

**SECTION 5**

**Smoke Sealing**





### General:

The test procedure for smoke sealed doorsets is given by reference to BS476 Section 31.1.

The performance criteria for smoke sealed doorsets is given by reference to BS5588 (and BS9999) in the following terms:

**'A fire door required to resist the passage of smoke at ambient temperature conditions should, when tested in accordance with BS476 : Section 31.1 with the threshold taped and subjected to a pressure of 25Pa, have a leakage rate not exceeding 3m<sup>3</sup>/m/h. The threshold gap should be sealed either with a leakage rate not exceeding 3m<sup>3</sup>/m/h at 25Pa or just contacting the floor; where this is impracticable the threshold gap should not exceed 3mm at any point.'**

**NOTE 1: Reference to BS476 Section 31.1 shows that the performance is measured with seals in a new condition. i.e. There is an operational test but this is not a durability test.**

**NOTE 2: The performance requirement does not state at which point during the swing of the door that the maximum permitted 3mm gap should be achieved. However, it is reasonable to believe that this maximum gap should apply to the door in its closed position.**

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.

### Under Door Sealing:

Unless used with a sill (*with a four sided frame*), the under door gap cannot be controlled by the doorset manufacturer who can only assemble doorsets to provide for a nominal dimension from the bottom of the door to the bottom of the frame jamb (*subject to BS4787 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'.

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

**NOTE: 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 BS5588 (BS9999). These may be fitted on site as a variation to existing doorsets as necessary, to suit particular location requirements.**

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.**

### Edge Sealing:

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

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

1/ Brush seals

2/ Elastometric 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 / elastometric 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.



### Edge Sealing contd.:

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 and BS1567. 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 doorsets. 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 (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.

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 doorsets. 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 doorsets.

### General Notes:

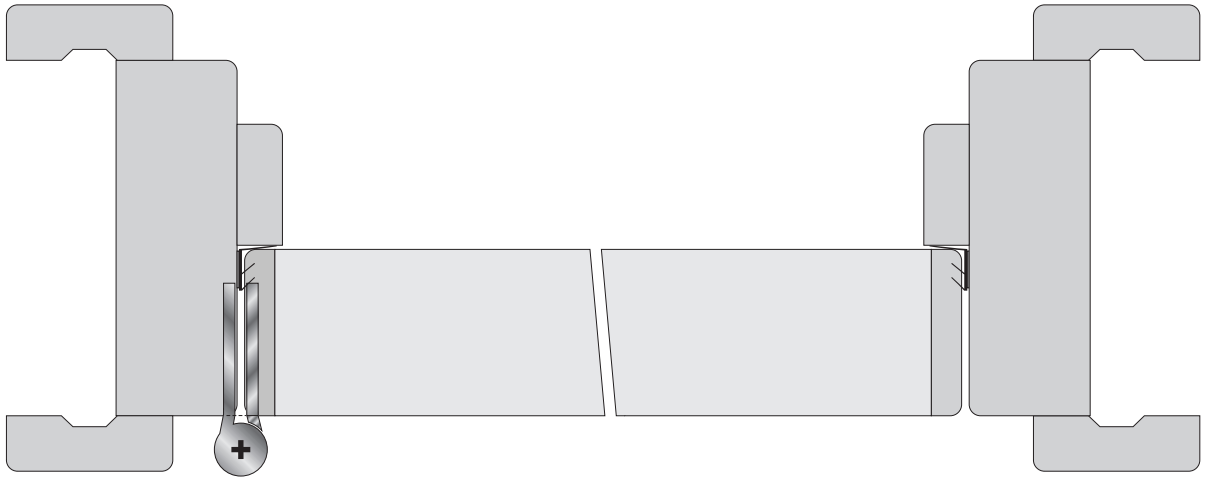
**NOTE 1: For optimum performance seals should compress to approx. 50% of maximum. Over compression can lead to distortion of the seal with subsequent leakage and possible interference with the door operation.**

