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Fire assessment report

Assessment of FireStrip-ALX linear gap seals

Client: Boss Products (Australia) Pty Ltd

Job number: FAS190039 Revision: R1.0

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Amendment schedule

Version	Date	Information relating to report			
R1.0	Issue: 14/11/2019	Reason for issue	Report issued to BOSS Fire and Safety for review and comment.		
			Prepared by	Reviewed by	Approved by
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General conditions of use

Executive summary

This report documents the findings of the assessment undertaken to determine the likely fire resistance level (FRL) and / or performance of various linear gaps protected with BOSS FireStrip-ALX linear gap seals if tested in general accordance with AS 1530.4:2014[1] and assessed in general accordance with AS 4072.1-2005[2].

Assessment 1 described in section 5 of this report found that the proposed variations are likely to achieve the FRLs shown in Table 1, if tested in general accordance with AS 1530.4:2014 and assessed in general accordance with AS 4072.1-2005.

Table 1 Assessment 1 variations and outcomes

Joint	Ref. test	Max. gap width (mm)	Floor/ wall separating element details			Local fire protection	FRL
			Type	Min. Density (kg/m^3)	Min. thickness (mm)		
A1	Chilt/IF03 047	15	Autoclaved aerated concrete	525	140	BOSS FireStrip-ALX sealant, minimum depth of 25mm, on the unexposed side	-/240/90
A2		25				BOSS FireStrip-ALX sealant, minimum depth of 50mm, on the unexposed side	-/240/60
A3		50				BOSS FireStrip-ALX sealant, minimum depth of 75mm, on the unexposed side	-/240/180
A4		100				BOSS FireStrip-ALX sealant, minimum depth of 100mm, on the unexposed side	-/180/180
E1		15				BOSS FireStrip-ALX sealant, minimum depth of 25mm, on the unexposed side	-/240/240
E2		25				BOSS FireStrip-ALX sealant, minimum depth of 50mm, on the unexposed side	-/240/240
E3		50				BOSS FireStrip-ALX sealant, minimum depth of 75mm, on the unexposed side	-/240/240
E4		100				BOSS FireStrip-ALX sealant, minimum depth of 100mm, on the unexposed side	-/120/120

Assessment 2 described in section 6 of this report found that the proposed variations are likely to achieve the outcomes shown in Table 2, if tested in general accordance with AS 1530.4:2014 and AS 4072.1-2005.

[1] Methods for fire tests on building materials, components and structures Fire-resistance tests for elements of construction.
[2] Components for the protection of openings in fire-resistant separating elements Service penetrations and control joints.

Table 2 Assessment 2 variations and outcomes

Joint	Ref. test	Max. gap width (mm)	Floor/ wall separating element details			Local fire protection	FRL
			Type	Min. Density (kg/m^3)	Min. thickness (mm)		
B1	WF 148052	25	Autoclaved aerated concrete	670	250	BOSS FireStrip-ALX sealant, minimum depth of 12mm, on the unexposed side	-/120/0
B2		50				BOSS FireStrip-ALX sealant, minimum depth of 25mm, on the unexposed side	-/30/0
B3		150				BOSS FireStrip-ALX sealant, minimum depth of 100mm, on the unexposed side	-/120/120
C1	WF 160399	10				BOSS FireStrip-ALX sealant, minimum depth of 12mm, on the unexposed side	-/240/*
C2		35				BOSS FireStrip-ALX sealant, minimum depth of 20mm, on the unexposed side	-/240/60
C3		50				BOSS FireStrip-ALX sealant, minimum depth of 25mm, on the exposed side	-/240/0
C4		75				BOSS FireStrip-ALX sealant, minimum depth of 50mm, on both sides	-/240/60
F1	WF 148052	25	Autoclaved aerated concrete			BOSS FireStrip-ALX sealant, minimum depth of 12mm, on the unexposed side	-/120/0
F2		50				BOSS FireStrip-ALX sealant, minimum depth of 25mm, on the unexposed side	-/90/90
F3		150				BOSS FireStrip-ALX sealant, minimum depth of 100mm, on the unexposed side	-/120/120
G1	WF 160399	10				BOSS FireStrip-ALX sealant, minimum depth of 12mm, on the unexposed side	-/240/*
G2		35				BOSS FireStrip-ALX sealant, minimum depth of 20mm, on the unexposed side	-/180/60

Joint	Ref. test	Max. gap width (mm)	Floor/ wall separating element details			Local fire protection	FRL
			Type	Min. Density (kg/m^3)	Min. thickness (mm)		
G3		50				BOSS FireStrip-ALX sealant, minimum depth of 25mm, on the exposed side	-/60/30
G4		75				BOSS FireStrip-ALX sealant, minimum depth of 50mm, on both sides	-/240/90
*Gap size too small to fit thermocouple (10mm).							

Assessment 3 described in section 7 of this report found that the proposed variations are likely to achieve the outcomes shown in Table 3, if tested in general accordance with AS 1530.4:2014 and AS 4072.1-2005.

Table 3 Assessment 3 variations and outcomes

Joint	Ref. test	Max. gap width (mm)	Floor/ wall separating element details			Local fire protection	FRL
			Type	Min. Density (kg/m^3)	Min. thickness (mm)		
D1	WF 157402	10	Autoclaved aerated concrete	670	250	BOSS FireStrip-ALX sealant, minimum depth of 12mm, on the unexposed side	-/120/30
D2		25				BOSS FireStrip-ALX sealant, minimum depth of 12mm, on the unexposed side	-/0/0
D3		50				BOSS FireStrip-ALX sealant, minimum depth of 25mm, on the unexposed side	-/60/0
D4		100				BOSS FireStrip-ALX sealant, minimum depth of 100mm, on the unexposed side	-/120/60
H1		10				BOSS FireStrip-ALX sealant, minimum depth of 12mm, on the unexposed side	-/60/60
H2		25				BOSS FireStrip-ALX sealant, minimum depth of 12mm, on the unexposed side	-/60/0
H3		50				BOSS FireStrip-ALX sealant, minimum depth of 25mm, on the unexposed side	-/30/0

Joint	Ref. test	Max. gap width (mm)	Floor/ wall separating element details			Local fire protection	FRL
			Type	Min. Density (kg/m^3)	Min. thickness (mm)		
H4		100				BOSS FireStrip-ALX sealant, minimum depth of 100mm, on the unexposed side	-/120/120

Limitations of assessment

The fire resistance period for insulation for 120mm thick concrete slabs is specified as 120min in Table 5.5.1 in AS 3600:2018[3]. For 150mm thick concrete slabs, the standard specifies a fire resistance period for insulation of 180min and for 175mm thick concrete slabs it specifies a fire resistance period for insulation of 240min.

The referenced test report Chilt/IF03047 comprised of 140mm thick Thermalite concrete wall and floor separating elements while the referenced test reports WF 148052, WF 160399 and WF 157402 comprised of 250mm thick autoclaved aerated concrete wall and floor separating elements. Some of the reference tests with achieved insulation performance ratings of 240min (wall systems E1, E2, E3) and 120min (wall systems F3, H4 and floor system B3).

The outcomes of this assessment, which are based on these test results, shall not be interpreted as universally applicable for the assessed products in all practical applications. It is acknowledged that with reduced safety margins arising from thinner concrete floor separating elements, the influence of other factors such as defects in products, faults in installation and workmanship bear greater influence on the performance of the systems.

Furthermore, when used in practical applications, the FRL of the proposed linear gaps are limited by the insulation performance rating of the separating element. The separating element shall have been either tested or assessed to achieve the required FRL in accordance with AS 1530.4:2014.

The variations and outcome of this assessment are subject to the additional limitations and requirements described in sections 2, 4 and 8 of this report. The results of this report are valid until 30 November 2024.

[3] Standards Australia, Concrete Structures, 2018

Contents

1. Introduction

This report documents the findings of the assessments undertaken to determine the likely FRL of various linear gaps protected with BOSS FireStrip-ALX sealant if tested in general accordance with AS 1530.4:2014 and AS 4072.1-2005. This assessment was carried out at the request of Boss Products (Australia) Pty Ltd. The sponsor details are included in Table 4.

It has been confirmed by the sealant manufacturer, FSi Limited (previously known as Firestopit Limited), that the chemical composition and manufacturing process of the products referenced in the test report have not changed since the date of the test. The sealants are identified as BOSS FireStrip-ALX in Australia.

It has also been confirmed that FSi Limited has taken ownership of all intellectual property and details of the products including test report Chilt/IF0347 prepared by Chiltern International Fire Limited (CIFL) dated 21 August 2003 sponsored by Cambridge Manufacturing Services Ltd.

BOSS Fire and Safety declares that they have obtained the approval from other test sponsors to use their report in this assessment as per the email correspondence dated 24 September 2019 between the client, Ben Peach of FSi Limited and Omar Saad of Warringtonfire.

Table 4 Sponsor details

Client	Address
BOSS Fire and Safety	Unit 1, 16 Atkinson Rd, Taren Point NSW 2229

2. Framework for the assessment

An assessment is an opinion about the likely performance of a component or element of structure if it were subject to a standard fire test.

No specific framework, methodology, standard or guidance documents exists in Australia for doing these assessments. Therefore, we have followed the Guide to Undertaking Assessments In Lieu of Fire Tests prepared by the Passive Fire Protection Federation (PFPF) in the UK[4].

