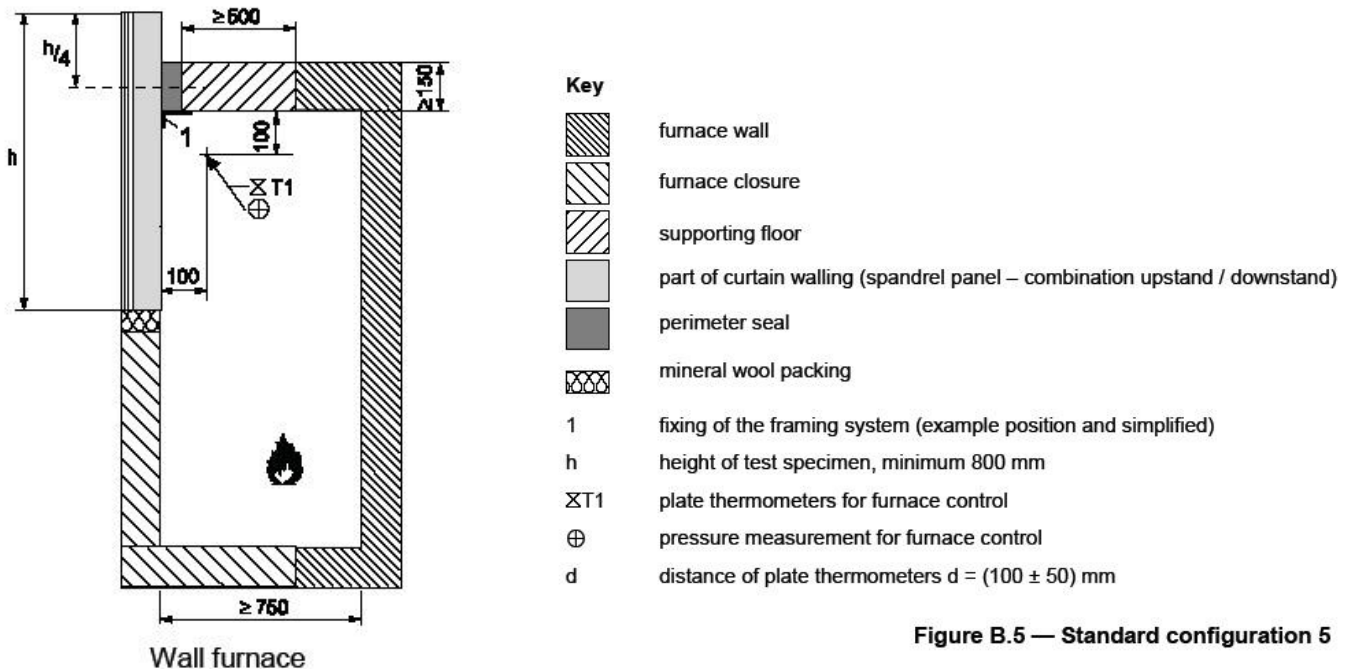


Figure B.5 — Standard configuration 5

Figure 46: EN 1364-4 Curtain wall - test configuration 5 for perimeter seals

### 7.3.4 Direct field of application (DIAP) of European fire resistance tests

All European fire resistance test methods also contain 'direct field of application' (DIAP) rules. These enable simple changes such as limited: extrapolations, substitutions, size variations, and other relatively small changes of the obtained test data to increase the scope of applicability of the test result. This direct application can be undertaken by the manufacturer without having to get an assessment, or get a laboratory or other notified body involved. For example; masonry wall constructions are allowed if the penetration seal has been tested in a lightweight (flexible) partition. Similarly, horizontal linear joint seals between walls and floors are allowed if a horizontal joint has been tested horizontally in a wall.

Tables 7 & 8 below are examples of direct application rules which should be used when considering testing penetration seals for plastic and metal pipes.

