Fire Assessment Report

AR23087

The fire resistance of Soudaseal FR Sealant installed into Vertical and Horizontal Linear Gaps

Issued to:	Soudal Ltd
Report Date:	24/04/2024
Revision:	3
Assessment number:	AR23087
Valid till:	24/04/2029

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1.1 Document Revision Schedule

Revision #	Date	Description
1	22/03/2024	Initial issue for Client review
2	12/04/2024	Minor changes as per client request Results for AC NFS seal added
3	24/04/2024	Issued to Client

1.2 Signatories

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2. Introduction

The objective of the report is to assess the likely fire resistance performance of Soudal Soudaseal FR installed into concrete separating elements in horizontal and vertical orientations if tested to AS1530.4-2014

The following variations were considered in the assessment:

- Different thicknesses of concrete separating element
- Different installation orientations (Fire side, non-fire side, both sides)
- Installation into wall-floor separating elements.
- Installation into Aerated Concrete separating elements
- Applicability of test results to AS1530.4

3. Test reports

The following test reports were considered in the assessment:

Table 1 – Test reports considered in the assessment.

Test report #	Concrete Thickness	Test Orientation	Test Standard
PF23101	**120mm**	**Horizontal**	**AS 1530.4: 2014**
PF23102	**150mm**	**Vertical**	**AS 1530.4: 2014**
PF24003	**165mm**	**Horizontal**	**AS 1530.4: 2014**
PF24004	**120mm**	**Vertical**	**AS 1530.4: 2014**
PF24005	**120mm**	**Vertical**	**AS 1530.4: 2014**
PF24006	**165mm**	**Vertical**	**AS 1530.4: 2014**
PF24014	**165mm**	**Vertical**	**AS 1530.4: 2014**
22646A	**140mm***	**Vertical**	**EN 1363.1:2020**
13492A	**200mm***	**Vertical**	**EN 1363.1:1999**

*conducted in aerated concrete

4. Assessment Summary

4.1 Sealant installation and specification

Soudaseal FR is a high-quality, fire-resistant, smoke-tight, neutral, elastic, one-component joint and adhesive sealant based on SMX Polymer (Hybrid). Soudaseal FR properties are described as

- High level of fire retardation
- Permanently elastic after curing (without fire load)
- Outstanding bond strength on nearly all surfaces, even on slightly wet surfaces
- Very good mechanical characteristics
- Easy to use and apply, also under difficult circumstances.
- Colourfast and UV resistant
- Paintable
- No bubble formation within sealant (in high temperature and humidity applications)
- Does not contain isocyanates, solvents or halogens Applications

The following installation method shall be followed when using Soudaseal FR.

The substrate must be clean, dry and free from dust. The substrate shall be free from large cracks, crumbling of substrate or blow-outs. PEF backing rod shall be pressed into the linear joint, either from the non-fire side or from both sides, recessed to the required depth. Sealant shall be applied on top of the backing rod with excess sealant removed to be flush with the surface of the substrate.

5. Assessment results

5.1 Concrete Separating Element

5.1.1 Vertical Seals – Both Faces

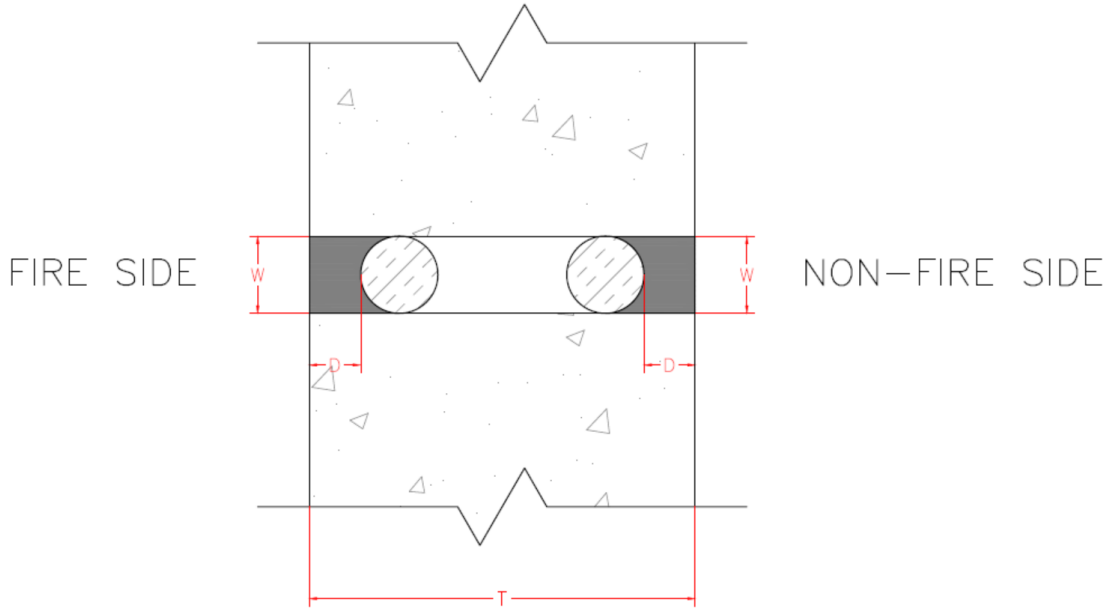


Figure 1 – Typical sealant insulation

Table 2 - Vertical seal performance in concrete when installed from both faces

Sealant Dimensions Width x Depth, mm	Minimum Thickness (T), mm		
	120mm	150mm	165mm
40 x 30	-/90/90	-/240/210	-/240/210
30 x 20	-/150/120	-/240/240	-/240/240
15 x 15	-/150/120	-/240/240	-/240/240
10 x 10	-/180/150	-/180/150	-/240/240

5.1.2 Vertical Seals – Non-Fire Side

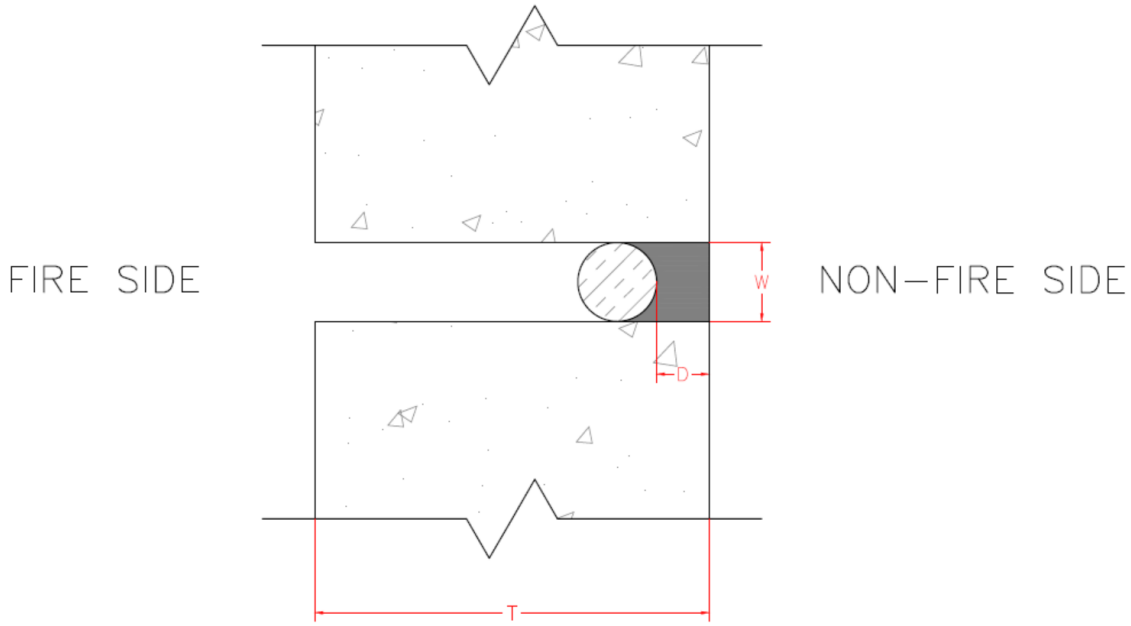


Figure 2 – Typical sealant insulation

Table 3 - Vertical seal performance in concrete when installed from non-fire side only

