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ASSESSMENT REPORT

An assessment of the fire resistance performance of 78mm thick vertically orientated Speedpanel wall system with movement potential of joint prior to fire event if tested in accordance with AS1530.4-2014

Client: Speedpanel (VIC) Pty Ltd

Job number: FAS180517 Issuing consultant: Imran Ahamed

Date: 21 December 2018 Revision: 26593800.1

Amendment schedule

Version	Issue date	Description	Prepared by	Reviewed by
26593800	12/12/2013	Initial Issue	S. Hu	K. Nicholls
26593800.1	21/12/2018	Revalidation in accordance with AS1530.4-2014	I. Ahamed	H. Wong

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General conditions of use

Contents

1. Introduction

This report presents an assessment on the fire resistance performance of 78mm thick vertically orientated Speedpanel wall system with movement potential of joint prior to fire event if tested in accordance with AS1530.4-2014.

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 refers to BWA 2286900.5, describing a test of a vertically orientated 78mm thick Speedpanel wall system 3m × 3m in size. The wall was loaded to simulate a wall of increased height. The test was conducted by Exova Warringtonfire and sponsored by Speedpanel Vic Pty Ltd.

The assessment also refers to FR 4322 and EWFA 2741700.1 for 78mm thick Speedpanel wall panel systems which were sponsored by Speedpanel Vic Pty Ltd.

This assessment also refers to tests AFTF/080502 and WARRES 117117 which utilised the heating conditions of BS 476: Part 20: 1987.

Supplementary reference is made to FTCR/96/0057 and an ad-hoc test undertaken by Fire Protection Ltd on the 9/8/2001 utilising the heating conditions of BS476: Part 20: 1987 in order to establish insulation performance.

The above reports were sponsored by TBA Textiles Limited, who has provided permission for the data to be referenced in this report.

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

3. Variation to tested prototypes

The proposed construction is made from 78mm thick vertically orientated Speedpanel as tested in BWA 2286900.5 with consideration given to the following variations:

- The wall shall be up to 6m high.
- Head details shall be as shown in figure 2 to 7.
- The initial gap at the head shall be constructed as figure 2 for head detail 1 and as figure 5 for head detail 2.

Refer to Table 1 and figure 1 to 7 for a summary of the proposed construction.

Table 1 Schedule of Components for Continuous Speedpanel Walls

ID	Item	Description
1	Wall Panel	78mm thick Speedpanel panels as tested in BWA 2286900.5
2	Top Track	Minimum 120mm (legs) × 82mm wide x 1.15mm C track with 65mm wide slotted hole Fixed to support structure with track fixings (item 4) and fixed to the Speedpanel panel (Item 1) with 10 gauge × 16mm long self-drilling screws at 500mm centres into flat face of Speedpanel.
3	Side and Bottom Track	Minimum 50mm (legs) × 82mm wide × 1.15mm C track Fixed to support structure with track fixings (item 4) and fixed to the Speedpanel panel (Item 1) with 10 gauge × 16mm long self-drilling screws at 500mm centres.
4	Track Fixing	Mechanical fixing of track (Item 1) and Steel angle (Item 5) to surround with M6.5 × 38mm mushroom spike nails or Hilti X-DW27MX at 400mm centres shall be in accordance with project engineer's specification.
5	Steel Angle	50mm × 50mm × 1.15mm BMT angle Fixed to support structure with track fixings (item 4)
6	Head Protection	15mm thick Firefly Titan blanket Installed at one side of the head C-track that allows enough slack to allow for downward movement. Wrapped around the steel angle (Item 5) as shown in figure 2 and fixed to top track (Item 2) with 10 gauge × 30mm self-drilling screws at 250mm centres.
7	Sealant	Hilti CP 606 fire resistance acoustic mastic sealant Used to seal all gaps between tracks and panels. Used to seal all gaps between Firefly Titan blanket and panels.
8	Panel Fixing	10 gauge × 16mm self-drilling screw Speedpanel panels screwed together at vertical joints with fixing screws at 1000mm centres at one side of the panel
9	Head Protection	87mm deep × 50mm wide Firetherm Intuspan Friction fitted between head C-track and Speedpanel panels.
10	Flashing	0.7mm BMT × 130mm wide galvanised steel flashing with slotted holes Screw fixed into head C-track and panel at head track and Speedpanel panels at 250mm centres on one side by using 10 gauge × 16mm long Self-drilling screws.

