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BRE Global Assessment Report

An assessment of the fire performance of 3C Intumescent Acoustic Sealant used as a linear gap seal against the adopted integrity and insulation criteria of BS 476: Part 20: 1987

Prepared for: County Construction Chemicals Limited

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1 Introduction

County Construction Chemicals are suppliers of an intumescent acrylic sealant system which has been designed primarily for use within the construction industry. The sealant has been subjected to extensive fire testing using heating and general conditions as defined in BS 476: Part 20: 1987. The tests were performed with the sealant used to seal linear gaps between differing substrates of varying size and orientation. In addition, the sealant has been tested to the requirements of BS 476: Part 22: 1987 as part of a number of gypsum partition assemblies.

The purpose of this report is to assess the data produced from the fire test programme and make recommendations on appropriate specifications for 3C Intumescent Acoustic Sealant when used as a linear gap seal to achieve various periods of fire resistance in terms of both "integrity only" and "integrity and insulation" performance.

2 Scope

This assessment report covers the fire performance of 3C Intumescent Acoustic Sealant when used as a linear gap seal, in terms of the adopted integrity and insulation criteria of BS 476: Part 20: 1987 for fire exposures of up to four hours.

3 Supporting data

This assessment is based on supporting test data which is more than five years old. This supporting data has therefore been reviewed against current test procedures.

The sealant has been subjected to a number of ad hoc fire tests adopting the heating conditions, procedures and performance criteria of BS 476: Part 20: 1987 and also to testing performed to the requirements of BS 476: Part 22: 1987. Details of the testing is summarised below in table 1.

Table 1 Summary of fire tests performed with 3C Intumescent Acoustic Sealant

Test Laboratory	Test #	Test Date	Test Method	Comments
Warrington Fire Research	WARRES 54260/B	16.10.91	BS 476: Part 20: 1987 (General Principles)	Ad hoc test in indicative furnace
Warrington Fire Research	WARRES 54845/B	29.11.91	BS 476: Part 20: 1987 (General Principles)	Ad hoc test in indicative furnace
Warrington Fire Research	WARRES 59021	19.4.93	BS 476: Part 20: 1987 (General Principles)	Ad hoc test in indicative furnace
Warrington Fire Research	WARRES 59022	21.4.93	BS 476: Part 20: 1987 (General Principles)	Ad hoc test in indicative furnace

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Test Laboratory	Test #	Test Date	Test Method	Comments
Warrington Fire Research	WARRES 60288/B	05.01.94	BS 476: Part 20: 1987 (General Principles)	Ad hoc test in indicative furnace
Chiltern International Fire	RF 99109	28.10.99	BS 476: Part 22: 1987	Penetration seals test in gypsum board partition
Chiltern International Fire	RF 00011	21.01.00	BS 476: Part 22: 1987	Penetration seals test in gypsum board partition
Chiltern International Fire	RF 00019	28.02.00	BS 476: Part 22: 1987	Penetration seals test in gypsum board partition

The contents of the above reports should be viewed in conjunction with this document.

Details of the constructions tested, and the fire performances achieved is presented in tables 2 to 7 as follows:

Table 2 Summary of results from WARRES 54260/B

Specimen Reference	Orientation	Substrate	Gap Size (mm)	Seal Depth (mm)	Integrity (min.)	Insulation (min.)
H1	Horizontal	Lightweight concrete	20	20	240	54
H2	Horizontal	Lightweight concrete	10	6	240	**
H3	Horizontal	Lightweight concrete	20	20	240	71
H4	Horizontal	Lightweight concrete	30	30	240	92
V1	Vertical	Lightweight concrete	35	25	240	168
V2	Vertical	Lightweight concrete	20	20	240	73
V3	Vertical	Lightweight concrete	10	6	231	**

Notes:-

1. ** unclassified insulation values
2. All are single seals of 1m length located flush with fire side of construction
3. All supporting constructions 150mm thick
4. All backing strips comprised of 25mm thick polyethylene foam
5. Test discontinued after 240 minutes

Table 3 Summary of results from WARRES 54845/B

Specimen Reference	Orientation	Substrate	Gap Size (mm)	Seal Depth (mm)	Integrity (min.)	Insulation (min.)
V1	Vertical	Lightweight concrete	35	20	240	92*
V2	Vertical	Lightweight concrete	15	15	240	42*
V3	Vertical	Lightweight concrete	12	12	240	**
V4	Vertical	Lightweight concrete	15	10	240	40*
V5	Vertical	Lightweight concrete	20	15	240	49*
V6	Vertical	Lightweight concrete	35	20	240	92*

Notes:-

1. * insulation measurement discontinued due to detachment of fixed thermocouples
2. ** unclassified insulation values
3. All are single seals of 1m length located flush with fire side of construction
4. All supporting constructions 150mm thick

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5. All backing strips comprised of 25mm thick polyethylene foam
6. Test discontinued after 240 minutes

Table 4 Summary of results from WARRES 59021

Specimen Reference	Orientation	Substrate	Gap Size (mm)	Seal Depth (mm)	Integrity (min.)	Insulation (min.)
H1	Horizontal	Hardwood	25	25	66	64
H2	Horizontal	Hardwood	10	15	63	40
H3	Horizontal	Softwood	10	35	91	81
H4	Horizontal	Softwood	25	35	74	74
V1	Vertical	Softwood	25	35	82	82
V2	Vertical	Softwood	10	35	87	80
V3	Vertical	Hardwood	10	15	59	37
V4	Vertical	Hardwood	25	25	61	51

Notes:-

1. All are single seals of 0.9m length located flush with fire side of construction
2. Backing strips for H1, H4, V1 and V4 comprised of 30mm diameter polyethylene foam; backing strips for H2, H3, V2 and V3 comprised of 25mm diameter polyethylene foam
3. All supporting constructions 100mm thick
4. Test discontinued after 92 minutes

Table 5 Summary of results from WARRES 59022

Specimen Reference	Orientation	Substrate	Gap Size (mm)	Seal Depth (mm)	Integrity (min.)	Insulation (min.)
H1	Horizontal	Steel	25	25	240	40*
H2	Horizontal	Steel/Concrete	25	25	240	48*
H3	Horizontal	Concrete	30	25	240	48*
H4	Horizontal	Lightweight Concrete/Vicuclad	25	25	240	48*
V1	Vertical	Steel	25	25	240	58*
V2	Vertical	Steel/Concrete	25	25	240	52*
V3	Vertical	Concrete	30	25	240	33*
V4	Vertical	Lightweight Concrete/Vicuclad	25	25	240	58*

Notes:-

1. * insulation measurement discontinued due to detachment of fixed thermocouples
2. All are single seals of 0.9m length located flush with fire side of construction
3. All backing strips comprised of 35mm diameter polyethylene foam
4. All supporting constructions 150mm thick
5. Test discontinued after 240 minutes

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Table 6 Summary of results from WARRES 60288/B

Specimen Reference	Orientation	Substrate	Gap Size (mm)	Seal Depth (mm)	Mineral Wool Backing Depth (mm)	Integrity (min.)	Insulation (min.)
V1	Vertical	Lightweight concrete	35	35 (fire side)	30	158	121
V2	Vertical	Lightweight concrete	12	10 (both sides)	25	240	240
V3	Vertical	Lightweight concrete	12	20 (fire side)	55	240	160
V4	Vertical	Lightweight concrete	35	30 (both sides)	30	240	240