This guide provides a framework to undertake assessments in the absence of specific fire test results. *'Some areas where assessments may be offered are:*

- *Where a modification is made to a construction which has already been tested*
- *Interpolation or extrapolation of results of a series of fire resistance tests, or utilisation of a series of fire test results to evaluate a range of variables in a construction design or a product*
- *Where, for various reasons – eg size or configuration – it is not possible to subject a construction or a product to a fire test.'*

Assessments will vary from relatively simple judgements on small changes to a product or construction through to detailed and often complex engineering assessments of large or sophisticated constructions.

2.1 Declaration

The guide to undertaking assessments in lieu of fire tests prepared by the PFPF in the UK requires a declaration from the client. By accepting our fee proposal FAS190039 dated 01/10/2019, Boss Products (Australia) Pty Ltd confirmed 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.

[4] Guide to Undertaking Assessments In Lieu of Fire Test - The Passive Fire Protection Federation (PFPF), June 2000, UK.

- They agree to withdraw this assessment from circulation if the component or element of structure is the subject of a fire test by a test authority in accordance with the standard against which this assessment is being made and the results are not in agreement with this assessment.
- 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, they agree to ask the assessing authority to withdraw the assessment.

3. Description of the specimen and variations

3.1 System description

Fire test report Chilt/IF03047 comprises of various linear gaps within 140mm thick Thermalite floor slabs/ blockwork walls and test reports WF 148052, WF 157402 and WF 160399 comprise of various linear gaps within 250mm thick autoclaved aerated concrete floor slabs/blockwork walls.

3.2 Referenced test data

The assessment of the variation to the tested system and the determination of the likely performance is based on the results of the fire tests documented in the reports summarised in Table 5. Further details of the tested systems are described in Appendix A.

Table 5 Referenced test data

Report number	Test sponsor	Test date	Testing authority
Chilt/IF03047	Cambridge Manufacturing Services Ltd	21/08/2003	Chiltern International Fire Limited (UK)
WF 148052	Firestopit Limited	20/09/2005	Bodycote Warringtonfire Global Safety (UK)
WF 157402	Firestopit Limited	17/10/2006	
WF 160399	Firestopit Limited	15/02/2007	

3.3 Variations to tested systems

Identical linear gap sealing systems have not been subject to a standard fire test. We have therefore assessed the different systems using baseline test information for similar systems. The variations to the tested systems, together with the referenced baseline standard fire tests, are described in Table 6.

Table 6 Variation to tested systems

Assessment no	Item	Reference test	Description	Variations
1.	Linear gaps	Chilt/IF03047 (BS 476: Parts 20 and 22: 1987[5])	The separating elements were: 1. A 140mm thick Thermalite blockwork wall 2. A 140mm thick Thermalite floor slab	Assessment of the applicability of test results in general accordance with AS 1530.4:2014 and AS 4072.1-2005. **For wall/floor elements (A1 to A4 and E1 to E4):** Autoclaved aerated concrete with a nominal dry density greater than 525kg/m^3 and a thickness not less than 140mm may be used instead of Thermalite concrete blockwork.
2.	Linear gaps	WF 148052 and WF 160399 (BS 476: Part 20: 1987)	The separating elements were: 1. A 250mm thick aerated concrete wall 2. A 250mm thick aerated concrete floor slab.	

[5] British Standards Institute (1987) Fire tests on building materials and structures, Method for determination of the fire resistance of elements of construction (general principles), BS 476.20:1987

Assessment no	Item	Reference test	Description	Variations
3.	Linear gaps	WF 157402 (BS EN 1363-1:1999[6])	The separating elements were: 1. A 250mm thick aerated concrete wall 2. A 250mm thick aerated concrete floor slab.	**For all systems:** Reduced length of the linear gap exposed to the furnace chamber (900mm instead of 1000mm as per AS 1530.4:2014) is allowed.

The assessments presented in this report do not address any variations with respect to the linear gap width and sealant material depth of the proposed systems. As described in Table 7, only the applicability of the test results with variations as outlined in Table 6 is assessed in general accordance with AS 1530.4:2014 and AS 4072.1-2005.

3.4 Purpose of the test method

Section 2 of AS 1530.4:2014 specify the general requirements for conducting fire resistance tests and section 10 of the Standard specifies the guidelines for determining the fire resistance of elements of construction penetrated by services such as linear gaps. AS 4072.1-2005 sets out the minimum requirements for the construction, installation and application of fire resistance tests to sealing systems. These include linear gaps between building elements that are required to have a FRL.

3.5 Schedule of components

Table 7 outlines the schedule of components for the assessed systems subject to a fire test, as referenced in sections 5, 6 and 7.

Table 7 Schedule of components for proposed linear gaps in assessments 1-3

Item		Description
1	**Name**	Separating floor lintels/slabs
	Material	Thermalite concrete
	Density	Not reported in the referenced test
	Thickness	140mm
2	**Name**	Separating wall blockwork
	Material	Thermalite concrete
	Density	Not reported in the referenced test
	Thickness	140mm
3	**Name**	Separating floor lintels/slabs
	Material	Autoclaved aerated concrete lintel
	Density	670 kg/m^3
	Thickness	250mm
4	**Name**	Separating wall blockwork
	Material	Autoclaved aerated concrete lintel
	Density	670 kg/m^3
	Thickness	250mm
Floor linear gap system A1 – Refer to Figure 1 for details		
A1	**Joint width**	15mm
	Details of sealant	

[6] British Standards Institute (1999) Fire resistance tests, General requirements, BS EN 1363.1:1999

Item		Description
	Manufacturer / reference	CIFL
	Material	Linear gap seal consisting of alternating layers of 1.5mm thick graphite based intumescent sheet and 25mm thick cell foam
	Uncompressed thickness	28mm
	Fixing method	Friction fitted within the cavity and flush with the unexposed side
Floor linear gap system A2 – Refer to Figure 1 and Figure 2 for details		
A2	**Joint width**	25mm
	Details of sealant	
	Manufacturer / reference	CIFL
	Material	Linear gap seal consisting of alternating layers of 1.5mm thick graphite based intumescent sheet and 25mm thick cell foam
	Uncompressed thickness	56mm
	Fixing method	Friction fitted within the cavity and flush with the unexposed side
Floor linear gap system A3 – Refer to Figure 1 for details		
A3	**Joint width**	50mm
	Details of sealant	
	Manufacturer / reference	CIFL
	Material	Linear gap seal consisting of alternating layers of 1.5mm thick graphite based intumescent sheet and 25mm thick cell foam
	Uncompressed thickness	82mm
	Fixing method	Friction fitted within the cavity and flush with the unexposed side
Floor linear gap system A4 – Refer to Figure 1 for details		
A4	**Joint width**	100mm
	Details of sealant	
	Manufacturer / reference	CIFL
	Material	Linear gap seal consisting of alternating layers of 1.5mm thick graphite based intumescent sheet and 25mm thick cell foam
	Uncompressed thickness	137mm
	Fixing method	Friction fitted within the cavity and flush with the unexposed side
Floor linear gap system B1 – Refer to Figure 3 and Figure 4 for details		
B1	**Joint width**	25mm
	Details of sealant	
	Manufacturer / reference	Firestopit Limited / LGS20/2
	Material	Compressible linear gap seal consisting of alternating layers of 3mm thick graphite based intumescent polymer facing strips and elastomeric foam bonded with high tack double sided tape.
	Uncompressed thickness	29mm
	Fixing method	Friction fitted within the cavity
Floor linear gap system B2 – Refer to Figure 3 and Figure 4 for details		
B2	**Joint width**	50mm
	Details of sealant	
	Manufacturer / reference	Firestopit Limited / LGS50/2

Item		Description
	Material	Compressible linear gap seal consisting of alternating layers of 3mm thick graphite based intumescent polymer facing strips and elastomeric foam bonded with high tack double sided tape.
	Uncompressed thickness	54mm
	Fixing method	Friction fitted within the cavity
Floor linear gap system B3 – Refer to Figure 3 and Figure 4 for details		
B3	**Joint width**	150mm
	Details of sealant	
	Manufacturer / reference	Firestopit Limited / LGS150/2
	Material	Compressible linear gap seal consisting of alternating layers of 3mm thick graphite based intumescent polymer facing strips and elastomeric foam bonded with high tack double sided tape.
	Uncompressed thickness	170mm
	Fixing method	Friction fitted within the cavity
Floor linear gap system C1 – Refer to Figure 5 and Figure 6 for details		
C1	**Joint width**	10mm
	Details of sealant	
	Manufacturer / reference	Firestopit Limited / 12x12
	Material	Compressible linear gap seal consisting of alternating layers of 1.2mm thick graphite based intumescent sheets and flame retardant foam.
	Uncompressed thickness	11.2mm
	Fixing method	Friction fitted within the cavity at nominally mid-depth containing a butt joint nominally 300mm from one end.
Floor linear gap system C2 – Refer to Figure 5 and Figure 6 for details		
C2	**Joint width**	35mm
	Details of sealant	
	Manufacturer / reference	Firestopit Limited / 50x20
	Material	Compressible linear gap seal consisting of alternating layers of 1.2mm thick graphite based intumescent sheets and flame retardant foam.
	Uncompressed thickness	53.6mm
	Fixing method	Friction fitted within the cavity at nominally mid-depth containing a butt joint nominally 300mm from one end.
Floor linear gap system C3 – Refer to Figure 5 and Figure 6 for details		
C3	**Joint width**	50mm
	Details of sealant	
	Manufacturer / reference	Firestopit Limited / 60x25
	Material	Compressible linear gap seal consisting of alternating layers of 1.2mm thick graphite based intumescent sheets and flame retardant foam.
	Uncompressed thickness	63.6mm
	Fixing method	Friction fitted within the cavity at nominally mid-depth containing a butt joint nominally 300mm from one end.
Floor linear gap system C4 – Refer to Figure 5 and Figure 6 for details		
C4	**Joint width**	75mm
	Details of sealant	

