

'Q-Mark' Requirements:

If the door set design is required to provide a smoke control function to comply with Building Regulations, in the absence of a suitable pressurisation system, the door set must meet one of the following criteria:

(a) have a leakage rate not exceeding 3m³/m/hour (head and jambs only) when tested at 25Pa under BS 476 Fire tests on building materials and structures, Section 31.1 – Methods for measuring smoke penetration through door sets and shutter assemblies, Method of measurement under ambient temperature conditions; or

(b) meet the additional classification requirement of Sa when tested to BS EN 1634-3: 2004 – Fire resistance tests for door and shutter assemblies, Part 3 – Smoke control doors.

Smoke seals or combined intumescent/smoke seals that are fitted to the door to achieve the performance requirements specified above, must have been tested in accordance with the associated test method. Providing the smoke seals, any interruptions, door gaps, and the type/configuration of the door set are consistent with the detail tested, the door set will comply with current smoke control legislation under Approved Document B; and a suffix 'S' or 'Sa', as appropriate, may be added to the designation. Any other components installed where smoke leakage may occur must also be taken into account.



General:

Smoke sealing is a separate performance requirement to fire rating. i.e. there is no regulation that requires specifically that a fire rated door should also be a smoke sealed door. General purpose doors that are not fire rated may be specified as smoke sealed.

Sealing Options:

The following provides for general guidance, descriptions and illustrations showing typical measures that can be taken to provide for smoke sealing performances.

NOTE: Reference should be made to the particular seal manufacturer / supplier to obtain supporting test / assessment documentation and for further guidance with regard to installation recommendations.

Under Door (Threshold) Sealing:

Unless used with a sill (with a four sided frame), the under door gap cannot be controlled by the door set manufacturer who can only assemble door sets to provide for a nominal dimension from the bottom of the door to the bottom of the frame jamb (subject to BS4787 Pt. 1 tolerances). Similarly, it may be difficult for the Installation Contractor to control under door gaps as these are influenced to a major degree by the quality of the surrounding structure, and in particular the quality and nature of the floor preparation and finish.

Thresholds may be used to control under door gaps but these tend to be rejected where these might interfere with wheeled 'traffic' or create a trip hazard.

Mechanical drop seals (Automatic Door Bottoms) provide for an effective method for sealing the bottom edge of the doors (e.g. Norsound NOR810).

NOTE 1: This is the preferred option for sealing the bottom edge of doors where the under door gap cannot be controlled to the precision required by reference to BS9999. These may be fitted on site as a variation to existing door assemblies as necessary, to suit particular location requirements.

NOTE 2: Mechanical drop seals (Automatic Door Bottoms) for use with fire doors must be supported by fire test / assessment data to the required performances for use in wood doors. See Section 8 - Hardware for 'Q-Mark' approved drop seals (Automatic Door Bottoms) for use with FLAMEBREAK™ based doors.

Fixed elastomeric blade or brush seals may be used at the bottom edge of the door. However, the effectiveness of these will vary according to the variation in the operating gap during the swing of the door. i.e. They must essentially be set to suit the minimum gap through the swing of the door.

NOTE: Fixed bottom edge door seals should generally be used with threshold strips to ensure that the seals clear the floor through the whole swing of the door.

Sealing Options contd.:

Edge Sealing:

Most intumescent seal manufacturers supply combined intumescent / smoke seals that have been tested to BS476 Section 31.1 or BS EN 1634-3 and that are suitable for smoke sealing stiles and heads.

Fundamentally there are two types of combined intumescent / smoke seal.

- 1/ Brush seals
- 2/ Elastomeric blade seals.

The force acting on the seals at the hanging stile is different to the force acting at the closing stile. The hanging stile seals will be subjected to a compression force with minimal shear force while the closing stile seals will be subjected to shear forces but with some compression force. The head seals will generally be subjected to shear forces with some compression force.

Brush seals subjected to compression forces will often retain their compressed state within a short time after fitting.

NOTE: Some brush seals incorporate a plastic membrane that improves the life of the seal before settling at the compressed state.

Brush seals subjected to shear and compression forces will generally retain the compressed state within a short period after fitting, the shear forces (*friction*) may also cause wear.

Combined intumescent / elastomeric blade seals tend to suffer less from compression forces. However, shear forces, particularly if applied at the joint between the blade and the intumescent carrier can result in separation of the blade from the carrier.

Shear loadings, if excessive, can influence operating forces. There is a tendency to 'wind up' closers to overcome seal and possibly latch resistance to the extent that the forces necessary to use the doors may exceed those required by reference to Building Regulations -(England & Wales) - Approved Document 'M' and BS8300.

The smoke sealing element of edge fixed seals may need to be removed to accommodate hardware. Further, when using edge fixed seals, it may be difficult to accommodate variations in operating gap tolerances permitted by reference to BS4787. Variations in environmental conditions can affect the moisture content of the door or frame resulting in variations in the size of the operating gaps.

To overcome the problems identified above it is recommended that compression seals are applied to the doorstops to act at hanging stiles, head and the closing stiles of single leaf door assemblies. Multi blade type seals available from a number of sources are suitable for this application. Alternatively 'O' seals or single blade seals fitted to the face of the doorstop could be used. These act on the face of single action doors allowing for variations in operating gaps without detriment to the sealing. The seals remain unbroken when fitting hardware to the edge of the door.