Notes:-

1. All are single seals of 0.9m length located flush with fire side or both sides of construction
2. All supporting constructions 150mm thick
3. Test discontinued after 240 minutes

Table 7 Summary of results from RF 99109, RF 00011 and RF 00019

Test #	Description of Construction	Seal Depth (mm)	Integrity (min.)	Comments
RF 99109	70mm steel stud partition with 2 x 12.5mm Knauf Fireshield to each face and including mineral wool-based penetration seals and plastic pipe collars	Nominal 10mm	120	No loss of integrity reported at seal positions
RF 00011	70mm steel stud partition with 2 x 12.5mm Knauf Fireshield to each face and including mineral wool-based penetration seals; pillow penetration seals and plastic pipe collars	Nominal 10mm	112	Test terminated due to failure of penetration seal; no loss of integrity reported at seal positions
RF 00019	70mm steel stud partition with 2 x 12.5mm Knauf Fireshield to each face and including mineral wool-based penetration seals and plastic pipe collars	Nominal 10mm	120	Observations of the test indicate a gap of 30-35mm at head of partition at 120 minutes

Notes:-

1. 3C Intumescent Acoustic Sealant used as nominal 10mm diameter bead positioned centrally to depth of partition between steel studs and restraint frame; gap size unknown
2. Test discontinued after 120 minutes
3. Insulation at seal positions not measured

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4 Description of the proposed system

4.1 General

It is possible to summarise the fire performance of the sealant in terms of both "integrity only" and "integrity and insulation." It is also possible to rationalise the data in terms of substrates; gap size; depth of sealant; type and depth of backing materials and the presence of single or double seals.

4.2 Integrity only

4.2.1 General

In the case of seals formed in conjunction with non-combustible substrates there is no evidence that the nature or density of such a substrate had any significant effect on integrity performance. For example looking at WARRES 59022 horizontal specimens H1, H2 and H4 together with vertical specimens V1, V2 and V4 comprise of 25mm gaps sealed with 25mm depth of sealant. The substrates in question include concrete, steel and vermiculite board and in all cases an integrity performance of 240 minutes was achieved at which time the test was discontinued. Indeed, in the case of the ad hoc gap tests all seals made in conjunction with non-combustible substrates and combustible backing strips, achieved 240 minutes integrity with the sole exception of one vertical specimen which achieved 231 minutes. It is therefore proposed to group all non-combustible substrates together for integrity only specifications and to examine the effect of including mineral wool backing strips in lieu of combustible materials.

4.2.2 Non-combustible substrates

In all cases of single seals with combustible backing strips the results were from tests where the seals were located on the fire side of the construction which may be considered to be a "worst case", hence, there is no restriction of the position of the seal within the depth of the fire separating element, nor on the overall thickness of the element other than that it should be capable of achieving the required period of fire integrity.

The seal which achieved 231 minutes integrity was the minimum depth seal as tested on the minimum gap width in the vertical orientation (WARRES 54260/B, Specimen V3), the specimen falling some 9 minutes or approximately 4% short of achieving a full 240 minutes integrity. Increasing the depth of the seal from 6mm to 7mm represents an increase of approximately 17% and it is therefore proposed that 7mm be used to provide 240 minutes integrity on vertical gaps of up to 10mm width.

Two results are available from vertical gaps using single seals located on the fire side of the construction which have mineral wool backing strips and these can be compared with results from tests on seals to similar gap sizes but incorporating combustible backing strips as shown in table 8.

Table 8 Comparison of results from single vertical seals located on fire side of the construction in conjunction with combustible and mineral wool backing strips

Test Reference	Specimen Reference	Substrate	Gap Size (mm)	Seal Depth (mm)	Mineral Wool Backing Depth (mm)	Integrity (min.)
WARRES 60288/B	V1	Lightweight concrete	35	35	30	158
WARRES 54845/B	V6	Lightweight concrete	35	20	None	240

Test Reference	Specimen Reference	Substrate	Gap Size (mm)	Seal Depth (mm)	Mineral Wool Backing Depth (mm)	Integrity (min.)
WARRES 60288/B	V3	Lightweight concrete	12	20	55	240
WARRES 54845/B	V3	Lightweight concrete	12	12	None	240

Whilst in the case of the smaller seal there is no evidence of the mineral wool backing effecting integrity performance in the case of the seal to the larger gap size the presence of the mineral wool backing strip has resulted in a decrease in integrity performance, despite the fact that the depth of sealant was greater for the mineral wool backed seal. The reason for this may be that the increased insulation behind the sealant resulted in the sealant reaching a higher comparative temperature which in this case affected its stability within the opening. It is therefore proposed to limit the use of mineral wool backing strips on single seals located on the fire side of the construction for gap sizes in excess of 12mm to specifications of up to 120 minutes integrity, thereby giving a margin of safety over and above the result achieved in test. Where the seal is located on the non-fire side of the construction the use of mineral wool in lieu of a combustible backing strip would not be expected to have a detrimental effect on the integrity performance of the seal.

As there is generally no noticeable difference in integrity performance between horizontal and vertically orientated seals and the only seals in conjunction with non-combustible substrates which failed to achieve a full 240 minutes integrity were vertically orientated, it is proposed that the same designs be made available for horizontal gaps.

4.2.3 Combustible substrates

In the case of combustible timber substrates the integrity performance is governed by the rate of combustion of the timber itself, thereby allowing the sealant to be bypassed. Tests have been conducted in conjunction with both hardwood and softwood in the vertical and horizontal orientations with gap widths of 10mm and 25mm (WARRES 59021). Once more the results were from tests where the seals were located on the fire side of the construction which may be considered to be a "worst case", hence, there is no restriction of the position of the seal within the depth of the fire separating element, nor on the overall thickness of the element other than that it should be capable of achieving the required period of fire integrity.

In the case of hardwood a 10mm horizontal gap was sealed with sealant to a depth of 15mm and achieved an integrity performance of 63 minutes. Hence, this specification can be used for specifications of up to 60 minutes. Similarly, a 10mm vertical gap was sealed with sealant to a depth of 15mm and achieved an integrity performance of 59 minutes. A small increase in the sealant depth of, say, 1mm to 16mm should be sufficient to achieve a full 60 minutes integrity in this case.

A 25mm horizontal gap between hardwood was sealed with sealant to a depth of 25mm and achieved an integrity performance of 66 minutes. Hence, this specification can be used for specifications of up to 60 minutes. Similarly, a 25mm vertical gap was sealed with sealant to a depth of 25mm and achieved an integrity performance of 61 minutes. This specification can therefore be used for specifications of up to 60 minutes.

In the case of softwood a 10mm horizontal gap was sealed with sealant to a depth of 35mm and achieved an integrity performance of 91 minutes. Hence, this specification can be used for specifications of up to 90 minutes. As the char rate of hardwood is less than that of softwood the same specification is available for hardwood.

Similarly, a 10mm vertical gap was sealed with sealant to a depth of 35mm and achieved an integrity performance of 87 minutes, approximately 4% short of a full 90 minutes. An increase in the sealant depth of 2mm to 37mm represents an increase of 5.4% and therefore should be sufficient to achieve a full 90 minutes integrity. Again, as the char rate of hardwood is less than that of softwood the same specification is available for hardwood.