Item		Description
	Manufacturer / reference	Firestopit Limited / 85x50
	Material	Compressible linear gap seal consisting of alternating layers of 1.2mm thick graphite based intumescent sheets and flame retardant foam.
	Uncompressed thickness	85mm
	Fixing method	Friction fitted within the cavity at nominally mid-depth containing a butt joint nominally 300mm from one end.
Floor linear gap system D1 – Refer to Figure 7 and Figure 8 for details		
D1	**Joint width**	10mm
	Details of sealant	
	Manufacturer / reference	Firestopit Limited / LGS10/2
	Material	Compressible linear gap seal consisting of alternating layers of 3mm thick graphite based intumescent polymer facing strips and elastomeric foam bonded with high tack double sided tape.
	Uncompressed thickness	12mm
	Fixing method	Friction fitted within the cavity
Floor linear gap system D2 – Refer to Figure 7 and Figure 8 for details		
D2	**Joint width**	25mm
	Details of sealant	
	Manufacturer / reference	Firestopit Limited / LGS25/2
	Material	Compressible linear gap seal consisting of alternating layers of 3mm thick graphite based intumescent polymer facing strips and elastomeric foam bonded with high tack double sided tape.
	Uncompressed thickness	32mm
	Fixing method	Friction fitted within the cavity
Floor linear gap system D3 – Refer to Figure 7 and Figure 8 for details		
D3	**Joint width**	50mm
	Details of sealant	
	Manufacturer / reference	Firestopit Limited / LGS50/2
	Material	Compressible linear gap seal consisting of alternating layers of 3mm thick graphite based intumescent polymer facing strips and elastomeric foam bonded with high tack double sided tape.
	Uncompressed thickness	54mm
	Fixing method	Friction fitted within the cavity
Floor linear gap system D4 – Refer to Figure 7 and Figure 8 for details		
D4	**Joint width**	100mm
	Details of sealant	
	Manufacturer / reference	Firestopit Limited / LGS100/2
	Material	Compressible linear gap seal consisting of alternating layers of 3mm thick graphite based intumescent polymer facing strips and elastomeric foam bonded with high tack double sided tape.
	Uncompressed thickness	126mm
	Fixing method	Friction fitted within the cavity
Wall linear gap system E1 – Refer to Figure 9 for details		
E1	**Joint width**	15mm

Item	Description	
	Details of sealant	
	Manufacturer / reference	CIFL
	Material	Linear gap seal consisting of alternating layers of 1.5mm thick graphite based intumescent sheet and 25mm thick cell foam
	Uncompressed thickness	28mm
	Fixing method	Friction fitted within the cavity and flush with the unexposed side
Wall linear gap system E2 – Refer to Figure 9 for details		
E2	**Joint width**	25mm
	Details of sealant	
	Manufacturer / reference	CIFL
	Material	CIFL linear gap seal consisting of alternating layers of 1.5mm thick graphite based intumescent sheet and 25mm thick cell foam
	Uncompressed thickness	56mm
	Fixing method	Friction fitted within the cavity and flush with the unexposed side
Wall linear gap system E3 – Refer to Figure 9 for details		
E3	**Joint width**	50mm
	Details of sealant	
	Manufacturer / reference	CIFL
	Material	CIFL linear gap seal consisting of alternating layers of 1.5mm thick graphite based intumescent sheet and 25mm thick cell foam
	Uncompressed thickness	82mm
	Fixing method	Friction fitted within the cavity and flush with the unexposed side
Wall linear gap system E4 – Refer to Figure 9 for details		
E4	**Joint width**	100mm
	Details of sealant	
	Manufacturer / reference	CIFL
	Material	Linear gap seal consisting of alternating layers of 1.5mm thick graphite based intumescent sheet and 25mm thick cell foam
	Uncompressed thickness	137mm
	Fixing method	Friction fitted within the cavity and flush with the unexposed side
Wall linear gap system F1 – Refer to Figure 10 and Figure 11 for details		
F1	**Joint width**	25mm
	Details of sealant	
	Manufacturer / reference	Firestopit Limited / LGS20/2
	Material	Compressible linear gap seal consisting of alternating layers of 3mm thick graphite based intumescent polymer facing strips and elastomeric foam bonded with high tack double sided tape.
	Uncompressed thickness	29mm
	Fixing method	Friction fitted within the cavity
Wall linear gap system F2 – Refer to Figure 10 and Figure 11 for details		
F2	**Joint width**	50mm
	Details of sealant	

Item		Description
	Manufacturer / reference	Firestopit Limited / LGS50/2
	Material	Compressible linear gap seal consisting of alternating layers of 3mm thick graphite based intumescent polymer facing strips and elastomeric foam bonded with high tack double sided tape.
	Uncompressed thickness	54mm
	Fixing method	Friction fitted within the cavity
Wall linear gap system F3 – Refer to Figure 10 and Figure 11 for details		
F3	**Joint width**	150mm
	Details of sealant	
	Manufacturer / reference	Firestopit Limited / LGS150/2
	Material	Compressible linear gap seal consisting of alternating layers of 3mm thick graphite based intumescent polymer facing strips and elastomeric foam bonded with high tack double sided tape.
	Uncompressed thickness	170mm
	Fixing method	Friction fitted within the cavity
Wall linear gap system G1 – Refer to Figure 12 and Figure 13 for details		
G1	**Joint width**	10mm
	Details of sealant	
	Manufacturer / reference	Firestopit Limited / 12x12
	Material	Compressible linear gap seal consisting of alternating layers of 1.2mm thick graphite based intumescent sheets and flame retardant foam.
	Uncompressed thickness	11.2mm
	Fixing method	Friction fitted within the cavity at nominally mid-depth.
Wall linear gap system G2 – Refer to Figure 12 and Figure 13 for details		
G2	**Joint width**	35mm
	Details of sealant	
	Manufacturer / reference	Firestopit Limited / 50x20
	Material	Compressible linear gap seal consisting of alternating layers of 1.2mm thick graphite based intumescent sheets and flame retardant foam.
	Uncompressed thickness	53.6mm
	Fixing method	Friction fitted within the cavity at nominally mid-depth.
Wall linear gap system G3 – Refer to Figure 12 and Figure 13 for details		
G3	**Joint width**	50mm
	Details of sealant	
	Manufacturer / reference	Firestopit Limited / 60x25
	Material	Compressible linear gap seal consisting of alternating layers of 1.2mm thick graphite based intumescent sheets and flame retardant foam.
	Uncompressed thickness	63.6mm
	Fixing method	Friction fitted within the cavity at nominally mid-depth.
Wall linear gap system G4 – Refer to Figure 12 and Figure 13 for details		
G4	**Joint width**	75mm
	Details of sealant	
	Manufacturer / reference	Firestopit Limited / 85x50

Item		Description
	Material	Compressible linear gap seal consisting of alternating layers of 1.2mm thick graphite based intumescent sheets and flame retardant foam.
	Uncompressed thickness	85mm
	Fixing method	Friction fitted within the cavity at nominally mid-depth.
Wall linear gap system H1 – Refer to Figure 14 and Figure 15 for details		
H1	**Joint width**	10mm
	Details of sealant	
	Manufacturer / reference	Firestopit Limited / LGS10/2
	Material	Compressible linear gap seal consisting of alternating layers of 3mm thick graphite based intumescent polymer facing strips and elastomeric foam bonded with high tack double sided tape.
	Uncompressed thickness	12mm
	Fixing method	Friction fitted within the cavity
Wall linear gap system H2 – Refer to Figure 14 and Figure 15 for details		
H2	**Joint width**	25mm
	Details of sealant	
	Manufacturer / reference	Firestopit Limited / LGS25/2
	Material	Compressible linear gap seal consisting of alternating layers of 3mm thick graphite based intumescent polymer facing strips and elastomeric foam bonded with high tack double sided tape.
	Uncompressed thickness	32mm
	Fixing method	Friction fitted within the cavity
Wall linear gap system H3 – Refer to Figure 14 and Figure 15 for details		
H3	**Joint width**	50mm
	Details of sealant	
	Manufacturer / reference	Firestopit Limited / LGS50/2
	Material	Compressible linear gap seal consisting of alternating layers of 3mm thick graphite based intumescent polymer facing strips and elastomeric foam bonded with high tack double sided tape.
	Uncompressed thickness	54mm
	Fixing method	Friction fitted within the cavity
Wall linear gap system H4 – Refer to Figure 14 and Figure 15 for details		
H4	**Joint width**	100mm
	Details of sealant	
	Manufacturer / reference	Firestopit Limited / LGS100/2
	Material	Compressible linear gap seal consisting of alternating layers of 3mm thick graphite based intumescent polymer facing strips and elastomeric foam bonded with high tack double sided tape.
	Uncompressed thickness	126mm
	Fixing method	Friction fitted within the cavity

