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ASSESSMENT REPORT

Fire resistance performance of control joints protected by HB Fuller Fulacaulk FR sealants

Sponsor: HB Fuller Australia

Job number: FAS180425 Issuing consultant: Hon Wong

Date: 18 September 2019 Revision: R1.2

Amendment schedule

Version	Date	Information relating to report			
R1.0	Issue: 28/05/2019	Reason for issue	First Issue.		
			Prepared by	Reviewed by	Approved by
	Expiry: 31/05/2024	Name	Hon Wong	Omar Saad	Omar Saad
R1.1	Issue: 03/09/2019	Reason for issue	Re-issued to revise FRL of control Joints		
			Prepared by	Reviewed by	Approved by
	31/05/2024	Name	Hon Wong	Mahmoud Akl	Omar Saad
R1.2	Issue: 18/09/2019	Reason for issue	Minor typographic errors		
			Prepared by	Reviewed by	Approved by
	Expiry: 31/05/2024	Name	Hon Wong	Mahmoud Akl	Omar Saad
		Signature			

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General conditions of use

Contents

1. Introduction

This report presents an assessment on the fire resistance performance of HB Fuller Fulacaulk FR sealant protecting control joints in walls if tested in accordance with AS 1530.4:2014 and assessed in accordance with AS 4072.1-2005.

The tested prototypes described in section 2 of this report, when subjected to the proposed variations described in section 3 and tested in accordance with the relevant standards described in section 4 are assessed to achieve performance as summarised in section 5.

The validity of this assessment is conditional on compliance with sections 6, 7, 8 and 9 of this report.

Summaries of the test data on which this assessment is based are provided in Appendix A. A summary of the critical issues leading to the assessment conclusions including the main points of argument is discussed in Appendix B.

2. Tested prototypes

This assessment is based on reference tests FRT180011a.1 and FRT180400.1, being tests on control joints in concrete walls protected by H B Fuller Fulacaulk FR sealant in accordance with AS 1530.4:2014. The tests were sponsored by HB Fuller Australia and was conducted by Warringtonfire Australia Pty Ltd.

Refer to Appendix A for a full summary of the test data.

3. Variation to tested prototypes

The proposed construction shall be as tested in FRT180011a.1 and FRT180400.1 with control joints in 120mm thickness concrete wall of a series of widths protected by HB Fuller Fulacaulk FR sealant with consideration for varying the concrete thickness to 150mm and 175mm as tabled below:

Table 1 Schedule of control joints protected by H B Fuller Fulacaulk FR sealant as tested and variation in wall thickness

Separating element concrete wall thickness	Maximum joint width (mm)	Minimum sealant depth (mm)	Sealant location
120mm as tested	10	10	Both exposed and unexposed side
	20	10	Both exposed and unexposed side
	30	15	Both exposed and unexposed side
	40	20	Both exposed and unexposed side
150mm	10	10	Both exposed and unexposed side
	20	10	Both exposed and unexposed side
	30	15	Both exposed and unexposed side
	40	20	Both exposed and unexposed side
175mm	10	10	Both exposed and unexposed side
	20	10	Both exposed and unexposed side
	30	15	Both exposed and unexposed side
	40	20	Both exposed and unexposed side

Separating element concrete wall thickness	Maximum joint width (mm)	Minimum sealant depth (mm)	Sealant location
120mm as tested	10	10	Unexposed side only
	20	20	Unexposed side only
	30	30	Unexposed side only
150mm	10	10	Unexposed side only
	20	20	Unexposed side only
	30	30	Unexposed side only
175mm	10	10	Unexposed side only
	20	20	Unexposed side only
	30	30	Unexposed side only
120mm as tested	10	10	Fire exposed side only
	20	15	Fire exposed side only
	30	20	Fire exposed side only
150mm	10	10	Fire exposed side only
	20	15	Fire exposed side only
	30	20	Fire exposed side only
175mm	10	10	Fire exposed side only
	20	15	Fire exposed side only
	30	20	Fire exposed side only

3.1 Tested systems

The control joints were tested with 120mm thickness concrete walls in Tests FRT180011a.1 and FRT180400.1 protected by HB Fuller Fulacaulk FR sealants. The sealants were applied to both the unexposed and exposed sides of the control joints in Test FRT180011a.1. In Test FRT 180400.1 the sealants were applied to one side of each control joint only with 3 control joints protected on the exposed sides and 3 on the unexposed sides.

Table 2 Schedule of components for control joints in concrete wall tested in FRT180011a.1

Item	Description	
Separating element		
1.	Item name	Concrete Wall
	Product name	120mm thick concrete
	Density	2300 kg/m^3 (measured)
	Installation	The concrete strips were precast and stored at Warringtonfire Australia (WFA). The concrete strips were aligned as per the varying control joint sizes. The concrete strips were supported at the top and bottom edges by PFC's. Masonry anchors were used to fix the concrete strips to the PFC's.

