Sheet No: 6.7.2

6.7 Service sealing

Fire stopping and linear gap seals

Main application in respect to this *Design Guide*:

- Maintaining the fire resistance separation provided by compartment walls, floors and protected shafts when either a gap due to an imperfection of fit exists or where a functional gap has to be incorporated to accommodate a building design requirement.
- Maintaining the fire protection provided by protective corridors or protected stairways or cavity barriers when a gap exists as above.
- Used to create a barrier in small cavities to prevent fire and smoke spread.

There is significant confusion about the properties that a gap sealing system has to provide if the gap is to be sealed to maintain fire separation. In order to clarify the various functions and performance objectives the following definitions are included for clarity.

Fire Stopping. A seal provided to close an imperfection of fit or design tolerance between elements or components, excluding functional gaps, to restrict the passage of fire and smoke.

Linear gaps. A gap with a length of at least 10 times its width and where the gap width does not exceed 150mm. It may be functional or non-functional (see Figures 1 and 2).

Note: Gaps that do not comply with the above dimensional limitations shall be regarded as a penetration seal (6.7.1).

Functional linear gap. A gap of the above dimensions but which is installed in an element or building for a specific purpose, e.g. a movement joint, rather than an imperfection of fit.

Functional linear gap seal. A seal that accommodates the function that the gap has been incorporated for, e.g. expansion, and also maintains the fire resistance of the elements bounding the gap.

Non-functional linear gap seal. A seal that only has the purpose of maintaining the fire resistance of the elements bounding the gap, i.e. fire stopped.

This data sheet considers the relative performance (only in respect of fire) of a number of proprietary linear gap sealing systems, but is not intended to be comprehensive. When evaluating the potential performance of proprietary sealing systems that are not listed, the criteria or fire performance headings should be used by the specifier to establish their suitability.

BEFORE READING THIS DATA SHEET PLEASE REFER TO THE INTRODUCTION

IMPORTANT

THESE DATA SHEETS ARE ONLY INTENDED TO GIVE GENERIC INFORMATION.

DATA ON PROPRIETARY PRODUCTS MUST BE OBTAINED FROM THE MANUFACTURERS

Function of fire stopping and linear gap seals

In the case of functional linear gap seals the seal must accommodate the function whether that be to perform as an expansion gap, a movement gap, an acoustic or weather seal. This data sheet does not assess the relative merits of the different seal types to perform these various functions. The designer/specifier should however ensure that the performance criteria can be met.

To maintain the integrity of the wall/floor/barrier for the duration defined in Table 4.8 of the *Design Guide*, when either a functional or non-functional gap exists within or at the perimeter of the element.

To restrict the rise in temperature on the surface of the wall/floor or barrier at a point where gaps exist.

Restrict the passage of smoke through such gaps for the same duration as the integrity.

In the case of functional gaps, to withstand the in-service conditions.

Withstand the deflection and any differential movement between the two surfaces/edges forming the gap which is likely to be experienced both in use and during fire exposure whilst maintaining the requirements above.

Be capable of interfacing with the appropriate associated construction and remain in place.

Maintain the seal over the life time of the building, or for a shorter duration if allowed for in the fire safety management plan, in respect of the anticipated ambient conditions.

Evidence of fire performance

Evidence of performance shall comply with all of the following:

- **Fire resistance (integrity).** The ability of the seal to maintain integrity which shall be supported by test evidence generated in accordance with an ad-hoc test using the methodology of BS476: Part 22[1h], or to the CEN standard EN 1364, Part 1[26] with respect to the associated construction appropriate to its use and preferably supported by a Field of Application Report identifying any restrictions in use.
- **Temperature rise (insulation).** The sealing system should be able to maintain the unexposed face temperature below hazardous levels offering protection consistent with the surrounding construction. This performance should be supported by test/assessment evidence as for integrity.
- **Smoke resistance.** The seal should be impermeable to smoke and the method of installation shall be such that no visible gaps exist and if possible quantifiable leakage information should be available to justify any claims made by the manufacturer or installer. Preferably the wall/ceiling/floor with system installed shall have been tested to the methodology of BS476: Part 31[1j] and demonstrated a leakage rate of not more than $10m^3/m^2/hr$.
- **Deflection and differential movement.** The method of installation of the seal shall be able to accommodate any in-service deflection of the adjacent elements.