Sealant Dimensions Width x Depth, mm	Minimum Thickness (T), mm		
	120mm	150mm	165mm
40 x 30	-/180/90	-/240/150	-/240/150
30 x 20	-/60/60	-/60/60	-/240/60
15 x 15	-/180/90	-/180/90	-/240/180
10 x 10	-/180/120	-/180/120	-/240/240

5.1.3 Horizontal Seals – Both Sides

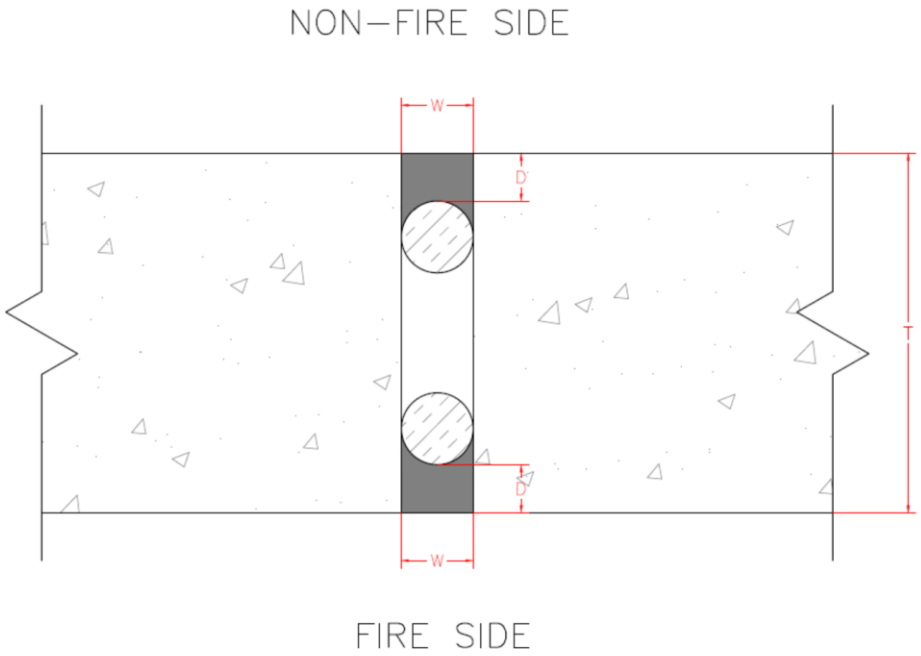


Figure 3 – Typical sealant insulation

Table 4 - Horizontal seal performance in concrete when installed from both faces

Sealant Dimensions Width x Depth, mm	Minimum Thickness (T), mm		
	120mm	150mm	165mm
40 x 30	-/180/150	-/180/150	-/240/240
30 x 20	-/180/150	-/180/150	-/240/240
15 x 15	-/180/150	-/180/150	-/240/240
10 x 10	-/180/180	-/180/180	-/240/240

5.1.4 Horizontal Seals – Non-Fire Side

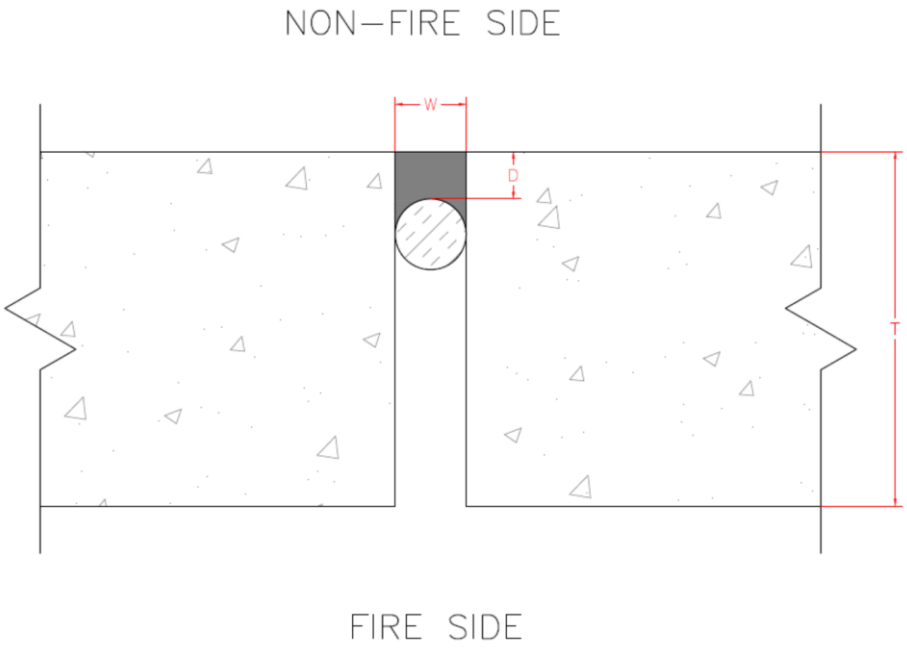


Figure 4 – Typical sealant insulation

Table 5 - Horizontal seal performance in concrete when installed from non-fire side only

Sealant Dimensions Width x Depth, mm	Minimum Thickness (T), mm		
	120mm	150mm	165mm
40 x 30	-/180/90	-/180/90	-/240/120
30 x 20	-/180/90	-/180/90	-/240/150
15 x 15	-/180/90	-/180/90	-/240/150
10 x 10	-/180/150	-/180/150	-/240/240