Item	Description	
Fire-stopping protections		
Sealant		
2.	Product name	HB Fuller - Fulacaulk FR
	Density	1606 kg/m^3 (measured)
	Installation	The sealant was installed in all control joints as detailed in various service descriptions below.
Backing Rod		
3.	Item name	Open cell backing rod
	Material	Polyethylene
	Size	Varying size as per the control joints.
	Installation	The backing rod of varying sizes were installed at all control joints as detailed in various service descriptions below.
Control joint A		
A	Control joint detail	Control Joint - nominally 1000mm long × 10mm wide, 10mm deep
	Aperture size	10mm × 1000mm
	Local fire-stopping protection	
	Protection	Backing rod (item 3) of size 20mm × 20mm, was installed into the control joint at a depth of 10mm from both exposed and unexposed faces of wall. The sealant (item 2) was applied into the control joint to the depth of backing rod and finishing flush with the face of the wall.
Control joint B		
B	Control joint detail	Control Joint - nominally 1000mm long × 20mm wide, 10mm deep
	Aperture size	20mm × 1000mm
	Local fire-stopping protection	
	Protection	Backing rod (item 3) of size 30mm × 20mm, was installed into the control joint at a depth of 10mm from both exposed and unexposed faces of wall. The sealant (item 2) was applied into the control joint to the depth of backing rod and finishing flush with the face of the wall.

Item	Description	
Control joint C		
C	Control joint detail	Control Joint - nominally 1000mm long × 30mm wide, 15mm deep
	Aperture size	30mm × 1000mm
	Local fire-stopping protection	
	Protection	Backing rod (item 3) of size 40mm × 20mm, was installed into the control joint at a depth of 15mm from both exposed and unexposed faces of wall. The sealant (item 2) was applied into the control joint to the depth of backing rod and finishing flush with the face of the wall.
Control joint D		
D	Control joint detail	Control Joint - nominally 1000mm long × 40mm wide, 20mm deep
	Aperture size	40mm × 1000mm
	Local fire-stopping protection	
	Protection	Backing rod (item 3) of size 60mm × 30mm (two backing rods of 30mm × 30mm), was installed into the control joint at a depth of 20mm from both exposed and unexposed faces of wall. The sealant (item 2) was applied into the control joint to the depth of backing rod and finishing flush with the face of the wall.

The following are details of specimen wall and control joints tested in FRT180011a..1

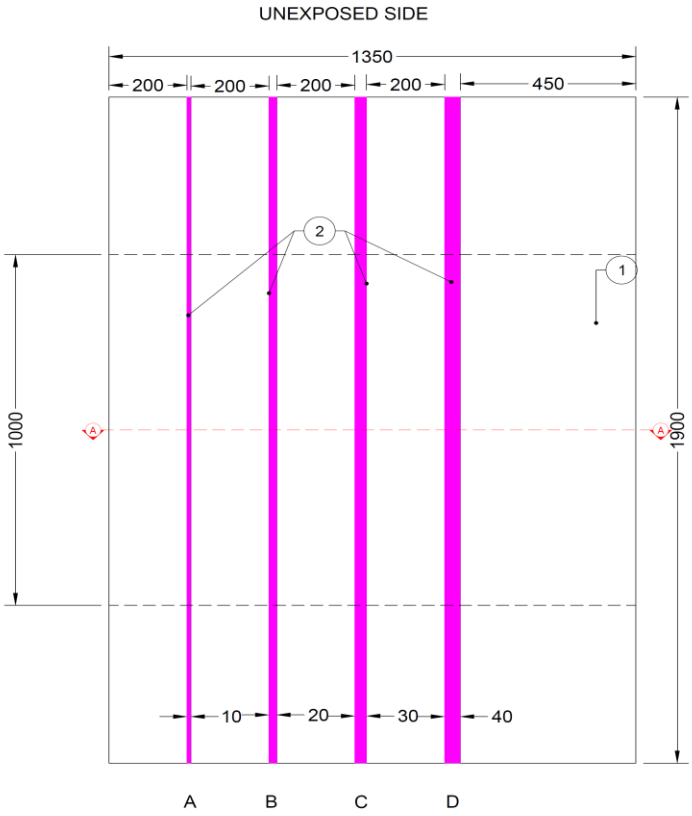

Figure 1 Elevation of test specimen wall and control joints from unexposed side.