- **Compatibility with associated construction.** The seal shall be able to be easily formed or otherwise able to accommodate any irregularity in the aperture, particularly fire stopping, and have sufficient adhesion to retain itself in position.
- **Durability.** Evidence shall be available to show that the materials used in the construction of the seal are not going to be adversely affected by the ambient conditions and, if appropriate, abuse during the anticipated life of the seal.

Generic materials used for fire stopping

Linear gaps have two distinct variations as identified at the beginning of this data sheet, namely functional linear gaps or non-functional linear gaps ('fire stopping'). A number of generic non-proprietary materials have traditionally been used to 'fire stop' accidental gaps and indeed some of these materials are recognised in building regulations. This data sheet considers the relative merits and de-merits of these materials.

For functional gaps proprietary seals need to be installed. Their primary function will be to satisfy the purpose for which they have been installed and fire separation will only be a secondary function.

The following products are covered in this data sheet:

1. Non-functional linear gap seals, 'fire stopping'
    - 1.1 Mineral fibre fire stopping
    - 1.2 Cementicious materials
2. Functional linear gap seals
    - 2.1 Intumescent mastics
    - 2.2 Non-intumescent mastics
    - 2.3 Composite foam/intumescent gaskets

1. Non-functional linear gap seals, 'fire stopping'

This section considers the merits of the materials identified in regulations by generic description as being suitable for 'fire stopping' or the sealing of non-functional gaps. The materials described under the heading of sealing functional linear gaps are also suitable for fire stopping applications.

1.1 Mineral fibre fire stopping

This section only considers the performance of 'stone' or rock fibre mineral wool as glass based mineral wool melts at low temperatures and is not suitable for fire stopping applications.

Fire performance data

- **Fire resistance (integrity).** When installed correctly, i.e. the void being fully filled and the fibre well compressed, high levels of integrity can be obtained. However, the material is vulnerable to inadequate installation and is therefore very installer dependent. The mineral wool can also become detached when subjected to cyclic differential movement between elements forming the gap. The material may also be prone to damage by vermin in concealed areas. (☆☆☆☆)

- **Temperature rise (insulation)**. Mineral wool has good insulating properties when installed correctly and at the proper depth but as above, the temperature rise would be increased by poor installation. (☆☆☆☆)
- **Smoke resistance**. Mineral wool is not particularly impermeable unless capped off with a sealant and as such it will permit the leakage of smoke. When it gets hot the resins will break down and produce smoke. (☆☆☆)
- **Deflection and differential movement.** Mineral wool is able to accommodate movement because of its resilience and recovery, although in cyclic, differential movement situations it may creep and work loose. (☆☆☆☆)
- **Compatibility with associated construction.** Mineral wool, unless under high degrees of compression, has a low adhesion to the associated construction but is able to accommodate irregular apertures. It is more suited to sealing gaps in vertical elements than in horizontal elements due to its low adhesion. (☆☆☆)
- **Durability**. Mineral wool has excellent longevity properties. (☆☆☆☆☆)

1.2 Cementicious materials

This section considers the use of cement mortar, gypsum based plasters and cement plaster vermiculite mixes.