A 25mm horizontal gap between softwood was sealed with sealant to a depth of 35mm and achieved an integrity performance of 74 minutes. Hence, this specification can be used for specifications of up to 60 minutes. Similarly, a 25mm vertical gap was also sealed with sealant to a depth of 35mm and achieved an integrity performance of 82 minutes. Again, this specification can be used for specifications of up to 60 minutes.

4.2.4 Use in conjunction with gypsum partitions

As noted in tables 1 and 7, three fire tests have been conducted where the sealant has been used in conjunction with steel stud and gypsum board partitions. In all cases the partitions were designed to provide 120 minutes fire resistance to evaluate the performance of various penetration seal systems and a single nominal 10mm diameter bead of mastic was used to seal the gap between the steel studs and test restraint frame. In no cases was the sealant reported to have failed prior to the failure of the overall construction. It is therefore concluded that use in conjunction with plasterboard partitions is acceptable, for use between the studs and the supporting construction, with integrity specifications being based of those developed for steel or timber substrates (as defined by the stud specification) as given in table 10.

Hence it is possible to summarise the available horizontal and vertical integrity only specifications in tables 9 and 10 as follows:

Table 9 Horizontal Orientation - Single Seals - Integrity Only

Gap Size (mm)	Substrates	Seal Depth (mm)	Seal Location	Backing Strip	Integrity (min.)	Supporting Test Data
< or = 10	Normal and Lightweight Concrete/Masonry/Steel/Non-combustible Board	6	Either Face	**	240	WARRES 54260/B, Specimen H2
11 to 15	Normal and Lightweight Concrete/Masonry/Steel/Non-combustible Board	10	Either Face	**	240	WARRES 54845/B, Specimen V4*
16 to 20	Normal and Lightweight Concrete/Masonry/Steel/Non-combustible Board	15	Either Face	**	240	WARRES 54845/B, Specimen V5*
21 to 35	Normal and Lightweight Concrete/Masonry/Steel/Non-combustible Board	20	Either Face	**	240	WARRES 54845/B, Specimen V6*
< or = 12	Normal and Lightweight Concrete/Masonry/Steel/Non-combustible Board	20	Fire Face	30mm Mineral Wool	240	WARRES 60288/B, Specimen V3*
13 to 35	Normal and Lightweight Concrete/Masonry/Steel/Non-combustible Board	35	Fire Face	30mm Mineral Wool	120	WARRES 60288/B, Specimen V1*
< or = 10	Hardwood	15	Either Face	Any (to 12mm gap)	60	WARRES 59021, Specimen H2

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Gap Size (mm)	Substrates	Seal Depth (mm)	Seal Location	Backing Strip	Integrity (min.)	Supporting Test Data
< or = 10	Hardwood	35	Either Face	Any (to 12mm gap)	90	WARRES 59021, Specimen H3
11 to 25	Hardwood	25	Either Face	**	60	WARRES 59021, Specimen H1
< or = 10	Softwood	35	Either Face	Any (to 12mm gap)	90	WARRES 59021, Specimen H3
11 to 25	Softwood	35	Either Face	**	60	WARRES 59021, Specimen H4

* Whilst this gap size and sealant depth was only tested in a vertical orientation the general fire performance characteristics of the sealant suggest that such an orientation may be considered as the "worst case" and therefore the result from the vertical specimen is used to justify the horizontal specification.

** Combustible material (i.e. polyethylene foam) for seals positioned on either face or mineral wool for seals positioned on the non-fire face only.

Table 10 Vertical Orientation - Single Seals - Integrity Only

Gap Size (mm)	Substrates	Seal Depth (mm)	Seal Location	Backing Strip	Integrity (min.)	Supporting Test Data
< or = 10	Normal and Lightweight Concrete/Masonry/Steel/Non-combustible Board	6	Either Face	**	210	WARRES 54260/B, Specimen V3
< or = 10	Normal and Lightweight Concrete/Masonry/Steel/Non-combustible Board	7	Either Face	**	240	WARRES 54260/B, Specimen V3
11 to 15	Normal and Lightweight Concrete/Masonry/Steel/Non-combustible Board	10	Either Face	**	240	WARRES 54845/B, Specimen V4
16 to 20	Normal and Lightweight Concrete/Masonry/Steel/Non-combustible Board	15	Either Face	**	240	WARRES 54845/B, Specimen V5
21 to 35	Normal and Lightweight Concrete/Masonry/Steel/Non-combustible Board	20	Either Face	**	240	WARRES 54845/B, Specimen V6
< or = 12	Normal and Lightweight Concrete/Masonry/Steel/Non-combustible Board	20	Fire face	30mm Mineral Wood	240	WARRES 60288/B, Specimen V3
13 to 35	Normal and Lightweight Concrete/Masonry/Steel/Non-combustible Board	35	Fire face	30mm Mineral Wool	120	WARRES 60288/B, Specimen V1

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Gap Size (mm)	Substrates	Seal Depth (mm)	Seal Location	Backing Strip	Integrity (min.)	Supporting Test Data
< or = 10	Hardwood	15	Either Face	Any (to 12mm gap)	30	WARRES 59021, Specimen V3
< or = 10	Hardwood	16	Either Face	Any (to 12mm gap)	60	WARRES 59021, Specimen V3
< or = 10	Hardwood	37	Either Face	Any (to 12mm gap)	90	WARRES 59021, Specimen V2
11 to 25	Hardwood	25	Either Face	**	60	WARRES 59021, Specimen V4
< or = 10	Softwood	35	Either Face	Any (to 12mm gap)	60	WARRES 59021, Specimen V2
< or = 10	Softwood	37	Either Face	Any (to 12mm gap)	90	WARRES 59021, Specimen V2
11 to 25	Softwood	35	Either Face	**	60	WARRES 59021, Specimen V1

** Combustible material (i.e. polyethylene foam) for seals positioned on either face or mineral wool for seals positioned on the non-fire face only.

The preceding specifications are all achieved by the use of single seals positioned at either the fire side or non-fire side of the construction. As all the tests from which these specifications are derived are from tests where the seal was positioned on the fire side of the construction the relocation of a part of the depth of sealant required to achieve a particular period of performance to the non-fire side of the construction should not affect the overall performance in a detrimental way providing that the depth of seal is still physically capable of performing as a seal.

In respect to this type of sealant this mechanical performance is normally achieved by ensuring a maximum gap width to seal depth ratio of 2:1. Hence, providing that this gap width to seal depth ratio is not exceeded and that taken together the depth of sealant of the seals at both faces equals or exceeds that of the appropriate single seal it is proposed that the single seal specifications presented in tables 9 and 10 may be replaced by seals to both faces of the construction. These specifications are summarised in tables 11 and 12 where, for the smallest gap sizes, a practical minimum sealant depth of 5mm has been incorporated.