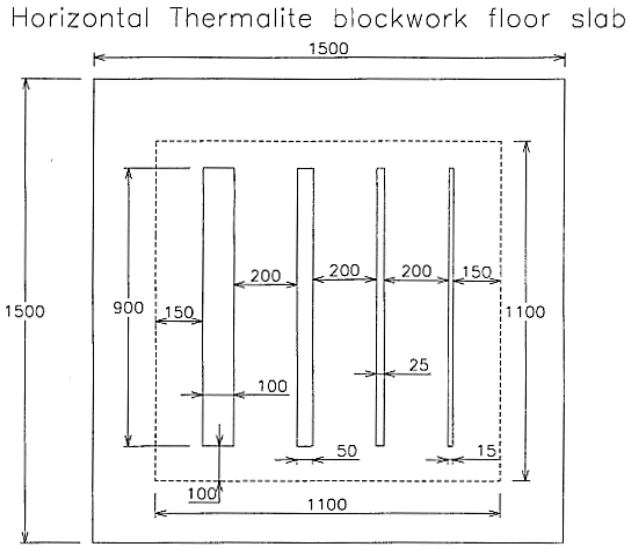

Figure 1 Floor linear gap systems A1-A4 – assessment 1 (as shown in Chilt/IF03047) – dimensions in mm

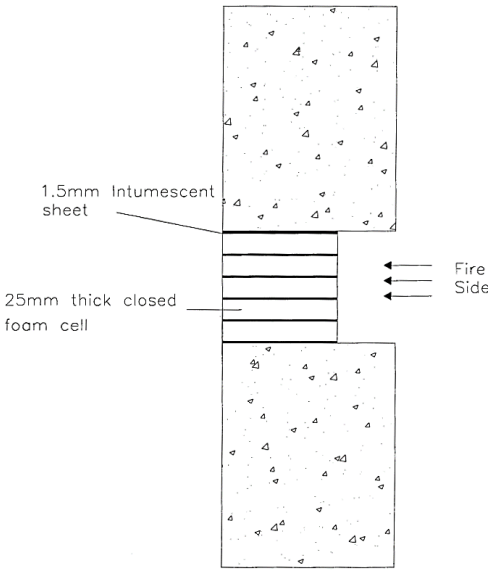

Figure 2 Floor linear gap system A2 – assessment 1 (as shown in Chilt/IF03047) – dimensions in mm

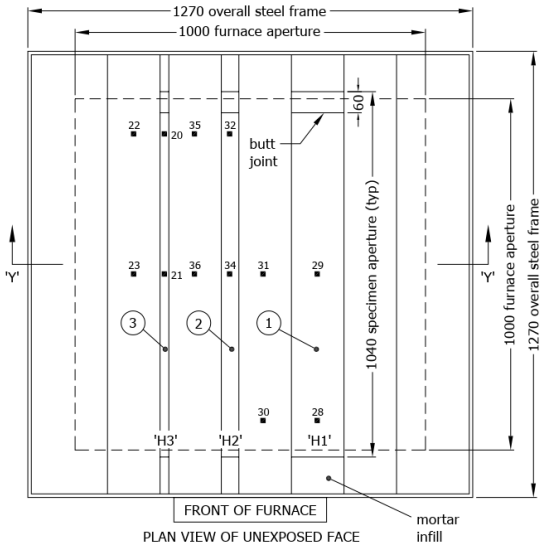

Figure 3 Floor linear gap systems B1-B3 – assessment 2 (as shown in WF 148052) – dimensions in mm

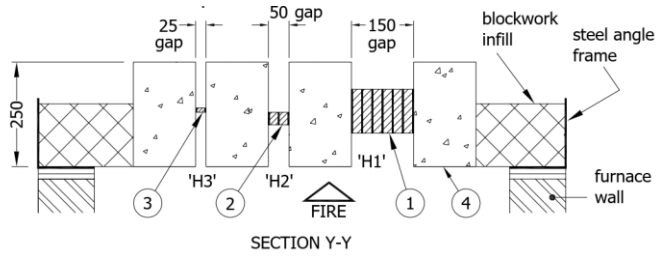

Figure 4 Cross-section of floor linear gap systems B1-B3 – assessment 2 (as shown in WF 148052) – dimensions in mm

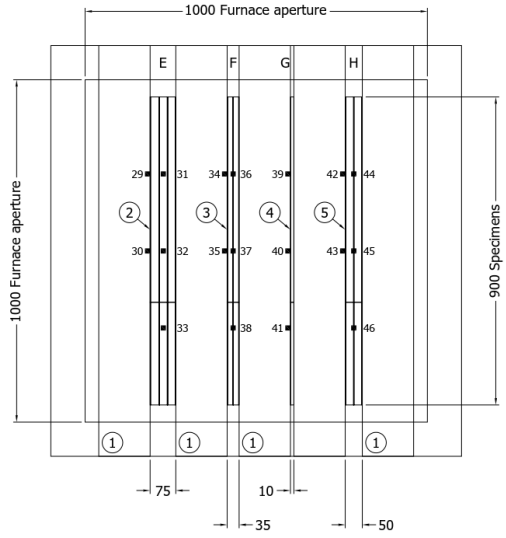

Figure 5 Floor linear gap systems C1-C4 – assessment 2 (as shown in WF 160399) – dimensions in mm

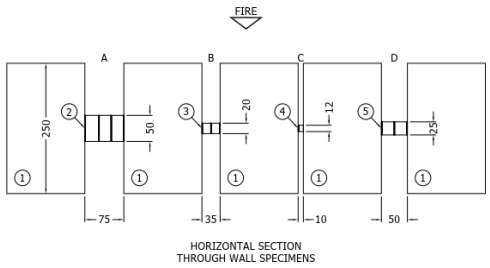

Figure 6 **Cross-section of floor linear gap systems C1-C4 – assessment 2 (as shown in WF 157402) – dimensions in mm**

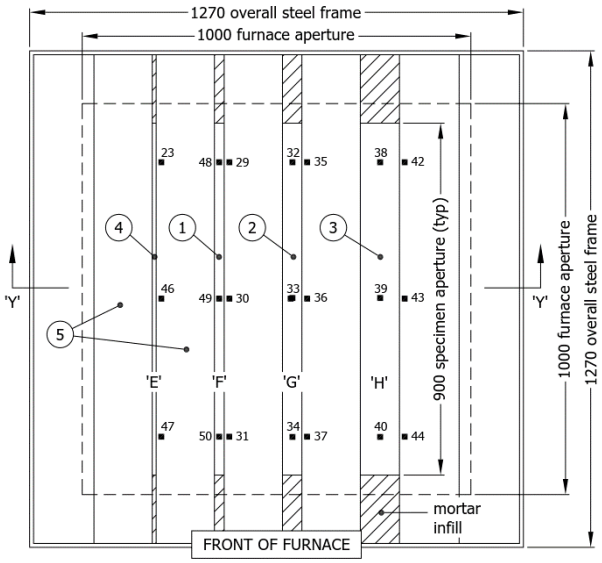

Figure 7 **Floor linear gap systems D1-D4 – assessment 3 (as shown in WF 157402) – dimensions in mm**

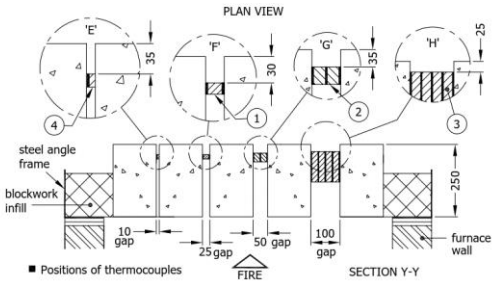

Figure 8 **Cross-section of floor linear gap systems D1-D4 – assessment 3 (as shown in WF 157402) – dimensions in mm**

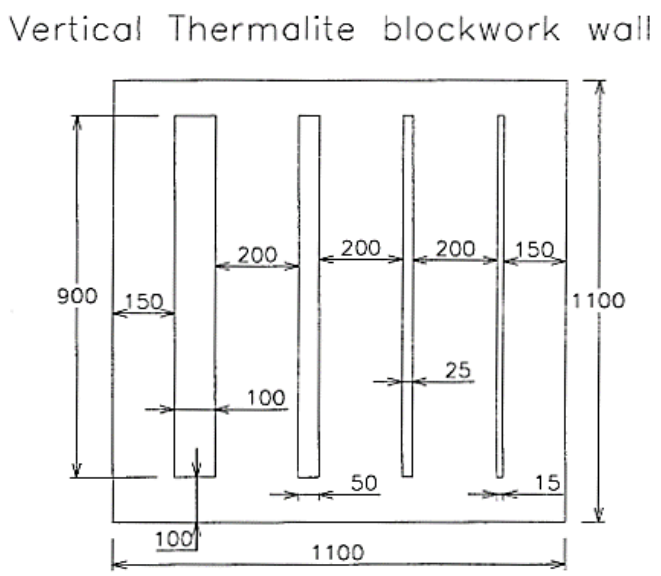

Figure 9 Wall linear gap systems E1-E4 – assessment 1 (as shown in Chilt/IF03047) – dimensions in mm

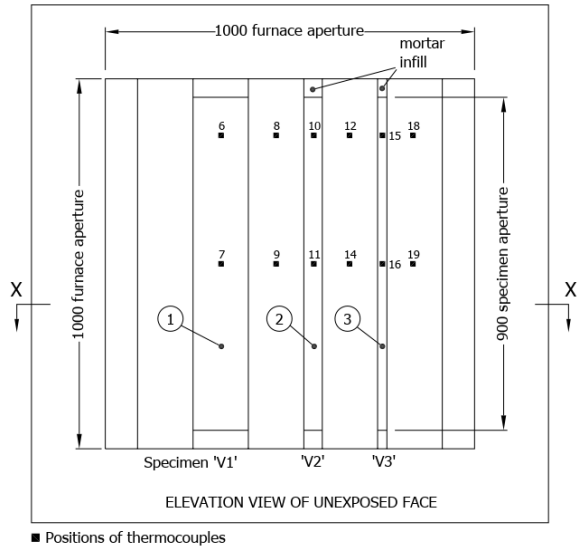

Figure 10 Wall linear gap systems F1-F3 – assessment 2 (as shown in WF 148052) – dimensions in mm