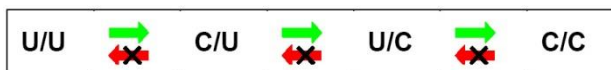
		Tested			
		U/U	C/U	U/C	C/C
Covered	U/U	Y	N	N	N
	C/U	Y	Y	N	N
	U/C	Y	Y	Y	N
	C/C	Y	Y	Y	y

U/U = Uncapped inside and outside the furnace

U/C = Uncapped inside and capped outside the furnace

C/U = Capped inside and uncapped outside the furnace

C/C = Capped inside and outside the furnace



**Table 7: Example of field of direct application rule for plastic pipes (prEN 1366-3: 2016)**

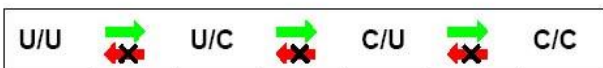
		Tested			
		U/U	C/U	U/C	C/C
Covered	U/U	Y	N	N	N
	C/U	Y	Y	Y	N
	U/C	Y	N	Y	N
	C/C	Y	Y	Y	y

U/U = Uncapped inside and outside the furnace

U/C = Uncapped inside and capped outside the furnace

C/U = Capped inside and uncapped outside the furnace

C/C = Capped inside and outside the furnace



**Table 8: Example of field of direct application rule for metal pipes (prEN 1366-3: 2016)**

## 7.4 Assessments or 'expert or engineering judgments'

The sheer range of products and sizes and configurations of passive fire protection products means that it is almost impossible to test every single variant. It would also be uneconomic to do so and fire-stopping products are no exception. Consequently, assessments or 'expert judgments' are used following the generation of fire test evidence to expand the scope of the applicability of the tested product/system. Assessments are normally the view of a recognised expert in a particular fire test, and the performance of products in that test, that may be used for the purpose of interpreting or applying results in connection with National Regulations.

Assessments have been used in this way, in the UK, for many years and have been accepted as having a similar status to a test report. It is normal for UKAS-accredited test laboratories to conduct the assessments although this is by no means mandatory. Some fire consultants and suitably qualified/experienced fire engineers would also be expected to have the appropriate knowledge

ASFP recommends that such assessments are conducted in accordance with the *PFPF Guide for Assessments In Lieu Of Fire Resistance Tests*. Assessments, which follow the guidance within the PFPF Guide, will provide the end user with confidence that the evaluation has been carried out with the necessary care and expertise and is appropriate to the intended use. The guide can be downloaded from here: <http://ftsg.co.uk/pubs.html>

## 7.5 Extended application (EXAP)

With the increasing uptake of CE marking of construction products, it is likely that the use of assessments to increase the scope of a manufacturer's product range will be reduced and be superseded by 'Extended Application' or 'EXAP' report which is part of a European standard protocol in support of CE marking. Extended application is the outcome of a process that predicts a test result on the basis of one or more tests for a variation of a product. It is effectively, the documenting and justification of 'assessments'. EXAP involves the application of defined rules that may incorporate calculation procedures together with agreed expert judgment rules. It should be noted that under EXAP procedures, expert judgment on its own is forbidden; rules originating from expert judgement are permitted, but these must be documented in the EXAP standard.

Although the agreed rules for writing such an EXAP report are available to all, the writing of the report requires a high level of experience in the testing of fire-stopping systems, to ensure that the rules are interpreted correctly, only a body 'notified' to the European Commission for undertaking such an activity such as an accredited test laboratory can issue EXAP reports. See section 8 for more information on CE marking and the role of extended application.

Assessment Reports that are not based on a relevant European EXAP standard will still be possible, however, this type of assessment will increasingly only be suitable for national use.

## 7.6 Assessments or 'expert/engineering judgments' for specific end-use situations

Just as all the combinations of permutations of fire-stopping cannot all be tested, so the total range of end-use (on-site) applications cannot be tested either. Special conditions will arise from site to site which may mean that the manufacturer's instructions and tested installation method cannot be followed. In such circumstances, an evaluation of likely performance needs to be undertaken. This is normally conducted via a site specific 'assessment' or 'expert judgment' report as per 7.4 above. The report should address the on-site condition and the required amendments to the construction and provide justification that the proposed changes are acceptable. Typical areas where site specific assessments may be required are:

- a) 'one-off' projects or applications, where the cost of testing would otherwise make the application uneconomic
- c) Where, for various reasons (e.g. size or configuration), it is not possible to subject a construction or a product to a fire test.