**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 BS5588 (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.**



Fig. 5.1

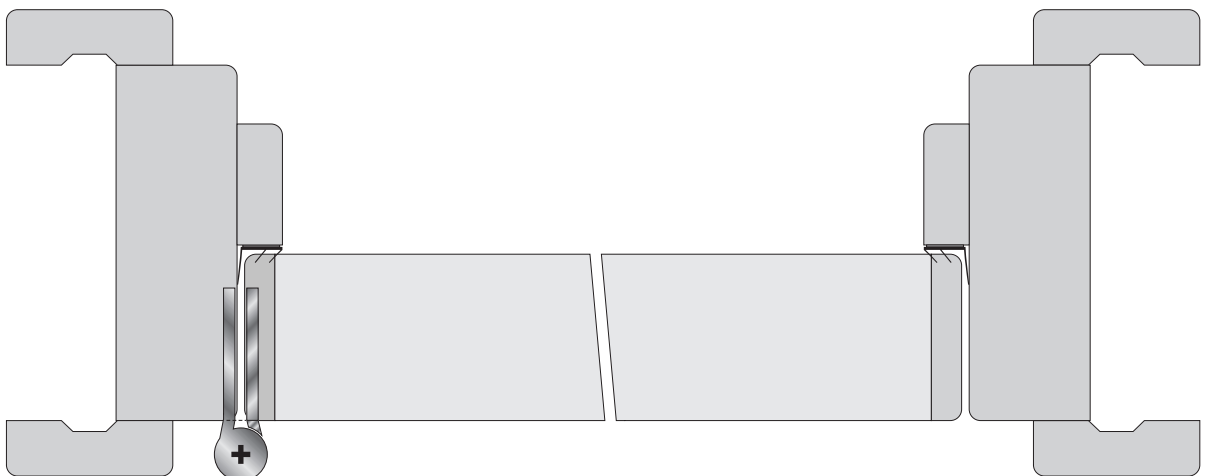


The use of separate smoke seals (*independent of intumescent seals*) is recommended.

This illustration shows the use of the Norsound 710 seal that has been tested to BS476 Section 31.1 and which can be fitted to frame reveal near to the doorstop. Seals located in this position provide for optimum smoke sealing performances and are less likely to suffer from conflicts with hardware or other seals. The Norsound 710 seal located in this position will also have a minimal influence on door leaf operating forces.