5.1.5 Wall-to-Floor Seals – Both Sides

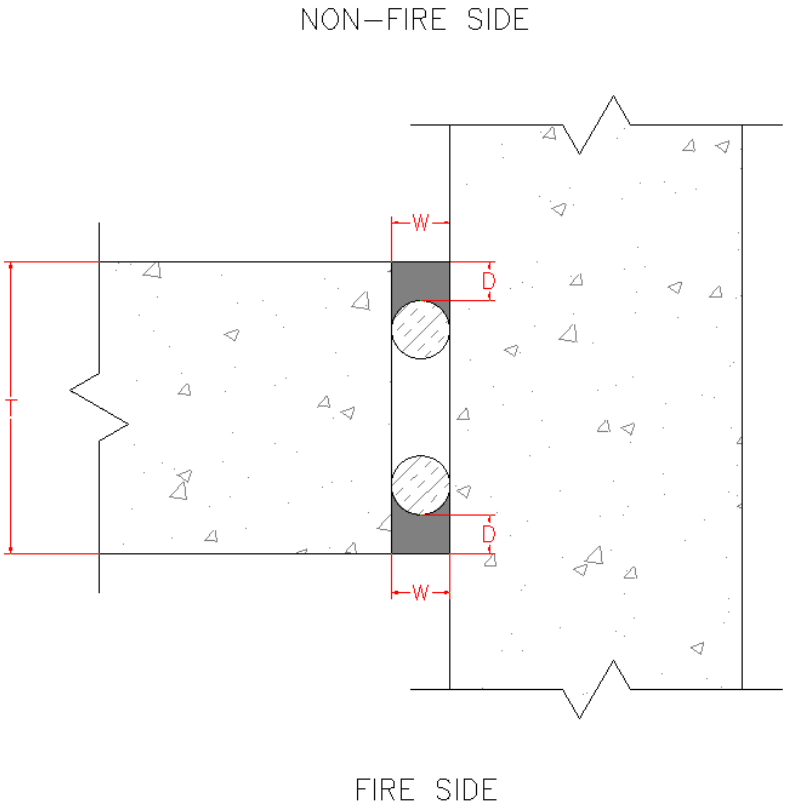


Figure 5 – Typical sealant insulation

Table 6 – Wall-to-floor joint performance in concrete when installed from both sides

Sealant Dimensions Width x Depth, mm	Minimum Thickness (T), mm		
	120mm	150mm	165mm
40 x 30	-/180/150	-/180/150	-/240/240
30 x 20	-/180/150	-/180/150	-/240/240
15 x 15	-/180/150	-/180/150	-/240/240
10 x 10	-/180/180	-/180/180	-/240/240

5.1.6 Wall-to-Floor Seals – Non-Fire Side

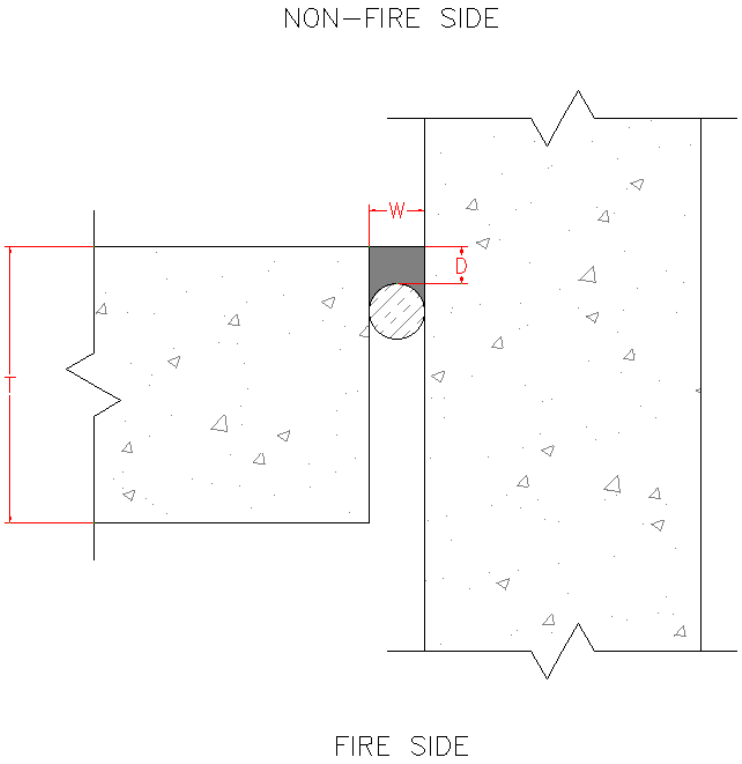


Figure 6 – Typical sealant insulation

Table 7 – Wall-to-floor joint performance in concrete when installed from non-fire side only

Sealant Dimensions Width x Depth, mm	Minimum Thickness (T), mm		
	120mm	150mm	165mm
40 x 30	-/180/90	-/180/90	-/240/120
30 x 20	-/180/90	-/180/90	-/240/150
15 x 15	-/180/90	-/180/90	-/240/150
10 x 10	-/180/150	-/180/150	-/240/240

5.2 Aerated Concrete Separating Element (550kg/m3)

5.2.1 Vertical Seals – Both Sides

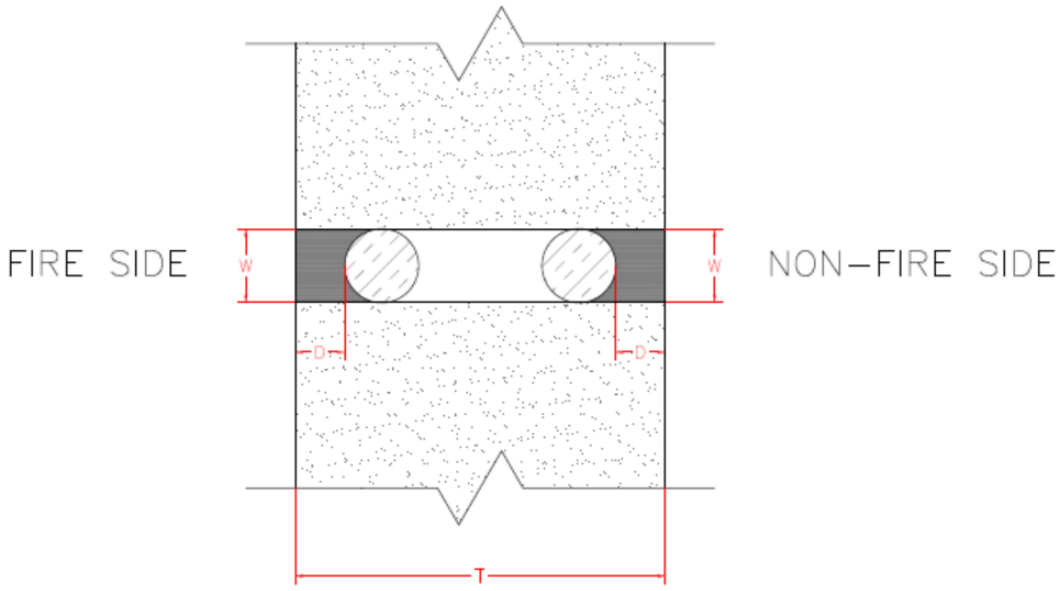


Figure 7 – Typical sealant insulation

Table 8 - Vertical seal performance in aerated concrete when installed from both sides

Sealant Dimensions Width x Depth, mm	Minimum Thickness (T), mm	
	140mm	200mm
30 x 20	-/120/120	-/240/240