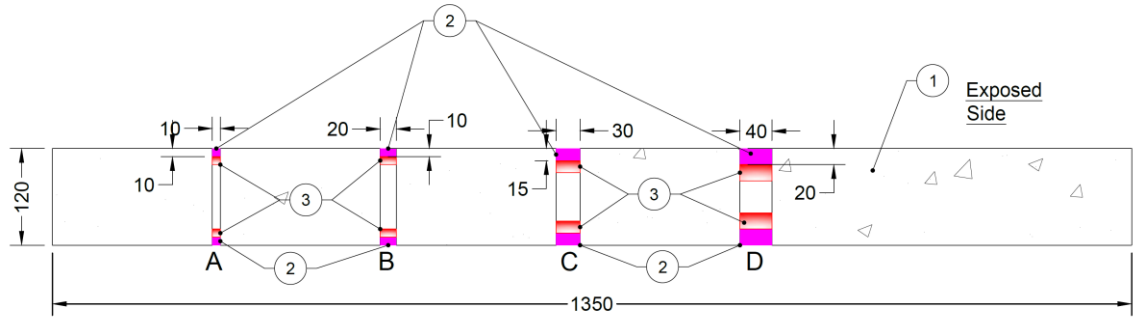

Figure 2 Cross-section A-A

Table 3 Schedule of components for control joints in concrete wall tested in FRT180400.1

Item	Description	
Separating element		
4.	Item name	Concrete wall strips
	Product name	120mm thick concrete
	Density	2400 kg/m^3 (measured)

Item	Description	
	Installation	The concrete strips were precast and stored at Warringtonfire Australia (WFA). The concrete strips were aligned as per the varying control joint sizes. The concrete strips were supported at both the edges by PFC. Masonry anchors were used to fix the concrete strips to the PFCs.
Fire-stopping protections		
Sealant		
5.	Product name	HB Fuller – Fulacaulk FR
	Density	1606 kg/m^3 (measured)
	Installation	The sealant was installed in the control joints as detailed in various control joint descriptions below.
Backing Rod		
6.	Item name	Open cell backing rod
	Material	Polyethylene
	Size	Various sizes as per the control joints.
	Installation	The backing rod of varying sizes were installed at all the control joints as detailed in various control joint descriptions below.
Control joint A		
A	Control joint detail	Control joint – nominally 1000mm long × 30mm wide; 20mm deep. Sealant applied on exposed side only.
	Aperture size	30mm × 1000mm
	Local fire-stopping protection	
	Protection	Backing rod (item 3) of size 32mm × 29mm, was installed into the control joint at a depth of 20mm from the exposed face of the wall. The sealant (item 2) was applied into the control joint to the depth of backing rod and finished flush with the face of wall. The backing rod & sealant is applied only on the exposed side.
Control joint B		
B	Control joint detail	Control joint – nominally 1000mm long × 20mm wide; 15mm deep. Sealant applied on exposed side only.
	Aperture size	20mm × 1000mm
	Local fire-stopping protection	
	Protection	Backing rod (item 3) of size 29mm × 20mm, was installed into the control joint at a depth of 15mm from the exposed face of the wall.

Item	Description	
		The sealant (item 2) was applied into the control joint to the depth of backing rod and finished flush with the face of wall. The backing rod & sealant is applied only on the exposed side.
Control joint C		
C	Control joint detail	Control joint – nominally 1000mm long × 10mm wide; 10mm deep. Sealant applied on exposed side only.
	Aperture size	10mm × 1000mm
	Local fire-stopping protection	
	Protection	Backing rod (item 3) of size 21mm × 18mm, was installed into the control joint at a depth of 10mm from the exposed face of the wall. The sealant (item 2) was applied into the control joint to the depth of backing rod and finished flush with the face of wall. The backing rod & sealant is applied only on the exposed side.
Control joint D		
D	Control joint detail	Control joint – nominally 1000mm long × 30mm wide; 30mm deep. Sealant applied on unexposed side only.
	Aperture size	30mm × 1000mm
	Local fire-stopping protection	
	Protection	Backing rod (item 3) of size 32mm × 29mm, was installed into the control joint at a depth of 30mm from the unexposed face of the wall. The sealant (item 2) was applied into the control joint to the depth of backing rod and finished flush with the face of wall. The backing rod & sealant is applied only on the unexposed side.
Control joint E		
E	Control joint detail	Control joint – nominally 1000mm long x 20mm wide; 20mm deep. Sealant applied on unexposed side only.
	Aperture size	20mm x 1000mm
	Local fire-stopping protection	
	Protection	Backing rod (item 3) of size 29mm x 20mm, was installed into the control joint at a depth of 20mm from the unexposed face of the wall. The sealant (item 2) was applied into the control joint to the depth of backing rod and finished flush with the face of wall. The backing rod & sealant is applied only on the unexposed side.
Control joint F		
F	Control joint detail	Control joint – nominally 1000mm long × 10mm wide; 10mm deep. Sealant applied on unexposed side only.
	Aperture size	10mm × 1000mm

Item	Description	
	Local fire-stopping protection	
	Protection	Backing rod (item 3) of size 21mm × 18mm, was installed into the control joint at a depth of 10mm from the unexposed face of the wall. The sealant (item 2) was applied into the control joint to the depth of backing rod and finished flush with the face of wall. The backing rod & sealant is applied only on the unexposed side.