Fire performance data

- **Fire resistance (integrity).** Cementicious materials have excellent integrity performance when installed correctly and with sufficient depth. Differential movement between the associated constructions bounding the gap may lead to cracking. (☆☆☆☆)
- **Temperature rise (insulation)**. Cementicious materials, with the exception of gypsum based products, are relatively conductive when heated and this can lead to the temperature rise criteria being exceeded. (☆☆)
- **Smoke resistance**. Cementicious materials are impermeable and unless cracked will have excellent smoke restricting properties.(☆☆☆☆)
- **Deflection and differential movement**. Being rigid in nature the materials are not able to accommodate differential movement between adjacent elements and may crumble away, although being strong in nature they may be able to resist failing until distortion is significant. (☆☆)
- **Compatibility with associated construction.** Cementicious material have a high adhesion (except possibly on smooth surfaces), but are unable to respond to erosion of the construction. (☆☆☆☆)
- **Durability**. Most cementicious materials would be considered durable, both to physical impact and chemical/moisture attack, albeit gypsum based products may be prone to degradation with respect to the latter. (☆☆☆☆)

2. Functional linear gaps

This section considers the performance of sealing systems and proprietary sealants which are able to seal linear gaps in order to maintain the fire resistance of the bounding elements and to accommodate the function for which they have been installed.

2.1 Intumescent mastics

This section considers the performance of mastic sealants, with and without a backing strip, which take advantage of the benefits of intumescent materials to provide the fire performance.

Fire performance data

- **Fire resistance (integrity).** The principle of using an intumescent mastic sealant is that the mastic quantities are chosen such that the intumescent material is able to reduce the erosion of the mastic material in order to extend the duration for which the gap can be sealed. As such, as long as the mastic is manufactured and installed within the field of application generated by the test evidence, it has adequate integrity for the application. For wide gaps a suitable backing rod may be necessary and this should feature in the evidence of performance. (☆☆☆☆☆)
- **Temperature rise (insulation).** Subject to the depth of mastic being sufficient to maintain integrity for the required duration, these are generally able to satisfy the temperature rise requirements as the activated intumescent foam has good insulating properties. (☆☆☆☆☆)
- **Smoke resistance.** Subject to the mastic bead being run continuously, the smoke resistance is excellent. (☆☆☆☆)
- **Deflection and differential movement.** These products have reasonable compressibility and recovery with an ability to accept movement as covered by the physical properties of the mastic and if appropriate, the backing rod. (☆☆☆☆☆)
- **Compatibility with associated construction.** The product can normally be fitted easily to an irregular aperture and the 'stickiness' or self-adhesion properties normally ensure that it stays in place. (☆☆☆☆☆)
- **Durability.** Most forms of intumescent mastic are able to withstand normal environmental conditions. Ageing tests performed by the Intumescent Fire Seals Association (IFSA) have shown that in normal internal environments intumescent products show no significant degradation[37]. (☆☆☆☆)

2.2 Non-intumescent mastics

There are a number of materials that are used as mastics and which claim to be fire resisting. A number of these are however only conventional mastics supported by a backing rod that is in itself fire resisting. When using these materials it is important to be assured that the backing rod material is that which has been tested with the mastic. It is often the case that if a fire resisting material is used for the backing it is unlikely to have the ability to provide the functional requirement for the seal. This section mainly addresses those materials that do not rely upon a special backing rod material.

FIRE PERFORMANCE DATA

- **Fire resistance (integrity).** The non-intumescent mastic seals that are not too heavily reliant on the performance of the backing rod do not have an ability to react to a gap where the edges are being eroded away. However, if the mastic is installed in compliance with the assessment or field of application report generated from the test evidence then the integrity should be adequate. Where the sealant is heavily dependent upon the performance of the backing rod then the risk of a loss of integrity is greater. (☆☆☆)
- **Temperature rise (insulation).** Non-intumescent mastics are not able to provide as much insulation as intumescent mastics because of the lack of expansion. However, if the mastic is applied at a depth sufficient to maintain integrity it should be able to at least satisfy the maximum temperature rise criterion. (☆☆)
- **Smoke resistance.** Being a mastic material, if continuously applied they should provide an adequate seal to cold smoke but may produce smoke or break down and become permeable to smoke in the 'hot' condition, especially if the backing rod does not need to have any special fire properties. (☆☆☆)
- **Deflection and differential movement.** Mastics have a reasonable tolerance to differential movement in the cold state but unlike intumescent materials they have a poor tolerance to differential movement in the hot state. (☆☆)
- **Compatibility with associated construction.** Mastic can normally be fitted easily to an irregular aperture and the natural adhesion ensures that it remains in place in the cold state. It may not remain in place so easily when hot. (☆☆☆☆)
- **Durability.** Most forms of mastic materials are able to withstand normal environmental conditions. (☆☆☆☆☆)