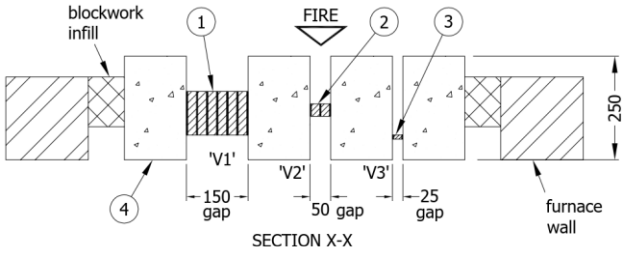

Figure 11 Cross-section of wall linear gap systems F1-F3 – assessment 2 (as shown in WF 148052) – dimensions in mm

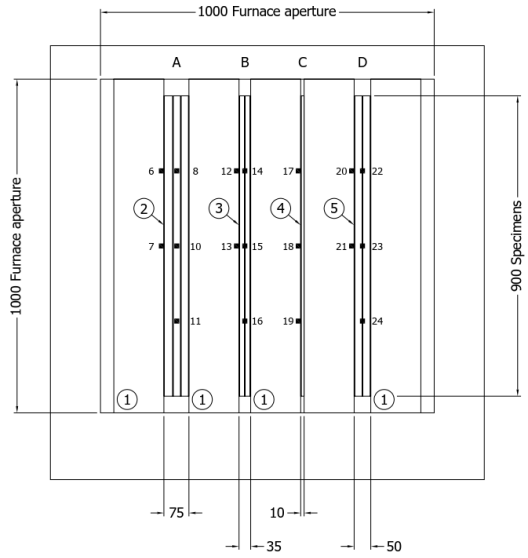

Figure 12 Wall linear gap systems G1-G4 – assessment 2 (as shown in WF 160399) – dimensions in mm

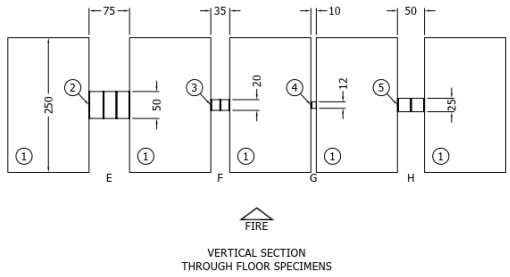

Figure 13 Cross-section of wall linear gap systems G1-G4 – assessment 2 (as shown in WF 157402) – dimensions in mm

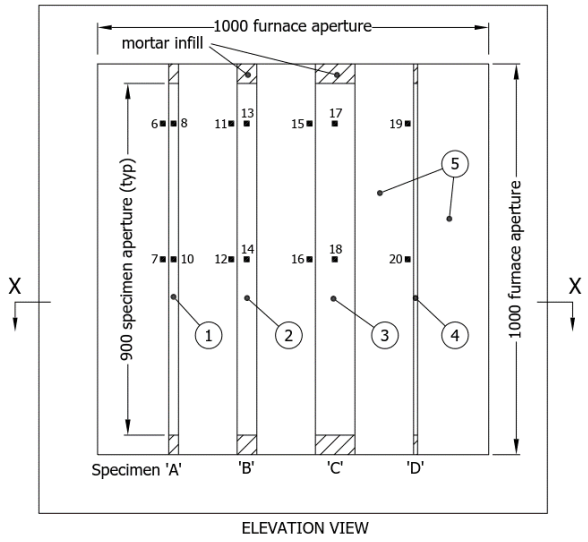

Figure 14 Wall linear gap systems H1-H4 – assessment 3 (as shown in WF 157402) – dimensions in mm

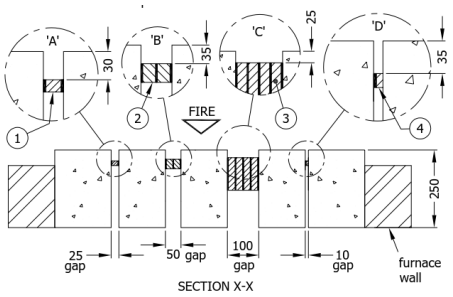

Figure 15 Cross-section of wall linear gap systems H1-H4 – assessment 3 (as shown in WF 157402) – dimensions in mm

4. Scope, objective and assumptions

4.1 Scope and objective

- The scope of this report is limited to an assessment of the variations to the tested systems described in section 3.3.
- This report details the methods of construction, test conditions and assessed results that would have been expected if the specific elements of construction described here had been tested in general accordance with AS 1530.4:2014 and AS 4072.1-2005.
- The results of this assessment are applicable to linear gaps exposed to fire from the side exposed to fire during testing only.
- This report is only valid for the assessed systems. Any changes with respect to size, construction details, loads, stresses, edge or end conditions, other than those identified in this report, may invalidate the findings of this assessment. If there are changes to the system, a reassessment will be needed to verify consistency with the assessment in this report.
- The data, methodologies, calculations and conclusions documented in this report specifically relate to the assessed systems and must not be used for any other purpose.
- This report has been prepared based on information provided by others. Warringtonfire has not verified the accuracy and/or completeness of that information and will not be responsible for any errors or omissions that may be incorporated into this report as a result.

5. Assessment 1

5.1 Description of variation

Assessment 1 refers the test report Chilt/IF03047. This report comprises of fire tests of linear gaps within floor and wall separating elements (systems A1 to A4 and E1 to E4 in Table 7). The proposed variations are as follows.

- Assessment of the applicability of test results in general accordance with AS 1530.4:2014 and AS 4072.1-2005.
- The separating element may be made of autoclaved aerated concrete instead of Thermalite concrete with a nominal dry density greater than 525kg/m^3 and a thickness not less than 140mm.

5.2 Methodology

The approach and method of assessment used for this assessment is summarised in Table 8.

Table 8 Method of assessment

Assessment method	
Level of complexity	Simple assessment
Type of assessment	Qualitative

5.3 Assessment

Chilt/IF03047 comprises of various horizontal and vertical linear gaps with widths varying between 15mm to 100mm – Refer to Figure 1, Figure 2 and Figure 9 for details. The separating elements were made of 140mm thick Thermalite concrete blockwork slab. However, the density of the tested element was not referenced in the report.

The ad hoc test was conducted in accordance with BS 476: Parts 20 and 22: 1987. A comparison of the guidelines between this and the Australian standards AS 1530.4:2014 and AS 4072.1-2005 is provided in section B.1 of Appendix B in this report. As per the discussion presented in section B.1.8, the results are considered to be in general accordance with AS 1530.4:2014 and AS 4072.1-2005.

As Thermalite concrete is not a common brand in Australia, it is therefore proposed that the tested specimens may be replaced with autoclaved aerated concrete material (such as Hebel blocks) which has been tested by others to achieve fire resistance level of -/240/240. The density shall not be less than 525kg/m^3 for the wall/floor separating elements and the slab thickness shall not be less than 140mm.

Compared to autoclaved aerated concrete, Thermalite concrete separating elements tested in Chilt/IF03047 show equal or better fire resistance performance having similar gap width and lower slab thickness. However It is also noted the depth of the linear gap seals used on Thermalite separating elements are generally higher compared to other referenced tests in sections 6 and 7.

Based on above information, if the separating elements of floor and wall linear gap systems A1 to A4 and E1 to E4 were changed to aerated concrete with a density not less than 525kg/m^3, while maintaining the minimum 140mm slab thickness, the results of the referenced tests are unlikely to be changed significantly.

5.4 Conclusion

This assessment demonstrates that the linear gaps assessed are likely to achieve the FRLs shown in Table 9, if tested in general accordance with the AS 1530.4:2014 and AS 4072.1-2005.

Table 9 Summary of Assessment 1 conclusions

Product	Reference test	FRL
Floor linear gap system A1	Chilt/IF03047	-/240/90
Floor linear gap system A2	Chilt/IF03047	-/240/60
Floor linear gap system A3	Chilt/IF03047	-/240/180
Floor linear gap system A4	Chilt/IF03047	-/180/180
Wall linear gap system E1	Chilt/IF03047	-/240/240
Wall linear gap system E2	Chilt/IF03047	-/240/240
Wall linear gap system E3	Chilt/IF03047	-/240/240
Wall linear gap system E4	Chilt/IF03047	-/120/120

Some of the reference tests with the 150mm thick separating element achieved insulation performance ratings of 240min (wall systems E1, E2 and E3).

When used in practical applications, the FRL of the proposed linear gaps are limited by the insulation performance rating of the separating element. The separating element shall have been either tested or assessed to achieve the required FRL in accordance with AS 1530.4:2014.

6. Assessment 2

6.1 Description of variation

Assessment 2 refers the test reports WF 148052 and WF 160399. These reports comprise of fire tests of linear gaps within floor and wall separating elements (systems B1 to C4 and F1 to G4 in Table 7). The proposed variations are as follows.

- Assessment of the applicability of test results in general accordance with AS 1530.4:2014 and AS 4072.1-2005.

6.2 Methodology

The approach and method of assessment used for this assessment is summarised in Table 10.