The following are details of specimen wall and control joints tested in FRT180400.1

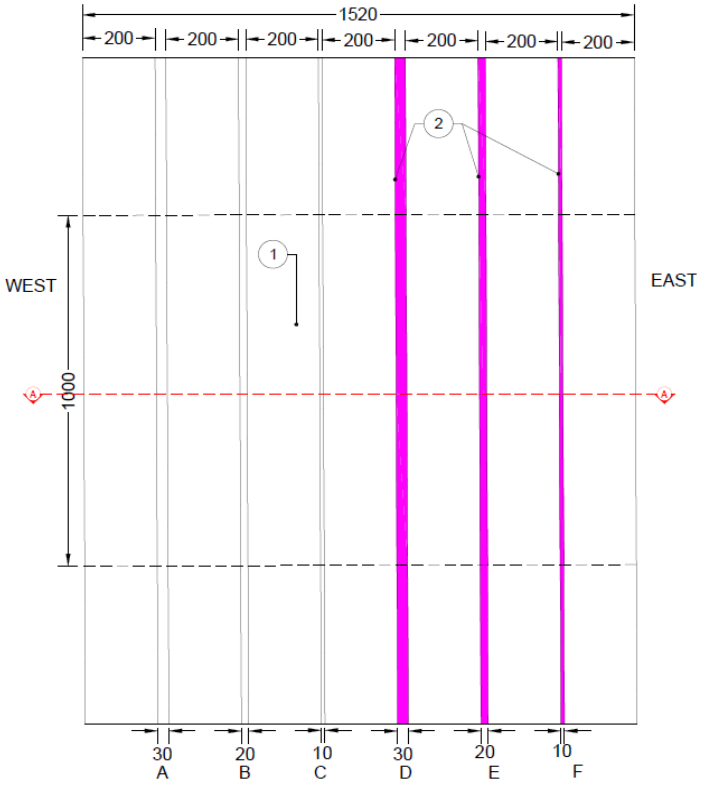

Figure 3 Elevation of test specimen wall and control joints from unexposed side

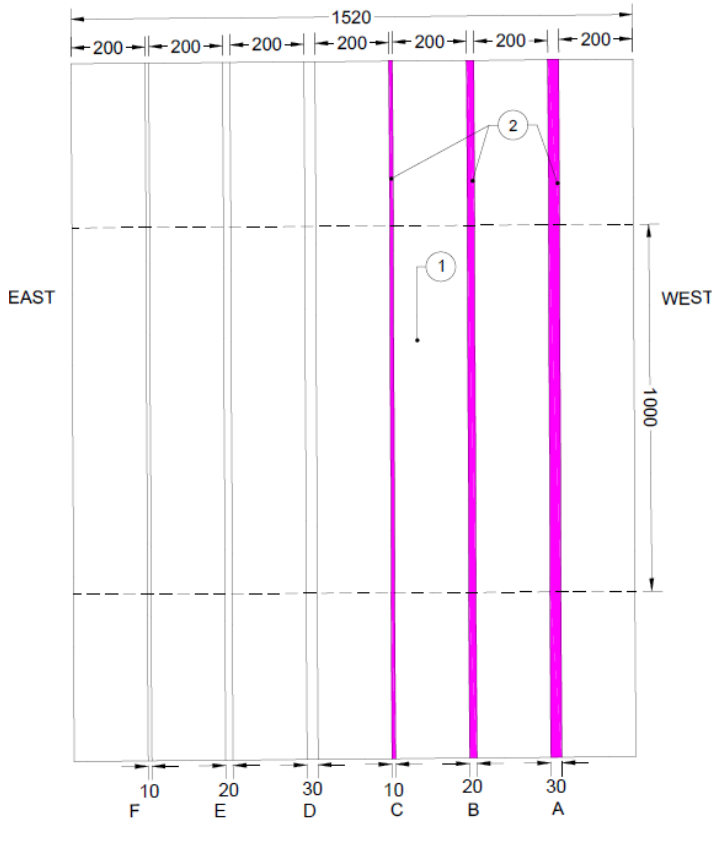

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Figure 4 Elevation of test specimen wall and control joints from exposed side

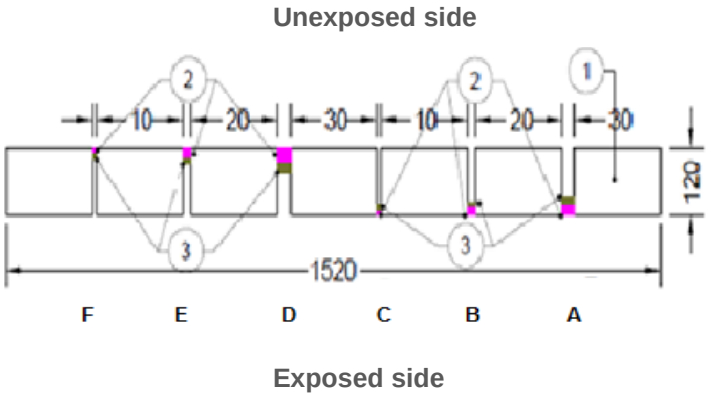

Figure **5** Cross-section A-A (from figure 3)