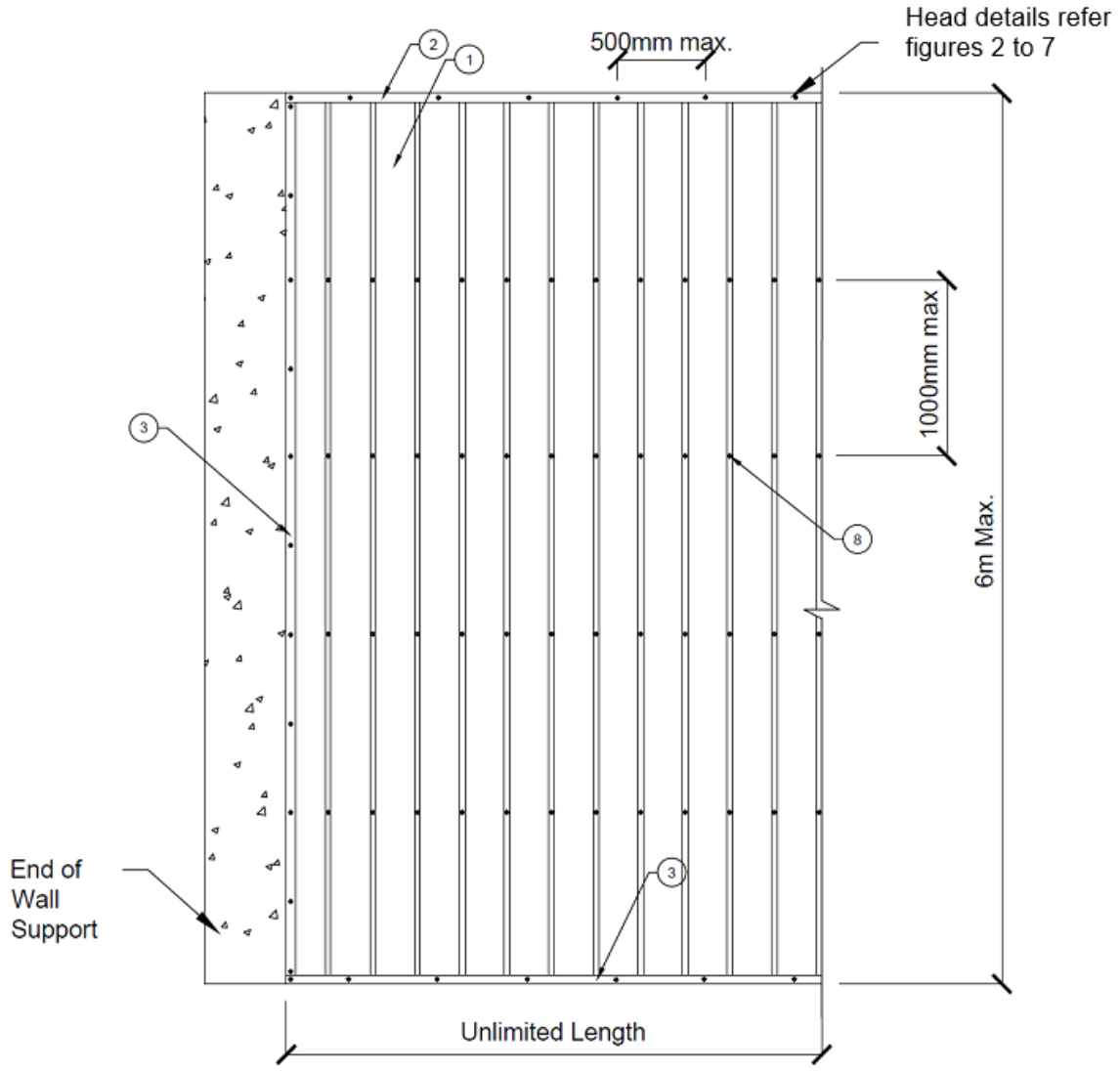


Figure 1 Typical Elevation of Wall

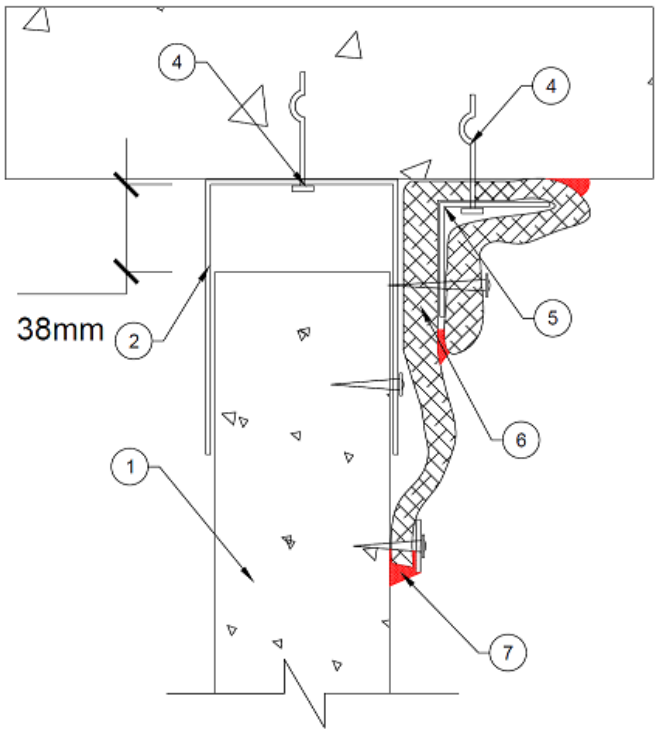


Figure 2 Head Detail 1 of the Wall with Initial Gap Size

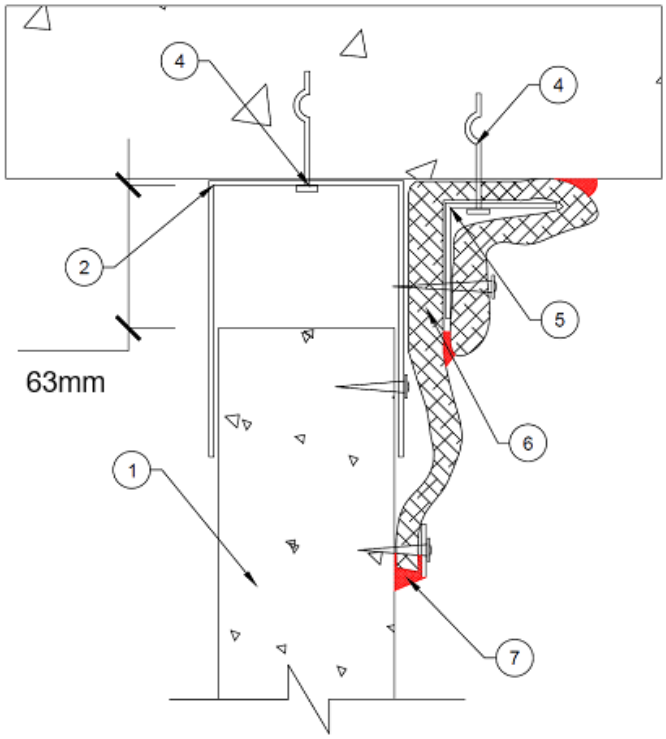


Figure 3 Head Detail 1 of the Wall with Maximum Gap Size

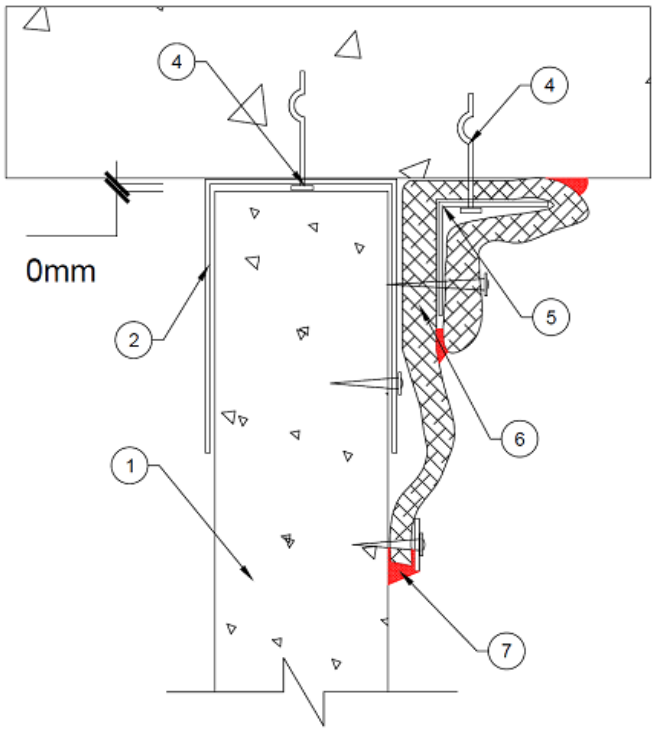


Figure 4 Head Detail 1 of the Wall with Minimum Gap Size

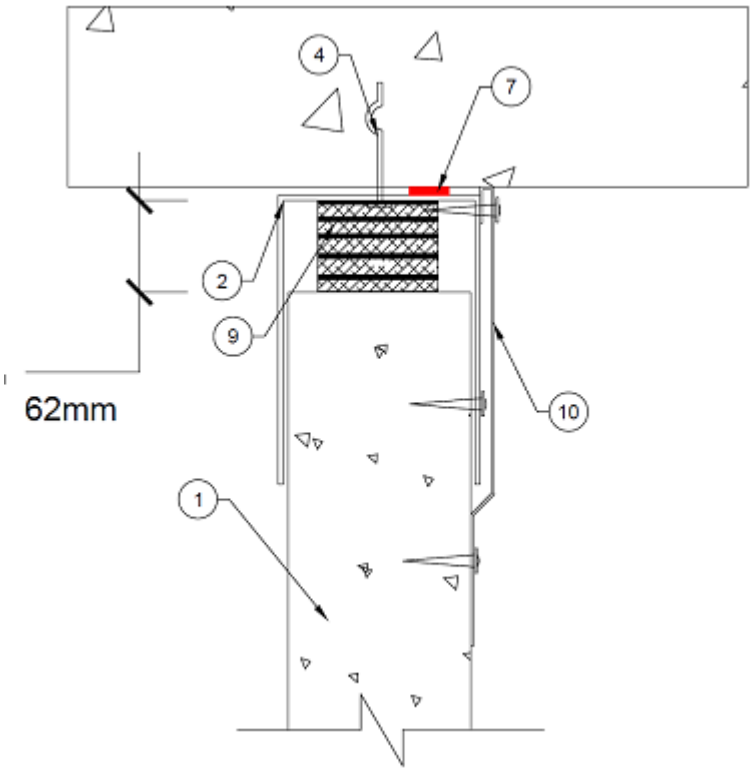


Figure 5 Head Detail 2 of the Wall with Initial Gap Size

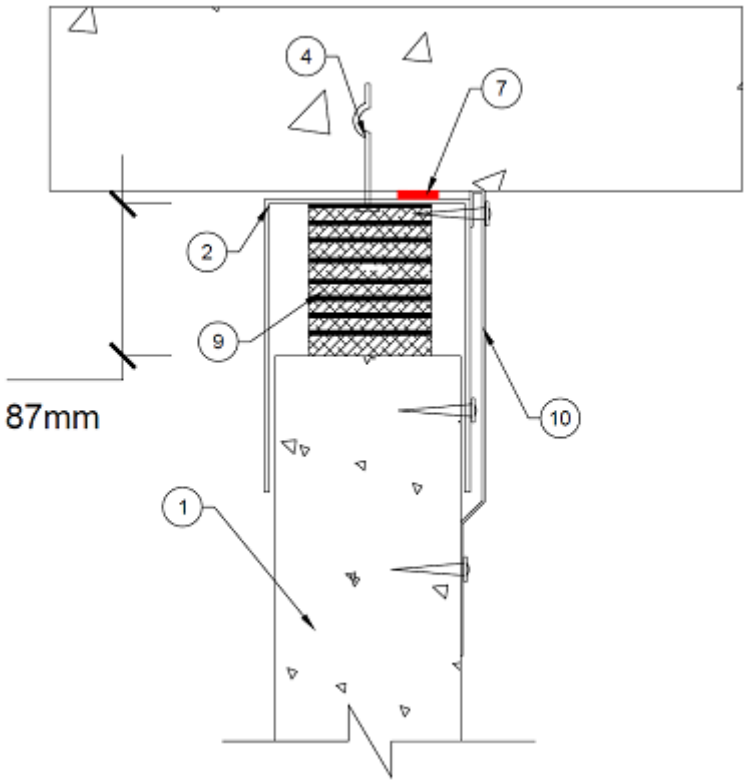


Figure 6 Head Detail 2 of the Wall with Maximum Gap Size

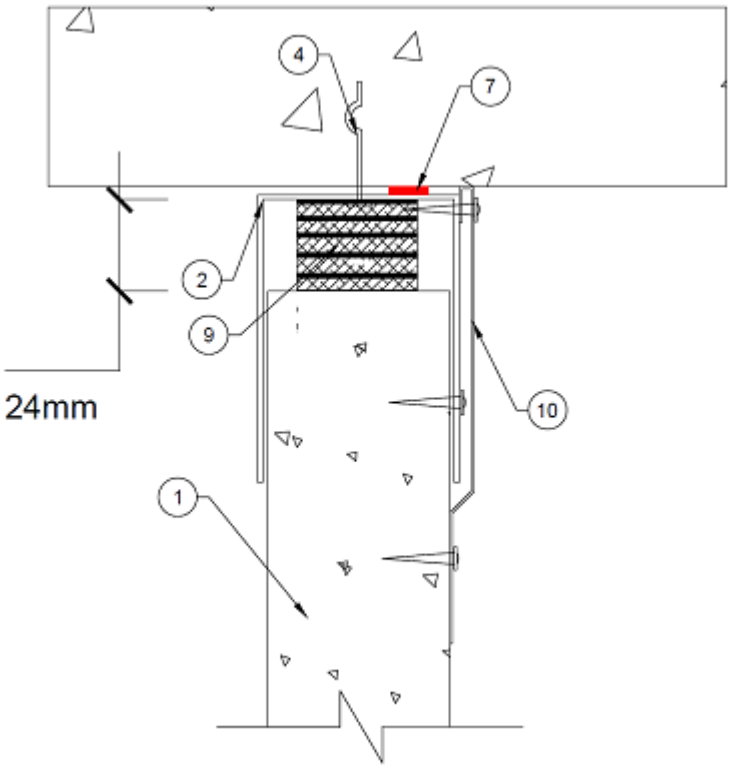


Figure 7 Head Detail 2 of the Wall with Minimum Gap Size

4. Referenced test standard

This report is prepared with reference to the requirements of AS1530.4-2014.