NOTE: It is recommended that the stiles and head of the doors (particularly to the closing face of the doors) are slightly rounded (2~3mmR) or splayed, to act as a lead for the compression of seals. This will provide for improved durability with a reduction in the operating forces necessary to use the doors.

Single action pairs of fire doors should generally provide for simultaneous opening. It is also desirable to maintain a continuous seal, i.e. not interrupted to accommodate hardware, if possible. Use of combined intumescent seals with blades off set to one edge of the seal may be used for this application. It is recommended that the seal is recessed into the door edge such that the smoke seal blade overlaps the adjacent doors by 0.5 to 1mm. This has an added advantage in that the forces applied during operation are felt more on the flexible blade and less at the vulnerable blade / carrier joint. As the recommended frame seals overlap the face of the door, it is possible to adjust the meeting stile gap by use of packing at the hinge positions without detriment to the perimeter sealing. i.e. There is only one gap to adjust.

The meeting stiles of pairs of doors treated in this manner will need to be beveled (*provided with a 'leading edge' generally not greater than 2°*) to ensure that the doors may be opened simultaneously without damage to the smoke sealing blade and to ensure that the doors can be operated using acceptable forces.

It is recommended that the smoke sealing blade should be positioned as near to the opening face of the door as possible. This should allow for the fitting of hardware without the necessity to remove any of the smoke seal.

Rebating of meeting stiles is generally not recommended for fire doors as these then become sequential opening. However, where this is necessary, compression type seals as recommended for the frame jambs might be used.

Sealing Options contd.:

Double Action Door Assemblies:

Double action doors where the pivot is located centrally within the door thickness do not suffer from the 'door growth' problem associated with single action door sets. Combined intumescent / smoke seals of either the brush or blade types can be used at the hanging and closing stiles. However, it is recommended that these seals are set to a position that provides for a 0.5 - 1mm overlap with the component that is to be sealed. This will ease the stress at the seal / carrier junction and make maximum use of the flexibility of the seal.

Smoke sealing at the top and bottom of a double action door may be more difficult due to possible conflicts with double action pivot fixings. This section illustrates a method for providing for optimum smoke sealing for double action door sets.

General Notes:

NOTE 1: For optimum performance seals should compress to approx. 50% of maximum. Over compression can lead to distortion of the seal with subsequent leakage and possible interference with the door operation.

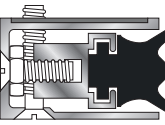
NOTE 2: Whereas it is desirable for smoke seals to be continuous and unbroken to accommodate hardware, some sealing systems have been successfully tested to provide for the performances described by reference to BS9999 with part of the seals removed to suit hardware items. Reference should be made to the seal manufacturer's / supplier's test data where this consideration applies.

NOTE 3: The fitting of smoke seals must not compromise the operation of the door.

Typical Perimeter Seal Options

Fig. 5.1

Independent Perimeter Seals

	Frame Rebate fixed seal - adhesive backing & kerf fixing options. Elastomeric blade seals.
	Frame Rebate fixed seal - adhesive backing & kerf fixing options. Elastomeric blade seals.
	Frame fixed seal 'Tear Drop'- adhesive backing with kerf fixing carrier options.
	Multi blade kerf fixing elastomeric blade seals.
	Door stop face fixed carrier with seal. Can generally be added as a upgrade to existing installations.
	Adjustable door stop face fixed carrier with seal. Can generally be added as a upgrade to existing installations.

Combined Intumescent / Smoke Seals

	Single off-set Elastomeric blade Intumescent / smoke seal.
	Twin centre Elastomeric blade Intumescent / smoke seal.
	Twin end located Elastomeric blade Intumescent / smoke seal.
	Centre located Intumescent with Brush smoke seal.
	Centre located Intumescent / Brush smoke seal with centre plastic membrane.

There is an extensive range of tested seals that are suitable for use as perimeter smoke seals when used with Flamebreak™ doors.

The selection and positioning of perimeter smoke seals should be planned in advance with due regard to:

- Possible conflicts with other hardware.
- Durability (anticipated frequency of use of the door).
- Influence on door operating forces.