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Table 11 Horizontal Orientation - Double Seals - Integrity Only

Gap Size (mm)	Substrates	Seal Depth (mm)	Seal Location	Backing Strip	Integrity (min.)	Supporting Test Data
< or = 10	Normal and Lightweight Concrete/Masonry/Steel/Non-combustible Board	5	Both Faces	**	240	WARRES 54260/B, Specimen H2
11 to 15	Normal and Lightweight Concrete/Masonry/Steel/Non-combustible Board	5.5 to 7.5	Both Faces	**	240	WARRES 54845/B, Specimen V4*
16 to 20	Normal and Lightweight Concrete/Masonry/Steel/Non-combustible Board	8 to 10	Both Faces	**	240	WARRES 54845/B, Specimen V5*
21 to 35	Normal and Lightweight Concrete/Masonry/Steel/Non-combustible Board	10.5 to 17.5	Both Faces	**	240	WARRES 54845/B, Specimen V6*
< or = 12	Normal and Lightweight Concrete/Masonry/Steel/Non-combustible Board	10	Both Faces	25mm Mineral Wool	240	WARRES 60288/B, Specimen V2*
13 to 35	Normal and Lightweight Concrete/Masonry/Steel/Non-combustible Board	30	Both Faces	30mm Mineral Wool	240	WARRES 60288/B, Specimen V4*
< or = 10	Hardwood	7.5	Both Faces	Any (to 12mm gap)	60	WARRES 59021, Specimen H2
< or = 10	Hardwood	17.5	Both Faces	Any (to 12mm gap)	90	WARRES 59021, Specimen H3
11 to 25	Hardwood	12.5	Both Faces	**	60	WARRES 59021, Specimen H1
< or = 10	Softwood	17.5	Both Faces	Any (to 12mm gap)	90	WARRES 59021, Specimen H3
11 to 25	Softwood	17.5	Both Faces	**	60	WARRES 59021, Specimen H4

* Whilst this gap size and sealant depth was only tested in a vertical orientation the general fire performance characteristics of the sealant suggest that such an orientation may be considered as the "worst case" and therefore the result from the vertical specimen is used to justify the horizontal specification.

** Combustible material (i.e. polyethylene foam).

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Table 12 Vertical Orientation - Double Seals - Integrity Only

Gap Size (mm)	Substrates	Seal Depth (mm)	Seal Location	Backing Strip	Integrity (min.)	Supporting Test Data
< or = 10	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	5	Both Faces	**	240	WARRES 54260/B, Specimen V3
11 to 15	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	5 to 7.5	Both Faces	**	240	WARRES 54845/B, Specimen V4
16 to 20	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	7.5 to 10	Both Faces	**	240	WARRES 54845/B, Specimen V5
21 to 35	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	10.5 to 17.5	Both Faces	**	240	WARRES 54845/B, Specimen V6
< or = 12	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	10	Both Faces	25mm Mineral Wool	240	WARRES 60288/B, Specimen V2
13 to 35	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	30	Both Faces	30mm Mineral Wool	240	WARRES 60288/B, Specimen V4
< or = 10	Hardwood	7.5	Both Faces	Any (to 12mm gap)	30	WARRES 59021, Specimen V3
< or = 10	Hardwood	8	Both Faces	Any (to 12mm gap)	60	WARRES 59021, Specimen V3
< or = 10	Hardwood	18.5	Both Faces	Any (to 12mm gap)	90	WARRES 59021, Specimen V2
11 to 25	Hardwood	12.5	Both Faces	**	60	WARRES 59021, Specimen V4
< or = 10	Softwood	17.5	Both Faces	Any (to 12mm gap)	60	WARRES 59021, Specimen V2
< or = 10	Softwood	18.5	Both Faces	Any (to 12mm gap)	90	WARRES 59021, Specimen V2
11 to 25	Softwood	17.5	Both Faces	**	60	WARRES 59021, Specimen V1

** Combustible material (i.e. polyethylene foam).

4.3 Integrity and Insulation

4.3.1 General

In the case of seals formed in conjunction with non-metallic non-combustible substrates, there is no evidence that the nature or density of such a substrate had any significant effect on integrity performance. It is therefore proposed to group all non-combustible substrates together for integrity and insulation specifications with the exception of steel substrates which will be classified separately.

Because of the minimum size requirement for fixed thermocouples positioned in accordance with the BS standard it is normal for the insulation performance of recessed seals within gaps of less than 12mm width to be deemed as being "unclassified".

In all the ad hoc tests the fixed thermocouples where used were attached to the unexposed face of the polyethylene backing strips and in many situations the measurement of the insulation performance of the seals ceased as the fixed thermocouples became detached from their substrates due to the deterioration of the polyethylene, the tester having deemed that the nature of the sealant was unsuitable for the use of a roving thermocouple. Clearly, under such circumstances any large extrapolations of the data would be unsafe. However, where the temperatures recorded at the time that measurement ceased are significantly below those normally associated with failure some degree of extrapolations may be possible.

As in the case of integrity only specifications in the main there is little evidence to suggest that the orientation of the seal has a significant effect on the insulation performance. In the case of insulation performance, whilst many results ended prematurely for the reason given above, there is some evidence of differences in performance as shown by the comparison between Specimens H1 and V2 in WARRES 54260/B (20mm gaps and 20mm seal depths) where the horizontal specimen achieved 54 minutes insulation whilst a similar vertical specimen achieved 73 minutes insulation. However, in circumstances where there is an adequate margin of safety, it is proposed that vertical specimens may be used to justify the insulation performance of horizontal seals or vice versa.

4.3.2 Non-combustible substrates except for steel

Most of the information available involves the use of single seals located on the fire side of the construction incorporating combustible backing strips and this information will be examined first.

A 15mm vertical gap sealed on the fire side only with sealant to a depth of 10mm (WARRES 54845/B, Specimen V4) achieved an insulation performance of 40 minutes before the fixed thermocouple on the backing strip became detached. Whilst the temperature of the thermocouple at the time of detachment was only 79°C extrapolation by a full 20 minutes to 60 minutes is considered to be unsafe. Hence, this specification can be used for single seal insulation specifications of up to 30 minutes for both horizontal and vertical seals. Moving the seal to the none fire side of the construction will have the effect of shielding the seal from the full effects of the fire, hence, it is proposed that all insulation specifications developed from data where the seal(s) was positioned on the fire side are applicable for seals positioned anywhere within the depth of the construction.

A 20mm vertical gap sealed on the fire side with sealant to a depth of 15mm achieved an insulation performance of 49 minutes (WARRES 54845/B, Specimen V5) before the fixed thermocouple on the backing strip became detached. This time the temperature of the thermocouple at the time of detachment is believed to have been around 90°C. However, horizontal Specimen H1 of WARRES 54260/B, which did not suffer from thermocouple detachment, achieved only 54 minutes insulation on a similar gap size but with a 20mm deep seal positioned on the fire side. Hence, the 15mm deep specification may only be used to support insulation specifications of up to 30 minutes for both horizontal and vertical seals in 20mm wide openings.

For 20mm wide vertical seals alone Specimen V2 of WARRES 54260/B achieved 73 minutes insulation with a seal depth of 20mm positioned on the fire side. Hence this specification is available to support 60-minute insulation specifications for single vertical seals.

A number of results are available on gap sizes greater than 20mm where insulation measurement was discontinued due to thermocouple detachment as summarised in table 13.