Table 10 Method of assessment

Assessment method	
Level of complexity	Simple assessment
Type of assessment	Qualitative

6.3 Assessment

WF 148052 and WF 160399 comprise of various horizontal and vertical linear gaps with widths varying between 10mm to 150mm – Refer to Figure 3 to Figure 6 and Figure 10 to Figure 13 for details. The separating elements were made of 250mm thick autoclaved aerated concrete lintels with a density of 670kg/m^3.

The tests were conducted in accordance with BS 476: Parts 20: 1987 with additional guidelines adopted from BS EN 1366-4. A comparison of these guidelines and the Australian standards AS 1530.4:2014 and AS 4072.1-2005 is provided in section B.1 of Appendix B. As per the discussion presented in section B.1.8, the results are considered to be in general accordance with AS 1530.4:2014 and AS 4072.1-2005.

Based on above information, if the separating elements of floor and wall linear gap systems B1 to C4 and F1 to G4 were tested in general accordance with AS 1530.4:2014 and AS 4072.1:2005, while maintaining a density not less than 670kg/m^3 and the minimum 250mm slab thickness, the results of the referenced tests are unlikely to be changed significantly.

6.4 Conclusion

This assessment demonstrates that the linear gaps assessed are likely to achieve the FRLs shown in Table 11, if tested in general accordance with the AS 1530.4:2014 and AS 4072.1-2005.

Table 11 Summary of Assessment 2 conclusions

Product	Reference test	FRL
Floor linear gap system B1	WF 148052	-/120/0
Floor linear gap system B2	WF 148052	-/30/0
Floor linear gap system B3	WF 148052	-/120/120
Floor linear gap system C1	WF 160399	-/240/*
Floor linear gap system C2	WF 160399	-/240/60
Floor linear gap system C3	WF 160399	-/240/0
Floor linear gap system C4	WF 160399	-/240/60
Wall linear gap system F1	WF 148052	-/120/0
Wall linear gap system F2	WF 148052	-/90/90

Product	Reference test	FRL
Wall linear gap system F3	WF 148052	-/120/120
Wall linear gap system G1	WF 160399	-/240/*
Wall linear gap system G2	WF 160399	-/180/60
Wall linear gap system G3	WF 160399	-/60/30
Wall linear gap system G4	WF 160399	-/240/90
*Gap size small to fit thermocouple (10mm).		

Some of the reference tests with the 250mm thick separating element achieved insulation performance ratings of 120min (floor system B3 and wall system F3).

When used in practical applications, the FRL of the proposed linear gaps are limited by the insulation performance rating of the separating element. The separating element shall have been either tested or assessed to achieve the required FRL in accordance with AS 1530.4:2014.

7. Assessment 3

7.1 Description of variation

Assessment 3 refers the test report WF 157402. This report comprises of fire tests of linear gaps within floor and wall separating elements (systems D1 to D4 and H1 to H4 in Table 7). The proposed variations are as follows.

- Assessment of the applicability of test results in general accordance with AS 1530.4:2014 and AS 4072.1-2005.

7.2 Methodology

The approach and method of assessment used for this assessment is summarised in Table 12.

Table 12 Method of assessment

Assessment method	
Level of complexity	Simple assessment
Type of assessment	Qualitative

7.3 Assessment

WF 157402 comprises of various horizontal and vertical linear gaps with widths varying between 10mm to 100mm – Refer to Figure 7, Figure 8, Figure 14 and Figure 15 for details. The separating elements were made of 250mm thick autoclaved aerated concrete lintels with a density of 670kg/m^3.

The test was conducted in accordance with BS EN 1363-1:1999 in conjunction with additional guidelines adopted from prEN 1366-4:2001. A comparison of these guidelines and the Australian standards AS 1530.4:2014 and AS 4072.1-2005 is provided in section B.2 of Appendix B in this report. As per the discussion presented in section B.2.6, the tests are considered to be in accordance with AS 1530.4:2014 and AS 4072.1-2005.

Based on above information, if the separating elements of floor and wall linear gap systems D1 to D4 and H1 to H4 were tested in general accordance with AS 1530.4:2014 and AS 4072.1: 2005, while maintaining a density not less than 670kg/m^3 and the minimum 250mm thickness, the results of the referenced tests are unlikely to be changed significantly.

7.4 Conclusion

This assessment demonstrates that the linear gaps assessed are likely to achieve the FRLs shown in Table 13, if tested in general accordance with the AS 1530.4:2014 and AS 4072.1-2005.

Table 13 Summary of Assessment 3 conclusions

Product	Reference test	FRL
Floor linear gap system D1	WF 157402	-/120/30
Floor linear gap system D2	WF 157402	-/0/0
Floor linear gap system D3	WF 157402	-/60/0
Floor linear gap system D4	WF 157402	-/120/60
Wall linear gap system H1	WF 157402	-/60/60
Wall linear gap system H2	WF 157402	-/60/0
Wall linear gap system H3	WF 157402	-/30/0
Wall linear gap system H4	WF 157402	-/120/120

Some of the reference tests with the 250mm thick separating element achieved insulation performance ratings of 120min (wall system H4).

When used in practical applications, the FRL of the proposed linear gaps are limited by the insulation performance rating of the separating element. The separating element shall have been either tested or assessed to achieve the required FRL in accordance with AS 1530.4:2014.

8. Validity

Warringtonfire Australia does not endorse the tested or assessed product in any way. The conclusions of this assessment may be used to directly assess fire hazard, but it should be recognised that a single test method will not provide a full assessment of fire hazard under all conditions.

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

This assessment is based on information and experience available at the time of preparation. The published procedures for the conduct of tests and the assessment of test results are subject to constant review and improvement. It is therefore recommended that this report be reviewed on or, before, the stated expiry date.

This assessment represents our opinion about the performance likely to be demonstrated on a test in general accordance with AS 1530.4:2014 and AS 4072.1-2005, based on the evidence referred to in this report.

This assessment is provided to the Boss Products (Australia) Pty Ltd for its own purposes and we cannot express an opinion on whether it will be accepted by building certifiers or any other third parties for any purpose.

Appendix A Summary of supporting test data

A.1 Test report – Chilt/IF03047

Table 14 Information about test report

Item	Information about test report
Report sponsor	Cambridge Manufacturing Services Ltd
Test laboratory	Chiltern International Fire (UK)
Test date	The fire resistance test was completed on 21/08/2003
Test standards	The test was done in general accordance with BS 476: Parts 20 and 22: 1987.
Variation to test standards	Variations to relevant Australian standards addressed in section B.1.
General description of tested specimen	The test comprised of wall and floor separating elements incorporating various gap sealing systems. The blockwork floor and wall comprised of 140mm thick Thermalite concrete. The density of the separating elements was not reported. The separating floor element had the overall dimensions of 1500mm (L) × 1500mm (W) × 140mm (T) and was made up of Thermalite concrete slab arranged to provide 1-off 15mm (W) × 900mm (L), 1-off 25mm (W) × 900mm (L), 1-off 50mm (W) × 900mm (L) and 1-off 100mm (W) × 900mm (L) linear gaps. The separating wall element had the overall dimensions of 1100mm (L) × 1100mm (W) × 140mm (T) and was made up of Thermalite concrete wall arranged to provide 1-off 15mm (W) × 900mm (L), 1-off 25mm (W) × 900mm (L), 1-off 50mm (W) × 900mm (L) and 1-off 100mm (W) × 900mm (L) linear gaps. Each gap was sealed with alternating layers of graphite based intumescent sheets with closed cell foam bonded together to form a multi-layer sandwich construction. Each seal was friction fitted into the gaps. A description of each gap seal is given in Table 15.
Instrumentation	The temperature of the unexposed surface of each linear joint seal was monitored by means of 3 thermocouples fixed to the surface of each joint.

Table 15 Test specimen description for Chilt/IF03047

System	Gap width (mm)	Description
A1	15	25mm deep, friction fitted and flush with the unexposed face.
A2	25	50mm deep, friction fitted and flush with the unexposed face.
A3	50	75mm deep, friction fitted and flush with the unexposed face.
A4	100	100mm deep, friction fitted and flush with the unexposed face.
E1	15	25mm deep, friction fitted and flush with the unexposed face.
E2	25	50mm deep, friction fitted and flush with the unexposed face.
E3	50	75mm deep, friction fitted and flush with the unexposed face.
E4	100	100mm deep, friction fitted and flush with the unexposed face.

The test specimen achieved the results shown in Table 16.

Table 16 Summary of test results for Chilt/IF03047

Reference	Integrity (min)	Insulation (min)
A1	241*	105
A2	241*	85
A3	241*	234

Reference	Integrity (min)	Insulation (min)
A4	197	196
E1	241**	241**
E2	241**	241**
E3	241**	241**
E4	155	155

*The test was terminated at the request of the sponsor, at which time, the specimen had not failed integrity.

**Test duration. The test was discontinued after a period of 241 minutes at the request of the sponsor. The specimen had not failed integrity or the insulation criteria.