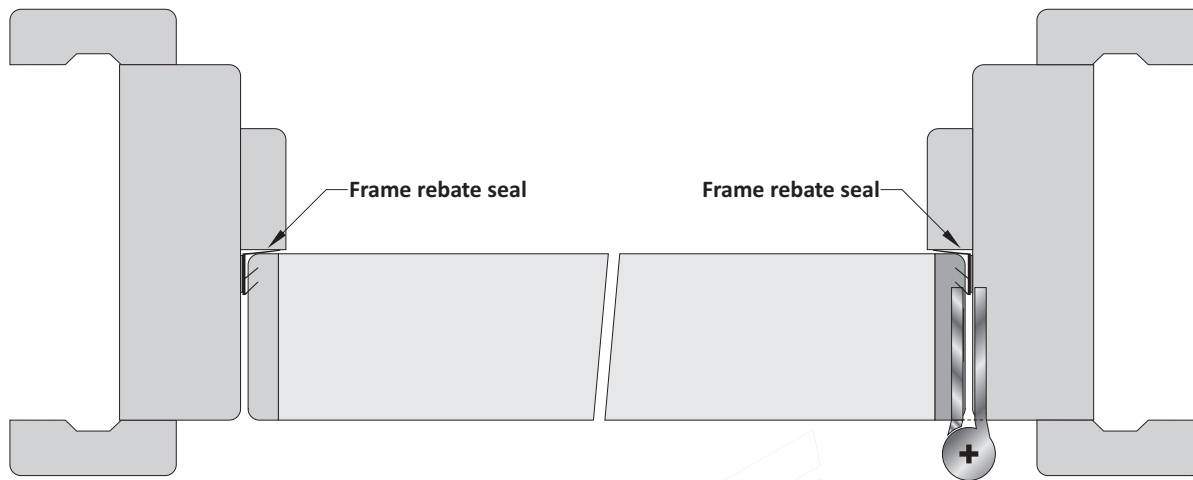
5.4 Smoke Sealing

FLAMEBREAK

Smoke Sealing - Perimeter Sealing - Single Action - Jamb:

Independent Frame Rebate Seal

Fig. 5.2



Frame rebate seals can be fitted independently and located to suit the particular door location requirements.

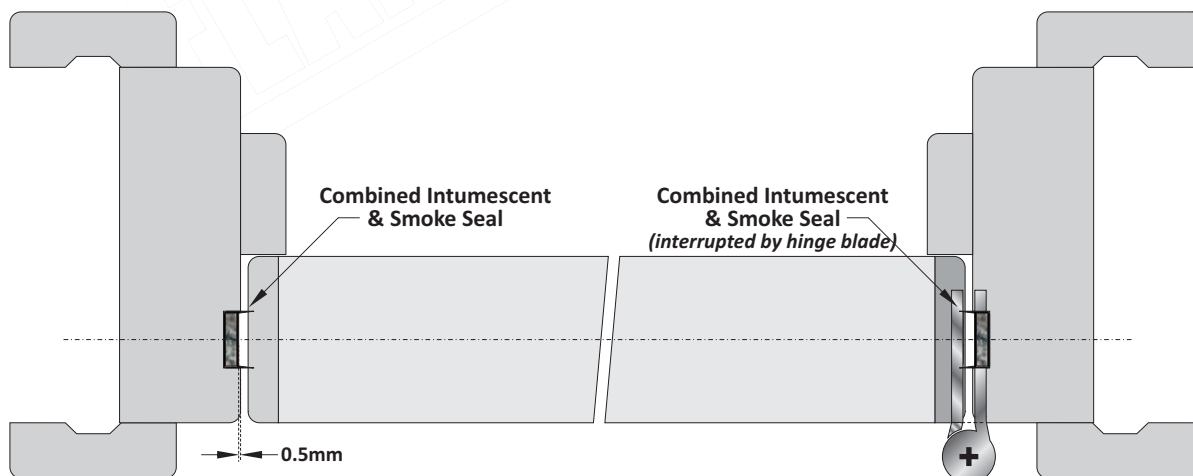
This detail illustrates the Norsound NOR710 perimeter seal that has been extensively tested for both smoke sealing and acoustic door applications. Similar tested frame rebate seal designs are available from a number of sources that are intended to be located in the frame rebate

Seals located in this position provide for optimum smoke sealing performances and are less likely to suffer from conflicts with hardware or other seals. They are likely to have a minimal influence on operating forces and can be easily replaced in the event of damage.

NOTE : The use of a 2~3mm R pencil round is recommended, to be applied to the closing edges of the door leaf to provide for a lead for the compression of seals and to improve seal durability.

Combined Intumescent / Smoke Seals

Fig. 5.3



Numerous designs of combined intumescent / smoke seals have been tested and proven to be capable of providing for compliance with BS9999 requirements. However their use should be carefully planned to minimise conflicts with hardware fittings.

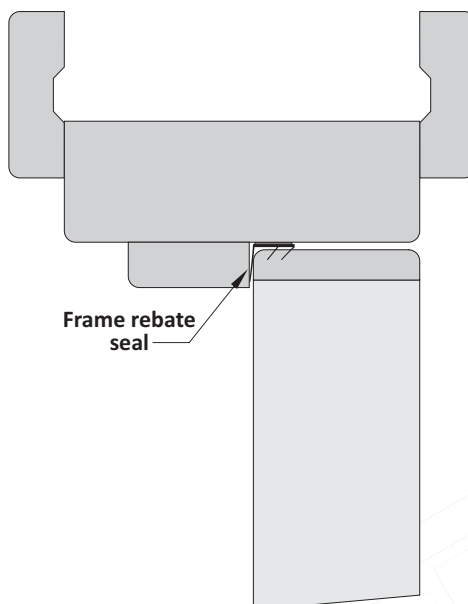
These types of perimeter seals can have an influence on operating forces depending upon the particular door width / thickness - See Section 10 - Door Assembly Coordination for further guidance.

NOTE : Over recessing the seal carrier by 0.5mm will relieve stress on the blade / carrier joint and the use of a 2~3mm R pencil round is recommended, to be applied to the closing edges of the door leaf to provide for a lead for the compression of seals and to improve seal durability.