4. Referenced test standard

The report is prepared with reference to the requirement of AS 1530.4:2014 and AS 4072.1:2005 for service penetrations and control joints

5. Formal assessment summary

On the basis of the discussion presented in this report, it is the opinion of this testing authority that if the tested prototype described in section 2 had been varied as in section 3, it will achieve the fire resistance performance as stated below if tested in accordance with the test method referenced in section 0 when subject to the requirements of section 7.

Table 4 Summary of assessment of the performance of control joints in concrete walls protected by H B Fuller Fulacaulk sealants on both exposed and unexposed sides

Concrete wall thickness (mm)	Maximum joint width (mm)	Minimum sealant depth (mm)	Sealant location	Tested and assessed FRL
120	10	10	Both exposed and unexposed side	-/120/120
	20	10	Both exposed and unexposed side	-/120/120
	30	15	Both exposed and unexposed side	-/120/120
	40	20	Both exposed and unexposed side	-/120/120
150	10	10	Both exposed and unexposed side	-/180/180
	20	10	Both exposed and unexposed side	-/180/180
	30	15	Both exposed and unexposed side	-/180/180
	40	20	Both exposed and unexposed side	-/180/180
175	10	10	Both exposed and unexposed side	-/240/240
	20	10	Both exposed and unexposed side	-/240/240
	30	15	Both exposed and unexposed side	-/240/240
	40	20	Both exposed and unexposed side	-/240/240

Table 5 Summary of assessment of the performance of control joints in concrete walls protected by H B Fuller Fulacaulk FR sealants on one side only

Concrete wall thickness (mm)	Maximum joint width (mm)	Minimum sealant depth (mm)	Sealant location (one side only)	Tested and assessed FRL
120	10	10	Fire exposed side	-/120/120
	20	20	Fire exposed side	-/120/0
	30	30	Fire exposed side	-/120/30
150	10	10	Fire exposed side	-/180/180
	20	20	Fire exposed side	-/180/0
	30	30	Fire exposed side	-/180/30
175	10	10	Fire exposed side	-/240/240
	20	20	Fire exposed side	-/240/0
	30	30	Fire exposed side	-/240/30
120	10	10	Unexposed side	-/120/120
	20	15	Unexposed side	-/120/90
	30	20	Unexposed side	-/120/90
150	10	10	Unexposed side	-/180/180
	20	15	Unexposed side	-/180/120

Concrete wall thickness (mm)	Maximum joint width (mm)	Minimum sealant depth (mm)	Sealant location (one side only)	Tested and assessed FRL
	30	20	Unexposed side	-/180/120
175	10	10	Unexposed side	-/240/240
	20	15	Unexposed side	-/240/180
	30	20	Unexposed side	-/240/240

6. Direct field of application

The results of the referenced assessment are applicable to control joints in concrete walls protected by HB Fuller Fullacaulk FR sealants with sealant depths and exposure to fire from the direction as indicated.

7. Requirements

This report details the methods of construction, test conditions and assessed results that would have been expected had the specific elements of construction described herein been tested in accordance with AS 1530.4:2014

All services shall be supported in the manner in which they are assessed as described in section 3. Any further variations with respect to size, constructional details, loads, stresses, edge or end conditions, other than those identified in this report, may invalidate the conclusions drawn in this report.

8. Validity

This assessment report does not provide an endorsement by Warringtonfire Australia Pty Ltd of the actual products supplied.

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.

Because of 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.

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

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 the subject of constant review and improvement and it is recommended that this report be reviewed on or, before, the stated expiry date.

The information contained in this report shall not be used for the assessment of variations other than those stated in the conclusions above. The assessment is valid provided no modifications are made to the systems detailed in this report. All details of construction should be consistent with the requirements stated in the relevant test reports and all referenced documents.

9. Authority

9.1 Applicant undertakings and conditions of use

By using this report as evidence of compliance or 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 structure be 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, 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 assessing authority to withdraw the assessment.

9.2 General conditions of use

Appendix A Summary of supporting data

A.1 Test report – FRT180011a.1

A.1.1 Report sponsor

H B Fuller Australia

A.1.2 Test laboratory

Warringtonfire Australia Pty Ltd, Unit 2, 409-411 Hammond Road, Dandenong, Victoria 3175, Australia.

A.1.3 Test date

A.1.3.1 The fire resistance test was conducted on 10/01/2019.