## 7.7 European classification

Once a fire test and any extended application have been conducted a 'classification document' can be produced. This classification is created in accordance with European standard BS EN 13501-2: *Fire classification of construction products and building elements: Part 2: Classification using test data from fire resistance tests*. The purpose of the classification is to provide a European recognised class, which can then be used to determine compliance with the building codes and regulations of the various member states of

the European Union. It can also form the basis of defining the fire performance in any CE marking of the product.

Note: In the past UK and Irish building regulation requirements did not use fire resistance classifications to express the performance of many passive fire protection products. However, the statutory guidance documents to those regulations such as AD-B now provide visible recognition of the European classes so that end-users will become more familiar with them.

## 8 CE marking under the Construction Products Regulation

### 8.1 CE Marking fire-stopping products under the Construction Products Regulation



The Construction Products Regulation (CPR) replaced the Construction Products Directive (CPD) in 2011 and came into force in July 2013. The CPR lays out seven Basic Works Requirements which need to be addressed before a product can be placed into the European market. Safety in case of fire is just one Basic Works Requirement. The others include:

- Mechanical resistance and stability
- Hygiene, health and environment
- Safety & accessibility in use
- Protection against noise
- Energy economy and heat retention
- Sustainable use of natural resources (new)

The document that addresses the Basic Works Requirements for each type of construction product is the European technical specification (see 8.2).

### 8.2 European technical specifications (hEN v. EAD)

For most construction products, the European technical specification used to describe and define the product is a harmonised product standard (hEN), written by CEN the European Standards body. These harmonised standards state what essential characteristics are to be determined prior to the placing of the product on the market in order to satisfy the Basic Works Requirements listed in 8.1



However, in the case of fire-stopping products, the European technical specification is known as a European Assessment Document (EAD) produced by EOTA, the European Organisation for Technical Assessments. This European Assessment Document has several parts:

- Part 1 general requirements
- Part 2 penetration seals
- Part 3 linear joint seals
- Part 4 air transfer grilles
- Part 5 cavity barriers

EADs can be down loaded free of charge from <http://is.gd/EJgsE4> or [www.eota.be](http://www.eota.be).

### 8.3 Procedure for obtaining a European Technical Assessment



A manufacturer wanting to get his product CE marked will approach a Technical Assessment Body such as a UKAS-accredited UK certification body. Most passive fire protection products have a high level of attestation of verification of performance – that is to say the degree to which the product is proven to meet the standard is high. It is not enough for the manufacturer to simply test the product himself and make a declaration, or for him to get a third party laboratory to test the products and make a declaration. The third party body has to be involved from the beginning to end of the process. The process involves:

- Independent selection of samples for test.
- Undertaking an initial inspection of the factory
- Evaluating the manufacturer's factory production control system

- Undertaking, or organising the testing of the product at an independent laboratory  
[In addition to fire testing, these will include other characteristics such as performance under internal and external exposure conditions, cold state load bearing capacity, impact resistance, durability, moisture resistance, etc. as defined in the European Assessment Document]
- Assembling all the relevant documentation
- Issuing a Certificate of Conformity
- CE marking the product

The outcome of the process is a European Technical Assessment issued by the Technical Assessment Body. The manufacturer can then issue a Declaration of Conformity (based on the Certificate of Conformity from the Technical Assessment Body).

The whole process, whilst seemingly complex, will result in a more level playing field for manufacturers throughout the European single market. It will prevent the current situation whereby manufacturers can sell fire-stopping products that have not been adequately tested, that are produced in a factory with no independent checks on quality or where products from the production line bear little relation to what was fire tested. The process is similar to voluntary third party certification although there are differences which are explained in section 9.

#### **8.4 When will CE marking be mandatory for fire-stopping?**

Currently, CE marking is still voluntary for fire-stopping products. This is because CE marking is only mandatory for products covered by a harmonised European product standard (hEN) such as that for fire dampers, fire door ironmongery etc. Eventually, all the EADs will be replaced by hENs which will then, by definition, make CE marking against them mandatory. However, this process will take some years.