**NOTE :** *The use of a 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.*

Fig. 5.2

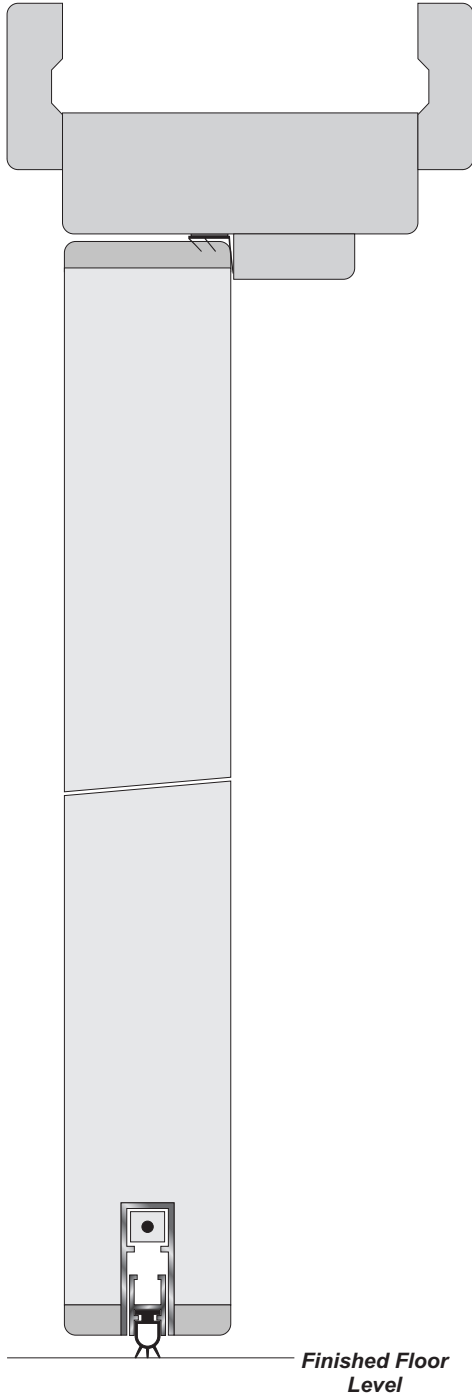


Although providing for optimum smoke sealing performances when fitted to the frame reveal, the Norsound 710 seal design included consideration for face fixing onto the face of a min. 12mm doorstop while still providing for a leakage rate of less than  $3\text{m}^3/\text{m}/\text{hr. @ } 25\text{Pa}$ . required by reference to the relevant standards, thus providing for increased scope for the avoidance of conflict with hardware.

This location will also provide for a limited slamming buffer performance to reduce noise when the door is operated.



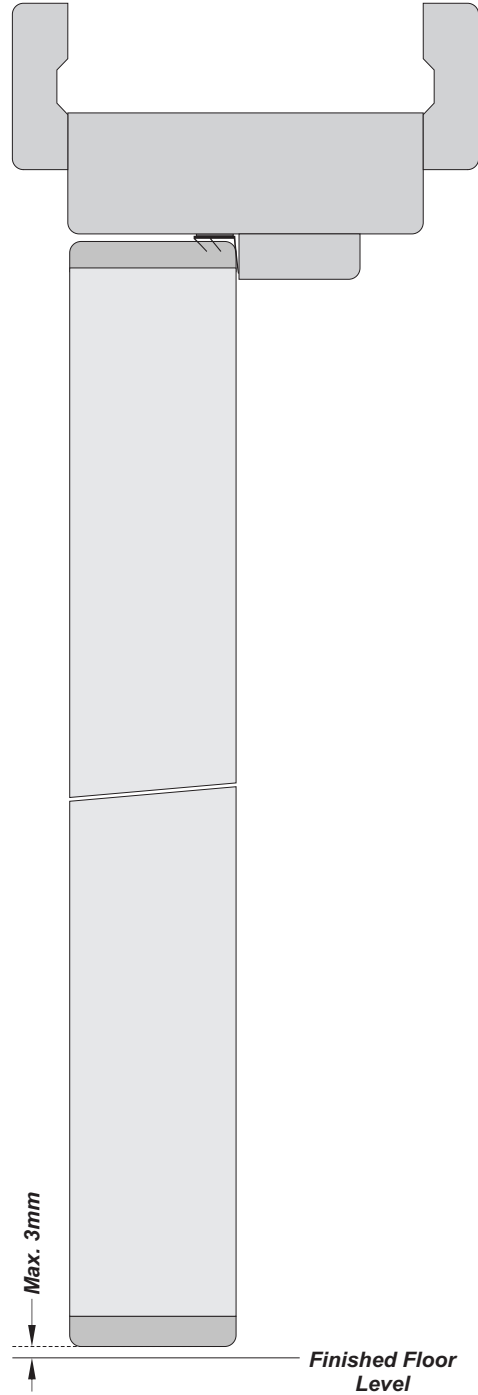
Fig. 5.3



Sealing at the head of the door should (where possible) be of the same type and aligned with the seals at the door stiles.

BS5588 (BS9999) requires that seals should be used at the threshold of smoke sealed doorsets. The Norsound NOR810 Automatic Drop seal is illustrated as one option for threshold sealing.

Fig. 5.4



BS5588 (BS9999) requires that: Where it is impractical to provide for seals at the threshold, the maximum threshold gap between the bottom of the door and the top of the finished floor should not exceed 3mm.

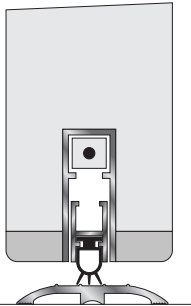


Fig. 5.5

Automatic Drop Seals should generally be used with hard floor finishes e.g. vinyl floors. Whereas these will work with soft floor finishes e.g. carpet, the durability of the seal may be reduced.