A.1.4 Test standards

The test was conducted in accordance with AS 1530.4:2014.

A.1.5 Variations to test standards

None

A.1.6 General description of tested specimen

The wall system consisted of six 1900mm long × 200mm wide × 120mm thick concrete wall strips supported at the ends using PFC's to form five control joints of various widths in which four control joints were reported. Masonry anchors were used to fix the concrete strips to the PFC's giving the wall overall width of 1350mm. The control joints were protected by HB Fuller Fulacaulk FR Sealant.

A.1.7 Instrumentation

The test report states that the instrumentation was in accordance with AS 1530.4:2014.

A.1.8 Test results

The tested specimen control joints achieved the following results:

Table 6 Test Results Summary

Control Joint	Local fire-stopping protection	Aperture size (mm)	Sealant depth (mm)	Performance (FRL)
A	HB Fuller - Fulacaulk FR	10 × 1000	10	-/240/120
B	HB Fuller - Fulacaulk FR	20 × 1000	10	-/240/120
C	HB Fuller - Fulacaulk FR	30 × 1000	15	-/240/120
D	HB Fuller - Fulacaulk FR	40 × 1000	20	-/240/120

A.2 Test report – FRT180400.1

A.2.1 Report sponsor

HB Fuller Australia

A.2.2 Test laboratory

Warringtonfire Australia Pty Ltd, Unit 2, 409-411 Hammond Road, Dandenong, Victoria 3175, Australia.

A.2.3 Test date

The fire resistance test was conducted on 14/02/2019.

A.2.4 Test standards

The test was conducted in accordance with AS 1530.4:2014.

A.2.5 Variations to test standards

The pressure was 2Pa above the limits prescribed in the standard during the 144-150-minute period. The pressure and temperature were within the limits for rest of the test duration. This overpressure resulted in more onerous test conditions, thus would not have invalidated the test result.

A.2.6 General description of tested specimen

The wall system consisted of seven 1900mm long × 200mm wide × 120mm thick concrete wall strips supported at the ends using parallel flange channel (PFC) to form six control joints of various widths. Masonry anchors were used to fix the concrete strips to PFC giving the floor overall width of 1520mm. The control joints were protected by HB Fuller – Fulacaulk FR sealant.

A.2.7 Instrumentation

The test report states that the instrumentation was in accordance with AS 1530.4:2014

A.2.8 Test results

The following are results for the tested specimen control joints.

Table 7 Test Results Summary

Control joint	Local fire-stopping protection	Aperture size (mm)	Sealant depth (mm)	Performance (FRL)
A	HB Fuller – Fulacaulk FR	30 × 1000	20 on the exposed side	-/240/30
B	HB Fuller – Fulacaulk FR	20 × 1000	15 on the exposed side	-/240/0
C	HB Fuller – Fulacaulk FR	10 × 1000	10 on the exposed side	-/240/120
D	HB Fuller – Fulacaulk FR	30 × 1000	30 on the unexposed side	-/240/90
E	HB Fuller – Fulacaulk FR	20 × 1000	20 on the unexposed side	-/240/90
F	HB Fuller – Fulacaulk FR	10 × 1000	10 on the unexposed side	-/240/120

Appendix B Assessment of specific variations

B.1 Variations to concrete walls with control joints protected by HB Fuller Fulacaulk FR sealant

B.1.1 Proposed constructions

B.1.1.1 The proposed construction shall be as tested in FRT180011a.1 and FRT180400.1 in accordance with AS 1530.4:2014 with control joints in 120mm thickness concrete wall of a series of widths protected by HB Fuller Fulacaulk FR sealant with consideration for varying the concrete thickness to 150mm and 175mm.

B.1.2 Discussion

B.1.2.1. The control joints in Tests FRT180011a.1 and FRT180400.1 were conducted with 120mm thickness concrete walls as separating elements.

B.1.2.2. The referenced tests were intended to simulate exposure of the control joints protected by the HB Fuller Fulacaulk FR sealant for up to 240 minutes.

Performance of control joints tested in FRT180011a.1 with sealants of both sides

B.1.2.3. Test FRT180011a.1 was conducted with sealant applied to both the exposed and unexposed sides of the four control joints.

B.1.2.4. The tested specimen 120mm thick concrete wall in the test did not experience integrity failure up to 240 minutes of heat exposure. Increasing the thickness of the concrete wall to 150mm or 175mm would simply add to the insulation, in addition to improvement in integrity, of the wall system as the thicker walls would have a greater thermal mass and would hold the wall temperature to within 120°C for a longer period. This would translate to the concrete aggregate drying out later and lower deflection.

B.1.2.5. From the above discussion it can be deduced that the thicker concrete walls (and the control joints) will have a lessor chance of cracking and also experience lesser deflection. The result is that the thicker concrete walls and control joints would perform equal or better in integrity and insulation performance.