Smoke Sealing - Perimeter Sealing - Single Action - Head:

Independent Frame Rebate Smoke Seal.

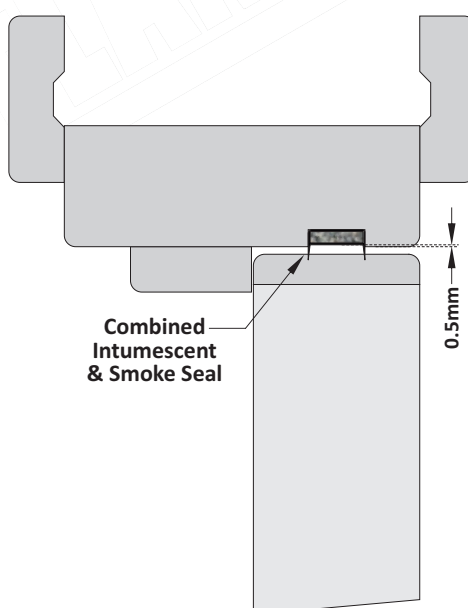
Fig. 5.4



Generally the smoke sealing fitted to the head (*and threshold if a 4 sided frame is used*) should be of the same type and size as the Jamb Seals and positioned to provide for continuous alignment in a single plane around the door.

Combined Intumescent / Smoke Seal.

Fig. 5.5

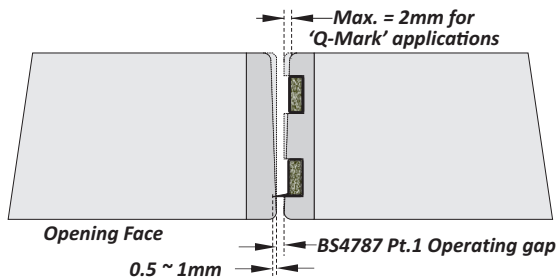


Generally the smoke sealing fitted to the head (*and threshold if a 4 sided frame is used*) should be of the same type and size as the Jamb Seals and positioned to provide for continuous alignment in a single plane around the door.

Smoke Sealing - Meeting Stiles - Single Action - Simultaneous Opening:

Meeting Stiles - Square Combined Intumescent / Smoke Seals:

Fig. 5.6



Combined Intumescent / Smoke Seals - Single Action - Simultaneous Opening:

NOTE: For simultaneous opening an important consideration is that the closing face (frame doorstep face) of the door should clear the adjacent door during operation without detriment to operating gaps described in BS4787 - Pt.1 when the doors are opened or closed in any order. To achieve this it may be necessary to profile the lippings. The necessary adjustments for the leading edge will be determined by the door leaf width & thickness but should not exceed the maximum 2mm reduction for 'Q' marked fire door applications. (See 'Door Growth' Calculations - Section 9 page 9.32).

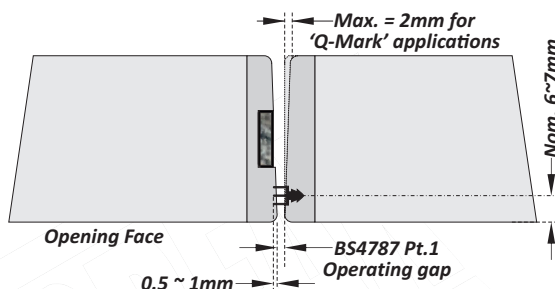
For single action doors the use of a combined intumescent seal / smoke seal often provides for the simplest solution for the smoke sealing of meeting stiles for fire door applications.

Use of seal designs using an elastomeric blade seal set to one side of the intumescent seal carrier will generally provide for reduced conflict with hardware fittings.

To provide for minimal influences on operating forces and to improve the durability of the smoke seal it is recommended that the seals are recessed such that the blade overlaps the adjacent door by 0.5 ~ 1mm.

Meeting Stiles - Square Independent Smoke Seal:

Fig. 5.7



Independent Smoke Seals - Single Action - Simultaneous Opening:

NOTE: For simultaneous opening an important consideration is that the closing face (frame doorstep face) of the door should clear the adjacent door during operation without detriment to operating gaps described in BS4787 - Pt.1 when the doors are opened or closed in any order. To achieve this it may be necessary to profile the lippings. The necessary adjustments for the leading edge will be determined by the door leaf width & thickness but should not exceed the maximum 2mm reduction for 'Q' marked fire door applications. (See 'Door Growth' Calculations - Section 9 page 9.32).

For non fire rated doors or as an alternative to the use of combined intumescent / smoke seals, the smoke sealing performance can be provided by the use of an independent smoke seal.

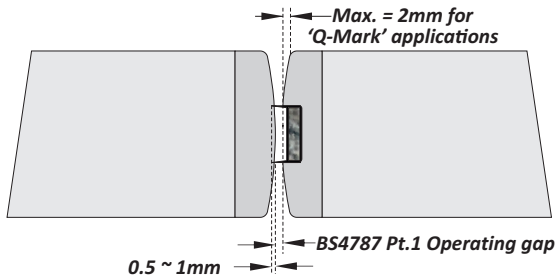
This option can often be considered where conflicts with hardware might otherwise apply and provides for the independent replacement of the smoke seal without the need to change the intumescent provisions.

