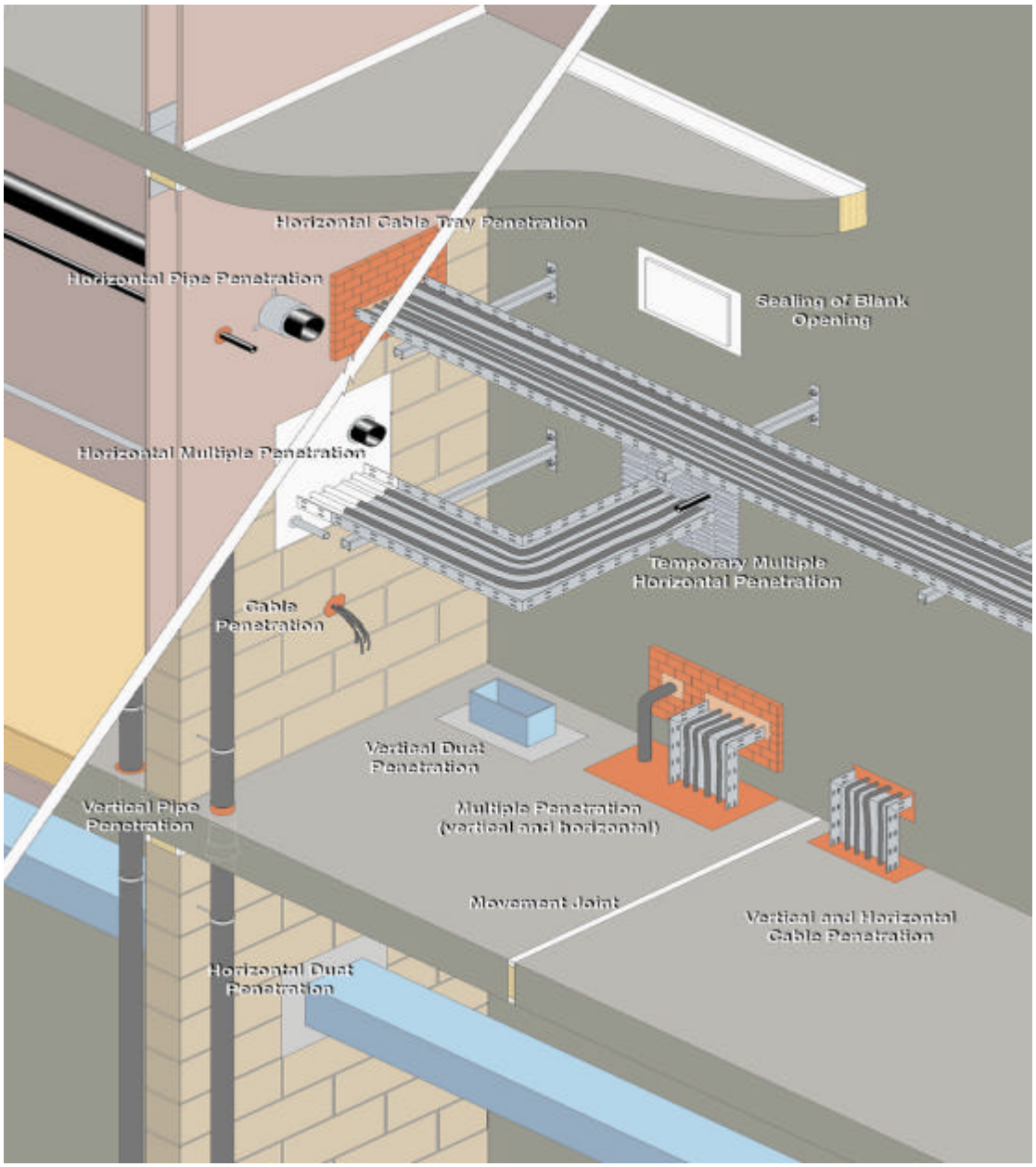
Fire Stopping and Penetration Seals for the Construction Industry

SECOND EDITION



Association for Specialist Fire Protection
Fire Test Study Group

INTRODUCTION

The Association for Specialist Fire Protection (ASFP) was formed in 1976. The objectives of the Association are to encourage, organize, finance, and undertake research and experimental work related to passive fire protection and to promote the consideration of all questions affecting the passive fire protection of buildings.

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The Fire Test Study Group (UK) (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 “Fire Spread” to the Building Regulations 1991.

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

FTSG members have strongly supported 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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FIRE STOPPING AND PENETRATION SEALS FOR THE CONSTRUCTION INDUSTRY

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Association for Specialist Fire Protection (ASFP) in conjunction with the Fire Test Study Group (FTSG)

Foreword

I am delighted to introduce you to this latest and updated issue of the "Red Book" which has been designed to be the definitive guide to the provision of proprietary materials and systems used to provide fire protection for the fire stopping and sealing of penetrations in fire separating elements.

The recent European Construction Products Directive will change the way in which products are tested and assessed and this edition of the "Red Book" explains the changes.

The assessment panel of the ASFP judges the suitability of every product included in this book; users can rest assured these have been tested to the existing BS and/or BS EN standards. The book also provides details of the proposed EN test methods.

Designers, regulators, fire authorities, building owners and installers can all rely on this information and the explanatory notes provided by industry experts on all aspects of the protection requirements.

I extend my congratulations to all those involved with the production of this edition of the "Red Book" which provides an authoritative source of guidance on the safe provision of fire resistance with regard to the sealing of penetrations within compartmentation elements of buildings.

Brian Robinson CBE, QFSM, FIFireE
PRESIDENT, ASFP

PREFACE

This publication has been prepared by members of the ASFP and presents economical methods for the provision of proprietary materials and systems used to provide fire protection for the fire stopping and sealing of penetrations within fire separating elements to provide compliance with building regulations. It provides a comprehensive guide to proprietary materials and systems all of which are manufactured and/or marketed by members of ASFP.

This publication includes information concerning non-rigid fire barriers. Information on rigid fire barriers is to be found in the ASFP publication 'Fire rated non-load bearing partitions' which is sometimes referred to as the 'purple book'.

The information contained in this document has been primarily included to give the reader guidance with regard to the fire performance of fire stopping and penetration sealing systems. Limited mention is also made in some cases of the thermal and acoustic performance of these systems. For more information concerning the thermal and acoustic performance of the system reader is advised to contact the relevant manufacturer.

SCOPE

Section 1
Contains background information into why fire stopping is required in general and in particular with regard to the needs of the building regulations.

Section 2
Contains outline procedures for fire resistance test and assessment procedures using UK and European methods.

Section 3
Contains an explanation on how to use this document.

Section 4
Contains generic information on the various types of fire stopping that are available.

Section 5
Contains the system datasheets.

DEFINITIONS

Assessment (also referred to as Appraisal): 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: An aperture through a separating element that has been sealed to maintain the integrity and insulation performance of the separating element for the duration of the specified fire resistance period.

Cavity Barrier: A construction provided to close a concealed space against penetration of smoke or flame, or provided to restrict the movement of smoke or flame/heat within such a space and of greater than 100mm high or wide.

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. The basis of compartmentation is to subdivide buildings into areas of manageable risk, to provide adequate means of escape, and to provide fire separation for adjoining buildings.

Construction Joints: Gaps left by design during the construction of a building which requires a rigid or flexible seal to maintain the fire resistance of the structural element.

Engineering appraisal/judgement: An independent, technical appraisal of the likely performance of a construction component used in an end use application if it could be subjected to a standard fire test.

Fire-resisting (fire resistance): The ability of a component or construction of a building to satisfy, for a stated period of time, some or all of the appropriate criteria for flame/heat specified in the relevant part of BS 476 or appropriate BS EN standard (Approved Document B and BS 5588-11).

Fire-resisting partition: An internal non-load bearing vertical dividing structure designed to resist the spread of fire, heat, and the products of combustion for a stipulated period of time. Such a partition can include a glazed section or a fire door.

Fire-resisting suspended ceiling: A suspended ceiling designed to contribute to the overall fire resistance of a floor assembly or to prevent the collapse of steel beams supporting a floor or roof, for a stipulated period of time. It may also provide fire resistance as a membrane in the same way as a partition.

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: A compartment wall, compartment floor, cavity barrier

and construction enclosing a protected escape route and/or a place of special fire hazard. (Approved Document Building). It is the means by which the building is divided into compartments of manageable size and specific area, to ensure secure containment of fire and smoke for as long as specified.

Fire-stopping: Sealing products that take up imperfections of fit or design tolerance between the fire-resisting fixed elements of a building to restrict the passage of fire and smoke. They continue to take up any imperfections of fit at all times and have the same fire rating as the fixed elements of which they form a part and/or interface.

Insulation: The resistance to the transfer of excessive heat, i.e. an ability to provide insulation from high temperatures.

Integrity: The resistance to fire penetration, i.e. an ability to maintain the integrity of the element.

Linear joint seal: A system designed to maintain a fire separating function or, if relevant, to accommodate a specified degree of movement and of less than or equal to 100mm high or wide.

Penetration Sealing System: The assembly consisting of the penetrating item, service or services and the penetration seal, materials and devices, together with any supporting construction, designed to maintain the integrity and insulation performance of the separating element for the duration of the specified fire resistance period.

Reaction to fire: The performance of a material or system in a fire situation with regard to the amount and rate of heat evolved, the amount and rate of spread of flame and the amount and rate of smoke and toxic fume evolved.

Responsible person: 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

Service Supporting 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.

Services: Services consist of cables, conduits, pipes, chimneys, ducts, trunking, air ventilation systems, fire rated ventilation ducts or fire rated service ducts and shafts.