Table 13 Summary of the insulation performance of single fire side seals on gaps > 20mm where measurement was discontinued because of thermocouple detachment

Gap Size (mm)	Orientation	Substrate(s)	Seal Depth (mm)	Time when measurement ceased (min.)	Maximum temp. when measurement ceased (°C)	Supporting Test Data
25	Horizontal	Steel	25	40	119 (TC#6)	WARRES 59022/B, Specimen H1
25	Horizontal	Steel/Dense Concrete	25	48	67(TC#7)	WARRES 59022/B, Specimen H2
25	Horizontal	Vicuclad/ Lightweight Concrete	25	48	87(TC#12)	WARRES 59022/B, Specimen H4
25	Vertical	Steel	25	58	122(TC#13)	WARRES 59022/B, Specimen V1
25	Vertical	Steel/Dense Concrete	25	52	123(TC#16)	WARRES 59022/B, Specimen V2
25	Vertical	Vicuclad/ Lightweight Concrete	25	58	108(TC#19)	WARRES 59022/B, Specimen V4
30	Horizontal	Dense Concrete	25	48	55(TC#10)	WARRES 59022/B, Specimen H3
30	Vertical	Dense Concrete	25	33	19(TC#'s 17 + 18)	WARRES 59022/B, Specimen V3
35	Vertical	Lightweight Concrete	20	92	72(TC#22)	WARRES 54845/B, Specimens V1 + V6

Excluding results where steel is used, we have a total of 2# 25mm gaps sealed on the fire side with a 25mm depth of sealant, namely WARRES 59022, Specimens H4 and V4. In the case of Specimen H4 the thermocouple detached after 48 minutes when the recorded back face temperature was 87°C whereas in the case of Specimen V4 temperature recording ceased after 58 minutes when a temperature of 108°C had been reached, the temperature having risen only 26°C in the preceding 10 minutes. It is therefore reasonable to assume that a limiting temperature of 199°C (180°C + ambient) would not have been reached within the next two minutes had the thermocouple remained attached.

In addition, in the same test a 30mm wide horizontal gap sealed on the fire side to the same depth (Specimen H3) also had the thermocouple detach after 48 minutes, this time with a recorded back face temperature of only 55°C. Hence, even though the gap is larger than for Specimen H4 the insulation performance is no worse.

As we are offering 240-minute horizontal integrity only specification on gap widths of up to 35mm and there appears to be no detrimental effect on insulation performance by increasing the gap width where the seal is positioned flush with the exposed face of the construction it is proposed to use this

specification for seals providing 60 minutes insulation in a horizontal orientation for gap widths of up to 35mm.

In the case of vertical orientation Specimen V1 of WARRES 54260/B comprised of a 35mm wide gap sealed on the fire side to a depth of 25mm. The construction achieved an insulation performance of 168 minutes; hence, it is proposed that this specification be used for seals providing 150 minutes insulation in a vertical orientation for gap widths of up to 35mm.

There is only limited data for single seals formed in conjunction with mineral wool backing strips. A 12mm wide vertical gap sealed on the fire side with a 10mm depth of sealant with a 55mm depth mineral wool backing strip achieved an insulation performance of 160 minutes (WARRES 60288, Specimen V3). It is therefore proposed to offer this specification for 150 minutes vertical seals and 120 minutes horizontal seals, reflecting the poorer comparative performance seen with horizontal constructions.

In the same test a 35mm wide vertical gap sealed on the fire side with a sealant depth of 35mm and mineral wool backing strip depth of 30mm achieved an insulation performance of 121 minutes (Specimen V1). Hence, it is proposed to offer this specification for 120 minutes vertical seals and 90 minutes horizontal seals.

4.3.3 Steel substrates

With seals used in conjunction with steel substrates again the insulation performance of seals of less than 12mm width are deemed "unclassified".

Four results are available on 25mm gaps sealed with a 25mm depth of sealant, namely WARRES 59022, Specimens H1, H2, V1 and V2 with insulation measurement terminating at 40, 48, 58 and 52 minutes at achieved temperatures of 119, 67, 122 and 123°C, respectively. It may be argued that were the nature of the substrate to have an effect on the insulation performance of the seal the presence of the steel will have the controlling influence rather than the density of any adjacent concrete. Indeed, the 58-minute result was on a seal where both sides of the opening were of steel.

In the case of horizontal seals we have information of satisfactory performance at 48 minutes (Specimen H2) when the back face temperature was 67°C, some 132°C short of the limiting temperature of 199°C. The temperature of the same thermocouple at 38 minutes was 48°C, hence, the heating rate for the previous 12 minutes was 67-48 = 19 divided by 12 minutes = 1.6°C/minute which, if maintained, would have resulted in a temperature at 60 minutes of 67+19 = 86°C. It is therefore believed reasonable and conservative to utilise this seal depth specification on horizontal seals for 60 minutes insulation.

In the case of vertical seals Specimen V1 had a back face temperature at 58 minutes of 122°C and a heating rate over the previous 10 minutes of 122-97/10 = 2.5°C/minutes. Hence it is again conservative to utilise this seal depth specification for 60 minutes insulation on vertical seals.

As previously argued with seals positioned on the exposed side of the construction gap width should not significantly affect performance, hence, as with other non-combustible substrates it is proposed that these specifications be available for gap widths of up to 35mm.

4.3.4 Timber substrates

In this case the nature of the timber should not affect the insulation performance providing that integrity can be maintained. In all cases the results from the timber substrate specimens are actual results from test # WARRES 59021. As with non-combustible substrates the insulation performance of seals of less than 12mm width are deemed "unclassified". The gaps size will not be extended beyond the 25mm tested as width may have an effect on timber char rates.

For horizontal seals in conjunction with hardwood Specimen H1 being a 25mm deep seal in a 25mm gap achieved 64 minutes insulation, hence, this specification can be used where 60 minutes insulation is

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required. Similarly, with softwood Specimen H4 being a 35mm deep seal in a 25mm gap achieved 74 minutes insulation, hence, this specification can be used to support 60 minutes insulation specifications.

For vertical seals in conjunction with hardwood V4 being a 25mm deep seal in a 25mm gap achieved 51 minutes insulation, hence, this specification can be used where 30 minutes insulation is required. Similarly, with softwood Specimen V1 being a 35mm deep seal in a 25mm gap achieved 82 minutes insulation, hence, this specification can be used to support 60 minutes insulation specifications on both softwood and hardwood, the char rate of hardwood being better than softwood.

Hence it is possible to summarise the available horizontal and vertical specifications as follows:

Table 14 Horizontal Orientation - Single Seals - Integrity and Insulation

Gap Size (mm)	Substrates	Seal Depth (mm)	Seal Location	Backing Strip	Insulation (min.)	Supporting Test Data
< or = 11	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	6	Fire Face	**	Unclassified	WARRES 54260/B, Specimen H2
< or = 12	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	20	Either Face	55mm Mineral Wool	120	WARRES 60288/B, Specimen V3*
< or = 15	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	10	Either Face	**	30	WARRES 54845/B, Specimen V4
16 to 20	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	15	Either Face	**	30	WARRES 54845/B, Specimen V5
12 to 35	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	25	Either Face	**	60	WARRES 59022,Spec. H4 and V4
12 to 35	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	35	Either Face	30mm Mineral Wool	90	WARRES 60288/B, Specimen V1*
< or = 10	Steel	6	Either Face	**	Unclassified	WARRES 54260/B, Specimen H2
< or = 35	Steel	25	Either Face	**	60	WARRES 59022, Spec. H1 and H2
< or = 11	Hardwood	15	Fire Face	**	Unclassified	WARRES 59021, Specimen H2
< or = 25	Hardwood	25	Either Face	**	60	WARRES 59021, Specimen H1
< or = 11	Softwood	35	Fire Face	**	Unclassified	WARRES 59021, Specimen H3
< or = 25	Softwood	35	Either Face	**	60	WARRES 59021, Specimen H4

* Result from the vertical specimen is used to justify the horizontal specification.