To provide for minimal influences on operating forces and to improve the durability of the smoke seal it is recommended that the seals are recessed such that the blade overlaps the adjacent door by 0.5 ~ 1mm.

Smoke Sealing - Meeting Stiles - Single & Double Action - Simultaneous Opening:

Meeting Stiles - Square Combined Intumescent / Smoke Seals:

Fig. 5.8



Combined Intumescent / Smoke Seals - Single Action & Double Action - Simultaneous Opening:

NOTE: For simultaneous opening an important consideration is that the closing face (frame doorstep face) of the door should clear the adjacent door during operation without detriment to operating gaps described in BS4787 - Pt.1 when the doors are opened or closed in any order. To achieve this it may be necessary to profile the lippings. The necessary adjustments for the leading edge will be determined by the door leaf width & thickness but should not exceed the maximum 2mm reduction for 'Q' marked fire door applications. (See 'Door Growth' Calculations - Section 9 page 9.32).

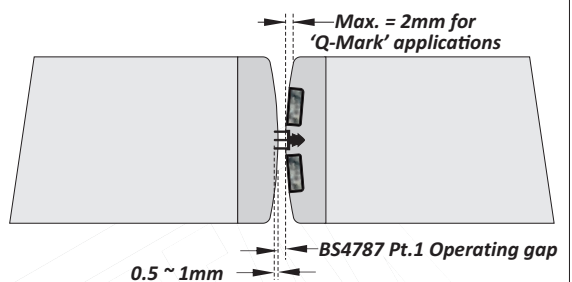
For single and double action doors the use of a combined intumescent seal / smoke seal often provides for the simplest solution for the smoke sealing of meeting stiles for fire door applications.

A combined intumescent / smoke seal located centre thickness at the meeting stiles of single action double leaf door assemblies (pairs) can often give rise to conflicts with other hardware fittings e.g. e.g. latches / flush bolts / automatic door bottoms (drop seals) etc. These potential problems are less likely to apply to double action doors.

To provide for minimal influences on operating forces and to improve the durability of the smoke seal it is recommended that the seals are recessed such that the blade overlaps the adjacent door by 0.5 ~ 1mm.

Meeting Stiles - Square Independent Smoke Seal:

Fig. 5.9



Independent Smoke Seals - Single Action - Simultaneous Opening:

NOTE: For simultaneous opening an important consideration is that the closing face (frame doorstep face) of the door should clear the adjacent door during operation without detriment to operating gaps described in BS4787 - Pt.1 when the doors are opened or closed in any order. To achieve this it may be necessary to profile the lippings. The necessary adjustments for the leading edge will be determined by the door leaf width & thickness but should not exceed the maximum 2mm reduction for 'Q' marked fire door applications. (See 'Door Growth' Calculations - Section 9 page 9.32).

For non fire rated doors or as an alternative to the use of combined intumescent / smoke seals, the smoke sealing performance can be provided by the use of an independent smoke seal.

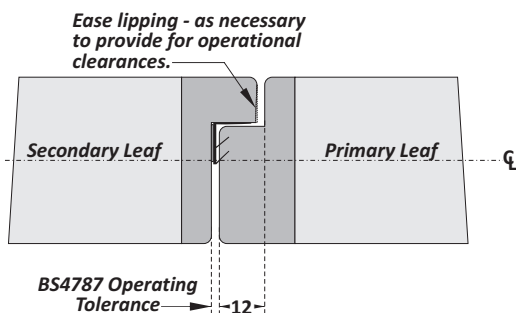
This option can often be considered where conflicts with hardware might otherwise apply and provides for the independent replacement of the smoke seal without the need to change the intumescent provisions.

To provide for minimal influences on operating forces and to improve the durability of the smoke seal it is recommended that the seals are recessed such that the blade overlaps the adjacent door by 0.5 ~ 1mm.

Smoke Sealing - Meeting Stiles - Single Action - Sequential Opening:

Meeting Stiles - Rebated Independent Smoke Seal:

Fig. 5.10



Rebated Meeting Stiles - Smoke Seals - Single Action - Sequential Opening:

For single action doors sequential opening double door assemblies (*pairs*), the use of frame rebate seals of the types illustrated by reference to **page 5.4** can be considered.

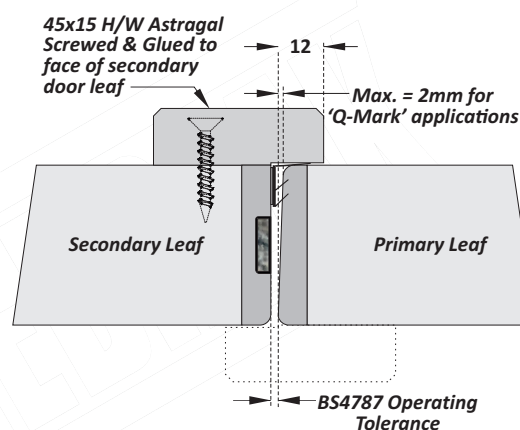
For 'Q' Marked fire rated door assemblies the use of rebates must be approved with the required intumescent seals positioned to suit.