5. Formal assessment summary

Based on the discussion presented in this report, it is the opinion of this registered testing authority that if the tested prototype described in Section 2 had been modified as described in Section 3, it will achieve the FRL as stated below if tested in accordance with the method referenced in Section 4 and subject to the requirements of Section 7.

FRL: -/120/120

Movement Potential of Joint Prior to Fire Event: maximum closing of 38mm and maximum opening of 25mm.

6. Direct field of application

The application of the results of this assessment is to walls of unlimited length exposed to the effects of fire from either direction.

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.

It is required that the lateral load capacity of the head track and base track be verified by the design engineer for the lateral load capacity under ambient loading conditions.

It is required the support construction above and below the wall be capable of providing adequate vertical and lateral support for the FRL period.

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 Aus Pty Ltd of the actual products supplied.

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

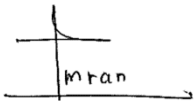
9.1 Applicant undertakings and conditions of use

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

9.3 Authorisation on behalf of Warringtonfire Aus Pty ltd

Prepared by:	Reviewed by:
	
Imran Ahamed	Hon Wong

9.4 Date of issue

21 December 2018

9.5 Expiry date

31 December 2023

Appendix A Summary of supporting data

A.1 Test report – BWA 2286900.5

A.1.1 Report sponsor

A.1.1.1 Speedpanel Vic, Pty. Ltd., 89-91 Canterbury Road, Kilsyth, Vic 3137

A.1.2 Test laboratory

A.1.2.1 Bodycote Warringtonfire Aus Pty Ltd, Unit 2, 409-411 Hammond Road, Dandenong, Victoria 3175, Australia.

A.1.3 Test Date

A.1.3.1 The test was conducted on 18th August 2008.

A.1.4 Test Standards

A.1.4.1 The test was conducted in accordance with AS 1530.4-2005 Sections 2 & 3.

A.1.5 Variations to Test Standard

A.1.5.1 None

A.1.6 General Description of Tested Specimen

A.1.6.1 The test specimen comprised a nominal 2790mm wide x 3000mm high x 78mm thick loadbearing wall made of vertically oriented 78mm thick Speedpanel panels that incorporated a “tongue and groove” detail on their vertical edges. The panels were made form 0.42mm galvanized mild steel.