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** Combustible material (i.e. polyethylene foam) for seals positioned on either face or mineral wool for seals positioned on the non-fire face only.

Table 15 Vertical Orientation - Single Seals - Integrity and Insulation

Gap Size (mm)	Substrates	Seal Depth (mm)	Seal Location	Backing Strip	Insulation (min.)	Supporting Test Data
< or = 11	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	6	Fire Face	**	Unclassified	WARRES 54260/B, Specimen V3
< or = 12	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	20	Either Face	55mm Mineral Wool	150	WARRES 60288/B, Specimen V3
< or = 15	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	10	Either Face	**	30	WARRES 54845/B, Specimen V4
16 to 20	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	15	Either Face	**	30	WARRES 54845/B, Specimen V5
12 to 20	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	20	Either Face	**	60	WARRES 54260/B, Specimen V2
12 to 35	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	25	Either Face	**	150	WARRES 54260/B, Specimen V1
12 to 35	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	35	Either Face	30mm Mineral Wool	120	WARRES 60288/B, Specimen V1
< or = 11	Steel	6	Fire Face	**	Unclassified	WARRES 54260/B, Specimen V3
< or = 35	Steel	25	Either Face	**	60	WARRES 59022, Specimen V1
< or = 11	Hardwood	15	Fire Face	**	Unclassified	WARRES 59021, Specimen V3
< or = 25	Hardwood	25	Either Face	**	30	WARRES 59021, Specimen V4
12 to 25	Hardwood	35	Either Face	**	60	WARRES 59021, Specimen V1
< or = 11	Softwood	35	Fire Face	**	Unclassified	WARRES 59021, Specimen V2
< or = 25	Softwood	35	Either Face	**	60	WARRES 59021, Specimen V1

** Combustible material (i.e. polyethylene foam) for seals positioned on either face or mineral wool for seals positioned on the non-fire face only.

As in the case of the integrity only seals the preceding specifications are all achieved by the use of single seals positioned at either the fire side or non-fire side of the construction and are derived from tests

where the seal was positioned on the fire side of the construction. Hence, the relocation of a part of the depth of sealant required to achieve a particular period of performance to the none fire side of the construction should not affect the overall insulation performance in a detrimental way providing that the mechanical performance is ensured by maintaining a maximum gap width to seal depth ratio of 2: 1.

These double seal specifications are summarised in tables 16 and 17 where, for the smallest gap sizes, a practical minimum sealant depth of 5mm has been incorporated and actual results from two double seal tests performed in vertical gap have been included. In the latter cases the maximum seal temperature at the end of 240 minutes was 60°C and 69°C respectively, hence, it is considered safe to translate these results from vertical seals to horizontal constructions.

Table 16 Horizontal Orientation - Double Seals - Integrity and Insulation

Gap Size (mm)	Substrates	Seal Depth (mm)	Seal Location	Backing Strip	Insulation (min.)	Supporting Test Data
< or = 12	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	10	Both Faces	25mm Mineral Wool	240	WARRES 60288/B, Specimen V2*
< or = 15	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	5 to 7.5	Both Faces	**	30	WARRES 54845/B, Specimen V4
16 to 20	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	8 to 10	Both Faces	**	30	WARRES 54845/B, Specimen V5
12 to 35	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	12.5 to 17.5	Both Faces	**	60	WARRES 59022,Spec. H4 and V4
12 to 35	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	17.5	Both Faces	30mm Mineral Wool	90	WARRES 60288/B, Specimen V1*
12 to 35	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	30	Both Faces	30mm Mineral Wool	240	WARRES 60288/B, Specimen V4*
< or = 35	Steel	12.5 to 17.5	Both Faces	**	60	WARRES 59022, Spec. H1 and H2
< or = 25	Hardwood	12.5	Both Faces	**	60	WARRES 59021, Specimen H1
< or = 25	Softwood	17.5	Both Faces	**	60	WARRES 59021, Specimen H4

* Result from the vertical specimen is used to justify the horizontal specification.

** Combustible material (i.e. polyethylene foam).

Table 17 Vertical Orientation - Double Seals - Integrity and Insulation

Gap Size (mm)	Substrates	Seal Depth (mm)	Seal Location	Backing Strip	Insulation (min.)	Supporting Test Data
< or = 12	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	10	Both Faces	25mm Mineral Wool	240	WARRES 60288/B, Specimen V2
< or = 15	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	5 to 7.5	Both Faces	**	30	WARRES 54845/B, Specimen V4
16 to 20	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	8 to 10	Both Faces	**	30	WARRES 54845/B, Specimen V5
12 to 20	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	10	Both Faces	**	60	WARRES 54260/B, Specimen V2
12 to 35	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	12.5 to 17.5	Both Faces	**	150	WARRES 54260/B, Specimen V1
12 to 35	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	30	Both Faces	30mm Mineral Wool	240	WARRES 60288/B, Specimen V4
< or = 35	Steel	12.5 to 17.5	Both Faces	**	60	WARRES 59022, Specimen V1
< or = 25	Hardwood	12.5	Both Faces	**	30	WARRES 59021, Specimen V4
12 to 25	Hardwood	17.5	Both Faces	**	60	WARRES 59021, Specimen V1
< or = 25	Softwood	17.5	Both Faces	**	60	WARRES 59021, Specimen V1

** Combustible material (i.e. polyethylene foam).

4.3.5 Use in conjunction with gypsum partitions

In the previously mentioned tests in conjunction with gypsum partitions the gaps were small; hence, no measurement of the insulation performance was possible. It is therefore proposed that when specifying the sealant for use with gypsum partitions such specifications be based on the general performance tables in terms of both integrity only and integrity and insulation but be limited by the performance of the partition in question. The sealant is used to seal gaps between the frame members of the partition and the surrounding construction.

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5 Conclusion

A number of fire tests have been performed at Warrington Fire Research and Chiltern International fire test laboratories to investigate the ability of 3C Intumescent Acoustic Sealant to reinstate the fire resistance of gaps formed in a variety of horizontally and vertically orientated fire separating constructions. The tests were conducted following the cellulosic heating conditions of BS 476: Part 20: 1987. Tests have also been performed to the requirements of BS 476: Part 22: 1987 on steel stud and gypsum board partitions incorporating the sealant at junctions between the partition and fire test restraint frame.

The data produced from the fire test programme has been appraised to make recommendations on appropriate "integrity only" and "integrity and insulation" specifications for 3C Intumescent Acoustic Sealant to achieve various periods of fire resistance for differing substrates, gaps sizes and orientations.

The proposed specifications for various periods of fire resistance are summarised in appendix 1.

6 Validity of the assessment

6.1 Declaration by applicant

We the undersigned confirm that we have read and complied with the obligations placed on us by the Passive Fire Protection Forum (PFPF) Guide to undertaking technical assessments and engineering evaluations based on fire test evidence 2021 Industry Standard Procedure.

We confirm that any changes which are the subject of this assessment, has not to our knowledge been tested to the standard against which this assessment has been made.