Use of off-set rebates as illustrated may be considered to accommodate other hardware considerations. e.g. latches / flush bolts / automatic door bottoms (*drop seals*) etc.

NOTE: This details is not approved for 'Q-Mark' fire door applications with Flamebreak™ based door constructions.

Meeting Stiles - Square Independent Smoke Seal:

Fig. 5.11



Astragal Meeting Stiles - Smoke Seals - Single Action - Sequential Opening:

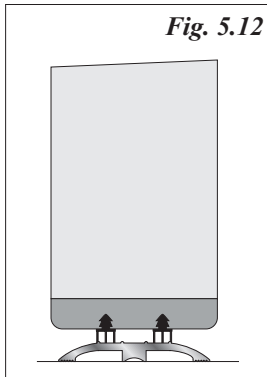
For single action doors sequential opening double door assemblies (*pairs*), the use of frame rebate seals of the types illustrated by reference to **page 5.4** can be considered for use with an astragal.

The astragal can be applied to the closing face of the secondary leaf. In this event the astragal needs to be scribed to the underside of the head door stop. Alternatively the astragal can be applied to the full door leaf height to the opening face of the primary leaf. If required, astragals can be applied to both leaves.

Meeting stiles using astragals are 'Q-Mark' approved for fire door applications and this option is recommended for use with multi performance door assemblies e.g. Fire / Smoke Sealed & Acoustic as the possibility of conflicts with other hardware is minimal.

Smoke Sealing - Single Action - Fixed Threshold Sealing:

Fig. 5.12



Fixed Bottom Edge Seals:

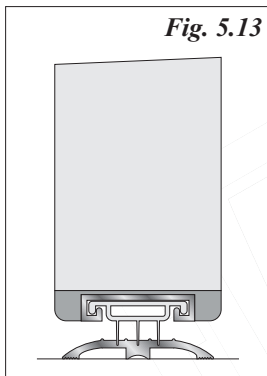
Brush or elastomeric blade seals can be used at the bottom edge of the door to provide for smoke sealing.

All fixed size bottom edge seals should be used with a threshold strip to ensure that the doors are effectively sealed when the door is in the closed position but that the seals clear the floor during the whole swing of the door.

A 4~5mm threshold plate height is generally sufficient to ensure the doors clear the floor when operated.

NOTE: Seals need to be located within the door thickness with due regard to the location of other hardware to minimise the risk of conflicts and the consequent interruption of the sealing provisions.

Fig. 5.13



Door Shoes:

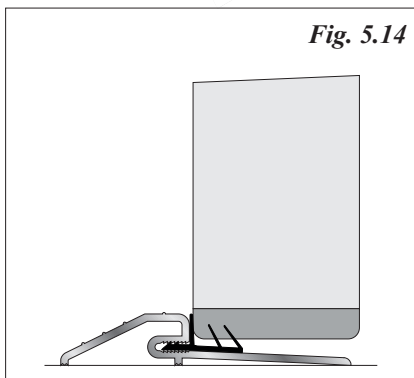
Provides for the same function as Fixed Bottom Edge seals but using a dedicated design with scope for some adjustment.

Door Shoes should be used with a threshold strip to ensure that the doors are effectively sealed when the door is in the closed position but that the seals clear the floor during the whole swing of the door.

A 4~5mm threshold plate height is generally sufficient to ensure the doors clear the floor when operated.

NOTE: Due consideration must be given to the location of other hardware to minimise the risk of conflicts and the consequent interruption of the sealing provisions.

Fig. 5.14



Combined Threshold with Seal:

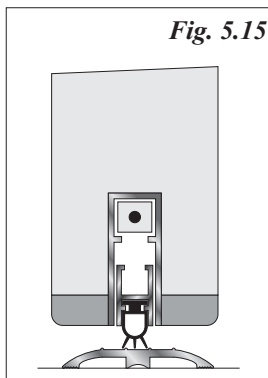
These devices do not require the removal of any part of the door leaf and can generally be used with a minimal risk of conflict with other hardware.

Some designs provide for the alignment of the sealing element with related perimeter seal designs for optimum sealing performances .

NOTE: Reference should be made to Building Regulations (England & Wales) Approved Document 'M' and BS8300 when selecting these devices as they can create a trip hazard.

Smoke Sealing - Automatic Door Bottoms (Drop Seals) - Threshold Sealing:

Fig. 5.15



Mortised Automatic Door Bottoms - (Drop Seals):

When the door closes, the sealing element is activated by a plunger such that the seal is retracted into the bottom edge of the door when opened and only becomes effective when the door is in the closed position.

Most designs are operated by a plunger in contact with the hanging jamb but there are some designs that are activated by contact with the closing jamb or by both the hanging and closing jambs (*stiles*).

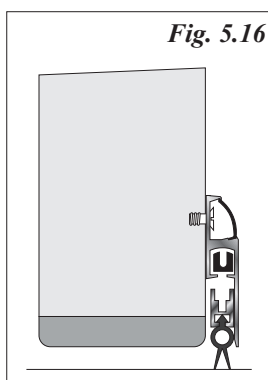
Whereas these are generally intended for single action use there are some designs (*usually positioned off set in the door thickness*) that can be used for double action applications.