Smoke barriers: An internal non-load bearing dividing structure designed to resist the spread of smoke for a stipulated period of time.

Structural fire protection: Products used to insulate the structural frame of a building or other construction to allow it to retain its required load bearing strength or limit the core temperature for a stipulated period of time. The time periods may be stipulated as requirements in building regulations, safety case studies or Safety designs according to the type of structure involved.

SECTION 1. FIRE PROTECTION – REGULATIONS AND REQUIREMENTS

1.1 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 occur 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.

1.2Building Regulations

1.2.1 England and Wales

The "Guidance" introduction in Approved Document B3 (Internal fire spread (structure)) of the Building Regulations 1991 for England and Wales states, among other requirements, that "In the Secretary of State's view, the requirements of B3 will be met:

a. if the loadbearing elements of structure of the building are capable of withstanding the effects of fire for an appropriate period without loss of stability,

b. if the building is sub-divided by elements of fire resisting construction into compartments

c. if any openings in fire-separating elements are suitably protected in order to maintain the integrity of the element (i.e. the continuity of the fire separation); and

d. if any hidden voids in the construction are sealed and subdivided to inhibit the unseen spread of fire and products of combustion, in order to reduce the risk of structural failure, and the spread of fire, in so far as they pose a threat to the safety of people in and around the building."

(Page 61 of Approved Document B3 – The Building Regulations 1991 2000 Edition).

Section 11.2 of Approved Document B3 goes on to say: "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"

(Page 79 of Approved Document B3 – The Building Regulations 1991 2000 Edition).

Section 11.12 adds, under the heading of 'Fire-stopping', a requirement that:

"Joints between fire separating elements should be fire stopped; and

All openings for pipes, ducts, conduits or cables to pass through any part of a fire separating element should be:

- kept as few in number as possible and
- kept as small as practical
- fire-stopped (which in the case of a pipe or duct, should allow for thermal movement)"

(Page 80 of Approved Document B3 – The Building Regulations 1991 2000 Edition).

1.2.2 Scotland

In Scotland Regulation 12.1 of the Building Standard states that

Every building shall be so constructed that, for a reasonable period, in the event of fire -
(a) its stability is maintained;
(b) the spread of fire and smoke within the building is inhibited; and
(c) the spread of fire to and from other buildings is inhibited.

Regulation 9 of the Building Standard stipulates that the requirements of the regulations can be satisfied only by compliance with the relevant standards. The relevant standards are set out in a series of Technical Standards of which Part D is the one that deals with 'Structural Fire Precautions' Regulation 9 sets out three ways by which the requirements of the Regulations can be satisfied:

i) By compliance with the relevant standards set out in the supporting Technical Standards; or

ii) By conforming with provisions which are stated in the Technical Standards to be deemed to satisfy the relevant standards; or

iii) By any other means which can be shown to satisfy the relevant standards.'

Section 3 of the introduction to Technical Standard D states:-

"To restrict the internal spread of fire, a *building* may have to be divided into *compartments* separated from each other by *compartment walls* or *compartment floors* intended to provide a complete barrier to fire between the *compartments*. In practice, the continuity of such walls and floors will have to be breached by openings for circulation or services and where this occurs special precautions are necessary to maintain the effectiveness of the barrier. The acceptable size of a *compartment* for this purpose is determined by its likely fire load which is, in turn, influenced by the *purpose group* of the *building*, or part of the *building*, in which it is situated and the provision, or otherwise, of active fire protection measures."

(Page 5D Technical Standard D Amended September 2001)

Technical Standard D contains a number of provisions that are deemed to satisfy the standard and for Fire Stopping these are paragraphs D3.14, D4.7, D5.8, D6.7 and D6.9 of the Amended September 2001 edition) For example see 3.14 paragraph **d.** with regard to the fire stopping of service openings.

D3.14* A *compartment wall* and a *compartment floor* must have no openings and must provide a barrier to fire between the parts of a *building* to be divided, including any *roof space*, **except**

a. for a *chimney* or *flue-pipe* which is of suitable construction, so that in the event of fire the level of fire safety performance required of the *compartment wall* or *compartment floor* is maintained; or

b. where there is an opening in the *compartment wall* with a suitable self-closing *fire door* with the same duration as the *compartment wall*, **except –** a lockable door to a cupboard or service *duct* with a floor area not more than 3 m2 need not be selfclosing, or

c. where there is an opening in the *compartment wall* with a shutter with the same duration as that required of the *compartment wall* actuated by a fusible link or other heat sensitive device with a controlled movement mechanism and audible warning when operated; or

d. where there is a *service opening* -
i. which is of suitable construction, or where the services are suitably protected, so that in the event of fire the level of fire safety performance required of the *compartment wall* or *compartment floor* is maintained, and
ii. which is suitably *fire-stopped*; or

e. where there is an opening in the *compartment floor*, which contains a stair only, other than an *escape stair*, and/or not more than 2 escalators, and is provided either -
i. at *compartment floor* level with a suitably activated shutter in the plane of the floor which when closed maintains the level of fire safety performance of the *compartment floor*, or
ii. at each floor level, other than the top floor level, with a suitably activated shutter in the vertical plane which moves to enclose the opening and provide a barrier with

the fire safety performance equivalent to a *compartment wall* with the same duration as the *compartment floor*.

(Pages 11D and 12D Technical Standard D Amended September 2001)

1.2.3 Northern Ireland

Technical Booklet E for Northern Ireland closely follows Approved Document B.

In Northern Ireland new Building Regulations came into force in November 1994. The fire safety requirements for these regulations are supported by Technical Booklet E, which contains provisions regarding structural fire resistance, compartmentation, etc. similar to those in the Approved Document for England and Wales. Unlike the provisions of the Approved Document, which are for guidance, the use of which is regarded as evidence tending to show that the requirements of the Building Regulations have been met, the provisions of Technical Booklet E are deemed to satisfy those requirements. Where the provisions of the Technical Booklet are not followed then the onus falls on the designer to show that the requirements of the regulations can be met by other means.

1.3 Meeting the need of building regulations

Due to the historic absence of UK or European Standard Test Methods (prEN1366-3/-4 has not been issued by CEN at the time of writing), the tests and subsequent appraisal of systems used for penetration seals are subject to widely varying interpretations. This inevitably leads to confusion for the specifier, the specialist fire protection contractor, the system manufacturer and the end user, which may lead to installations unable to provide the required standard of protection.

There are a wide range of materials and systems available which, if correctly specified and installed, will prevent the passage of flame/heat and smoke from passing through a service opening, or joint, for the required period of time. In many cases however, the sealing or fire stopping of openings or joints in elements of structure are treated as an afterthought, and are not given the degree of importance essential for fire protective constructions. There have been many cases where loose materials have been indiscriminately packed around services in an effort to seal the opening, but such installations would invariably perform inadequately in a fire.

The purpose of this publication is to provide sufficient information to enable the specifier, user and subsequent building owner (or his/her agent) to judge each system on an equal basis, and to avoid the confusion of attempting to establish the merits of varying test reports and assessments/appraisals.

Various types of systems, their application, the practical advantages and disadvantages in use, and their performance in fire are described in detail. The publication is intended to be treated as a “User Guide” for the supply of materials and systems that can be used to restrict the passage of flame/heat and smoke through openings in fire resisting separating elements.

The data sheets, and assessment of relevant information, have been prepared in accordance with the principles defined in Section 2, and have been checked and agreed by an independent panel of the Association for Specialist Fire Protection. This

independent panel consists of representatives from Warrington Fire Research Centre, Building Research Establishment and Chiltern International Fire (all of whom are UKAS approved laboratories and FTSG members).

The information contained within this publication, and the details provided in the data sheets, has therefore been subject to independent technical evaluation on a strictly equal basis with regard to types of systems, installation methods and orientation. This is especially important if one considers that, in practice, penetration seals will be attached to fixed elements of structure such as walls, floors, etc. During the technical evaluation of the system, the effects of expansion, contraction and deflection of these elements will also need to be considered, in order to fully evaluate the fire performance of the penetration seal. Additional information, such as the load bearing capacity and deformation of the supporting structure, will also need to be fully evaluated to determine whether or not the construction will provide the specified period of fire resistance.

It should be noted that the majority of lightweight barrier constructions tend to bow towards a fire, as the side exposed to the fire expands more than the "unexposed face" or "cold face". If adequate provision is not made for the relative movement of the barrier to the penetration seal, it is possible that an integrity failure may occur within the seal itself, or at the interface of the components used in the seal.

Some penetration sealing systems that are not designed to react/expand in a fire situation may require the surrounding structure to provide a tight compression fit on the product for the fire duration.

In areas where seismic activity is a possibility this parameter should be taken into account when designing the penetration seal or firestopping system. The manufacturer of the system in question should be consulted for their recommendations and supporting test and appraisal evidence.

Services passing through unsealed openings in elements of structure may allow flames/heat and smoke to pass through and create a fire hazard within the building. Properly constructed penetration sealing systems will however, reduce such hazards and provide a safer environment for the occupants of a building.

Before agreeing to the installation of penetration sealing systems the user and specifier will therefore need to:-

i) establish the effects of such penetration on the integrity and insulation performance of the fire separating element concerned;
ii) establish the fire performance of the penetration sealing system;
iii) establish the insulation performance of the penetrating service or services, and where necessary, the integrity failure of the service.

1.4 Recommendations for the specifier for fire stopping and penetration seals

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 because of this there is 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:

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

1.5 Recommendations for the Main Contractor / Installation Contractor

The placing of sub-contracts is a vital element in the installation of fire stopping and/or penetration seal systems and the Main Contractor should have in mind his/her 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. The Main Contractor should be totally satisfied as to the competence of sub-contractors where life-safety, as is the case with fire stopping and/or penetration sealing systems, is involved.