We agree to withdraw this assessment from circulation should the component or element of structure, or any of its component parts be the subject of a failed fire resistance test to the standard against which this assessment is being made.

We understand that this assessment is based on test evidence and will be withdrawn should evidence become available that causes the conclusion to be questioned. In that case, we accept that new test evidence may be required.

We are not aware of any information that could affect the conclusions of this assessment. If we subsequently become aware of any such information, we agree to ask BRE Global to withdraw the assessment.

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Signature: [signature]

Name: JAMES HURLEY

Position: DIRECTOR

Company: COUNTY CONSTRUCTION CHEMICALS LTD

Date: 31/7/23

6.2 BRE Global declaration

This assessment is issued on the basis of test data and information to hand at the time of issue. If contradictory evidence becomes available to BRE Global the assessment will be unconditionally withdrawn and the applicant will be notified in writing. Similarly, the assessment should be re-evaluated if the assessed construction is subsequently tested since actual test data is deemed to take precedence.

The assessment is valid initially until 14 January 2025 after which time it is recommended that it be submitted to BRE Global for re-evaluation.

This assessment has been carried out in accordance with the Passive Fire Protection Forum (PFPF) Guide to undertaking technical assessments of the fire performance of construction products based on fire test evidence 2021. It relates to the fire performance of the product and does not cover aspects of quality, durability, maintenance nor service requirements. This assessment relates only to the specimen(s) assessed and does not by itself imply that the product is approved under any Loss Prevention Certification Board approval or certification scheme or any other endorsements, approval or certification scheme.

The assessment report is not valid unless it incorporates the declaration duly signed by the applicant.

Next review date: 14 January 2025

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Appendix A Specification tables for 3C Intumescent Acoustic Sealant when used as a linear gap seal

Table A1 Horizontal Orientation - Single Seals - Integrity Only

Gap Size (mm)	Substrates	Seal Depth (mm)	Seal Location	Backing Strip	Integrity (min.)	Supporting Test Data
< or = 10	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	6	Either Face	**	240	WARRES 54260/B, Specimen H2
11 to 15	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	10	Either Face	**	240	WARRES 54845/B, Specimen V4
16 to 20	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	15	Either Face	**	240	WARRES 54845/B, Specimen V5
21 to 35	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	20	Either Face	**	240	WARRES 54845/B, Specimen V6
< or = 12	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	20	Fire Face	30mm Mineral Wool	240	WARRES 60288/B, Specimen V3
13 to 35	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	35	Fire Face	30mm Mineral Wool	120	WARRES 60288/B, Specimen V1
< or = 10	Hardwood	15	Either Face	Any (to 12mm gap)	60	WARRES 59021, Specimen H2
< or = 10	Hardwood	35	Either Face	Any (to 12mm gap)	90	WARRES 59021, Specimen H3
11 to 25	Hardwood	25	Either Face	**	60	WARRES 59021, Specimen H1
< or = 10	Softwood	35	Either Face	Any (to 12mm gap)	90	WARRES 59021, Specimen H3
11 to 25	Softwood	35	Either Face	**	60	WARRES 59021, Specimen H4

** Combustible material (i.e. polyethylene foam) for seals positioned on either face or mineral wool for seals positioned on the non-fire face only.

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Table A2 Vertical Orientation - Single Seals - Integrity Only

Gap Size (mm)	Substrates	Seal Depth (mm)	Seal Location	Backing Strip	Integrity (min.)	Supporting Test Data
< or = 10	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	6	Either Face	**	210	WARRES 54260/B, Specimen V3
< or = 10	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	7	Either Face	**	240	WARRES 54260/B, Specimen V3
11 to 15	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	10	Either Face	**	240	WARRES 54845/B, Specimen V4
16 to 20	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	15	Either Face	**	240	WARRES 54845/B, Specimen V5
21 to 35	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	20	Either Face	**	240	WARRES 54845/B, Specimen V6
< or = 12	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	20	Fire face	30mm Mineral Wood	240	WARRES 60288/B, Specimen V3
13 to 35	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	35	Fire face	30mm Mineral Wool	120	WARRES 60288/B, Specimen V1
< or = 10	Hardwood	15	Either Face	Any (to 12mm gap)	30	WARRES 59021, Specimen V3
< or = 10	Hardwood	16	Either Face	Any (to 12mm gap)	60	WARRES 59021, Specimen V3
< or = 10	Hardwood	37	Either Face	Any (to 12mm gap)	90	WARRES 59021, Specimen V2
11 to 25	Hardwood	25	Either Face	**	60	WARRES 59021, Specimen V4
< or = 10	Softwood	35	Either Face	Any (to 12mm gap)	60	WARRES 59021, Specimen V2
< or = 10	Softwood	37	Either Face	Any (to 12mm gap)	90	WARRES 59021, Specimen V2
11 to 25	Softwood	35	Either Face	**	60	WARRES 59021, Specimen V1

** Combustible material (i.e. polyethylene foam) for seals positioned on either face or mineral wool for seals positioned on the non-fire face only.

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Table A3 Horizontal Orientation - Double Seals - Integrity Only

Gap Size (mm)	Substrates	Seal Depth (mm)	Seal Location	Backing Strip	Integrity (min.)	Supporting Test Data
< or = 10	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	5	Both Faces	**	240	WARRES 54260/B, Specimen H2
11 to 15	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	5.5 to 7.5	Both Faces	**	240	WARRES 54845/B, Specimen V4*
16 to 20	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	8 to 10	Both Faces	**	240	WARRES 54845/B, Specimen V5*
21 to 35	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	10.5 to 17.5	Both Faces	**	240	WARRES 54845/B, Specimen V6*
< or = 12	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	10	Both Faces	25mm Mineral Wool	240	WARRES 60288/B, Specimen V2*
13 to 35	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	30	Both Faces	30mm Mineral Wool	240	WARRES 60288/B, Specimen V4*
< or = 10	Hardwood	7.5	Both Faces	Any (to 12mm gap)	60	WARRES 59021, Specimen H2
< or = 10	Hardwood	17.5	Both Faces	Any (to 12mm gap)	90	WARRES 59021, Specimen H3
11 to 25	Hardwood	12.5	Both Faces	**	60	WARRES 59021, Specimen H1
< or = 10	Softwood	17.5	Both Faces	Any (to 12mm gap)	90	WARRES 59021, Specimen H3
11 to 25	Softwood	17.5	Both Faces	**	60	WARRES 59021, Specimen H4

* Whilst this gap size and sealant depth was only tested in a vertical orientation the general fire performance characteristics of the sealant suggest that such an orientation may be considered as the "worst case" and therefore the result from the vertical specimen is used to justify the horizontal specification.