When used with soft floor finishes, the use of a low level threshold strip such as the Norsound 610 or 615 is recommended.

Q 'Q' Mark approved automatic door bottoms for use with fire doors are as follows:

Norsound NOR810 - Lorient IS8010si - Raven RP8 - Athmer Schall-Ex Duo L-15

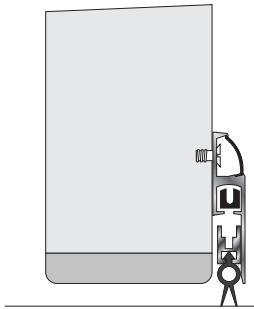


Fig. 5.6

Where under door gaps are found to be excessive for an installed doorset, consideration might be given to the use of a surface mounted Automatic Drop Seal such as the Norsound NOR815. These are surface mounted onto the closing face of the door and scribed between the doorstops.

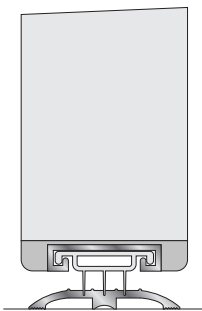


Fig. 5.7

Where there is a preference to avoid the use of mechanical devices such as Automatic Drop Seals, consideration might be given to the use of a door shoe such as the Norsound NOR850. This highly flexible and gap tolerant seal is housed in a carrier that is recessed into the bottom edge of the door.

It is necessary to use bottom edge seals with a threshold strip to ensure that the seals will clear the floor through the whole swing of the door.

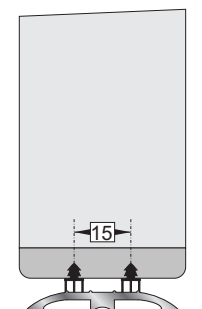


Fig. 5.8

Other bottom edge brush or elastometric blade seals can be used at the bottom edge of the door to provide for smoke sealing.

As with the door shoe option shown above, all fixed size bottom edge seals should be used with a threshold strip to ensure that the doorsets are sealed when the door is in the closed position but that the seals clear the floor during the whole swing of the door.

This solution shows the use of twin Norsound NOR720 seals used with a Norsound NOR600 series threshold strip.

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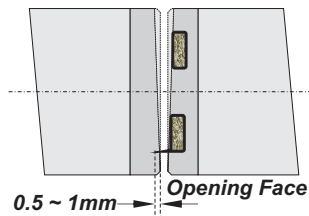
## Smoke Sealing

# FLAMEBREAK



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**Fig. 5.9**

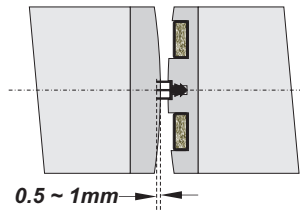


For single action doors the use of a combined intumescent seal / smoke seal often provides for the simplest solution for the sealing of meeting stiles.

Use of seal designs using an elastometric 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.

**Fig. 5.10**

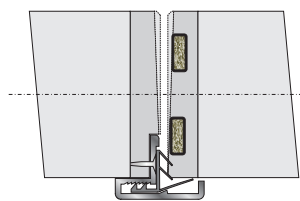


For unlatched doors and for the meeting stiles of double action doors without latching / locking hardware the use of a separate smoke seal (*Norsound NOR720 illustrated*) can be considered.

As with the combined intumescent / smoke seal design, 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.

Independent smoke seals of a similar design can also be considered for use with latched doors but these should be positioned in the door thickness in a manner that provides for minimal conflict with hardware fittings and with minimal influence on the forces necessary to operate the door.

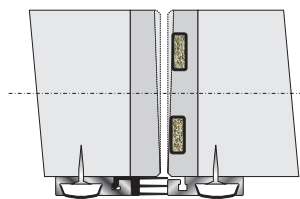
**Fig. 5.11**



Use of a combined astragal with seal (*Norsound NOR510 illustrated*) can be considered where the doors are intended for single action use. The astragal / seal can be fitted to the closing face of the secondary leaf or the opening face of the primary leaf.