In some cases the work of installing fire stopping and/or penetration sealing systems around penetrations in compartment walls and floors has traditionally been included in the scope of work for each of the service trade contractors. This traditional approach can raise problems because of interface between trades, and sometimes the system installation has been left to untrained personnel. An alternative 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 industry accreditation schemes. Approved Document B of the Building Regulations of England and Wales recognizes 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 fire stopping and/or penetration sealing system 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 and/or penetration sealing system in order that expert advice may be obtained in the event of damage or change to the system.

1.6 Recommendations for the Building Owner

Modern commercial and public buildings are dynamic environments in which change can be frequent and this is very likely to 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" designated by the employer(s) in the building should carry out their obligations under the Fire Safety (Workplace) Regulations. The provision and maintenance of the fire stopping and/or penetration sealing systems within the building should form part of the risk assessment carried out under these regulations for the building. Managers need to be aware that there may be liability issues in the failure to comply with regulations (e.g. as a criminal act). Where fire stopping and/or penetration sealing systems have to be removed or have become damaged for other purposes, they must be 'made-good' as soon as possible by competent contractors.

The Construction Design and Management Regulations (CDM) require all concerned in the process from design inception to completion of the building to prepare a file (the CDM file) containing details of all the work undertaken and materials used where safety is concerned. The CDM file can be an invaluable source of information on all aspects of fire safety work in the construction of the building that may be used by the occupant when preparing maintenance plans, modifications to the building or Fire Risk Assessments as required by the Fire Precautions (Workplace) Regulations.

1.7 Health and safety

Many systems used to seal penetrations in floors are unable to support loads, such as foot traffic, etc, and care must therefore be taken to establish whether or not the installed system is load bearing. If the seal is non-load bearing, access should be made physically impossible by installing guard rails, etc, or by installing independent walkway systems to prevent loads being applied directly to the surface of the seal. Manufacturer's and/or specialist advice must be sought.

1.8 Third Party Certification / Accreditation and Certificates of Conformity

Third Party Certification for products varies according to the terms of individual schemes, but essentially includes verification of the test evidence and scope of application or use of the product, and a regular audit of the factory 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 Accreditation for installers is a process whereby the contracting company employs appropriately trained staff to design and install the required passive fire protection system. Their work is independently audited by site inspections from the 3rd party organisation and a full record system is required as part of the scheme. The use of such accreditation is recognised in the Building Regulations, Approved Document B (Use of Guidance; Independent certification schemes).

Approved Document B states 'Use of Guidance; Materials and Workmanship – Independent certification schemes: There are many UK product certification schemes. Such schemes certify compliance with the requirements of a recognised 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.**'

(Page 5 of Approved Document B – The Building Regulations 1991).

The use of accredited installers will reduce the incidence of systems being installed by unskilled or unscrupulous contractors and/or the use of unsuitable systems and reduce essential work and re-work considerably.

Upon completion, a Certificate of Conformity is issued to the main contractor for each contract. These independent certification schemes raise the perceived profile of the supply and installation chain and provide the client with an increased level of comfort regarding the quality of fire stopping and/or penetration sealing systems.

SECTION 2. TEST AND APPRAISAL PRINCIPLES

2.1 Introduction

To date there have been no standardized methods within The UK for evaluating the contribution of firestopping and/or penetration sealing systems either via test or assessment. They have therefore been tested by analogy with methods for other separating elements such as the walls and floors within which they are intended to be used. As a result existing test and assessment data is difficult to compare, there being inevitable differences in methodology.

Given the wide range of products and product applications, it has not been possible to prescribe a fixed programme of tests. Any programme should be designed to cover, by test and subsequent appraisal the range of; sizes, applications and periods of fire resistance required based on the knowledge and expertise of the assessor.

For the future, considerable guidance is given in the forthcoming CEN fire test Standards for linear gap (prEN 1366-4) and penetration sealing systems (prEN1366-3) to enable the application of fire test data to be maximised and in a consistent way. However, historically, firm principles have not been present for tests to British Standards.

Following the ongoing development of test methods within CEN, testing is now more harmonised throughout Europe and all such testing is likely to be conducted in accordance with the latest available draft until the relevant Standard is finally published.

2.1.1 European testing and this publication

Currently, fire resistance tests for the products contained within this publication are most likely to have test evidence created by ad-hoc testing to the BS 476: Part 20 regime. The testing is deemed ad-hoc because there is no British Standard in existence specifically dealing with penetration and linear joint seals. However, this is all set to change.

The **Construction Products Directive** (CPD), a European initiative which aims to allow free trade within the European Union, has resulted in the introduction of **European test methods**, **classification of products** and **CE marking**.

The European test methods for the products contained within this document are currently still in a draft format but can and are being tested to:

> ***(pr)EN 1366: Part 3, fire resistance tests for service installations: penetration seals***, provides a test method for evaluating the performance of products such as pipe closure devices, cable supporting systems (trays and ladders) and non-combustible pipe sealing systems. Within the standard the issues of separating wall construction, insulation performance and pipe end conditions are covered in a level of detail above that of current testing practise.

(pr)EN1366: Part 4, fire resistance tests for service installations: linear joint seals, provides a test method for evaluating the performance of products used for sealing between two elements of construction such as two walls or a wall and floor slab. The standard addresses the fire test method and 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 standard.

Both test methods are based on **EN 1363: Part 1: 1999**, (Fire resistance tests – Part 1: General requirements) and therefore the test methods utilise the plate thermometer to establish and control the furnace temperature conditions.

The test methods also contain **field of direct application** rules, which enables a simple extrapolation of the obtained test data. It is in effect a very basic assessment, which allows certain variations from the original test specification. 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.

Once a test has been conducted a 'classification document' can be produced. This classification is created in accordance with **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 is important to consider that whilst the above test methods and classification deal with the resistance to fire requirements of the construction products directive, generally, compliance with this essential requirement alone is not enough for **CE marking**. The **CPD** lays out **six essential requirements** (ER's) that need to be satisfied before a product can be placed into the European market place. In most mainland European states CE marking is mandatory. But, whilst this is not the case in the UK, you are still required to comply with the essential requirements of the CPD. As harmonised European product standards will not be produced for firestopping and fire sealing products, the commission has mandated **EOTA** (European Organisation for Technical Approvals) to produce guidelines for satisfying the **CPD** requirements.

The guidelines, known as **ETAG's** (European Technical Approval Guidelines) will allow a Notified Body to produce an **ETA** (European Technical Approval). This approval will consider if required, all six of the ER's. This would include taking account of all other test information such as performance under internal and external exposure conditions, cold state loadbearing capacity, impact resistance, durability, moisture resistance, etc. It also includes any other performance characteristics, which are claimed by the manufacturer and detailed in the scope of the **ER's**.

The **ETA** is used in conjunction with on going factory production control (assuming the initial fire testing was by a notified laboratory) to allow the **Notified Body** to issue a certificate of conformity.

This process of assembling all the necessary evidence and documentation giving entitlement to apply CE marking to a product is known as **Attestation of Conformity.**

The whole process, whilst seemingly more complex than the current system, is intended to result in a more level playing field for manufacturers throughout the European Union.

2.1.2 Relationship with statutory provisions

Much of the guidance that supports fire safety legislation is given in terms of performance in relation to British or European Standards for systems, methods of test, design or in terms of European Technical Approvals. Typically therefore a system or structure should:
a) be in accordance with a specification or design which has been proven by fire test to be capable of meeting that performance; or
b) have been assessed from test evidence as meeting that performance.

Given that a test undertaken on a specific element of firestopping and/or penetration sealing system is a representative evaluation of the likely end use performance and providing the construction tested is replicated in the end use condition, there is little interpretation needed and it can be accepted that the installed element will provide the required fire resistance. However, where the element to be installed is altered, in even the slightest manner, the likely effect on the fire resistance performance must be evaluated. This is normally conducted via an assessment report provided by a UKAS accredited test laboratory. The assessment report should address the tested element and the required amendments to the construction and provide justification that the proposed changes are acceptable. The conclusions and limitations within any assessment report should be considered with care as these can often restrict the use of the tested/assessed element rendering the construction inappropriate to the particular end use under consideration.

ASFP recommends that assessments are conducted in accordance with the PFPF Guide For Assessments In Lieu Of Fire Resistance Tests, those that are not may still be acceptable for regulatory purposes although their validity should be confirmed prior to acceptance by the appropriate approving authority. 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.

Some areas where assessments may be offered are:

- Where a modification is required to a tested construction (this is by far the most common use of assessments)
- Interpolation or extrapolation of results of a series of fire resistance tests, or utilisation of a series of fire test results to evaluate a range of variables in a construction design or a product
- Where, for various reasons (e.g. size or configuration) it is not possible to subject a construction or a product to a fire test.

Assessments will vary from relatively simple judgements on small changes to a product or construction through to detailed and often complex engineering assessments of large or sophisticated elements.

2.2 Appraisal Principles for Penetration Sealing Systems

As discussed above, to date there have been no standardized methods within The UK for evaluating the contribution of firestopping and/or penetration sealing systems via assessment resulting in a variation in scope depending upon who provides the assessment. Basic guidelines exist in various forms but increasingly these are being superceded by adoption of draft European guidance which is currently in an advanced state of development (as at June 2003). The FTSG have agreed that the draft extended application documents currently under development in respect of the European Standards will be used as the principles for assessment of firestopping and/or penetration sealing systems and this will provide a degree of consistency which has not existed previously. It is anticipated that a subsequent revision of this document will allow consideration of assessment evidence produced using only Extended Application rules.