5.2.2 Vertical Seals – Fire Side

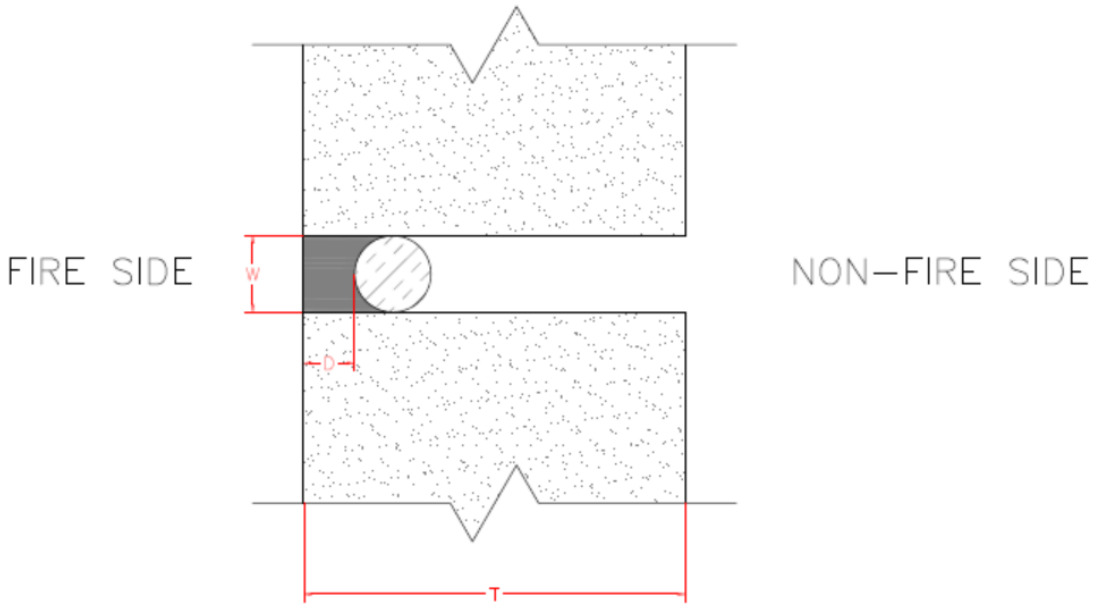


Figure 8 – Typical sealant insulation

Table 9 - Vertical seal performance in aerated concrete when installed from fire side

Sealant Dimensions Width x Depth, mm	Minimum Thickness (T), mm
	140mm
10 x 20	-/120/-
20 x 20	-/120/-
30 x 20	-/120/-

5.2.3 Vertical Seals – Non-Fire Side

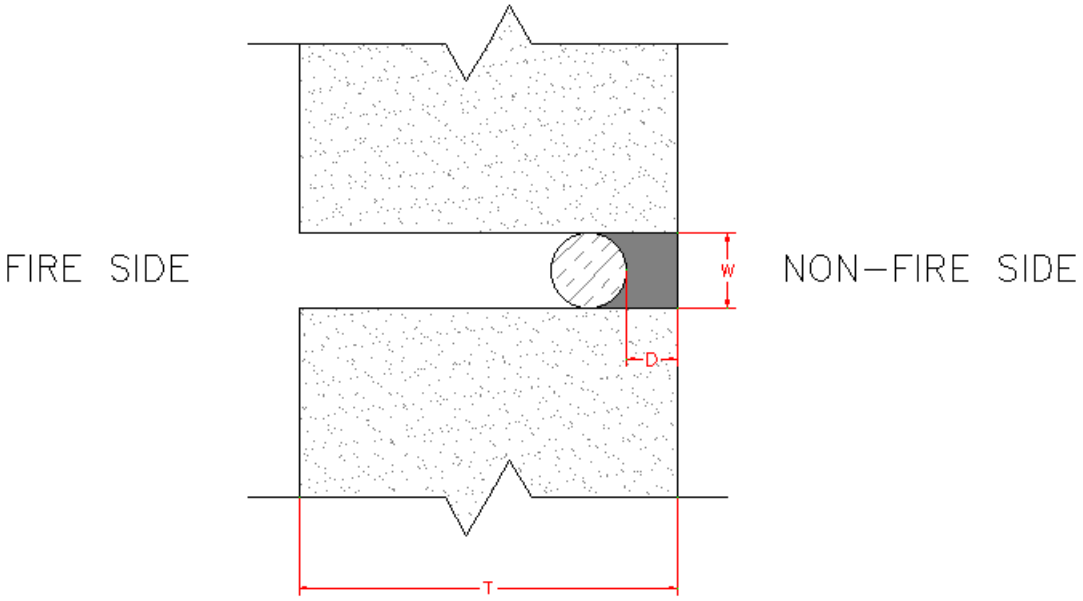


Figure 8 – Typical sealant insulation

Table 9 - Vertical seal performance in aerated concrete when installed from fire side

Sealant Dimensions Width x Depth, mm	Minimum Thickness (T), mm
	200mm
15 x 15	-/240/240

6. Conditions and limitations

The results obtained in the assessment are considered valid provided the following conditions and limitations are met.

- The concrete separating element shall be cleaned thoroughly so that there is no debris or dust prior to installation of the sealant
- There shall be no change in the cross-section of the joint over the length (that is, a single joint shall not have varying widths or varying depths of fire-stopping material)
- A facing material shall not be added to the fire-stopping system unless the facing material thickness is less than 2mm and has been subjected to a fire resistance test.
- The backing material shall not be varied from the tested fire-stopping system. Any variation shall be referred to the registered testing authority for confirmation that the backing material would not contribute to the fire resistance level of the tested system and will not reduce the fire resistance level
- Multiple seal systems shall have a spacing of not less than 200mm between seals.

7. Validity of the assessment

The assessment report is valid till 24/04/2029.

Any further variations with regards to size, construction details, stresses, edge or end conditions other than those identified in this report, may invalidate the conclusions drawn in this report.

This Assessment does not provide an endorsement by Fire TS Lab of the actual data provided.

The conclusions of this report may be used to directly assess the fire resistance performance under such conditions, but it should be acknowledged that a single test method will not provide a full assessment of the product under all fire conditions.

Because of the nature of fire resistance testing and the consequential difficulty in quantifying the uncertainty of measurement, it is not possible to provide a stated degree of accuracy. The inherent variability in testing procedures, materials and methods of construction and installation may lead to variations in performance between elements of similar construction.

This Assessment can only, therefore, relate to the actual prototype test specimens, testing conditions and methodology provided in the supporting data and does not imply any performance abilities of constructions of subsequent manufacture.

This Assessment is based on the information provided and experience available at the time of writing. The published procedures for the conduct of tests and the assessment of test results are subject to constant review and improvement and it is recommended that this document be reviewed on or before the stated expiry date. If contradictory evidence becomes available to the assessing authority, the assessment will be unconditionally withdrawn and the report sponsor 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 information contained in this document shall not be used for the assessment of variations other than those in the conclusions above. This document is valid providing no modifications are made to the systems described in this document.

All details of construction should be consistent with the requirements stated in the relevant test reports and all referenced documents.

8. Authority

By using this document as evidence of compliance of performance, the applicant(s) confirms that;

• to their knowledge the component or element of structure which is the subject of this assessment has not been subjected to a fire test to the standard against which this assessment is being made, and;

• they agree to withdraw this assessment from circulation should the component or element of the structure be subject to a fire test by a recognized test authority in accordance with the standard against which this assessment is being made and the results are not in agreement with this assessment and;

• they are not aware of any information that could adversely affect the conclusions of this assessment and if they subsequently become aware of any such information agree to ask the testing authority to withdraw the assessment.

This assessment may only be reproduced in full without modifications by the sponsor. Copies, extracts or abridgements of this report in any form shall not be published by other organisations or individuals without the permission of Fire TS Laboratory.