A.1.6.2 The perimeter framing comprised 83mm wide x 58mm high x 1.2mm thick steel C-tracks on the top and bottom of the wall system. End cap on the west side was 50mm wide x 59mm high x 0.6mm thick C-track and on the east side was 17mm wide x 60mm high x 0.6mm thick C-track.

A.1.6.3 The panels were fixed to the top and bottom C-tracks at nominal 250mm centres and fixed to each other along the horizontal centreline on both exposed and unexposed sides with 15mm long self-tapping screws.

A.1.6.4 Fire rated acrylic sealant was used to seal any gaps in the construction prior to testing.

A.1.6.5 The wall was loaded from the base of the wall at six points at 500mm centres. The average load that was applied at each point for the duration of the test was approximately 2.0kN per load point (4.3kN/m).

A.1.7 Instrumentation

A.1.7.1 The test report states that the instrumentation was in accordance with AS1530.4-2005.

A.1.8 Conditioning

A.1.8.1 The test load was applied to the wall for 15 minutes prior to the commencement of the fire resistance test.

A.1.9 Test results

A.1.9.1 The test was terminated at 144 minutes.

A.1.9.2 The ambient temperature at the start of the test was 29°C and varied between 29°C and 30°C during the test.

A.1.9.3 Post-test observations after 144 minutes are summarised below:

Specimen		Observation
min	sec	
144	47	The vertical load applied on the base of the wall system was increased from 2kN per jack to 2.6kN per jack.
154	20	The flaming at the interface of the top C-track and the panel, approximately 100mm west of the centre had continued to spread.
156	30	Flaming approximately 300mm long had become evident at the third vertical joint from the east edge, approximately 300mm from the base of the wall.
160	00	The vertical load applied on the base of the wall system was increased from 2.6kN per jack to 4kN per jack.
162	00	It had become evident that the flaming at the interface of the top C-track and the panel, approximately 100mm west of the centre had stopped.
169	00	The vertical load applied on the base of the wall system was increased from 4kN per jack to 5.9kN per jack.
172	00	It had become evident that the sealant at the interface of the top C-track and the panel in approximately two thirds of the west half of the wall system was flaming. Once the increased load was reached, it had become evident that the walls deflection towards the furnace had increases, exposing the furnace through the lower half of the wall on the east edge.
173	00	The test was stopped at the request of the sponsor.

A.1.9.4 The specimen achieved the following performance:

Criteria	Performance
Structural adequacy	No failure at 144 minutes
Integrity	120 minutes Ignition of sealant at interface of top C-track and panel initiated failure of specimen by sustained flaming for longer than 10 seconds.
Insulation (Wall System)	64 minutes Maximum temperature on top C-track (T/C B6) exceeded 180 K above the initial temperature.
Insulation (Panel only)	80 minutes Maximum temperature 15 mm from the edge of a vertical joint (T/C B8) exceeded 180 K above the initial temperature.

A.2 Test report – FR 4322

A.2.1 Report sponsor

A.2.1.1 Speedpanel VIC, Pty. Ltd., 89-91 Canterbury Road, Kilsyth, VIC 3137.

A.2.2 Test laboratory

A.2.2.1 BRANZ, Moonshine Road, Judgeford, Porirua City, New Zealand.

A.2.3 Test Date

A.2.3.1 The test was conducted on 22nd October 2009.

A.2.4 Test Standards

A.2.4.1 The test was stated to be conducted in accordance with AS 1530.4-2005.

A.2.5 Variations to Test Standard

A.2.5.1 None

A.2.6 General Description of Tested Specimen

A.2.6.1 The test specimen consisted of a non-loadbearing aerated concrete wall system manufactured by Speedpanel. The nominal dimensions of the wall system was 3,000mm high x 3,000mm wide x 78mm thick and made up of 12 pre-fabricated panels with two integrated Pyropanel fire doorsets. The two single acting doorsets were labelled doorset “A” and “B”. Both doorsets had the latch engaged and opened into the furnace.

A.2.6.2 The wall system consisted of 12 “Speedpanel” panels fitted together with tongue and groove (T&G) joints. The panels consisted of aerated concrete enclosed within a nominally 0.4mm thick galvanised steel envelope. The overall dimensions of an individual section (uncut) were measured as 2,975mm long x 285mm wide x 78mm thick. The wall sections tongue and groove measured 56mm wide x 38mm deep/long and tapered to 20mm wide.