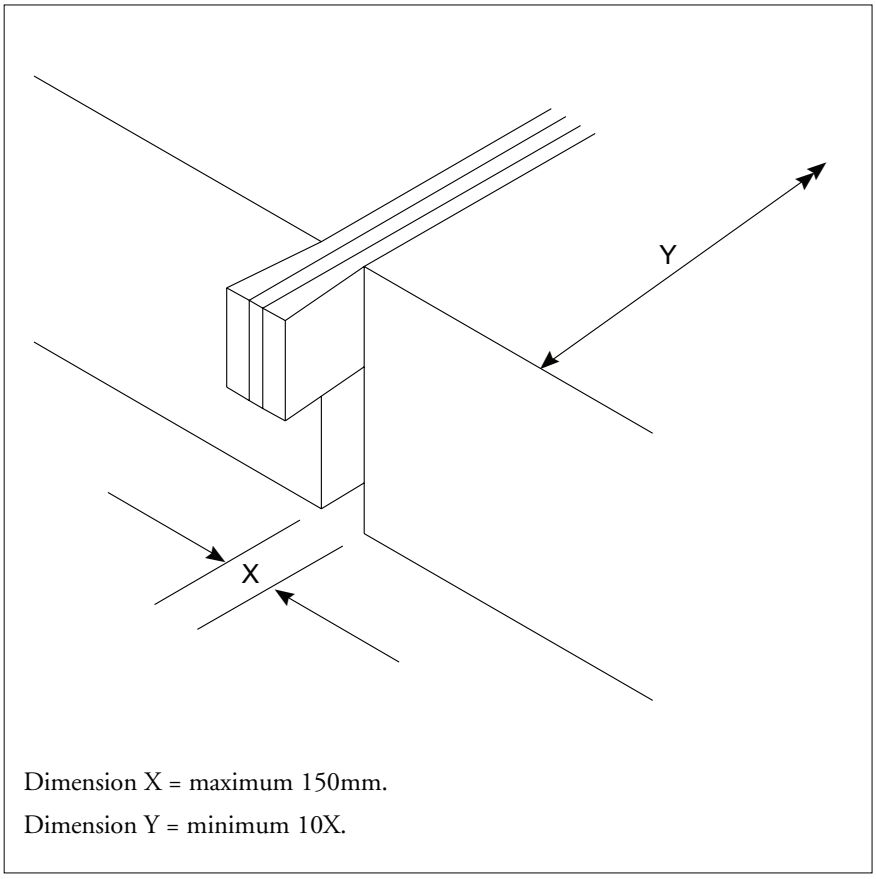
2.3 COMPOSITE FOAM/INTUMESCENT GASKETS

The principle of these composite systems is that the intumescent quantities are chosen such that the intumescent material is able to replace the gap produced by the foam melting or burning as a result of fire exposure (see Figure 1). These products are generally flexible and a combination of intumescent and a carrying foam based material.

FIRE PERFORMANCE DATA

- **Fire resistance (integrity).** As long as the product is manufactured and installed within the field of application generated by the test evidence, it has adequate integrity for the application. (☆☆☆☆☆)
- **Temperature rise (insulation).** Subject to the depth of seal being sufficient to maintain integrity these are able to satisfy the temperature rise requirements. (☆☆☆☆☆)
- **Smoke resistance.** Subject to the foam being of a closed cell type the smoke resistance is excellent. Closed cell foams are, however, harder to compress. Open cell foams will restrict smoke but not as well as closed cell. (☆☆☆☆)

- **Deflection and differential movement.** These products have an excellent compressibility and recovery with an outstanding ability to accept the design movement. (☆☆☆☆☆)
- **Compatibility with associated construction.** The product can normally be specified with sufficient depth of foam and thickness of intumescent to follow an irregular aperture and the degree of compression applied to the foam normally ensures that it stays in place. (☆☆☆☆☆)
- **Durability.** The foam and most forms of intumescent are able to withstand normal environmental conditions which are supported, in part, by ageing tests performed by the Intumescent Fire Seals Association, where the sodium silicate and graphite based materials normally used in such seals have been included in long term tests in excess of 10 years. (☆☆☆☆)



Dimension X = maximum 150mm.