2.2.1 The Assessment Report

The assessment report, prepared using the guidance of this document, should contain the following information:

1. The name and address of the issuing body.
2. The name and address of the sponsor.
3. The date of issue of the extended application report.
4. The unique reference number for the report.
5. Summary of the report(s) that the extended application is based upon.
6. The proposed extended field of application of the test results and the justification for that extension.
7. Reference to this document.
8. Classification of the modified construction in accordance with prEN 13501-2.
9. The following statement.

'This extended application report is issued on the basis of test data, information available and the guidance given in the Extended Application Principles For Tests Conducted in Accordance with BS 476: Part 22; 1987 (or prEN 1366-3). If contradictory evidence becomes available, the position of the extended application report shall be reviewed and the report sponsor notified. The extended application report is valid initially for a period of five years from the date of issue at which time it is recommended that it be returned for re-appraisal.'

The current principles of extended application for penetration sealing Systems (as at June 2003) are produced in the following tables.

Separating elements — Concrete or masonry

Variation	Effect	Comment
Decrease in thickness and/or density	-	Not acceptable

Separating elements – Lightweight constructions

Variation	Effect	Comment
Decrease in thickness	-	Not acceptable.
Non standard elements		Constructions not defined in prEN 1366-3 must be tested.
Change of linings	=	Acceptable for the standard constructions given in prEN 1366-3 if they have an equivalent thickness and the lightweight construction (horizontal or vertical) has an equivalent or greater fire resistance.
Change in aperture framing	-	Not acceptable.
Change (density, thickness or type) of insulation material.	-	Not acceptable.

Penetrating services — Changes to service items — Metal pipes

Variation	Effect	Comment
Change of type of pipe material	=	Acceptable provided melting point is equal to or greater than that tested and thermal conductivity equal to or less than that tested.
Increase in pipe diameter	-	Not acceptable.
Decrease in pipe diameter	=	Acceptable.
Increase in nominal pipe wall thickness.	=	Acceptable for integrity only.
Decrease in nominal pipe wall thickness.	-	Not acceptable.
Insulated pipes		Data relating to insulated pipes cannot be used to support assessments in respect of uninsulated pipes and vice versa.
Change of insulation material.		For pre-insulated pipes a change of insulation material is not acceptable. For post-insulated pipes insulation material may be changed within the same generic type, such as rock fibre, glass wools, PVC's etc where the alternative provides an equivalent or greater reaction to fire classification.
Change in thickness and/or density of insulation material to pre-insulated pipes.	-	Not acceptable.

Increase in thickness and/or density of insulation to post-insulated pipes.	-	Not acceptable.
Decrease in thickness of insulation to post-insulated pipes.	-	Not acceptable.*
Increase in length of applied insulation.	+	Acceptable.
Decrease in length of applied insulation.	-	Not acceptable.*

* May be acceptable based on proven calculation method.

Plastics/fibre reinforced plastics/glass pipes

Variation	Effect	Comment
Change of type of pipe material.	-	Not acceptable.
Increase in pipe diameter.	-	Not acceptable.
Decrease in pipe diameter.	=	Acceptable provided wall thickness is maintained.
Increase in nominal pipe wall thickness.	=	Acceptable up to 1 mm.
Decrease in nominal pipe wall thickness.	-	Not acceptable.

Where intumescent collars or wraps are to be used with plastics pipes the range of pipes required to be covered is often quite diverse. As different plastics have differing properties relating to the way they soften, distort and ignite it is not always possible to pick a worst case plastic. Even if this were the case the plastic type picked may not be the same for different intumescent types and compounds. This is due to the variances in pressure generation and reaction time of the material. A factor also affecting the performance of a pipe collar is the outer casing itself. Current market trends are moving towards lighter and thinner shells, even the use of plastic shells, which may not withstand the pressures required to close some pipe materials.

Because of this it is essential that a pipe collar or wrap, which is required to be used with a variety of plastics pipes, is tested with them.

The general parameters that need to be included are as follows:

- Each type of plastic (see note below).
- The smallest and largest pipe diameter in each plastic type.
- The thinnest and thickest pipe wall for each plastic type.

For the different plastic types it is possible to test the upper and lower limit types and cover anything in between. For example a test on polyethylene pipes (Vicat-softening point B 75 C) and polypropylene pipes (Vicat-softening point B 145 C) can be used to cover polyvinyl chloride pipes (Vicat-softening point B 70-75 C), which lies between the two, for pipe size/wall thickness within the tested ranges. Polyvinyl chloride has also demonstrated that it chars rather than ignites more readily (under fire resistance test conditions) than polyethylene and polypropylene, which are more prone to ignition as they decompose. Similar principles are also applicable to other plastic types.

Cables – Single / bundles not tested to standard configuration

Variation	Effect	Comment
Increase in size	-	Single cables or bundles — Not acceptable.
Decrease in size	=	Single cables or bundles — Acceptable subject to meeting 10 % of the tested conductor to cable cross sectional area (CSA) ratio.
Increase in conductor CSA	=	Acceptable — Up to 10 %.
Change of generic conductor material.	-	Not acceptable.
Change of type of insulation material.	-	Not acceptable.

Cable Trunking

Variation	Effect	Comment
Decrease in size	=	Acceptable subject to not exceeding the ratio of overall CSA of cable(s) to the internal CSA of the trunking.
Inclusion of trunking		If cable trunking has not been included in tests, results from cable trays of same generic material and thickness can be used. The perimeter of the trunking shall not exceed the maximum cable tray width and an internal seal must be provided within the trunking coincident with the position of external seal. CSA of cable(s) may be up to 60% of the internal CSA of the trunking.

Conduits

As pipes (steel or plastic as appropriate).

Busbars

No changes acceptable.

Support conditions

Distance of support from the face of the seal must not exceed that tested.

2.3 Extended application principles for generic seal types

Bag / pillow seals

Seal depth

Variation	Effect	Comment
Increase in seal depth	**= or +**	Acceptable.
Decrease in seal depth	-	Not acceptable.

Aperture

Variation	Effect	Comment
Increase in size	=	Increase in area up to 50 % acceptable. In the case of floors suitable support must be demonstrated.
Decrease in size	=	Acceptable where there is sufficient room for installation of the seal.
Change of shape	=	Acceptable

Size of bag / pillow

Variation	Effect	Comment
Change in size	=	Acceptable.

Seal material

Variation	Effect	Comment
Change of infill material	-	Not acceptable.
Change of bag/pillow outer material	-	Not acceptable.

Configuration

Variation	Effect	Comment
Change of packing density (volume fill)	-	Not acceptable.
Change of position within thickness of separating element	-	Distance of seal from exposed face in wall/floor cannot be reduced from that tested.
	= or +	Distance of seal from exposed face in concrete/masonry wall/floor can be increased from that tested.

Orientation

Variation	Effect	Comment
Change of orientation		Test evidence from wall applications cannot be used to support floor applications and vice-versa.

Board seals
Seal depth

Variation	Effect	Comment
Increase in seal depth	**= or +**	Acceptable.
Decrease in seal depth	-	Not acceptable.

Aperture

Variation	Effect	Comment
Increase in size	=	Increase in area up to 50 % acceptable within a standard lightweight supporting construction (when tested at 3 m by 3 m).
		When tested within a standard concrete or masonry supporting construction the increase in area up to 50 % is applicable only to concrete or masonry constructions.
Decrease in size	=	Smaller acceptable where there is sufficient room for installation of the seal.

Board and coating

Variation	Effect	Comment
Change of board material	-	Not acceptable.
Increase in board thickness	+	Acceptable (Supporting evidence for framing systems/fixings must be provided).
Decrease in board thickness	-	Not acceptable.
Increase in board density	+	Acceptable.
Decrease in board density	-	Not acceptable.
Change of coating material	-	Not acceptable.
Change in coating thickness	-	Not acceptable.
Change of perimeter/joint adhesive(s)	-	Not acceptable

Configuration

Variation	Effect	Comment
Change of position within thickness of separating element.	-	Distance of seal from exposed face in wall/floor cannot be reduced from that tested.
	= or +	Distance of seal from exposed face in concrete/masonry wall/floor can be increased from that tested.
Increase of air gap (if used)	= or +	Acceptable.
Decrease of air gap (if used)	-	Not acceptable.
Change of internal support frames	-	Not acceptable*
Variation in seal shape	=	Acceptable only without additional board to board joints.

* May be acceptable based on proven calculation method.

Orientation

Variation	Effect	Comment

Change of orientation		Floor seal generally more onerous than wall and may be used as supporting evidence for a wall mounted application. Test evidence from wall applications cannot be used to support floor applications.

Foam seals

Seal depth

Variation	Effect	Comment
Increase in seal depth	**= or +**	Acceptable.
Decrease in seal depth	-	Not acceptable.

Aperture

Variation	Effect	Comment
Increase in size	=	Increase in area up to 50 % acceptable within a standard lightweight supporting construction (when tested at 3 m by 3 m).
		When tested within a standard concrete or masonry supporting construction the increase in area up to 50 % is applicable only to concrete or masonry constructions.
Decrease in size	=	Smaller normally acceptable but consider overall size when services are fitted - sufficient room for installation. Seal/service area ratio should be maintained.

Seal material

Variation	Effect	Comment
Change of seal material	-	Not acceptable.

Configuration

Variation	Effect	Comment
Change of position within thickness of separating element	-	Distance of seal from exposed face in wall/floor cannot be reduced from that tested.
	= or +	Distance of seal from exposed face in concrete/masonry wall/floor can be increased from that tested.
Change of formwork	-	Not acceptable.

Orientation

Variation	Effect	Comment
Change of orientation		Floor seal generally more onerous than wall and may be used as supporting evidence for a wall mounted application. Test evidence from wall applications cannot be used to support floor applications.