A.2 Test report – WF 148052

Table 17 Information about test report

Item	Information about test report
Report sponsor	Firestopit Limited
Test laboratory	Bodycote Warringtonfire Global Safety (UK)
Test date	The fire resistance test was completed on 20/09/2005
Test standards	The test was done in accordance with BS 476: Part 20: 1987 and BS EN 1366-4.
Variation to test standards	Variations to relevant Australian standards addressed in section B.1
General description of tested specimen	The test comprised of wall and floor separating elements incorporating various gap sealing systems. The specimens were made of 250mm thick autoclaved aerated concrete with a density of 670kg/m^3. The separating floor element had the overall dimensions of 1200mm (L) × 1200mm (W) × 250mm (T) and was made up of autoclaved aerated concrete lintels arranged to provide 1-off 25mm (W) × 1040mm (L), 1-off 50mm (W) × 1040mm (L) and 1-off 150mm (W) × 1040mm (L). The separating wall element had the overall dimensions of 1000mm (L) × 1000mm (W) × 250mm (T) and was made up of autoclaved aerated concrete lintels arranged to provide 1-off 25mm (W) × 1000mm (L), 1-off 50mm (W) × 1000mm (L) and 1-off 150mm (W) × 1000mm (L). Cavity length in all gaps was reduced to 900mm with mortar infill for both wall and floor separating elements. Each gap was sealed with alternating layers of graphite based intumescent polymer strips and elastomeric foam bonded together with high tack double sided tape (referenced as LGS in the report). Each seal was friction fitted into the gaps. A description of each gap seal is given in Table 18.
Instrumentation	The test was conducted in conjunction with additional guidelines adopted from BS EN 1366-4. Given the test date, we assumed that the standard referenced is BS EN 1366-4:2001.

Table 18 Test specimen description for WF 148052

System	Gap width (mm)	Description
B1	25	12mm deep, friction-fitted on the unexposed face.
B2	50	25mm deep, friction-fitted on the unexposed face.
B3	150	100mm deep, friction-fitted on the unexposed face.
F1	25	12mm deep, friction-fitted on the unexposed face.
F2	50	25mm deep, friction-fitted on the unexposed face.
F3	150	100mm deep, friction-fitted on the unexposed face.

The test specimen achieved the results shown in Table 19. The mean and maximum temperature rise allowed on the unexposed face of the specimen by BS 476: Part 20: 1987 are 140 and 180 respectively, however, due to reduced size of the specimens, only the maximum temperature rise criterion was utilised for insulation.

Table 19 Summary of test results for WF 148052

Reference	Integrity* (min)	Insulation (min)
B1	132**	14
B2	31	20
B3	132**	132**

Reference	Integrity* (min)	Insulation (min)
F1	132**	24
F2	98	92
F3	132**	132**
*No collapse of the specimen, sustained flaming on the unexposed surface or loss of impermeability was observed for the periods given in the table. **Test duration. The test was discontinued after a period of 132 minutes.		

A.3 Test report – WF 157402

Table 20 Information about test report

Item	Information about test report
Report sponsor	Firestopit Limited
Test laboratory	Bodycote Warringtonfire Global Safety (UK)
Test date	The fire resistance test was completed on 17/10/2006
Test standards	The test was done in accordance with BS EN 1363-1:1999 and prEN 1366-4:2001.
Variation to test standards	Variations to relevant Australian standards addressed in section B.2
General description of tested specimen	The test comprised of wall and floor separating elements incorporating various gap sealing systems. The specimens were made of 250mm thick autoclaved aerated concrete with a density of 670kg/m^3. The separating floor element had the overall dimensions of 1200mm (L) × 1200mm (W) × 250mm (T) and was made up of autoclaved aerated concrete lintels arranged to provide 1-off 10mm (W) × 900mm (L), 1-off 25mm (W) × 900mm (L), 1-off 50mm (W) × 900mm (L) and 1-off 100mm (W) × 900mm (L). The separating wall element had the overall dimensions of 1000mm (L) × 1000mm (W) × 250mm (T) and was made up of autoclaved aerated concrete lintels arranged to provide 1-off 10mm (W) × 900mm (L), 1-off 25mm (W) × 900mm (L), 1-off 50mm (W) × 900mm (L) and 1-off 100mm (W) × 900mm (L). Each gap was sealed with alternating layers of graphite based intumescent polymer strips and elastomeric foam bonded together with high tack double sided tape (referenced as LGS in the report). Each seal was friction fitted into the gaps. A description of each gap seal is given in Table 21.
Instrumentation	The test was conducted in conjunction with additional guidelines adopted from prEN 1366-4:2001.

Table 21 Test specimen description for WF 157402

System	Gap width (mm)	Description
D1	10	12mm deep, friction-fitted on the unexposed face.
D2	25	12mm deep, friction-fitted on the unexposed face.
D3	50	25mm deep, friction-fitted on the unexposed face.
D4	100	100mm deep, friction-fitted on the unexposed face.
H1	10	12mm deep, friction-fitted on the unexposed face.
H2	25	12mm deep, friction-fitted on the unexposed face.
H3	50	25mm deep, friction-fitted on the unexposed face.
H4	100	100mm deep, friction-fitted on the unexposed face.

The test specimen achieved the results shown in Table 19. The mean and maximum temperature rise allowed on the unexposed face of the specimen by BS 476: Part 20: 1987 are 140 and 180 respectively, however, due to reduced size of the specimens, only the maximum temperature rise criterion was utilised for insulation.

Table 22 Summary of test results for WF 157402

Reference	Integrity (min)		Insulation (min)
	Cotton pad	Sustained flaming	
D1	120*	120*	54
D2	6	6	6

Reference	Integrity (min)		Insulation (min)
	Cotton pad	Sustained flaming	
D3	77	77	10
D4	120*	120*	88
H1	70	70	70
H2	66	66	9
H3	40	40	9
H4	120*	120*	210*
*Test duration. The test was discontinued after a period of 120 minutes.			

A.4 Test report – WF 160399

Table 23 Information about test report

Item	Information about test report
Report sponsor	Firestopit Limited
Test laboratory	Bodycote Warringtonfire Global Safety (UK)
Test date	The fire resistance test was completed on 15/02/2007
Test standards	The test was done in accordance with BS 476: Part 20: 1987 and BS EN 1366-4: 2006
Variation to test standards	Variations to relevant Australian standards addressed in section B.1
General description of tested specimen	The test comprised of wall and floor separating elements incorporating various gap sealing systems. The specimens were made of 250mm thick autoclaved aerated concrete with a density of 670kg/m^3. The separating floor element had the overall dimensions of 1000mm (L) × 1000mm (W) × 250mm (T) and was made up of autoclaved aerated concrete lintels arranged to provide 1-off 10mm (W) × 900mm (L), 1-off 35mm (W) × 900mm (L), 1-off 50mm (W) × 900mm (L) and 1-off 75mm (W) × 900mm (L). The separating wall element had the overall dimensions of 1000mm (L) × 1000mm (W) × 250mm (T) and was made up of autoclaved aerated concrete lintels arranged to provide 1-off 10mm (W) × 900mm (L), 1-off 35mm (W) × 900mm (L), 1-off 50mm (W) × 900mm (L) and 1-off 75mm (W) × 900mm (L). Each gap was sealed with alternating layers of graphite based intumescent polymer strips and elastomeric foam bonded together with high tack double sided tape. Each seal was friction fitted into the gaps at nominally mid-depth. A description of each gap seal is given in Table 24.
Instrumentation	The test was conducted in conjunction with additional guidelines adopted from prEN 1366-4:2006.

Table 24 Test specimen description for WF 160399

System	Gap width (mm)	Description
C1	10	12mm deep, friction-fitted on the unexposed face.
C2	35	20mm deep, friction-fitted on the unexposed face.
C3	50	25mm deep, friction-fitted on the unexposed face.
C4	75	50mm deep, friction-fitted on the unexposed face.
G1	10	12mm deep, friction-fitted on the unexposed face.
G2	35	20mm deep, friction-fitted on the unexposed face.
G3	50	25mm deep, friction-fitted on the unexposed face.
G4	75	50mm deep, friction-fitted on the unexposed face.

The test specimen achieved the results shown in Table 25. The mean and maximum temperature rise allowed on the unexposed face of the specimen by BS 476: Part 20: 1987 are 140 and 180 respectively, however, due to reduced size of the specimens, only the maximum temperature rise criterion was utilised for insulation.

Table 25 Summary of test results for WF 160399

Reference	Integrity* (min)	Insulation (min)
C1	240**	***
C2	240**	80
C3	240**	24

Reference	Integrity* (min)	Insulation (min)
C4	240**	85
G1	240**	***
G2	199	72
G3	89	30
G4	240**	106

*No collapse of the specimen, sustained flaming on the unexposed surface or loss of impermeability was observed for the periods given in the table.

**Test duration. The test was discontinued after a period of 240 minutes.

***Gap size deemed small to fit thermocouple (10mm).

Appendix B Summary of supporting test data

B.1 Relevance of BS 476: Part 20:1987 test data with respect to AS 1530.4:2014 and AS 4072.1-2005

B.1.1 General

- The fire resistance tests Chilt/IF03047, WF 148052 and WF 160399 were conducted utilising the heating conditions of BS 476: Part 20: 1987, which differs from AS 1530.4:2014. The effects these differences have on the fire resistance performance of test specimens are discussed below.

B.1.2 Furnace Temperature Regime

- The furnace temperature regime for fire resistance tests conducted in accordance with AS 1530.4:2014 follows a similar trend to BS 476: Part 20:1987.
- The parameters outlining the accuracy of control of the furnace temperature in AS 1530.4:2014 and BS 476: Part 20:1987 are not appreciably different.