B.1.2.6. The control joints at the end of the test did not show any cracking or opening of gaps in the sealants, on both the unexposed and exposed sides of the specimen wall.

B.1.2.7. It was noted that the thermocouples on the at the unexposed wall surface adjacent to all the control joints recorded temperatures of about 260°C whilst the sealant temperatures at the unexposed side (except for control joint A) were all lower than the wall surface temperatures. It was also noted that the wider joint D had the lowest sealant temperature recorded with the temperatures increasing with reducing joint gap width.

B.1.2.8. It is considered that the sealant temperature would have been affected by concrete which would have caused a temperature rise in the sealant via conduction from the sides of the wall in the joint. The test was conducted with an “overburn” of the 120mm thickness wall which would have been rated for only 120 minutes insulation. As the 120mm thick concrete was heated beyond 120 minutes, the wall would have begun to rise above its rated insulation performance i.e. at temperatures 180K above ambient. It would have been expected that some heat would have been transferred onto the sealants from the side walls of the control joints.

B.1.2.9. If the test were to be carried out separately for 180 minutes with a 150mm thick concrete wall and for 240 minutes with a 175mm thick concrete wall, the interface temperatures would have been no more than 180K above ambient temperature. The sealant temperatures would also follow the same reduction and are expected to be slightly lower than the interface temperatures as shown from the test results.

B.1.2.10. It is expected from the above discussion that the sealant temperature on the unexposed side would be at least equal or slightly lower than the temperature at the unexposed wall surface.

B.1.2.11. From the above discussion, it is considered that the control joints temperatures at the unexposed side would most likely be no higher than the wall surface temperature if tested in a 120mm thick concrete wall for 120 minutes, 150mm thick concrete wall for 180 minutes and 175mm thick concrete wall for 240 minutes. As the corresponding walls are deemed to perform to the corresponding FRL's, the tested control joints A, B, C and D with sealants applied to both the exposed and unexposed sides would perform to the required insulation performance if tested in the appropriate thickness specimen concrete wall.

B.1.2.12. In the light of the above, it can be considered that the results from the tests on control joints protected on both sides by HB Fuller Fulacaulk FR sealants in 120mm thick concrete walls may be applied to 150mm and 175mm thickness for integrity performance, with the insulation performance corrected for the thicker walls for higher FRL, if tested in accordance with AS 1530.4:2014.

Performance of control joints tested in FRT180400.1 with sealants only on exposed and only on the unexposed side.

B.1.2.13. Test FRT180400.1 was with sealant applied to the exposed side only of three specimen control joints and to the unexposed side only of the remaining three specimen control joints.

B.1.2.14. The tested specimen wall and control joints performed similarly to that in FRT180011a.1, i.e. therefore, therewas no integrity failure up to 240 minutes of heat exposure.

B.1.2.15. Insulation performance varied between the joints, with the control joints protected by sealants on the exposed side being more onerous.

B.1.2.16. The sealant on the exposed side would be exposed to full furnace temperatures and on the unexposed side of the sealant the "column" of air in the joint is open and vented to the unexposed side of the wall. The process promotes heat transfer from the sealant away from the control joint, resulting in a continual rise in temperature on the unexposed side of the control joint.

B.1.2.17. Where the sealant is on the unexposed side only, the hot gases have to pass through the depth of the control joint before imparting heat onto the sealant surface. The gases would have lost most of the heat via convective transfer along the walls of the control joint. The heat transfer to the wall will continue for the full duration of the fire test.

B.1.2.18. As expected, the temperatures measured in the joint on the unexposed side for control joints A and B showed a rise in temperatures to more than 400°C just after 120 minutes of heat exposure even though the temperatures of the unexposed wall surface at the interface were only about 125°C after 120 minutes.

B.1.2.19. Control joint C even though a thermocouple could not be fitted in the control joint at the unexposed side, the temperatures recorded were that representative of those of the performance of the concrete wall. At 120 minutes, the temperatures recorded at the interface wall surface around the control joint C were below 150°C. As the temperatures recorded for control joints A and B were below those at the interface, it follows that the control joint temperature for specimen C will be below or equal to that at the interface or no more than 150°C at 120 minutes. The insulation performance for specimen C therefore matches that of the separating element and follows that if the wall thickness were to be increased, control joint C will improve in insulation performance accordingly, i.e. 180 minutes for 150mm thick and 240 minutes for 175mm thick concrete walls.

B.1.2.20. The graphs from Test FRT180400.1 indicate that the temperatures at the unexposed sides in control joints A and B (including C) remained 200K higher (after 120 minutes) than the wall surface at the unexposed side for the full duration of heat exposed. It can be deduced that even if the control joints were to be tested with 150mm thick concrete wall for 180 minutes and 175mm concrete wall for 240 minutes exposure, the control joint temperatures at the unexposed side would not have lowered sufficiently to match the insulation performance of the corresponding thickness specimen wall. The test results for control joints A, B and C therefore cannot be reassessed to a higher insulation performance even if the wall thickness were to be increased up to 175mm.