Pairs of doors that are rebated or fitted with astragals are essentially sequential opening and fire doors of these designs should generally be fitted with door selectors to ensure that they close in the correct sequence.

**Fig. 5.12**



There are various seal designs that can be used to provide upgrading existing installations to provide for a smoke sealing performance.

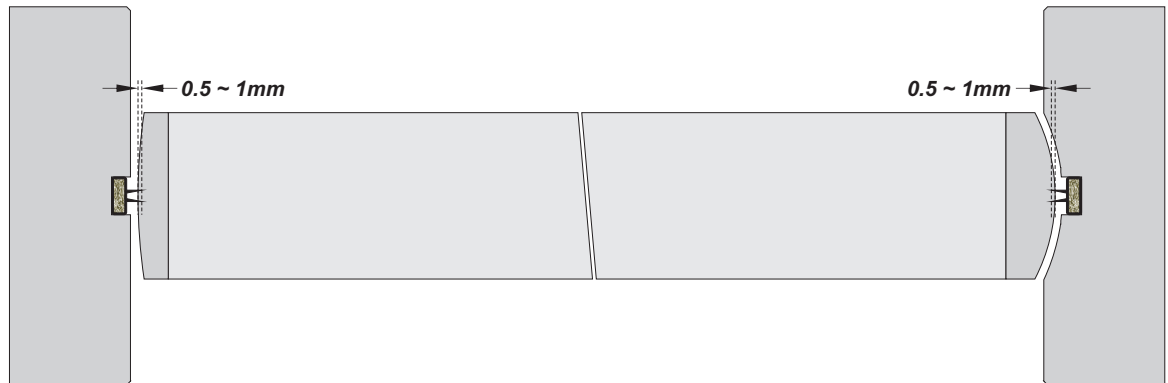
This detail shows the use of the Norsound NOR855 used in conjunction with the NOR855 carrier only.

This sealing arrangement allows pairs of doors to be simultaneously opened.





Fig. 5.13



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.

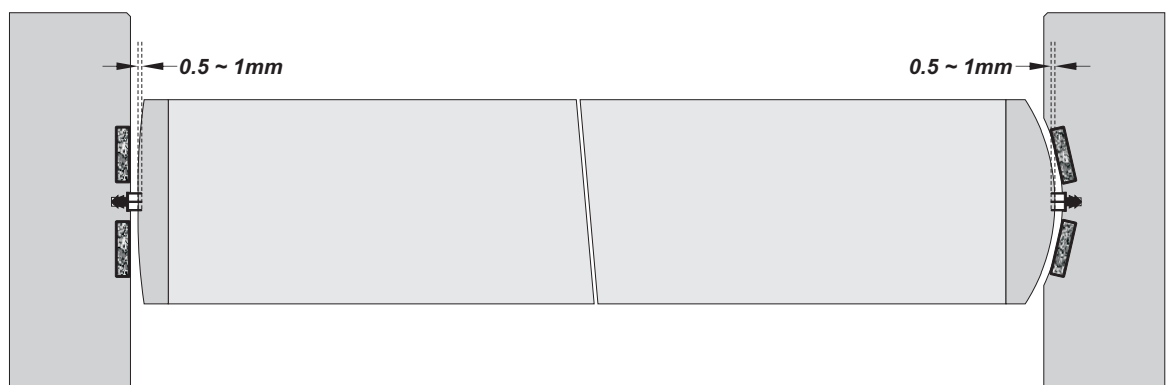
Seals of this type can generally be fitted to the frame (*as illustrated*) or to the door stiles.

Use of seal designs using an elastometric 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.

**NOTE:** See separate meeting stile details for double action pairs.

Fig. 5.14



Where appropriate a separate brush or elastometric 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. (*Norsound NOR720 seal illustrated*).