Appendix A – Discussion

Adhesion of sealant

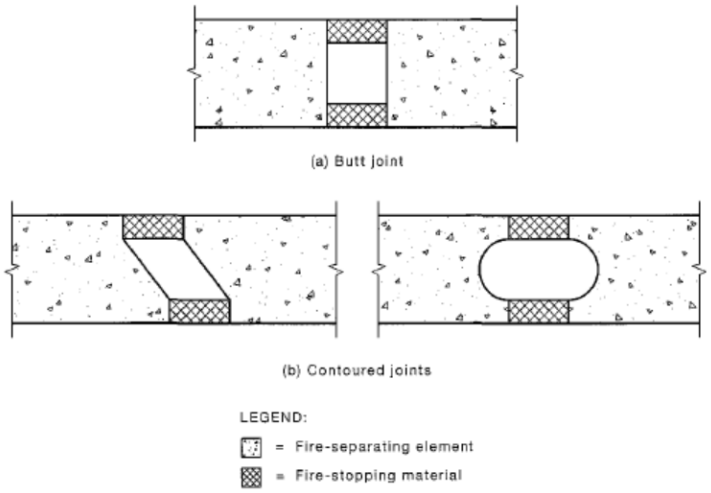
PF24004, PF24005 and PF24006 comprised of vertical control joints tested in a vertical concrete separating element. During the tests, it was observed that the outer layer of the seal was delaminating, and separating from the rest of the seal within the aperture. Following the delamination of the sealant, some specimen thermocouples became detached from the surface of the seal, and failure occurred shortly after. This phenomenon occurred in all tested seal widths and depths, and in all test orientations ("Both" and "NFS"), with the larger area seals (40mm x 30mm and 30mm x 20mm) being affected more severely than the smaller area seals. The premature failure also occurred in both 120mm and 165mm slab thicknesses. After a failure mechanism investigation and discussions with client representatives, it was determined that the delamination of the seal was likely caused by residual concrete dust from the separating element construction within the linear gap during sealant installation.

PF23102 and PF24014 comprised of a range of vertical control joints tested in a vertical concrete separating element. The delamination and detachment of sealant was not observed and premature failure did not occur, which produced more consistent and higher FRL ratings. This confirms the ability of the joint-sealing system to remain in place during fire conditions when installed in a vertical separating element across the range of tested seal areas

PF23101 and PF24003 comprised of a range of control joints tested in a horizontal concrete separating element. The delamination and detachment of sealant was not observed and premature failure did not occur, which produced more consistent and higher FRL ratings. This confirms the ability of the joint-sealing system to remain in place during fire conditions when installed in a horizontal separating element, across the range of tested seal areas.

Application of seals in contoured joints.

AS1530.4 states the results obtained from a single test on a butt joint may be applied to contoured joints provided that the joints have equal width and equal or greater depth of sealant, and equal or greater thickness of the fire-separating element. Provided this condition is met, the joint-sealing system may be applied in the following configurations.



Increase in concrete slab thickness

Test PF23102 comprised of two vertical 40mm x 30mm seals and two vertical 30mm x 20mm seals installed into a 150mm vertical concrete separating element. ‘Non-fire side’ and ‘both side” orientations were tested for each seal size. The tested seals demonstrated their ability to achieve an FRL of up to -/240/240 (refer to tables above for specific results). In the opinion of the laboratory, it is likely that an increase in separating thickness from 150mm to 165mm would not negatively influence the performance of the seals, provided the conditions and limitations are met.

Test PF24005 comprised of two vertical 15mm x 15mm seals and two vertical 10mm x 10mm seals installed into a 120mm vertical concrete separating element. ‘Non-fire side’ and ‘both side” orientations were tested for each seal size. The tested seals demonstrated their ability to achieve an FRL of up to -/180/150 (refer to tables above for specific results). The results acquired in Test 13492A further demonstrates that the seals can achieve an FRL of up to -/240/240 and that the FRL was not reduced when the seal was tested in a thicker concrete separating element. In the opinion of the laboratory, it is likely that an increase in separating thickness from 120mm to 150mm would not negatively influence the performance of the seals, provided the conditions and limitations are met.

Test PF24004 comprised of two vertical 40mm x 30mm seals and two vertical 30mm x 20mm seals installed into a 120mm vertical concrete separating element. ‘Non-fire side’ and ‘both side” orientations were tested for each seal size. The tested seals demonstrated their ability to achieve an FRL of up to -/180/90 (refer to tables above for specific results). While it is likely that the performance of the specimens was negatively influenced by improper surface preparation, further testing is required to achieve a higher FRL. In the opinion of the laboratory, it is likely that an increase in separating thickness from 120mm to 150mm would not negatively influence the performance of the seals, provided the conditions and limitations are met.

Test PF23101 comprised of two 40mm x 30mm seals, one 30mm x 20mm seal, and two 10mm x 10mm seals installed into a 120mm horizontal concrete separating element. ‘Non-fire side’ and ‘both side” orientations were tested for each seal size. The tested seals demonstrated their ability to achieve an FRL of up to -/180/180 (refer to tables above for specific results). In the opinion of the laboratory, it is likely that an increase in separating thickness from 120mm to 150mm would not negatively influence the performance of the seals, provided the conditions and limitations are met.

Interpolation of horizontal test specimens

Test PF24003 comprised of two 40mm x 30mm seals, one 30mm x 20mm seal, and two 10mm x 10mm seals installed into a 165mm horizontal concrete separating element. ‘Non-fire side’ and ‘both side” orientations were tested for each seal size. The tested seals demonstrated their ability to achieve an FRL of up to -/240/240 (refer to tables above for specific results).

Test PF23101 comprised of two 40mm x 30mm seals, one 30mm x 20mm seal, and two 10mm x 10mm seals installed into a 120mm horizontal concrete separating element. ‘Non-fire side’ and ‘both side” orientations were tested for each seal size. The tested seals demonstrated their ability to achieve an FRL of up to -/180/180 (refer to tables above for specific results).

During the range of tests, a maximum and minimum seal size was tested. Using the results, a conservative interpolation was conducted. In the opinion of the laboratory, it is likely that a sealing system measuring 15 x 15mm on both sides would achieve an FRL of up to -/180/150 if installed in a minimum 120mm slab, and up to -/240/240 if installed in a minimum 165mm slab. It is likely that a sealing system measuring 15 x 15mm on the non-fire side would achieve an FRL of up to -/180/90 if installed in a minimum 120mm slab, and up to -/240/150 if installed in a minimum 165mm slab.

In the opinion of the laboratory, it is likely that a sealing system measuring 30 x 20mm on both sides would achieve an FRL of up to -/240/240 if installed in a minimum 165mm slab. It is likely that a sealing system measuring 30 x 20mm on the non-fire side would achieve an FRL of up to -/180/90 if installed in a minimum 120mm slab, and up to -/240/150 if installed in a 165mm slab.

Floor to wall joint

Tests PF24003 and PF23101 demonstrated the ability of the sealing system to remain in place for the duration of each test across the range of tested sizes. This test orientation is considered more onerous than a floor-to-wall joint. In the opinion of the laboratory, results obtained from horizontal test specimens may be directly applied to the floor-to-wall joints with equivalent floor thicknesses as assessed.

Applicability of test 22646A and 13492A

Test 22646A comprised of four horizontal seals installed into a vertical aerated concrete separating element. Three of the seals (R, S, T) were installed from the fire-side only, installed onto PU rods. To measure the maximum temperature of the seals, a MIMS thermocouple was inserted into the cavity and pressed against the back of the PU rod. AS1530.4 requires the use of copper disc thermocouples in accordance with clause 2.2.3. In the opinion of the laboratory, the results recorded by the MIMS thermocouples are not able to be compared to results recorded by the more sensitive copper disc thermocouples, and therefore shall not be used to assign an equivalent FRL for seals R, S and T.