Several ASFP manufacturer members have voluntarily applied and obtained CE marking for their products. As more manufacturers follow, it is likely that there will be a presumption that most products will be CE marked and it will become de facto mandatory.

The ASFP has published a short guide to CE marking which can be downloaded here: <http://is.gd/GbGyXC>

#### **8.5 Classification of fire-stopping in European Assessment Documents**

Under EAD 026-2 (penetration seals) and EAD 026-3 (linear joint seals) there is a need to classify the product for its intended use. Note, this is not the fire classification, but the extent to which the fire classification is applicable to variations of the product. The tables below are reproduced from EADs 016-2 and 3 respectively to enable end users to be familiar with them and used them as a basis of comparison between products.

Test Condition	Designation	Test Condition	Designation
Integrity	E	Insulation	I
Horizontal Supporting Construction	H	Joint Width Range (mm)	W w1 to w2
Vertical Supporting Construction – Vertical	V	Manufactured Splice	M
Vertical Supporting Construction – Horizontal	T	Field Splice	F
No Movement Capability	X	Manufactured and Field Splice	B
Movement Capability (%)	M00	w1 is the lower width limit and w2 is the higher width limit	

**Table 9: Linear gap seal classification table**

Table 9 (above) indicates the classification in EN13501-1 obtained for the linear joint seals through the design of the tests conducted in EN1366-4, which is derived from a comparison between the envisaged field of application. The specified letters indicate the tested conditions and the given criteria e.g. EI 30 – H – M25 – B – W30 to 90.

Test Condition		Designation
Integrity		E
Insulation		I
Exposed Side	Unexposed Side	Pipe End Configuration
Uncapped	Uncapped	U / U
Capped	Uncapped	C / U
Uncapped	Capped	U / C
Capped	Capped	C / C

**Table 10: Service penetration seal classification table**

Table 10 (above) indicates the classification in EN13501-1 obtained for the service penetration seals through the design of the tests conducted in EN1366-3, which indicates envisaged field of application. The specified letters indicate the tested conditions and the given criteria e.g. E90 EI30 U/C.

## 9 Third party certification

### 9.1 Product certification

Voluntary third party product certification schemes vary according to the terms of individual schemes, but essentially include verification of the test evidence and scope of application or use of the product, and a regular audit of the factory quality assurance (QA) system to ensure that the product as supplied to the contractor is to the same design or formulation as the original test samples. Third party certification specifically involves:

- **Independent selection of samples for test**
- **Evaluation of manufacturer's factory production control system**
- **Initial inspection of the factory**
- **Undertaking, or organising, the testing of the product at an independent laboratory**  
In addition to fire testing, these will include other characteristics that are relevant to the performance of the product as considered under the individual scheme. Unlike CE marking, which stipulates which characteristics are required to be evaluated in the European Technical Specification, Third Party Schemes are free to be tailored to a specific product type. Usually, such schemes evaluate fitness for purpose, but concentrate on those product characteristics important to the fire performance of the product.
- **An appraisal of all the test and assessment evidence to be able to define a scope of certification**  
Again this is another area where third party certification schemes differ from CE marking. CE marking is quite rigid over the extent to which products variations are catered for. The limits being contained within EXAP standards (see 7.5). Voluntary third party certification schemes are not so constrained and can use expert judgment to significantly extend the scope of certificated products. Again, the schemes will differ and manufacturers should compare the 'technical schedules' of the schemes to find the most suitable scheme. These are publicly available on the certification body websites.
- **Undertaking audit testing/procedures** including regular retesting or other regular quality checks
- **Issuing a certificate**
- **Traceable labelling of product**

It should be noted that CE Marking is not a 'quality mark' but uses harmonised European classification and fire testing procedures. Voluntary third party product certification schemes are 'product quality' schemes and invariably include more checking procedures than are required for CE Marking.



**Figure 45: Certification bodies offering third party product certification**

The ASFP strongly supports third party certification of all passive fire protection products including fire-stopping products. It is a condition that manufacturers who wish to have products listed in this publication must have third party certification for the product. In this way, end-users can use this book as a source of products whose fire performance has been comprehensively evaluated by an independent third party certification body.