B.1.3 Furnace Thermocouples

- For furnace thermocouples specified in AS 1530.4:2014 are Type K, mineral insulated metal sheathed (MIMS) with a stainless steel sheath having a wire of diameter of less than 1.0mm and an overall diameter of 3mm. The measuring junction protrudes at least 25mm from the supporting heat resistant tube.
- The furnace thermocouple types in BS 476: Part 20:1987 shall be one of the following two types:
    a. Bare Nickel Chromium/Nickel Aluminium wires, 0.75mm to 1.5mm in diameter, welded or crimped together at their ends and supported and insulated from each other in a twin bore porcelain insulator. However, for 25mm approximately from the weld/crimp, the wires shall be exposed and be separated from each other by at least 5mm. (To be replaced or recalibrated after 6hrs of usage).
    b. Nickel Chromium/Nickel Aluminium wire contained within mineral insulation in a heat resisting steel sheath of diameter 1.5mm, the hot junctions being electrically insulated from the sheath. The thermocouple hot junction shall project 25mm from a porcelain insulator. The assembly shall have a response time on cooling in air of not greater than 30 seconds.
- The relative distance of the furnace thermocouples from the exposed face of the specimen, for both AS 1530.4:2014 and BS 476:Part 20:1987, is 100mm +10mm.

B.1.4 Furnace Pressure

- It is a requirement of AS 1530.4:2014 that for horizontal elements, a furnace pressure of 20Pa is established at 100mm below the underside of the floor assembly.
- Similar conditions are required by BS 476: Part 20:1987 for horizontal elements

B.1.5 Performance Criteria

- AS 1530.4:2014 specifies the following performance criteria for building materials and structures:
    a. Structural Adequacy – (Not relevant to the referenced test)
    b. Integrity
    c. Insulation

B.1.6 Integrity

- The integrity criteria differ slightly between AS 1530.4:2014 and BS 476: Part 20:1987.
- For uninsulated specimens or, for specimens that have exceeded their insulation criteria performance, the specimen shall be deemed to have failed the integrity criterion in accordance with AS 1530.4:2014 if it sustains flaming for 10 seconds, or if the ignition of the cotton pad occurs.
- The integrity criteria for BS 476: Part 20: 1987 are similar to the above. However, the use of cotton pad is not as strictly regulated in the BS standard. Therefore, the AS standard is considered more onerous in measuring the integrity performance of linear gaps.

B.1.7 Insulation

- The thermocouple locations for measuring insulation in AS 1530.4:2014 and BS 476: Part 20:1987 are different. AS 1530.4:2014 specifically nominates positions for thermocouples for maximum temperature rise and allows the application of a roving thermocouple anywhere on the specimen. In BS 476: Part 20:1987 there is a requirement to measure temperatures at specified minimum number locations, with additional thermocouples fitted at the discretion of the laboratory. Similarly, a roving thermocouple can be applied at any location.
- The failure criteria for insulation in AS 1530.4:2014 and BS 476: Part 20:1987 are relatively different in terms of the positioning of thermocouples as noted above.

B.1.8 Application of referenced test data to AS 1530.4:2014 and AS 4072.1-2005.

- The variations in furnace heating regimes, furnace pressure conditions, furnace thermocouples and the responses of the different thermocouple types to the furnace conditions are not expected to have an overall significant effect on the outcome of the referenced fire resistance test.
- However, the BS 476: Part20:1987 is known to be less onerous than AS 1530.4:2014 with respect to the application of cotton pads to determine integrity failure.
- Based on the above, it is considered that the results of the referenced reports cannot be used to conduct an assessment in strict accordance with AS 1530.4:2014 and AS 4072.1-2005. Therefore, the likely fire resistance performance of the systems is assessed only in general accordance with these standards.

B.2 Relevance of BS EN 1363-1:1999 and BS EN 1366-4: 2006 test data with respect to AS 1530.4:2014 and AS 4072.1-2005

B.2.1 Furnace Temperature Measurement

- The furnace thermocouples specified in AS 1530.4:2014 are type K, mineral insulated metal sheathed (MIMS) with a stainless-steel sheath having a wire of diameter of less than 1.0mm and an overall diameter of 3mm. The measuring junction protrudes at least 25mm from the supporting heat resistant tube.
- The furnace thermocouple specified in BS EN 1363-1:1999 is made from folded steel plate that faces the furnace chamber. A thermocouple is fixed to the side of the plate facing the specimen with the thermocouple hot junction protected by a pad of insulating material.
- The plate part is to be constructed from 150 ±1 mm long by 100 ±1 mm wide by 0.7 ±0.1 mm thick nickel alloy sheet strips.
- The measuring junction is to consist of Nickel Chromium/Nickel Aluminium (Type K) wire as defined in IEC 60584-1[7], contained within mineral insulation in a heat-resisting steel alloy sheath of nominal diameter 1 mm, the hot junctions being electrically insulated from the sheath.
- The thermocouple hot junction is to be fixed to the geometric centre of the plate, by a small steel strip made from the same material as the plate. The steel strip can be welded to the plate or may be screwed to it to facilitate replacement of the thermocouple. The strip should be approximately 18 mm by 6 mm if it is spot-welded to the plate, and nominally 25 mm by 6 mm if it is to be screwed to the plate. The screw is to be 2 mm in diameter.
- The assembly of plate and thermocouple should be fitted with a pad of inorganic insulation material 97 ±1 mm by 97 ±1 mm by 10 ±1 mm thick with a density of 280 ±30 kg/m^3.
- The relative location of the furnace thermocouples for the exposed face of the specimen, for AS 1530.4:2014 and BS EN 1363.1:1999, is 100mm +10mm and 100mm +50mm respectively.
- The furnace control thermocouples required by BS EN 1363.1:1999 are less responsive than those specified by AS 1530.4:2014. This variation in sensitivity can produce a potentially more onerous heating condition for specimens tested to BS EN 1363.1:1999, particularly when the furnace temperature is changing quickly in the early stages of the test.

B.2.2 Furnace Pressure Regime

- It is a requirement of AS 1530.4:2014 that for a single horizontal penetration tested in a vertical separation element that has a height of more than 1m, it shall be tested with a pressure of 20±3 Pa at the top of the separation element and in such cases the horizontal penetrating service shall be included in the zone where the positive pressure exceeds 10Pa.
- Furthermore, if more than one penetration sealing system is tested in a vertical separation element, the pressure conditions specified above shall apply to the lowest penetration.
- Similarly, as per BS EN 1366-4:2006, a vertical furnace shall be operated so that a minimum pressure of 15Pa exists in the centre of the test specimen mounted in the lowest position.
- It is a requirement of AS 1530.4:2014 and BS EN 1363-1:1999 that for horizontal elements, a furnace gauge pressure of 20Pa is established at a height 100mm below the floor soffit level.
- The parameters outlining the accuracy of control of the furnace pressure in AS 1530.4:2014 and BS EN 1363-1:1999 are also not appreciably different.

[7] Thermocouples - Part 1: EMF specifications and tolerances

B.2.3 Specimen Size

- BS EN 1366-4:2006 states that a linear joint seal shall be of uniform design cross sectional area and for non-movement joints, a shorter length of not less than 900mm can be used.
- AS 1530.4:2014 states that the length of the linear gap exposed to the furnace chamber shall not be less than 1m. The linear gaps tested in the reference test reports all have a length of 900mm. However, the difference in the cavity length is not expected to have an overall significant effect on the outcome of the referenced fire resistance test. Therefore, they are assumed to be in agreement with the Australian Standards' requirements.

B.2.4 Integrity Performance Criteria

- The integrity criteria differ slightly between AS 1530.4:2014 and BS EN 1363.1:1999
- While a specimen maintains its insulation performance, the specimen shall be deemed to have failed the integrity criterion in accordance with AS 1530.4:2014 if it collapses or sustains flaming or other conditions on the unexposed face, which ignite the cotton pad when applied for up to 30 seconds. Gap gauges are not used to evaluate integrity.
- Except for minor technical variations, the integrity criteria in BN EN 1363.1:1999 are generally applied in a comparable manner.

B.2.5 Specimen Temperature Measurement and insulation performance criteria

- For linear gaps, AS 1530.4:2014 specifies the following requirements when placing thermocouples on the unexposed face in Clause 10.5.1 (f).
    a. At least three on the surface of the seal, with one thermocouple for each 0.3m^2 of surface area, up to a maximum of five, uniformly distributed over the area (one thermocouple being located at the centre of the seal)
    b. On the surface of the seal, 25mm from the edge of the opening, with one thermocouple for each 500mm of the perimeter.
    c. On the surface of the separating element, 25mm from the edge of the opening, with one thermocouple for each 500mm of the perimeter.
- Furthermore, Clause 10.5.3 of AS 1530.4:2014 specifies that thermocouples used for the evaluation of the insulation performance of linear gaps 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 such circumstances, the size of the pad may be reduced to facilitate the fitting of the thermocouple.
- A review of Figures 5 to 11 of BS EN 1366-4:2006 show that while the unexposed surface thermocouple locations specified are in agreement with those specified in AS 1530.4:2014, the BS EN standard is more onerous in certain aspects.

B.2.6 Application of Test Data to AS 1530.4:2014

- The variations in furnace heating regimes, furnace thermocouples, cavity length and the responses of the different thermocouple types to the furnace conditions are not expected to have significant effect on the outcome of the referenced fire resistance test.
- It is noted that test reports WF 148052 and WF 157402, a thermocouple on the unexposed surface sealant was not placed at the bottom end of the tested wall joint specimens. Hence, it is not in strict accordance with AS 1530.4: 2014 which stipulates that at least 3 thermocouples should be placed on the surface of the seal. The bottom end of the vertical seal is subjected to a lower pressure from the exposed side. Therefore, the outcome of the test is unlikely to have significantly been altered due to the presence of these thermocouples.

- Based on the above discussion it is considered that the results relating to the integrity and insulation performance of the referenced tests can be used as a basis to assess the FRL of the specimens if tested in accordance with AS 1530.4:2014.