In contrast, seal Q was installed from both sides and used thermocouples compliant with clause 2.2.3, installed in accordance with clause 10.5.1. All thermocouples of test 13492A were also compliant with clause 2.2.3 and installed in accordance with clause 10.5.1. This is consistent with the requirements of AS1530.4 and therefore can be used to assign an equivalent FRL.

At the conclusion of both the tests, there were no instances of ignition of cotton pad or spontaneous and sustained flaming, and therefore no integrity failures. This is consistent with the requirements of AS1530.4 and therefore can be used to assign an equivalent FRL.

Specimens of tests 22646A and 13492A were measured to be 1000mm in length. To increase the length of the seal, AS1530.4 requires that at least one test in a horizontal orientation is carried out to examine the ability of a joint-sealing system to remain in place during fire conditions.

Variation of separating element density

For elements manufactured from similar types of concrete or masonry, the result of the prototype test may be applied to materials of density within ±15% of the tested specimen. Therefore, seals may be installed in aerated concrete separating elements within the range of 467.5- 632.5kg/m3.

Appendix B – Supporting Data

Test PF23101

The test was conducted as per AS 1530.4-2014 Section 10 – Service Penetrations and Control Joints and AS 4072.1-2005 - Service Penetrations and Control Joints on 14/12/2023. No departures from the testing method occurred.

The test comprised of 5 control joint sealing systems in a horizontal concrete separating element. The joints were installed to a 120mm (nominal) thick concrete slab. PEF Rod lengths were installed into the joint with the PEF Rod at the corresponding depth from the surface of the concrete slab. Sealant was applied to the joint, flush with the surface of the concrete slab. The seal length was measured to be 1200mm. The ends of each seal were packed with ceramic fibre.

Specimen #	Joint	Actual Integrity (min)	Actual insulation (min)	FRL
A	40mm × 30mm sealant to non-fire side only	181 NF	115 minutes	-/180/90
B	10mm × 10mm sealant to non-fire side only	181 NF	169 minutes	-/180/150
C	10mm × 10mm sealant to both sides	181 NF	181 minutes	-/180/180
D	30mm × 20mm sealant to both sides	181 NF	160 minutes	-/180/150
E	40mm × 30mm sealant to both sides	181 NF	179 minutes	-/180/150

The test was terminated at 181 minutes. No integrity failure was observed during the test.

For specimens A - E, insulation failure was recorded by thermocouples attached to the separating element, 25mm from the seal.

Test PF23102

The test was conducted as per AS 1530.4-2014 Section 10 – Service Penetrations and Control Joints and AS 4072.1-2005 - Service Penetrations and Control Joints on 13/12/2023. No departures from the testing method occurred.

The test comprised of 4 vertical control joint sealing systems in a vertical concrete separating element. The joints were installed to a 150mm (nominal) thick concrete slab. PEF Rod lengths were installed into the joint with the PEF Rod at the corresponding depth from the surface of the concrete slab. Sealant was applied to the joint, flush with the surface of the concrete slab. The seal length was measured to be 1200mm. The ends of each seal were packed with ceramic fibre.

Specimen #	Joint	Actual Integrity (min)	Actual insulation (min)	FRL
A	40mm × 30mm sealant to non-fire side only	243 NF	173 minutes	-/240/150
B	15mm × 15mm sealant to both faces	243 NF	243 NF	-/240/240
C	30mm × 20mm sealant to both faces	243 NF	243 NF	-/240/240
D	40mm × 30mm sealant to both faces	243 NF	229 minutes	-/240/210

The test was terminated at 243 minutes. No integrity failure was observed during the test.

For specimens A and D, insulation failure was recorded by thermocouples attached to the separating element, 25mm from the seal.

Test PF24003

The test was conducted as per AS 1530.4-2014 Section 10 – Service Penetrations and Control Joints and AS 4072.1-2005 - Service Penetrations and Control Joints on 10/01/2024. No departures from the testing method occurred.

The test comprised of 5 control joint sealing systems in a horizontal concrete separating element. The joints were installed to a 165mm (nominal) thick concrete slab. PEF Rod lengths were installed into the joint with the PEF Rod at the corresponding depth from the surface of the concrete slab. Sealant was applied to the joint, flush with the surface of the concrete slab. The seal length was measured to be 1200mm. The ends of each seal were packed with ceramic fibre.

Specimen	Joint	Actual Integrity (min)	Actual Insulation (min)	FRL
A	30mm × 20mm sealant to non-fire side only	243 NF	159 minutes	-/240/150
B	40mm × 30mm sealant to non-fire side only	243 NF	131 minutes	-/240/120
C	10mm × 10mm sealant to both faces	243 NF	243 NF	-/240/240
D	40mm × 30mm sealant to both faces	243 NF	243 NF	-/240/240
E	10mm × 10mm sealant to non-fire side only	243 NF	243 minutes	-/240/240

The test was terminated at 243 minutes. No integrity failure was observed during the test.

For specimens A and E, insulation failure was recorded by thermocouples attached to the separating element, 25mm from the seal. For specimen B, insulation failure was recorded by thermocouples attached directly to the seal.

Test PF24004

The test was conducted as per AS 1530.4-2014 Section 10 – Service Penetrations and Control Joints and AS 4072.1-2005 - Service Penetrations and Control Joints on 12/01/2024. No departures from the testing method occurred.

The test comprised of 4 vertical control joint sealing systems in a vertical concrete separating element. The joints were installed to a 120mm (nominal) thick concrete slab. PEF Rod lengths were installed into the joint with the PEF Rod at the corresponding depth from the surface of the concrete slab. Sealant was applied to the joint, flush with the surface of the concrete slab. The seal length was measured to be 1200mm. The ends of each seal were packed with ceramic fibre.

Specimen	Joint	Actual Integrity (min)	Actual Insulation (min)	FRL
A	30mm × 20mm sealant to non-fire side only	75 minutes	75 minutes	-/60/60
B	30mm × 20mm sealant to both faces	151 minutes	147 minutes	-/150/120
C	40mm × 30mm sealant to non-fire side only	184 NF	102 minutes	-/180/90
D	40mm × 30mm sealant to both faces	99 minutes	99 minutes	-/90/90

The test was terminated at 184 minutes. Specimens A, B and D failed the integrity criteria at 75 minutes, 151 minutes and 99 minutes respectively. It was observed that a red glow was visible from a gap that had formed between the separating element and the sealant in each of these cases. A cotton pad was applied over the red glow for 30 seconds, resulting in combustion and therefore integrity failure.

For specimens A and D, insulation failure occurred at the time of integrity failure.

For specimen B, insulation failure was recorded by thermocouples attached directly to the seal at the location of integrity failure shortly after.

For specimen C, insulation failure was recorded by thermocouples attached to the separating element, 25mm from the seal.

Test PF24005

The test was conducted as per AS 1530.4-2014 Section 10 – Service Penetrations and Control Joints and AS 4072.1-2005 - Service Penetrations and Control Joints on 18/01/2024. No departures from the testing method occurred.