## 9.2 Installer certification

Third party certification for installers is a process whereby the contracting company employs appropriately trained, competent staff to install the required passive fire protection system. Their work is independently audited by site inspections from the third party organisation and a full record system is required as part of the scheme. Installer certification specifically involves:

- **Auditing of offices to check**
  - that written procedures are in place to account for the correct use of staff
  - records for the correct purchase of appropriate materials/products are present
- **Use of staff whose competency has been evaluated**
- **Use of proven e.g. CE marked or third party certificated fire-stopping products or systems**
- **Certificate of completion of works lodged with certification body**
- **Independent inspection of works by certification body**

As with third party product certification schemes, installer schemes vary slightly and it is useful to compare the requirements of each scheme.

The ASFP recommends that all passive fire protection is installed by third party certificated installers. In the case of fire-stopping this is particularly important as fire-stopping is often covered up and inaccessible after installation, so it is important to get it right on installation.

It is a condition of membership of the ASFP that contractors must have third party certification for installation. End-users can be confident that an ASFP contractor will have had their installation capability comprehensively evaluated by an independent third party certification body.



**Figure 46 Certification bodies/schemes offering third party installer certification**

## 9.3 Reference to third party certification in Statutory Guidance documents

The use of third party certification schemes is recognised in the Building Regulations, Approved Document B (Use of Guidance; Independent certification schemes).

In the section dealing 'Use of Guidance; Materials and Workmanship – Independent certification schemes: Approved Document B 2006 includes the following text:-

*“There are many UK product certification schemes. Such schemes certify compliance with the requirements of a recognized document, which is appropriate to the purpose for which the material is to be used. Materials, which are not so certified, may still conform to a relevant standard.*

*“Many certification bodies which approve such schemes are accredited by UKAS.*

*“Since the fire performance of a product, component or structure is dependent upon satisfactory site installation and maintenance, independent schemes of certification and registration of installers and maintenance firms of such will provide confidence in the appropriate standard of workmanship being provided.*

*“Building control may accept the certification of products, components, materials or structures under such schemes as evidence of compliance with the relevant standard. Similarly Building Control Bodies may accept the certification of the installation or maintenance of products, components, materials or structures under such schemes as evidence of compliance with the relevant standard. A Building Control Body will wish to establish in advance of the work that any such scheme is adequate for the purposes of the Building Regulations.”*

## 10 REFERENCE DOCUMENTS

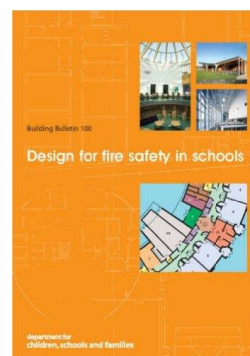
The documents listed below contain guides and codes of practice on building design that consider the use of fire-stopping to ensure fire safety. The list is not exhaustive:

- Department of Health HTM 05 Series, available from <http://is.gd/nQ2PAe> including:



- HTM 05-01 *Managing healthcare fire safety*
- HTM 05-02 2015 *Guidance in support of functional provisions for healthcare premises*
- HTM 05-03 Part A: *Final General fire safety*
- HTM 05-03 Part J: *Guidance on fire engineering of healthcare*
- HTM 05-03 Part M: *Final Guidance on the fire safety of atria*

- The Department for Children, Schools and Families have published Building Bulletin 100 – *Designing & managing against the risk of fire in schools*. <http://is.gd/EHwYC9>



- BS 9999: 2008 *Code of practice for fire safety in the design, management and use of buildings*



- BS 9991: 2015: *Fire safety in the design, management and use of residential buildings. Code of practice*
- *Guidance on the Preparation of a Generic Fire Design Guide*, University Safety and Health Association <http://is.gd/aBqn4v>
- FPA *Design Guide for the Fire Protection of Buildings – Essential principles*, <http://is.gd/C75CwC>
- Electrical Safety Council: Best Practice Guide No. 5 (Issue 2) - *Electrical installations and their impact on the fire performance of domestic premises used as single family houses*. <http://is.gd/dxopPi>