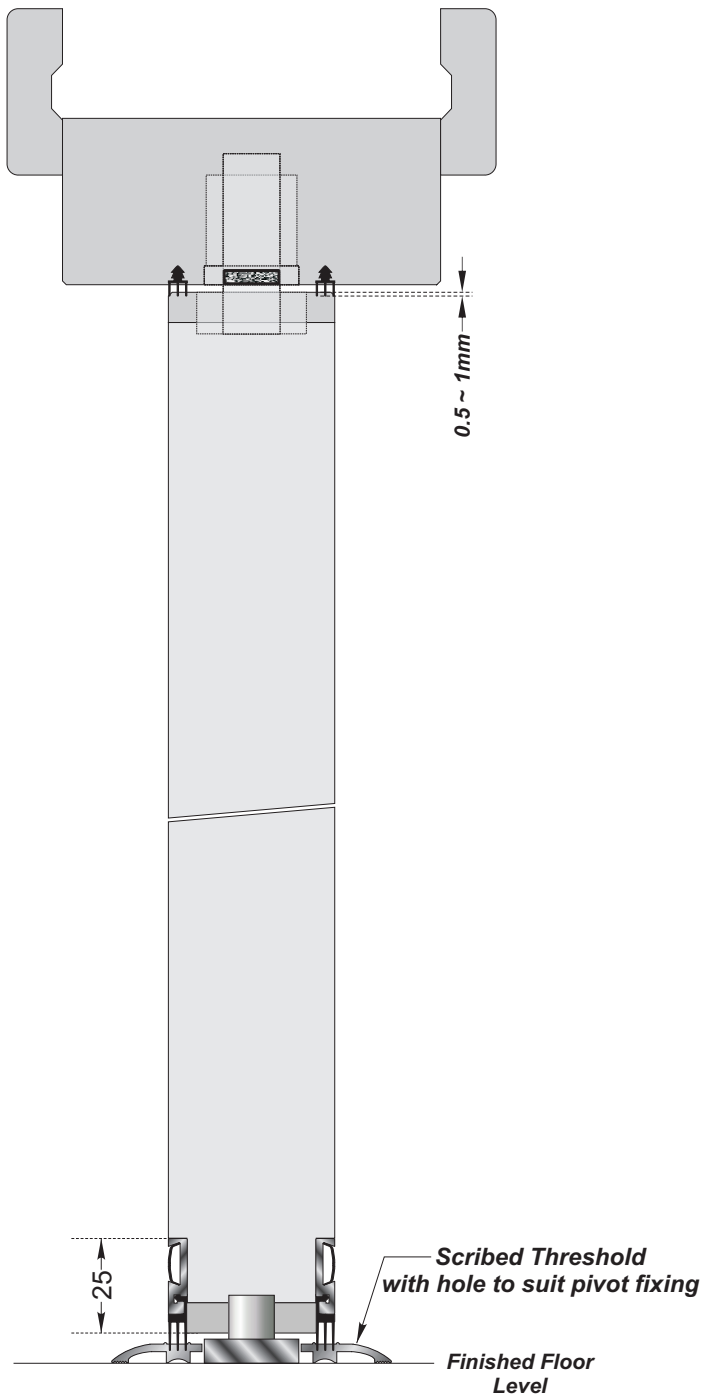
To provide for minimal influences on operating forces and to improve the durability of the smoke seal it is recommended that the seals are recessed such that the blade overlaps the door by 0.5 ~ 1mm.

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

**NOTE:** See separate meeting stile details for double action pairs.



Fig. 5.15



**NOTE:** Seals from other sources providing for similar functions are likely to provide for similar performances. (See General Notes Section 5.10).

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 (Norsound NOR625 illustrated). 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.

**NOTE 2:** This detail can also be used as an alternative to the Norsound NOR720 solution suggested for use at the head 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.






Extensive testing for smoke sealing performances to BS 476 Section 31.1 has been carried out by a number of seal manufacturers and suppliers using FLAMEBREAK® based (and other) door constructions providing for sufficiently similar results to provide for a basis for selecting smoke seals from a number of sources.