The test comprised of 4 vertical control joint sealing systems in a vertical concrete separating element. The joints were installed to a 120mm (nominal) thick concrete slab. PEF Rod lengths were installed into the joint with the PEF Rod at the corresponding depth from the surface of the concrete slab. Sealant was applied to the joint, flush with the surface of the concrete slab. The seal length was measured to be 1200mm. The ends of each seal were packed with ceramic fibre.

Specimen	Joint	Actual Integrity (min)	Actual Insulation (min)	FRL
A	10mm × 10mm sealant to both faces	181 NF	154	-/180/150
B	10mm × 10mm sealant to non-fire side only	181 NF	147	-/180/120
C	15mm × 15mm sealant to both faces	168	146	-/150/120
D	15mm × 15mm sealant to non-fire side only	181 NF	114	-/180/90

The test was terminated at 181 minutes. Specimen C failed the integrity criteria at 168 minutes. It was observed that a red glow was visible from a gap that had formed between the separating element and the sealant, which developed into an open flame for > 10 seconds, resulting in integrity failure.

For specimens A - D, insulation failure was recorded by thermocouples attached to the separating element, 25mm from the seal.

Test PF24006

The test was conducted as per AS 1530.4-2014 Section 10 – Service Penetrations and Control Joints and AS 4072.1-2005 - Service Penetrations and Control Joints on 16/01/2024. No departures from the testing method occurred.

The test comprised of 4 vertical control joint sealing systems in a vertical concrete separating element. The joints were installed to a 165mm (nominal) thick concrete slab. PEF Rod lengths were installed into the joint with the PEF Rod at the corresponding depth from the surface of the concrete slab. Sealant was applied to the joint, flush with the surface of the concrete slab. The seal length was measured to be 1200mm. The ends of each seal were packed with ceramic fibre.

Specimen	Joint	Actual Integrity (min)	Actual Insulation (min)	FRL
A	40mm × 30mm sealant to non-fire side only	243 NF	152	-/240/150
C	30mm × 20mm sealant to non-fire side only	243 NF	86	-/240/60

The results of specimens B and D were excluded from the assessment as the performance was negatively affected by surface conditions.

The test was terminated at 243 minutes.

For specimens A, insulation failure was recorded by thermocouples attached to the separating element, 25mm from the seal.

For specimens C, insulation failure was recorded by thermocouples attached to the separating element, 25mm from the seal.

Test PF24014

The test was conducted as per AS 1530.4-2014 Section 10 – Service Penetrations and Control Joints and AS 4072.1-2005 - Service Penetrations and Control Joints on 16/01/2024. No departures from the testing method occurred.

The test comprised of 4 vertical control joint sealing systems in a vertical concrete separating element. The joints were installed to a 165mm (nominal) thick concrete slab. PEF Rod lengths were installed into the joint with the PEF Rod at the corresponding depth from the surface of the concrete slab. Sealant was applied to the joint, flush with the surface of the concrete slab. The seal length was measured to be 1200mm. The ends of each seal were packed with ceramic fibre.

Specimen	Joint	Actual Integrity (min)	Actual Insulation (min)	FRL
A	10mm × 10mm sealant to non-fire side only	243 NF	243 NF	-/240/240
B	10mm × 10mm sealant to both faces	243 NF	243 NF	-/240/240
C	15mm × 15mm sealant to both faces	243 NF	243 NF	-/240/240
D	15mm × 15mm sealant to non-fire side only	243 NF	182 minutes	-/240/180

The test was terminated at 243 minutes. No integrity failure was observed during the test.

For specimen D, insulation failure was recorded by thermocouples attached to the separating element, 25mm from the seal.

Test 22646A

The test was conducted as per EN 1363-1:2020 and EN 1366-4:2021 on 09/03/2023. No departures from the testing method occurred.

The relevant test specimens comprised of 4 horizontal control joint sealing systems in a vertical rigid aerated concrete separating element. The joints were installed to a 140mm (nominal) thick rigid aerated concrete wall (density 550kg/m^3), with 1000mm sections cut from the wall to accommodate the joints. PU foam backer rod lengths were installed into the joint with the PU Rod at the corresponding depth from the surface of the aerated concrete wall. Sealant was applied to the joint, flush with the surface of the wall. The seal length was measured to be 1000mm.

Specimen	Joint	Actual Integrity (min)	Actual Insulation (min)	Equivalent FRL
Q	30mm × 20mm sealant to both faces	132 NF	132 NF	-/120/120
R	10mm × 20mm sealant to fire side only	132 NF	29 minutes	-/120/-
S	20mm × 20mm sealant to fire side only	132 NF	30 minutes	-/120/-
T	30mm × 20mm sealant to fire side only	132 NF	28 minutes	-/120/-

The test was terminated at 132 minutes. No integrity failure was observed during the test.

For specimens R - T, insulation failure was recorded by sheathed thermocouples in contact with the PU foam backer, within the linear joint.

Test 13492A

The test was conducted as per EN 1363-1:1999 and EN 1366-4:2006 on 25/11/2008. No departures from the testing method occurred.

The relevant test specimens comprised of 2 vertical control joint sealing systems in a vertical rigid aerated concrete separating element. The joints were installed to a 200mm (nominal) thick rigid aerated concrete wall (density 550kg/m^3), with 1000mm sections cut from the wall to accommodate the joints. PE backer rod lengths were installed into the joint with the PE Rod at the corresponding depth from the surface of the concrete slab. Sealant was applied to the joint, flush with the surface of the concrete slab. The seal length was measured to be 1000mm.

Specimen	Joint	Actual Integrity (min)	Actual Insulation (min)	Equivalent FRL
C	15mm × 15mm sealant to non-fire side only	240 NF	240 NF	-/240/240
H	30mm × 20mm sealant to both sides	240 NF	240 NF	-/240/240

The test was terminated at 240 minutes. No integrity or insulation failure was observed during the test.

Appendix C – Applicability of Test Results

A technical comparison between AS 1530.4 and EN 1363-1 / EN 1366-4 was conducted to evaluate the applicability of the test results of test reports 22646A and 13492A. The assessment outcomes derived from the test reports listed above may be used for the determination of likely fire resistance performance of the control joints in line with the general principles of AS 1530.4:2014 and AS 4072.1:2005.

Furnace Temperature measurement

The furnace thermocouples of AS1530.4 shall be K-type mineral insulated metal sheathed (MIMS) with a stainless-steel sheath having wire diameter less than 1.0 mm and an overall diameter of 3 mm. The MIMS thermocouple shall be supported such that the measuring junction protrudes a minimum of 25mm from the support. The thermocouples shall be replaced every 40 h.

The minimum number of thermocouples used to measure furnace temperature shall be the greater of four, or for planar or multiple specimen tests, the nearest whole number to the area of the furnace opening in square metres multiplied by 0.6. Thermocouples are located initially 100 mm from the face of the test specimen and maintained, where practicable, at a distance of 50 to 150 mm during the test. The thermocouples used to measure the temperature of the furnace shall be uniformly distributed to give a reliable indication of the average temperature in the vicinity of the test specimen.

The furnace thermocouples of EN 1363.1 shall be plate thermometers comprised of a folded austenitic nickel-based superalloy plate, a 1-3mm K type MIMS thermocouple and an inorganic insulation pad. The folded metal plate shall have the nominal dimensions 150mm x 100mm x 0.7mm. The inorganic insulation pad shall have the nominal dimensions 97mm x 97mm x 10mm. The thermocouple hot junction shall be fixed to the geometric centre of the plate by a small strip made from the same material as the plate. Before the plate thermometers are first used, the folded plate part shall be aged in a preheated oven at 1 000 °C for 1 h, or in a fire resistance furnace for 90 min during a standard temperature/time curve test. The thermocouple and the insulation pad shall be replaced after 50 h exposure in the furnace.