Mastic seals

Seal depth

Variation	Effect	Comment
Increase in seal depth	**= or +**	Acceptable.
Decrease in seal depth	**-**	Not acceptable.

Increase in backing material depth	**+**	Acceptable for Class A1 and A2 materials.
Decrease in backing material depth	-	Not acceptable.

Aperture

Variation	Effect	Comment
Increase in size	=	Increase in area up to 50 % acceptable within a standard lightweight supporting construction (when tested at 3 m by 3 m).
		When tested within a standard concrete or masonry supporting construction the increase in area up to 50 % is applicable only to concrete or masonry constructions.
Decrease in size	=	Smaller normally acceptable but consider overall size when services are fitted - sufficient room for installation. Seal/service area ratio should be maintained.

Seal material

Variation	Effect	Comment
Change of mastic composition	-	Not acceptable.
Change of backing material	-	Not acceptable unless equivalent or greater reaction to fire and insulation performance.

Configuration

Variation	Effect	Comment
Change of position within thickness of separating element	-	Distance of seal from exposed face in wall/floor cannot be reduced from that tested.
	= or +	Distance of seal from exposed face in concrete/masonry wall/floor can be increased from that tested.

Orientation

Variation	Effect	Comment
Change of orientation		Floor seal generally more onerous than wall and may be used as supporting evidence for a wall mounted application. Test evidence from wall applications cannot be used to support floor applications.

Mortar seals

Seal depth

Variation	Effect	Comment
Increase in seal depth	**=**	Acceptable.
Decrease in seal depth	-	Not acceptable

Aperture

Variation	Effect	Comment
Increase in size	=	Increase in area up to 50 % acceptable within a standard lightweight supporting construction (when tested at 3 m by 3 m).

		When tested within a standard concrete or masonry supporting construction the increase in area up to 50 % is applicable only to concrete or masonry constructions.
Decrease in size	=	Smaller acceptable where there is sufficient room for installation of the seal.

Seal material

Variation	Effect	Comment
Change of material	-	Not acceptable.

Configuration

Variation	Effect	Comment
Change of position within thickness of separating element	-	Distance of seal from exposed face in wall/floor cannot be reduced from that tested.
	= or +	Distance of seal from exposed face in concrete/masonry wall/floor can be increased from that tested.

Orientation

Variation	Effect	Comment
Change of orientation		Floor seal generally more onerous than wall and may be used as supporting evidence for a wall mounted application. Test evidence from wall applications cannot be used to support floor applications.

Pipe closures – Plastic pipes: wraps/collars

Seal depth

Variation	Effect	Comment
Increase in seal depth	**= or +**	Acceptable.
Decrease in seal depth	-	Not acceptable

Seal thickness (The smallest dimension between the inner and outer surfaces of the seal)

Variation	Effect	Comment
Increase/decrease in seal thickness	-	Not acceptable

Aperture

Variation	Effect	Comment
Change of aperture size.	-	Not acceptable.
Change of aperture shape e.g. round to square.	-	Not acceptable.

Seal material

Variation	Effect	Comment
Change of material(s)	-	Not acceptable.

Configuration

Variation	Effect	Comment

Change of position within thickness of separating element		Test results from surface mounted pipe collars cannot be used to cover fully recessed/cast-in applications. May be used to cover partly recessed (up to 50 % of its depth into the wall/floor).
	-	Distance of cast in collars or wraps from the exposed face cannot be increased.

Plug / block seals

Seal depth

Variation	Effect	Comment
Increase in seal depth	=	Acceptable.
Decrease in seal depth	-	Not acceptable

Aperture

Variation	Effect	Comment
Increase in size	=	Increase in area up to 50 % acceptable within a standard lightweight supporting construction (when tested at 3 m by 3 m).
		When tested within a standard concrete or masonry supporting construction the increase in area up to 50 % is applicable only to concrete or masonry constructions.
Decrease in size	=	Smaller acceptable where there is sufficient room for installation of the seal.

Size of plug / block

Variation	Effect	Comment
Change in size	=	Acceptable.

Seal material

Variation	Effect	Comment
Change of material	-	Not acceptable.

Configuration

Variation	Effect	Comment
Change of position within thickness of separating element	-	Distance of seal from exposed face in wall/floor cannot be reduced from that tested.
	= or +	Distance of seal from exposed face in concrete/masonry wall/floor can be increased from that tested.

Orientation

Variation	Effect	Comment
Change of orientation		Floor seal generally more onerous than wall and may be used as supporting evidence for a wall mounted application. Test evidence from wall applications cannot be used to support floor applications.

Putty seals

Seal depth

Variation	Effect	Comment
Increase in seal depth	=	Acceptable.
Decrease in seal depth	-	Not acceptable

Aperture

Variation	Effect	Comment
Increase in size	=	Increase in area up to 50 % acceptable within a standard lightweight supporting construction (when tested at 3 m by 3 m).
		When tested within a standard concrete or masonry supporting construction the increase in area up to 50 % is applicable only to concrete or masonry constructions.
Decrease in size	=	Smaller normally acceptable but consider overall size when services are fitted - sufficient room for installation. Seal/service area ratio should be maintained.

Seal material

Variation	Effect	Comment
Change of material	-	Not acceptable.

Configuration

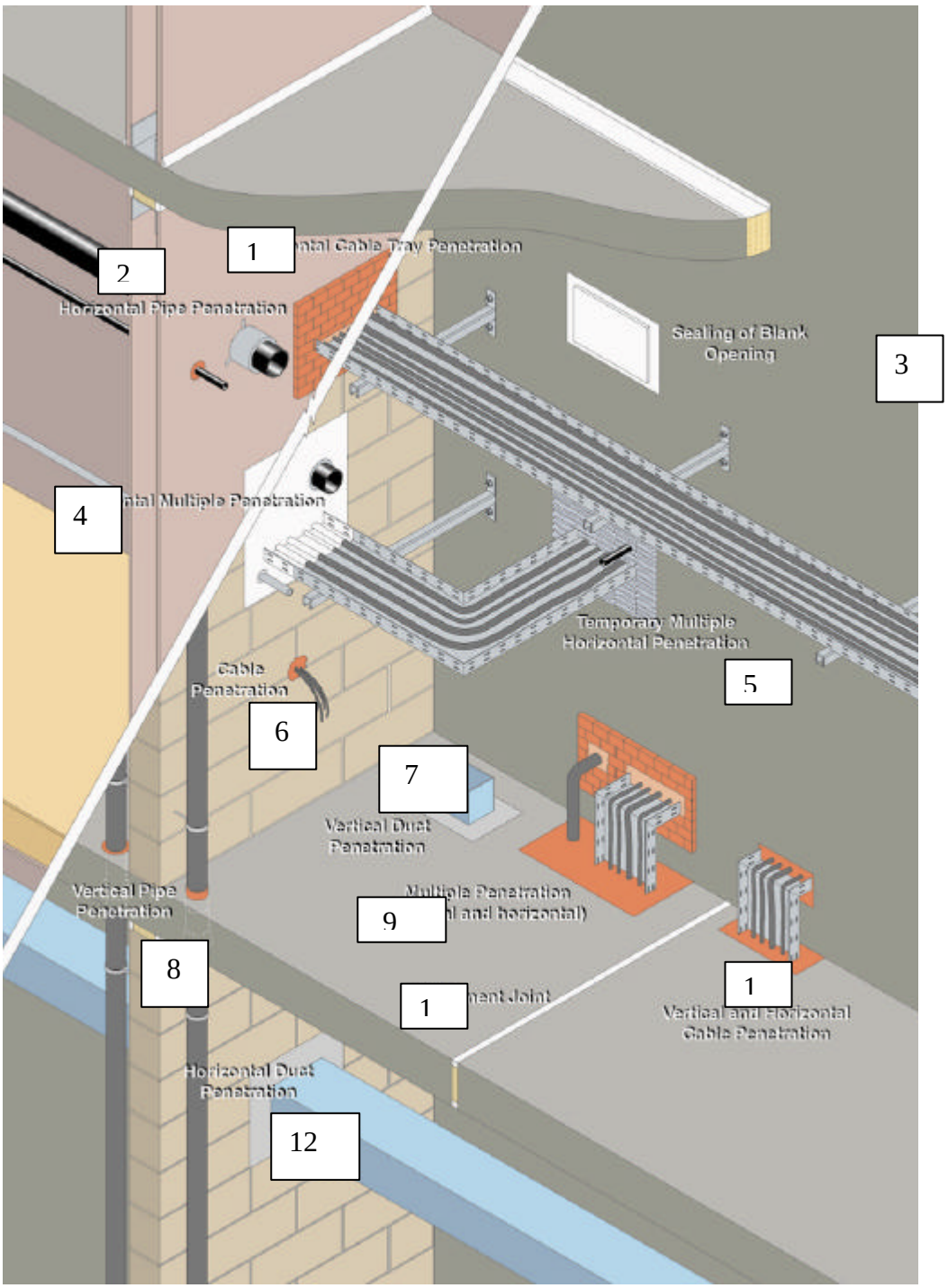
Variation	Effect	Comment
Change of position within thickness of separating element	-	Distance of seal from exposed face in wall/floor cannot be reduced from that tested.
	= or +	Distance of seal from exposed face in concrete/masonry wall/floor can be increased from that tested.
Decrease of air gap (if used)	-	Not acceptable.
Increase of air gap (if used)	=	Acceptable.

Orientation

Variation	Effect	Comment
Change of orientation		Floor seal generally more onerous than wall and may be used as supporting evidence for a wall mounted application. Test evidence from wall applications cannot be used to support floor applications.