**Seal manufacturers / suppliers who can provide suitable sealing systems for this purpose include:**


<i>Norseal Ltd. - Norsound</i>	<i>Pyroplex Plc.</i>
<i>Lorient Polyproducts Ltd.</i>	<i>Sealmaster Ltd.</i>
<i>Raven Seals (Royde &amp; Tucker Ltd.)</i>	<i>Pemko UK</i>

**NOTE: This listing is advisory only and reference should be made to the seal suppliers smoke sealing test data for further guidance and for recommended methods of fixing.**


### Jamb & Head Seals:

	Norsound	Lorient	Raven	Pyroplex	Pemko
		IS1212 / 1515 Batwing	RP120 / RP150 Delta	7516 / 7209 Double Flipper	
	NOR 710				S773
					S88 PK55

### Morticed Threshold Automatic Drop Seals:

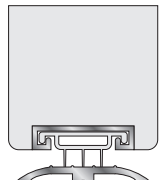
	Norsound	Lorient	Raven	Pyroplex	Pemko
	NOR 810 NOR 810S NOR 810T	IS8010 IS8030 IS8040 IS8050 IS8060	RP8Si RP70Si RP99Si		411 434 See PEMKO data for variants

### Surface Mounted Threshold Automatic Drop Seals:

	Norsound	Lorient	Raven	Pyroplex	Pemko
	NOR 815	IS8070S IS8080SI IS8090SI IS8091SI	RP38Si RP99Si RP60 RP92		4301 4131 430 412

**NOTE: All mechanical drop seal manufacturers recommend that these seals are used with hard floor finishes or threshold plates to provide for maximum durability.**

### Door Shoe Threshold Seals:

	Norsound	Lorient	Raven	Pyroplex	Pemko
	NOR 850	Threshold = IS4130 or IS4120  Door Shoes IS3016 IS3070	Threshold = RP82  Door Shoes RP4		Threshold = 173 Door Shoes 234 215 2221 211 217 216 210 216 221 220 222 2211



**Perimeter & Independent Blade / Brush Seals:**

	Norsound	Lorient	Raven	Pyroplex	Pemko
	NOR 755	IS7025 /7025SI IS7110 IS7120 IS7020Q	RP78 / 78Si. RP93 / 93Si RP94 / 94Si RP113		303 330 290 316 299 289 297 292 293 294 319 335 306 290 376
		IS7080 / 7080SI IS7090SI IS7190SI	RP24 RP47 RP10 RP84SI		379 322 350
	NOR 720	IS1206, IS1507 IS1511	RP61, RP73		S44, S77 S88, PK33 5025, 369, 371P, 372P

Where doorsets are required to provide for a fire rating in addition to a smoke sealing performance it is essential to use intumescent seals of the type and size described by reference to fire test / assessment reports to achieve the fire performance potential of the doorset.

**NOTE:** Whereas Norsound do not offer combined intumescent / smoke seals, these are available from their sister company Norseal Ltd.

**Combined Intumescent / Smoke Seals:**

	Norseal	Lorient	Raven	Pyroplex	Pemko
	104OF, 154OF, 204OF	LP1003AS, LP1004AS LP1504AS, LP2004AS LP2504AS	RP1504SA RP3004SA	8923, 8924, 8925	
	104DF, 154DF, 204DF, 254DF	LP1004DS LP1504DS, LP2004DS Finesse	RP63	8523, 8723, 8623	
	104FS, 154FS, 204FS, 254FS, 304FS	LP1003SS, LP1004SS LP1504SS, LP2004SS LP2504SS		8512, 8712, 8612, 8812, 8977	
	104FS+F, 154FS+F, 204FS+F, 254FS+F, 304FS+F			8510, 8710, 8610, 8810, 8977	
	NS-Safex		RP55	Safex	SFG45
	NorFAST				

**General Notes:**

**Note 1:** Manufacturers / suppliers other than those listed above may also supply sealing systems suitable for smoke sealing purposes.

**Note 2:** The seal manufacturer / supplier should provide for BS476 Section 31.1 (or equivalent) related test data to demonstrate compliance with BS5588 (BS9999) performance criteria.

**Note 3:** Consideration should be given to the positioning and fixing of smoke seals with due regard to the influence of sealing systems on the forces necessary to operate the doors with reference to Building Regulations - (England & Wales) - Approved Document 'M' and BS 8300.