The plate thermometer shall be located in a plane 100 mm from the exposed face of the separating element. At least one thermometer shall be provided for every 1,5 m2 of the heated area of the test construction, subject to a minimum number of four thermometers for each test construction. These thermometers shall be symmetrically distributed with respect to the heated area of the test construction. For vertical test constructions, the plate thermometers shall be oriented so that side 'A' faces the walls of the furnace opposite the test construction being evaluated.

It was determined that the furnace thermocouple requirements of AS1530.4 are deemed to be more onerous. It is likely that the MIMS thermocouples are more sensitive to temperature changes than the insulated plate thermometers.

Furnace Pressure conditions

AS 1530.4 requires that a pressure of 15 ± 3 Pa shall be established at the centre of a single horizontal penetration within a vertical separation element that has a maximum height of <1m. If a single horizontal penetration is tested in a vertical separation element that has a height of more than 1m, it shall be tested with a pressure of 20 ±3pa at the top of the separation element and in such cases the horizontal penetrating services shall be included in the zone where positive pressure exceeds 10Pa

EN 1366.4 requires that a vertical furnace shall be operated so that a minimum pressure of 15 Pa exists in the centre of the test specimen mounted in the lowest position.

For this specific application, the furnace pressure conditions requirements are similar between standards.

Specimen Size

AS 1530.4 requires that for control joints, the test assembly shall not be less than 1m x 1m and the length of the control joint exposed to the furnace chamber shall be not less than 1m.

EN 1366.4 requires that a linear joint seal shall be the maximum length that can be accommodated in the separating element selected for the test. For non-movement control joints, a shorter length may be used subject to a minimum of 900 mm.

The furnace thermocouple requirements of AS1530.4 are deemed to be slightly more onerous, however, the range of tested specimens were all ≥1m, therefore both requirements were met.

Specimen Thermocouples

AS 1530.4 requires that the thermocouples used for insulation measurement shall be K-type and have a wire diameter not exceeding 0.5mm. Each thermocouple shall have the tail of its measuring junction attached by silver soldering to the face of a 12 mm x 0.2 mm copper disc. Each thermocouple shall be covered with a 30mm x 30mm x 2.0mm thick inorganic insulating pad, cut to accommodate the thermocouple wires. The pad material shall have a density of 900 ±100 kg/m3. The disc and pad shall be pressed against the surface in such a way as will ensure that the disc is in firm contact with the surface of the test specimen. The measuring and recording equipment shall operate with a tolerance of ±4K

EN 1363.1 requires that the thermocouples used for insulation measurement shall be K-type and have a wire diameter of 0.5mm. K Type thermocouple wires shall be

soldered to the face of a 12 mm x 0.2 mm copper disc. It is also permitted to use thermocouples whose wires have been twisted together and then soldered to the copper disc. Each thermocouple shall be covered with a 30mm x 30mm x 2.0mm thick silicate-fibre-based insulating pad, cut to accommodate the thermocouple wires. The pad material shall have a density of 900 ±100 kg/m3. The disc and pad shall be fixed to the specimen, taking care to ensure that the air gap between them, if any, is a minimum. The measuring and recording equipment shall operate with a tolerance of ±4K

The specimen thermocouple requirements are similar between standards

Thermocouple Positioning

AS 1530.4 requires that for control joints:

- At least three on the surface of the seal, with one thermocouple for each 0.3m2 of surface area, up to a maximum of five, uniformly distributed over the area (one thermocouple being located at the centre of the seal)
- On the surface of the separating element, 25 mm from the edge of the opening, with one thermocouple for each 500 mm of the perimeter.
-

Thermocouples used for the evaluation of the insulation performance of control joints shall be positioned on the unexposed face of the sealing system and the separating element except where the unexposed face of the seal is recessed within the separating element. Where this occurs, thermocouples shall only be fitted to the seal when the joint width is greater than or equal to 12mm. Under these circumstances, the size of the pad may be reduced to facilitate the fitting of the thermocouple

EN 1366.4 shows the typical thermocouple layout for linear joints tested with a small-scale furnace in Figure 6. The figure includes:

- Three thermocouples on the surface of the seal, with one thermocouple at the centre of the seal, and two at equal distances from the centre thermocouple
- Four thermocouples on the surface of the separating element, ≤15 mm from the seal. Two thermocouples on each side, at approximately 1/3 and 2/3 of the length of the seal.
- Where a splice is included in the seal, an additional thermocouple shall be placed on top of the splice.

If a linear joint seal is recessed from the unexposed face of the supporting construction and the linear joint seal is less than 12 mm wide, thermocouples shall be installed on the supporting construction at a distance of not more than 15 mm from the joint seal

The thermocouple positioning requirements of AS1530.4 are deemed to be more onerous, as it requires an additional 2 thermocouples on the separating element. However, for the tested range, it is not likely that the additional two thermocouples would negatively influence the performance of the specimens.

Insulation Criteria

AS 1530.4 states that the specimen shall be deemed to have failed when the average temperature of the unexposed face of the test specimen exceeds the initial temperature by more than 140 K; or the temperature at any location on the unexposed face of the test specimen exceeds the initial temperature by more than 180 K.

EN 1363.1 states that the measurement of insulation performance is made by thermocouples on the unexposed face compared to the initial temperature. The specimen shall maintain its separating function without an increase of the average temperature above the initial average temperature by more than 140 K; or an increase at any location (including the roving thermocouple) above the initial average temperature by more than 180 K.

The insulation criteria are similar between standards.

Integrity Criteria

AS 1530.4 states that the measurements of the integrity of the test specimen shall be made by cotton pad, gap gauges or sustained flaming. The gap gauges shall not be used to evaluate integrity.

- Cotton Pad: The cotton pad in its frame shall be applied against the surface of the test specimen until ignition of the cotton pad or for a period of 30±2 s. Integrity failure shall be deemed to have occurred upon ignition of the cotton pad, defined as glowing or flaming.
- Flaming: sustained flaming on the surface of the unexposed face for 10 seconds or longer shall be deemed to be an integrity failure.

EN 1364.1 states that the integrity is the times in completed minutes for which the test specimen continues to maintain its separating function during the test without causing the ignition of a cotton pad applied, permitting the penetration of a gap gauge or resulting in sustained flaming. Integrity shall be determined in accordance with EN 1363-1, except that the gap gauges shall not be used.

- Cotton Pad: A cotton pad is employed by placing the frame against the surface of the test specimen for a maximum of 30 s, or until ignition (defined as glowing or flaming) of the cotton pad occurs. Charring of the cotton pad without flaming or glowing shall be ignored.
- The occurrence and duration of any flaming on the unexposed surface, together with the location of the flaming, shall be recorded.

The integrity criteria are similar between standards.

It was determined that the standards are relatively similar, with only minor differences between the testing standards. In the opinion of the laboratory, it is not likely that the performance of the range of tests would be negatively influenced if tested in accordance with AS 1530.4. Therefore, the application of test data to AS 1530.4 can be positively assessed, and an equivalent FRL can be assigned.