SECTION 3. HOW TO USE THIS GUIDE

3.1 Types of penetrations and joints



(Note: The above illustration does not depict fire (including cavity) barriers, for information on the systems that are appropriate for this type of application go directly to section 3.2)

3.2 Typical applicable products by type of penetration, joint and barrier from 3.1

(All fire stopping/sealing solutions are permanent unless stated.
Other fire stopping/sealing solutions may also apply to these scenarios)

1. Horizontal cable tray penetration
Mortars
Plugs/blocks

2. Horizontal pipe penetration
Pipe closures (plastic pipes only)
Sealants (metal pipes only)

3. Sealing of blank opening
Mortars
Plugs/blocks
Coated batts

4. Horizontal multiple penetration
Mortars
Plugs/blocks
Coated batts

5. Temporary multiple horizontal penetration
Bags/pillows. (Note: If adequately supported some bags/pillows can also be used for vertical penetrations)

6. Cable penetration
Mortar
Coated batts
Foam
Sealants

7. Vertical duct penetration
Mortar
Mineral fibre and sealant/mastic

8. Vertical pipe penetration
Pipe closures (plastic pipes only)
Sealants (metal pipes only)

9. Multiple penetration (vertical and horizontal)
Mortar
Coated batts
Pipe closures (plastic pipes only)
Sealants (metal pipes only)
Plugs/blocks

10. Vertical and horizontal cable penetration
Mortar
Coated batts

11. Movement joints

Sealants
Preformed elastomeric seals
Mineral fibre and sealant/mastic

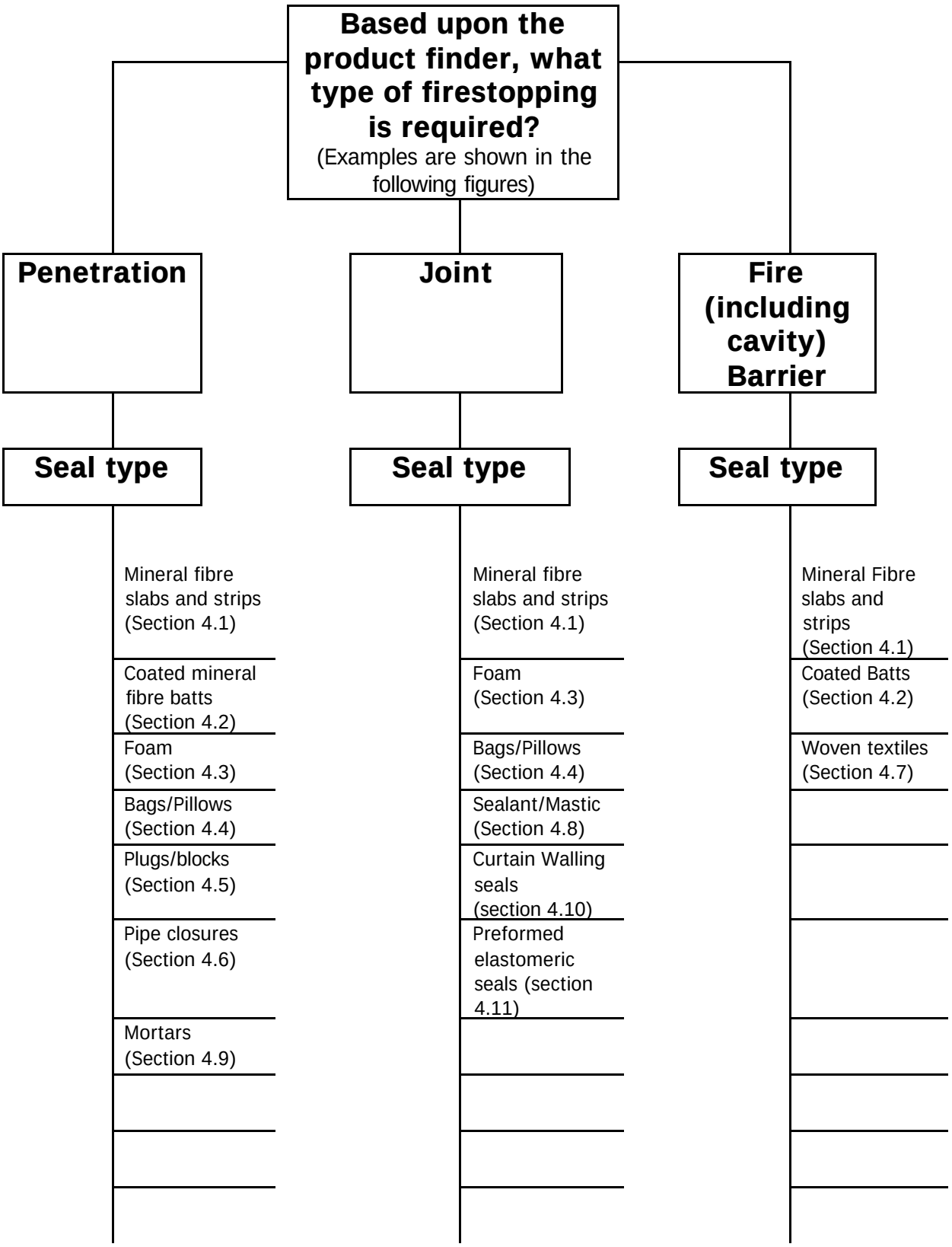
12. Horizontal duct penetration

Mortar
Mineral fibre and sealant/mastic

13. Fire (including cavity) barrier (Not shown in 3.1 diagram)

Coated batts
Mineral wool curtains
Woven textiles
Boards

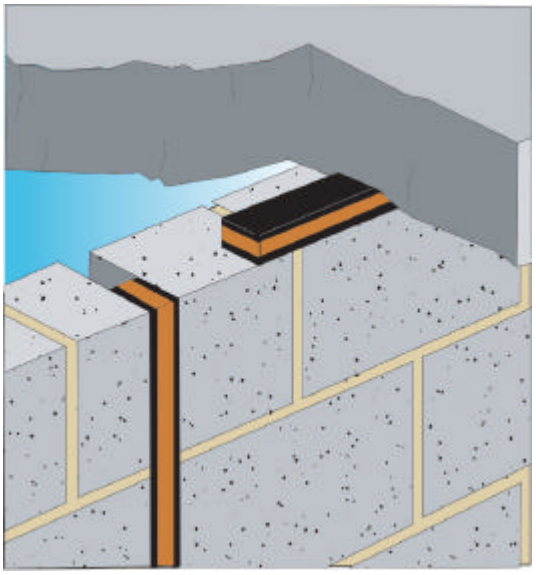
Product Flowchart



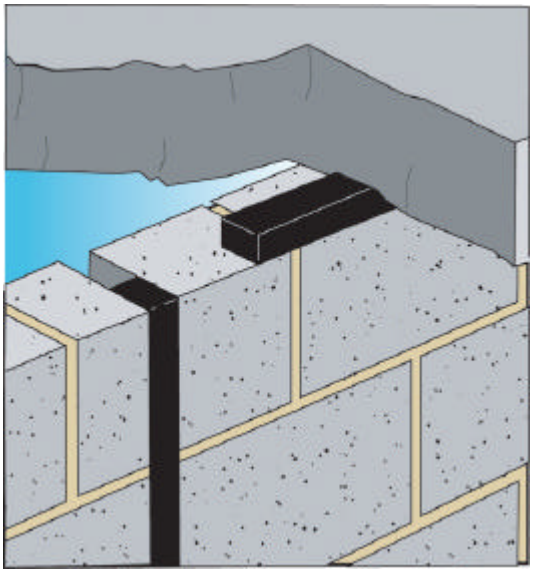
The diagrams in the following figures (Figures 2 to 4) show the types of seals which may be used

Examples of Joint Seals

Preformed elastomeric intumescent seal used to seal expansion joints in a blockwork wall and between a blockwork wall and a concrete soffit



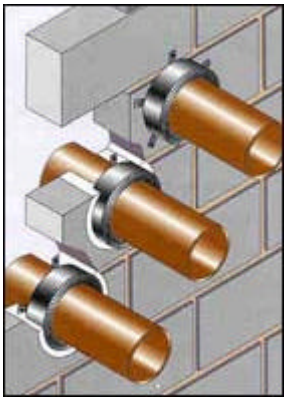
Preformed elastomeric intumescent seal used to seal movement joints in a blockwork wall and a concrete soffit



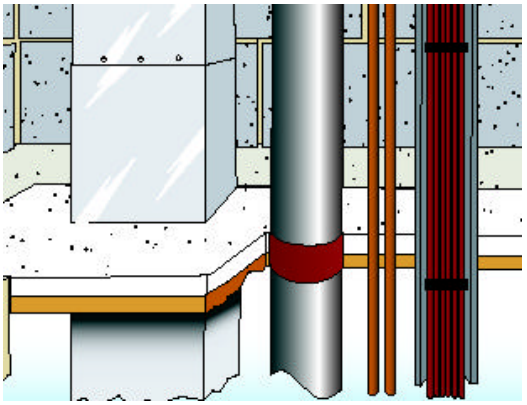
Linear and trapezoidal seals

Examples of Penetration Seals

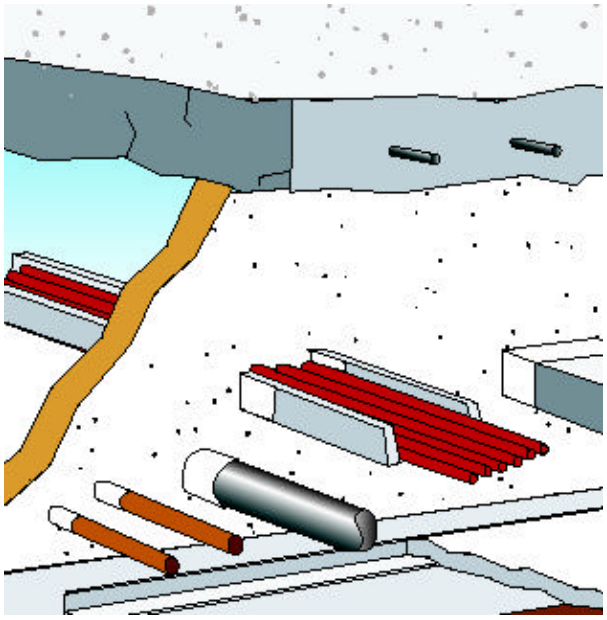
Pipe closures used around plastic pipes in a blockwork wall