Other designs are available that incorporate 'dedicated' edge fixed flush bolts for use with pairs of doors where both leaves need to be secured.

Whereas these devices can work with soft floor finishes e.g. carpet, the durability of the seal may be reduced, it is therefore generally recommended that these devices are used with low level threshold strips unless they are used with smooth floor finishes e.g. vinyl flooring.

NOTE: A number of Automatic Door Bottom designs are 'Q-Mark' approved for fire door applications when used with Flamebreak™ based door constructions - See Section 8 - Hardware.

Fig. 5.16



Surface Mounted Automatic Door Bottoms - (Drop Seals):

Surface mounted Automatic Door Bottoms (*Drop Seals*) are also available. These are generally fixed to the closing face of the door(s).

In this case (*for most designs*) the sealing element is operated by a plunger in contact with the hanging jamb door stop. i.e. the seal does not extend to the full width of the door.

NOTE: There are a limited number of designs that can be face fixed to the opening face of the door(s).

The use of surface mounted Automatic Door Bottoms results in a minimal risk of conflict with other hardware or sealing provisions.

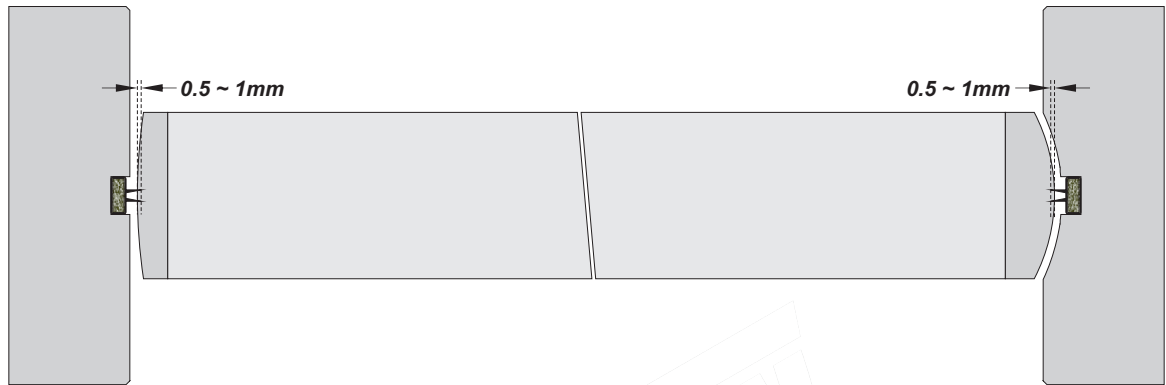
Surface mounted Automatic Door Bottoms can generally be used for fire door applications including as an added item for an existing installation to provide for compliance with BS9999 smoke sealing requirements for threshold smoke sealing.

Whereas these devices can work with soft floor finishes e.g. carpet, the durability of the seal may be reduced, it is therefore generally recommended that these devices are used with low level threshold strips unless they are used with smooth floor finishes e.g. vinyl flooring.

Smoke Sealing - Double Action - Hanging & Closing Jambs:

Smoke Sealing - Double Action - Hanging & Closing Jambs - OPTION 1:

Fig. 5.17



The use of a combined intumescent seal / smoke seal often provides for the simplest solution for the sealing at the hanging and closing stiles for double action doors that are generally unlatched. i.e. there is little risk of conflict with hardware items.

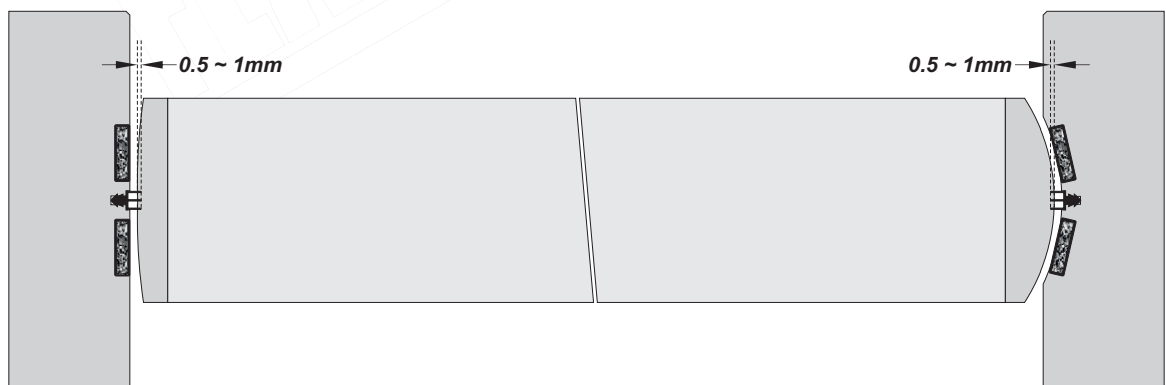
Seals of this type can generally be fitted to the frame (*as illustrated*) or to the door stiles.

Use of seal designs using an elastomeric blade or brush seal set central in an intumescent seal carrier will generally provide for reduced conflict with hardware fittings.