Dimension Y = minimum 10X.

Figure 1. Composite foam/intumescent gaskets - horizontal joint.

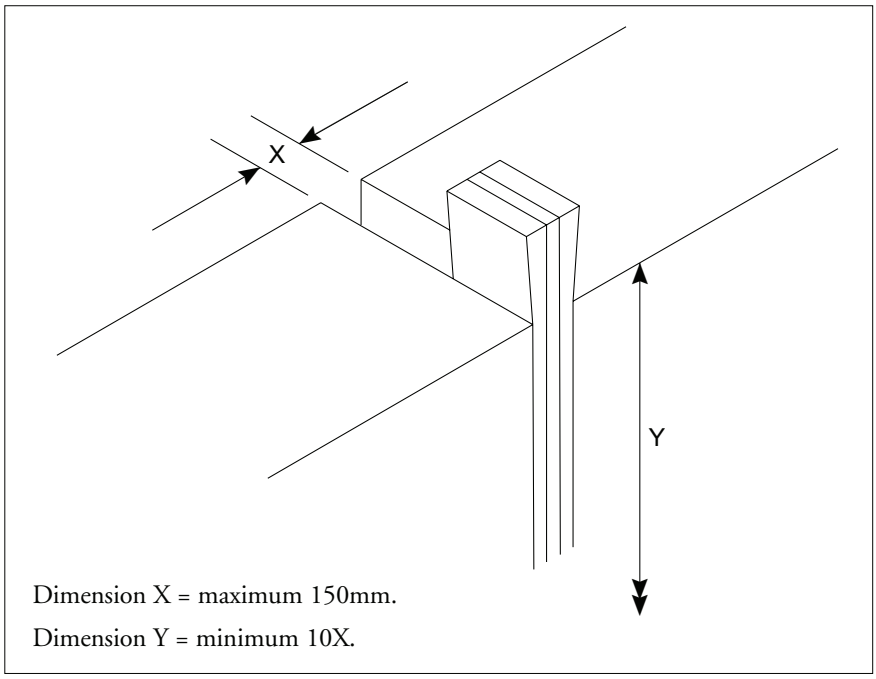


Figure 2. Composite foam/intumescent gaskets - vertical joint.

Table 1 below summarises the assessed relative abilities of the featured fire stopping and linear gap seals to satisfy the identified performance requirements.

Table1. Summary of performance data.

Requirements / Fire stopping and linear gap seals	Fire resistance (integrity)	Temperature rise (insulation)	Smoke resistance	Deflection and differential movement	Compatibility with associated construction	Durability
1. Non-functional linear gap seals, 'fire stopping'						
1.1 Mineral fibre fire stopping	☆☆☆☆	☆☆☆☆	☆☆☆	☆☆☆☆	☆☆☆	☆☆☆☆☆
1.2 Cementicious materials	☆☆☆☆	☆☆	☆☆☆☆	☆☆	☆☆☆☆	☆☆☆☆
2. Functional linear gap seals						
2.1 Intumescent mastics	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆
2.2 Non-intumescent mastics	☆☆☆	☆☆	☆☆☆	☆☆	☆☆☆☆	☆☆☆☆☆
2.3 Composite foam/ intumescent gasket	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆

Installation

The installation of fire stopping and linear gap seals should be executed by a suitably qualified person to the required standard for the appropriate system. It is advisable that where fire performance is required then an inspection by an independent body may be carried out on the completed work.

Sources for other information

Intumescent Fire Seals Association (IFSA), 20 Park Street, Princes Risborough, Buckinghamshire HP27 9AH.