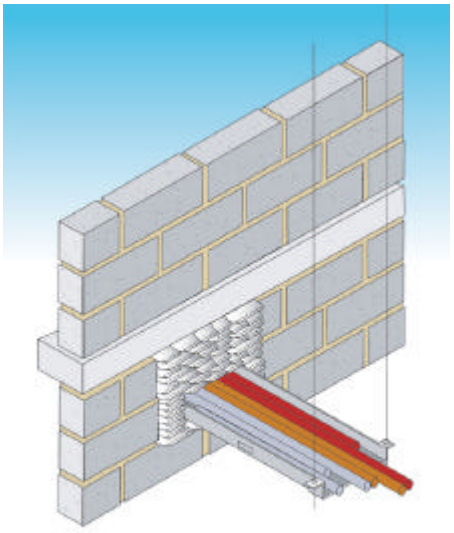
Mortar poured onto permanent floor shutter



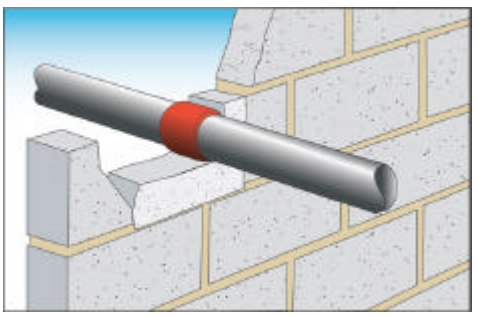
Coated batt used for a horizontal protection



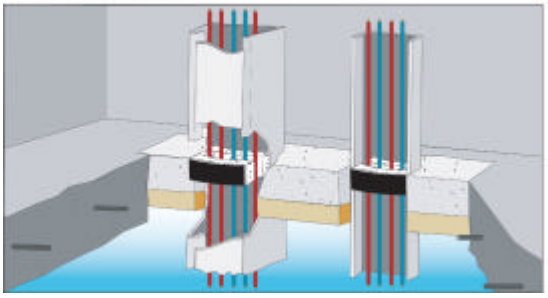
Pillows used to provide temporary multiple penetration for a horizontal cable tray penetration



Pipe wrap used around plastic pipes in a blockwork wall

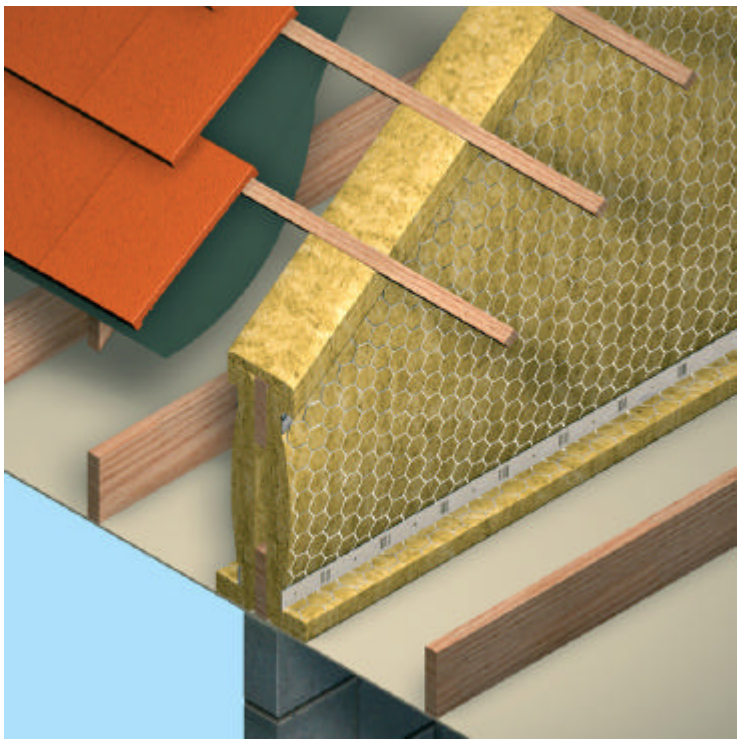


Multi-cable firestop using mortar and preformed elastomeric seals



Examples of Fire (including Cavity) Barrier Systems

Mineral fibre fire barrier system in a roof space



SECTION 4. GENERIC PRODUCT INFORMATION

The information contained in this document is primarily for fire evidence and the manufacturer of the product in question should be consulted for information on other parameters such as acoustic and thermal insulation.

4.1 Mineral Fibre Slabs and Strips

Description

Mineral fibre products for fire stopping are supplied in a number of forms; typically referred to as mats, batts, or pre-formed shapes. These products are usually manufactured from the range of higher melting point mineral wools. The usual density range is 75-250kg/m^3.

Areas of Use

Mineral fibre products can be used to fireseal penetrations through compartment walls and floors and allow additional services to be readily installed as required. In certain circumstances a supporting structure will be required - refer to manufacturers' recommendations. 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. Mineral fibre products can also be used at the junction between the head of a wall and a floor or roof soffit.

Performance

Mineral fibre products are tested using the furnace conditions and relevant performance criteria defined in BS 476 Part 20: 1987 for various supporting constructions. Individual system designers and manufacturers should be consulted for the design requirements of the proposed penetration system.

Installation

Mineral fibre products can be installed as pre-formed shapes or as standard batts for tailoring to fit openings. Batts can be friction fitted to the sides of the opening and around the penetrating services. A "fire resistant" sealant is generally applied to all joints and to the raw edges of the batt. Some systems may require secondary support. Again this will vary from Manufacturer to Manufacturer. Systems should be installed by a specialist contractor.

Maintenance, Inspection and Repair

Mineral fibre products generally require minimum of maintenance during the lifetime of the building, but annual inspections are desirable to recognise any mechanical damage and the necessary repairs made. The seals must be properly reinstated when services are re-routed.

4.2 Coated Mineral Fibre Batts

Description

Coated Mineral fibre batts for fire stopping are supplied in a number of forms; typically referred to as mats, slabs, batts or pre-formed shapes. These products are usually manufactured from the range of higher melting point mineral wools. The usual density range is 75-250kg/m^3.

Areas of Use
Coated mineral fibre batts can be used to fireseal penetrations through compartment walls and floors and allow additional services to be readily installed as required. In certain circumstances a supporting structure will be required - refer to manufacturers' recommendations. 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.

Performance
Coated mineral fibre batts are tested using the furnace conditions and relevant performance criteria defined in BS 476 Part 20: 1987 for various supporting constructions. Individual system designers and manufacturers should be consulted for the design requirements of the proposed penetration system.

Installation
Coated mineral fibre batts can be installed as pre-formed shapes or as standard batts for tailoring to fit openings. Batts can be friction fitted to the sides of the opening and around the penetrating services. A "fire resistant" sealant is generally applied to all joints and to the raw edges of the slab. Some systems may require secondary support. Again this will vary from Manufacturer to Manufacturer. Systems should be installed by a specialist contractor.

Maintenance, Inspection and Repair
Coated mineral fibre batts generally require minimum of maintenance during the lifetime of the building, but annual inspections are desirable to recognise any mechanical damage and the necessary repairs made. The seals must be properly reinstated when services are re-routed.

4.3 Foam

Description
Normally a two component silicone material which, when mixed together, cause the material to foam and increase its volume. The material vulcanises at normal room temperatures resulting in the formation of a highly resilient seal.

Systems can be expected to prevent the passage of cold smoke, halon gas and have good resistance to water, including flooding.

In floors, seals would not be considered load bearing.

Area of Use
Suitable for seals, particularly where access is difficult and where services are complex (see Installation).

The seals will accommodate small amounts of axial and lateral movement of the penetrating services and will achieve a degree of nuclear radiation attenuation. Refer to manufacturer's product specifications for actual radiation performance.

Performance
Room temperature vulcanising foams are tested using the furnace conditions and relevant performance criteria defined in BS 476: Part 20: 1987 for various supporting constructions. Protections periods may vary from one system to another in different

configurations, and orientations.

Physical performance characteristics will be similar to those for sealants/mastics.

In floors, seals would not be considered load bearing.

Installation
Metered mixing is essential and reaction times will vary.

Manufacturer's instructions must be referred to, ensuring the correct installation of the seal. Temporary or permanent damming boards are 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.

Specialist advice should be sought in the choice of damming board materials, which form an integral part of the design of the finished fire seal.

Maintenance, Inspection and Repair
Room Temperature Vulcanising Foams (R.T.V.'s) generally have a long service life.

An annual visual inspection is strongly recommended to check that the seal has not deteriorated or experienced mechanical damage.

It is good practice to inspect more frequently to ensure that, where a seal may have been modified for the addition of new and/or the removal of existing penetrating services, the seal ahs been reinstated.

In most cases the seals may be reinstated or repaired using more of the same material, strictly in accordance with the manufacturer's instructions.

Specialist advice should be sought when reinstating this type of seal.