To provide for minimal influences on operating forces and to improve the durability of the smoke seal it is recommended that the seals are recessed such that the blade overlaps the door by 0.5 ~ 1mm.

Smoke Sealing - Double Action - Hanging & Closing Jambs - OPTION 2:

Fig. 5.18



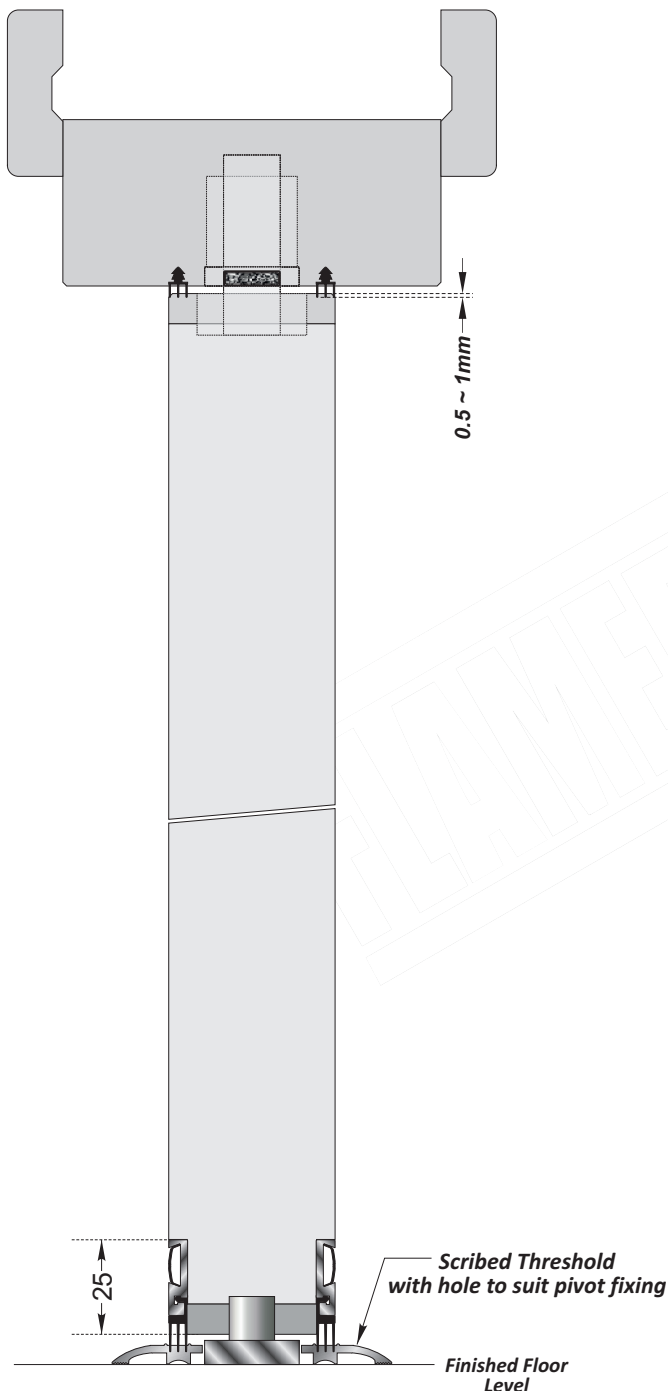
Where appropriate (*e.g. to suit intumescent seal requirements for the required performance*) a separate brush or elastomeric blade type seal may be used to seal at the hanging and closing stiles for double action doors. The seals should be located to ensure minimal conflict with hardware items.

To provide for minimal influences on operating forces and to improve the durability of the smoke seal it is recommended that the seals are recessed such that the blade overlaps the door by 0.5 ~ 1mm.

Seals of this type can generally be fitted to the frame (*as illustrated*) or to the door stiles.

Smoke Sealing - Double Action - Head & Threshold:

Fig. 5.19



Double Action Head & Threshold Sealing:

It is more difficult to provide for uninterrupted sealing at the head and threshold for double action doors due to the location of pivot fixings.

Whereas a single seal might be used at the head to align with the centre door thickness jamb / stile seals, it is necessary to remove a section of the sealing to allow for the fitting of the top pivot fixings.

For some bottom edge door fixings, the pivot straps need to be located approx. 8mm above the floor mounted closer.

NOTE: To achieve a maximum 3mm gap above the finished floor level it may, in some cases, require that strap fittings are over recessed into the bottom edge of the door.

This illustration shows a method for achieving maximum smoke sealing performances in a manner that provides for uninterrupted sealing systems that does not conflict with operating hardware.

The frame head is fitted with 2 rows of Norsound NOR720 (as illustrated) located to clear the top centre fittings. Whereas one strip is sufficient for smoke sealing purposes, the use of 2 strips is recommended to provide for an equal influence on both sides of double action doors that are generally unlatched.

For the threshold, it is recommended that a wide, low level threshold strip is used. This should be pre machined to suit the Floor Mounted Closer pivot locations.

NOTE 1: Alternatively, a split threshold can be used to allow fitting of the threshold from both faces of the door.

The faces of the door leaf at the bottom of the door are recessed to receive flexible seals such as the Norsound NOR855. The carriers must essentially be recess flush with the door and profiled at the hanging edges to suit the profile of the door.