** Combustible material (i.e. polyethylene foam).

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Table A4 Vertical Orientation - Double Seals - Integrity Only

Gap Size (mm)	Substrates	Seal Depth (mm)	Seal Location	Backing Strip	Integrity (min.)	Supporting Test Data
< or = 10	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	5	Both Faces	**	240	WARRES 54260/B, Specimen V3
11 to 15	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	5 to 7.5	Both Faces	**	240	WARRES 54845/B, Specimen V4
16 to 20	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	7.5 to 10	Both Faces	**	240	WARRES 54845/B, Specimen V5
21 to 35	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	10.5 to 17.5	Both Faces	**	240	WARRES 54845/B, Specimen V6
< or = 12	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	10	Both Faces	25mm Mineral Wool	240	WARRES 60288/B, Specimen V2
13 to 35	Normal and Lightweight Concrete/Masonry/Steel/ Non-combustible Board	30	Both Faces	30mm Mineral Wool	240	WARRES 60288/B, Specimen V4
< or = 10	Hardwood	7.5	Both Faces	Any (to 12mm gap)	30	WARRES 59021, Specimen V3
< or = 10	Hardwood	8	Both Faces	Any (to 12mm gap)	60	WARRES 59021, Specimen V3
< or = 10	Hardwood	18.5	Both Faces	Any (to 12mm gap)	90	WARRES 59021, Specimen V2
11 to 25	Hardwood	12.5	Both Faces	**	60	WARRES 59021, Specimen V4
< or = 10	Softwood	17.5	Both Faces	Any (to 12mm gap)	60	WARRES 59021, Specimen V2
< or = 10	Softwood	18.5	Both Faces	Any (to 12mm gap)	90	WARRES 59021, Specimen V2
11 to 25	Softwood	17.5	Both Faces	**	60	WARRES 59021, Specimen V1

** Combustible material (i.e. polyethylene foam).

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Table A5 Horizontal Orientation - Single Seals - Integrity and Insulation

Gap Size (mm)	Substrates	Seal Depth (mm)	Seal Location	Backing Strip	Insulation (min.)	Supporting Test Data
< or = 11	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	6	Fire Face	**	Unclassified	WARRES 54260/B, Specimen H2
< or = 12	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	20	Either Face	55mm Mineral Wool	120	WARRES 60288/B, Specimen V3*
< or = 15	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	10	Either Face	**	30	WARRES 54845/B, Specimen V4
16 to 20	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	15	Either Face	**	30	WARRES 54845/B, Specimen V5
12 to 35	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	25	Either Face	**	60	WARRES 59022,Spec. H4 and V4
12 to 35	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	35	Either Face	30mm Mineral Wool	90	WARRES 60288/B, Specimen V1*
< or = 10	Steel	6	Either Face	**	Unclassified	WARRES 54260/B, Specimen H2
< or = 35	Steel	25	Either Face	**	60	WARRES 59022, Spec. H1 and H2
< or = 11	Hardwood	15	Fire Face	**	Unclassified	WARRES 59021, Specimen H2
< or = 25	Hardwood	25	Either Face	**	60	WARRES 59021, Specimen H1
< or = 11	Softwood	35	Fire Face	**	Unclassified	WARRES 59021, Specimen H3
< or = 25	Softwood	35	Either Face	**	60	WARRES 59021, Specimen H4

* Result from the vertical specimen is used to justify the horizontal specification.

** Combustible material (i.e. polyethylene foam) for seals positioned on either face or mineral wool for seals positioned on the non-fire face only.

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Table A6 Vertical Orientation - Single Seals - Integrity and Insulation

Gap Size (mm)	Substrates	Seal Depth (mm)	Seal Location	Backing Strip	Insulation (min.)	Supporting Test Data
< or = 11	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	6	Fire Face	**	Unclassified	WARRES 54260/B, Specimen V3
< or = 12	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	20	Either Face	55mm Mineral Wool	150	WARRES 60288/B, Specimen V3
< or = 15	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	10	Either Face	**	30	WARRES 54845/B, Specimen V4
16 to 20	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	15	Either Face	**	30	WARRES 54845/B, Specimen V5
12 to 20	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	20	Either Face	**	60	WARRES 54260/B, Specimen V2
12 to 35	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	25	Either Face	**	150	WARRES 54260/B, Specimen V1
12 to 35	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	35	Either Face	30mm Mineral Wool	120	WARRES 60288/B, Specimen V1
< or = 11	Steel	6	Fire Face	**	Unclassified	WARRES 54260/B, Specimen V3
< or = 35	Steel	25	Either Face	**	60	WARRES 59022, Specimen V1
< or = 11	Hardwood	15	Fire Face	**	Unclassified	WARRES 59021, Specimen V3
< or = 25	Hardwood	25	Either Face	**	30	WARRES 59021, Specimen V4
12 to 25	Hardwood	35	Either Face	**	60	WARRES 59021, Specimen V1
< or = 11	Softwood	35	Fire Face	**	Unclassified	WARRES 59021, Specimen V2
< or = 25	Softwood	35	Either Face	**	60	WARRES 59021, Specimen V1

** Combustible material (i.e. polyethylene foam) for seals positioned on either face or mineral wool for seals positioned on the non-fire face only.

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Table A7 Horizontal Orientation - Double Seals - Integrity and Insulation

Gap Size (mm)	Substrates	Seal Depth (mm)	Seal Location	Backing Strip	Insulation (min.)	Supporting Test Data
< or = 12	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	10	Both Faces	25mm Mineral Wool	240	WARRES 60288/B, Specimen V2*
< or = 15	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	5 to 7.5	Both Faces	**	30	WARRES 54845/B, Specimen V4
16 to 20	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	8 to 10	Both Faces	**	30	WARRES 54845/B, Specimen V5
12 to 35	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	12.5 to 17.5	Both Faces	**	60	WARRES 59022,Spec. H4 and V4
12 to 35	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	17.5	Both Faces	30mm Mineral Wool	90	WARRES 60288/B, Specimen V1*
12 to 35	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	30	Both Faces	30mm Mineral Wool	240	WARRES 60288/B, Specimen V4*
< or = 35	Steel	12.5 to 17.5	Both Faces	**	60	WARRES 59022, Spec. H1 and H2
< or = 25	Hardwood	12.5	Both Faces	**	60	WARRES 59021, Specimen H1
< or = 25	Softwood	17.5	Both Faces	**	60	WARRES 59021, Specimen H4

* Result from the vertical specimen is used to justify the horizontal specification.

** Combustible material (i.e. polyethylene foam).

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Table A8 Vertical Orientation - Double Seals - Integrity and Insulation

Gap Size (mm)	Substrates	Seal Depth (mm)	Seal Location	Backing Strip	Insulation (min.)	Supporting Test Data
< or = 12	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	10	Both Faces	25mm Mineral Wool	240	WARRES 60288/B, Specimen V2
< or = 15	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	5 to 7.5	Both Faces	**	30	WARRES 54845/B, Specimen V4
16 to 20	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	8 to 10	Both Faces	**	30	WARRES 54845/B, Specimen V5
12 to 20	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	10	Both Faces	**	60	WARRES 54260/B, Specimen V2
12 to 35	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	12.5 to 17.5	Both Faces	**	150	WARRES 54260/B, Specimen V1
12 to 35	Normal and Lightweight Concrete/Masonry/ Non-combustible Board	30	Both Faces	30mm Mineral Wool	240	WARRES 60288/B, Specimen V4
< or = 35	Steel	12.5 to 17.5	Both Faces	**	60	WARRES 59022, Specimen V1
< or = 25	Hardwood	12.5	Both Faces	**	30	WARRES 59021, Specimen V4
12 to 25	Hardwood	17.5	Both Faces	**	60	WARRES 59021, Specimen V1
< or = 25	Softwood	17.5	Both Faces	**	60	WARRES 59021, Specimen V1

** Combustible material (i.e. polyethylene foam).

Report Ends