4.4 Bags/Pillows

Description
Bags/pillows 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. Since they are easily removed, they are particularly suited to areas where services are frequently re-routed. They can also provide temporary protection during construction work. 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. They are particularly useful where services are frequently re-routed, and can be used as temporary protection during the construction phase of a building.

Performance
Bags/pillows are tested using the furnace conditions and relevant performance criteria defined in BS476: Part 20: 1987. Protection periods may vary from one system to another and in different configurations, orientations and packing densities

(number of bags/pillows per square metre). To fully contain cold smoke, additional precautions will be required.

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 rating. 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.

Maintenance, Inspection and Repair

Since bags/pillows are easily removed it is advisable to regularly check that the seal is intact and that all bags/pillows are still in place. The seal must be properly re-instated when cables are re-routed or disturbed.

4.5 Plugs/blocks

Description

Plugs/blocks for fire stopping are available in a variety of shapes and sizes. They are generally cuboid for rectangular penetrations or cylindrical/conical for circular penetrations. Castellated plugs/blocks are available for trapezoidal metal decking. Plugs/blocks are formed from materials such as bonded vermiculite, mineral wool, gypsum/cementitious materials, polyurethane, modified rubber, etc. They can be either 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.

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.

Performance

Fire stopping plugs/blocks are tested using the furnace conditions and the relevant performance criteria defined in BS 476: Part 20: 1987.

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.

Since there are many different types of fire stopping brick, installation should be in accordance with the manufacturers' instructions. Specialist advice should be sought where these materials are to be used in combination with other fire stopping materials.

Maintenance, Inspection and Repair
Since plugs/blocks are often easy to remove, it is advisable to regularly check that the seal is intact and that all plugs/blocks are still in place. The seal must be properly re-instated when services are re-routed or disturbed. A minimum annual inspection is recommended.

4.6 Pipe closures
Description
Pipe closures are designed to preserve the integrity of a fire rated compartment where plastic pipes or trunking pass through floors or walls. Unlike metal or cable service penetrations, plastic pipes and trunking soften and collapse under heating, therefore some means of preventing the passage of hot gasses and smoke is required. This is achieved by strangling the cross-section of the pipe or trunking.

There are variations in design of pipe closures. The two main types are pipe collars and pipe wraps. Both systems confine an intumescent compound which expands on exposure to fire, rapidly exerting pressure upon the pipe. The plastic walls, 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.

Areas of Use
Pipe collars or pipe wraps can be used where plastic pipes or plastic trunking pass through fire resistant elements such as floors or walls.

Performance
Pipe closures are tested using the furnace conditions and relevant performance criteria defined in BS 476: Part 20: 1987 for various supporting constructions. Protection periods may vary from one system to another and in different configurations and orientations. The performance of a pipe closure will depend on the type of plastic used for the manufacture of the pipe, its diameter, and its wall thickness.

Installation
Pipe Collars
The normal method is to fit the collar to the wall or floor on the fire risk 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 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 specifications must be adopted.

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.

For exact details of fitting for any type of pipe closure, specialist advice should be sought.

Maintenance, Inspection and Repair

Some systems may deteriorate under adverse environmental conditions, (e.g., extremes of temperature or condensation) and may require replacement if exposed. Expert advice should be sought where pipe closures are likely to be used in any of these conditions.

4.7 Woven Textiles

Description

Woven textiles composed of high temperature glass or ceramic filaments (in some cases these are coated with other materials to enhance their fire performance properties) are available in various lengths, widths and thicknesses.

Areas of Use

Woven textiles products are used to provide non-rigid fire (including cavity) barriers to provide both vertical and horizontal compartmentation of structures, typically within roof voids and above suspended ceilings.

Performance

Woven textile products are generally tested to BS 476: Parts 6/7/20/22: 1987. Protection periods and performance will differ dependent upon configuration and method of assembly. Testing.

Installation

Woven textile products are easily cut on site using conventional tools. Fixing in place is normally by screwing to a framework. Specialist advice should be sought, particularly about methods of fixing, and installation should be carried out by a specialist contractor, strictly in accordance with the Manufacturers instructions. Particular attention should be given to any joints and edges.

Maintenance, Inspection and Repair

Woven textile products have a long life but annual inspection is to be encouraged to ensure the retention of the fixing system. Damaged sections must be replaced and in so doing, be in accordance with manufacturer's instructions.

4.8 Sealant / Mastic

Description

Single or multipack systems comprising organic, inorganic or intumescent fillers pre-dispersed in a suitable binder (ie acrylic, polysulphide, silicone etc). The materials are of high viscosity and are dispensed by gun or trowelled into the opening and between penetrating services. The materials cure by way of evaporation or chemical reaction to give either a flexible or rigid seal, dependent upon the binder system.

Systems can be expected to have resistance to cold smoke, halon gas and water, including flooding.

Areas of Use

They are suitable for penetration seals in all forms of fire resistant construction, particularly where openings are small, penetrations are complex and access is

difficult.

Performance
Sealants/Mastics are tested using the furnace conditions and relevant performance criteria defined in BS 476: Part 20: 1987 for various supporting constructions. Protection periods may vary from one system to another in different configurations and orientations.

This type of penetration seal would normally be used for small openings with the sealant in some cases being applied onto a combustible material such as polyethylene or onto a non-combustible backing material such as mineral wool. In the latter case this may form a part of the fire design of the seal.

Installation
Normally installed without the need for specialist equipment and often without the need for site mixing. Use of mastic guns or trowels is common, although for floor penetrations some materials can be poured using temporary or permanent damming boards.

Dusty/friable surfaces may need additional treatment prior to the application of the sealant/mastic - refer to manufacturer's instructions.

Maintenance, Inspection and Repair
Sealants and Mastics generally have a long service life, however some materials may deteriorate over prolonged periods, particularly when subjected to the elements.

An annual visual inspection is strongly recommended to check that the seal has not deteriorated.

It is good practice to inspect more frequently to ensure that the seal has been adequately maintained.

These types of seals may last for the life of the building, however where the seal may have deteriorated or suffered mechanical damage, it should be completely removed and replaced in accordance with the manufacturer's instructions.

4.9 Mortars
Description
Generally a gypsum or cementitious based powder blended with inorganic lightweight fillers, composite reinforcement and chemical modifiers. The compounds are designed to be mixed with water and placed around and between penetrating services giving a rigid seal with typical densities ranging between 800kg/m^3 and 2000kg/m^3. With some systems the fillers give positive expansion whilst curing, to overcome the possibility of shrinkage cracks.

Areas of Use
The systems are mainly used for sealing penetrations through concrete and masonry constructions although some can be used in conjunction with lightweight partitions or timber floors.

Whilst the systems are particularly useful for sealing small or complex penetrations some systems are capable of being used to seal large openings.

Performance
Mortars are tested using the furnace conditions and relevant performance criteria defined in BS 476: Part 20 1987 for various supporting constructions. Protection periods may vary from one system to another in different configurations and orientations.

In wall penetrations some systems will be capable of supporting the penetrating services in the fire without the need for additional mechanical support.

In floor penetrations some systems will be capable of supporting light loads such as maintenance foot traffic, although it is likely that some form of additional reinforcement will be necessary (ie weld mesh, rebar etc).

Systems can be expected to have resistance to cold smoke, halon gas and mechanical damage and may have good resistance to water, including flooding.

Installation
The mortar is mixed and applied using simple tools, generally without the need for specialist equipment. For large installations some materials are capable of being pumped after mixing.

In floor penetrations a temporary or permanent damming board is normally used with the mortar poured in place. Small penetrations can sometimes be made by trowelling the mortar into the opening without the use of a damming board.

For wall penetrations mortars are often trowelled using a single damming board or no damming board, dependent on the opening size.

Maintenance, Inspection and Repair
Mortar seals generally have a long service life; however, an annual visual inspection is strongly recommended to ensure that the seal has not deteriorated in situ. It is good practice to inspect more frequently to ensure that, where a seal may have been modified for the addition of new and/or the removal of existing penetration services, the seal has been reinstated.

In most cases, the mortar seals may be reinstated or repaired using more of the same material, strictly in accordance with the appropriate installation method.

Specialist advice should be sought especially when reinstating load bearing floor seals.

4.10 Curtain Wall Seals

Description
Normally mineral wool based, these products are often used in conjunction with metal support systems and/or mastics/self levelling compounds to seal the gap between a floor slab and a curtain walling system. Throughout their lifetime these sealing systems will have to withstand large amounts of movement due to wind induced flexing of the curtain walling panels.

Areas of Use
Generally used between floor slabs and curtain walling systems.

Performance
Curtain wall sealing systems are tested using the furnace conditions and relevant performance criteria defined in BS 476: Part 20: 1987 for various supporting constructions. Protection periods may vary from one system to another in different configurations and orientations.

Installation
Curtain walling sealing 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. Many systems require secondary support and/or the use of mastics/self levelling compounds. These requirements will vary from Manufacturer to Manufacturer. Systems should be installed by a specialist contractor.

Maintenance, Inspection and Repair
Annual inspections are desirable to recognise any mechanical damage and the necessary repairs made.

4.11 Preformed Elastomeric Seals
Description
Generally 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
Generally used to seal movement joints between two building elements, eg. between a floor and a wall.

Performance
Preformed elastomeric seals are tested using the furnace conditions and relevant performance criteria defined in BS 476: Part 20: 1987 for various supporting constructions. Protection periods may vary from one system to another in different configurations and orientations.

Installation
These products are fitted by compressing by hand and then by pushing into the gap that requires sealing.

Maintenance, Inspection and Repair
Preformed elastomeric seals generally have a long service life, however some materials may deteriorate over prolonged periods, particularly when subjected to the elements.

An annual visual inspection is strongly recommended to check that the seal has not deteriorated.