B.1.2.21. In Test FRT180011a.1, the wall temperature on the unexposed side at the interface of the control joints (with sealants on both sides) was approximately 260°C after 240 minutes of exposure.

B.1.2.22. Looking at the results from test 180400.1 where the sealants were installed at the unexposed sides only, i.e. control joints D, E and F, the hot gases within the control provided additional heat transfer to the control joints. The temperatures in the joints were much higher and varied from 350°C for specimen D and 365°C for specimen E to 318°C for specimen F. Compared with the data from FRT180011a.1, the interface temperatures on the unexposed specimen wall surface are much higher. These could be due to the heat transfer from the side wall surfaces within the control joints into the concrete.

B.1.2.23. The ambient temperature at the start of the Test in FRT180400.1 was 18 °C, giving a maximum temperature on the unexposed side of 198°C for failure in insulation performance. Control joint D had a maximum temperature of 200°C. The temperatures at the interface were around 350°C at the end of the 240 minutes but only 219°C at 120 minutes exposure.

B.1.2.24. From the discussion above, it is clear that the sealant temperatures were lower than the interface temperatures. However, the temperatures recorded at 120 minutes into the test, which corresponds to the rated performance of the specimen 120mm concrete wall, specimen D failed (by a 21K margin) to meet the pass/fail criteria i.e. they were higher than 198°C. As the sealant temperature profile tracks closely to that for the interface for control joints D and E, it is likely that control joints D and E will likely fall marginally short of the pass/fail criteria for 180 minutes exposure with 150mm concrete thickness and 240 minutes with 175mm thickness concrete walls. The likely insulation performance for both specimens D and E are 90 minutes for 120mm, 120 minutes for 150mm and 180 minutes for 175mm thickness walls.

B.1.2.25. With regards to specimen F where no thermocouples were fitted in the sealant on the unexposed side, the temperatures recorded were almost the same as for the bare wall. It appears that the narrow control joint width did not have any significant contribution to the temperature rise on the unexposed wall surface at the interface. The temperature recorded 120 minutes into the test was below 150°C. It can therefore be considered that control joint F will perform to 120 minutes of insulation in a 120mm thick concrete wall, 180 minutes in a 150mm concrete wall and 240 minutes in a 175mm thick concrete wall.

B.1.2.26. In light of the above, it can be considered that the proposed variations in wall thickness will not detrimentally affect the performance of the control joints in concrete walls protected by HB Fuller Fulacaulk FR sealant if tested in accordance with AS 1530.4:2014 .The results from tests performed with 120mm concrete walls will apply to the controls joints or equivalent widths and sealants in concrete walls of 150mm or 175mm thickness with corrections to the insulation performance as discussed above.

Table 8 Summary of assessment of the performance of control joints in concrete walls protected by H B Fuller Fulacaulk FR sealants

Concrete wall thickness (mm)	Maximum joint width (mm)	Minimum sealant depth (mm)	Sealant location	Tested and Asessed FRL
120	10	10	Both exposed and unexposed side	-/120/120
	20	10	Both exposed and unexposed side	-/120/120
	30	15	Both exposed and unexposed side	-/120/120
	40	20	Both exposed and unexposed side	-/120/120
150	10	10	Both exposed and unexposed side	-/180/180
	20	10	Both exposed and unexposed side	-/180/180
	30	15	Both exposed and unexposed side	-/180/180
	40	20	Both exposed and unexposed side	-/180/180
175	10	10	Both exposed and unexposed side	-/240/240

Concrete wall thickness (mm)	Maximum joint width (mm)	Minimum sealant depth (mm)	Sealant location	Tested and Asessed FRL
	20	10	Both exposed and unexposed side	-/240/240
	30	15	Both exposed and unexposed side	-/240/240
	40	20	Both exposed and unexposed side	-/240/240
120	10	10	Fire exposed side	-/120/120
	20	20	Fire exposed side	-/120/0
	30	30	Fire exposed side	-/120/30
150	10	10	Fire exposed side	-/180/180
	20	20	Fire exposed side	-/180/0
	30	30	Fire exposed side	-/180/30
175	10	10	Fire exposed side	-/240/240
	20	20	Fire exposed side	-/240/0
	30	30	Fire exposed side	-/240/30
120	10	10	Unexposed side	-/120/120
	20	15	Unexposed side	-/120/90
	30	20	Unexposed side	-/120/90
150	10	10	Unexposed side	-/180/180
	20	15	Unexposed side	-/180/120
	30	20	Unexposed side	-/180/120
175	10	10	Unexposed side	-/240/240
	20	15	Unexposed side	-/240/180
	30	20	Unexposed side	-/240/180