A.2.6.3 Twelve sections were installed within a galvanised steel perimeter frame, which was fixed to the specimen holder. The perimeter frame was constructed from 1.2mm thick galvanised steel “C” track on the sides and sill and galvanised steel angle at the head of the specimen. The “C” track measured 55mm x 80mm x 55mm and the angle measure 55mm x 70mm.

A.2.6.4 The C track web was fixed on the vertical left hand side of the specimen holder using six M12 (furnace frame) bolts spaced at 500mm centres. It was also cut to size, on the bottom, to accommodate the clear thresholds for both doorsets. The 70mm side of the angle was fixed to the head of the specimen holder using six M12 (furnace frame) bolts spaced at 500mm centre to centre. As the panels where installed (from left to right) the left hand side panel was fixed with seven equally spaced screws located in the vertical “C” track flanges and penetrated through to the wall panel. Both the track and angle inside corners were lined with CP606 sealant as the panels were installed.

A.2.6.5 To secure the T&G fitting of the wall panels, two rows of 12 screws were fixed at the panel joining seams 297mm and 740mm from the head of the specimen holder (i.e. just above the head of the doorsets)

A.2.6.6 As the wall was constructed, the aerated concrete panels were cut to size to accommodate two doorset apertures. The straight edges required for fixing the door frames to the wall system were achieved using “C” track sections fixed to the cut out jambs and head. CP606 sealant was applied to the inside of the track and both track flanges were screwed to the wall panel using 6 equally spaced screws.

A.2.6.7 Once the wall panels were fully installed, the final section of angle (50mm x 50mm) was fixed to the head of the unexposed face of the wall using 12 equally spaced self tapping screws and the outer angle flange bolted to the specimen holder with 11 equally spaced bolts.

A.2.6.8 CP606 sealant was applied where the wall system interfaced with the “C” track sections, angle sections, specimen frame and doorset frames. The right hand side of the specimen was capped with a “C” track section and remained unfixed as a 35mm wide floating edge which was packed with thermal ceramic insulation.

A.2.6.9 Details of the doors are not relevant to this assessment report.

A.2.7 Instrumentation

A.2.7.1 The test report states that the instrumentation was in accordance with AS 1530.4-2005.

A.2.8 Test results

A.2.8.1 The test was terminated at 240 minutes.

A.2.8.2 The ambient temperature at the start of the test was 14^{o}C

A.2.8.3 The specimen achieved the following performance:

Criteria	Performance
Integrity of panel	92 minutes No failure
Insulation on Panel Joint	126 minutes Maximum temperature on joint exceeded 180 K above the initial temperature.

A.3 Test report – EWFA 2741700.1

A.3.1 Report sponsor

A.3.1.1 Speedpanel VIC, Pty. Ltd., 89-91 Canterbury Road, Kilsyth, VIC 3137.

A.3.2 Test laboratory

A.3.2.1 Exova Warringtonfire Aus Pty Ltd, Unit 2, 409-411 Hammond Road, Dandenong, VIC 3175.

A.3.3 Test Date

A.3.3.1 The test was conducted on 20th July 2012.

A.3.4 Test Standards

A.3.4.1 The test was stated to be conducted in accordance with AS 1530.4-2005.

A.3.5 Variations to Test Standard

A.3.5.1 None

A.3.6 General Description of Tested Specimen

A.3.6.1 The test assembly comprised a nominal 2950mm wide × 3000mm high × 78mm thick non-loadbearing wall system made of vertically orientated 285mm × 78mm thick Speedpanel panels incorporated a " tongue and groove" detail on their vertical edges. The specimen was tested unloaded and with free vertical edges. The wall incorporated two Pyropanel FR Maxi doors, both opening inwards towards the furnace. The panels were made from an aerated concrete core encased in a 0.4mm BMT galvanised steel skin.

A.3.6.2 The test assembly was asymmetric that the head details varied from the East side to the West side. Fire rated sealant was applied in the 20mm gap between top C-track and wall panels. The five tested head track protecting options are summarised below:

- Option 1: Flashing installed on the exposed side only. (Temperatures recorded by T/C 121 and 122 on the unexposed side.)
- Option 2: One layer of 13mm thick × 120mm deep CSR Fyrchek plasterboard on the unexposed side only. (Temperatures recorded by T/C 123 and 124 on the unexposed side.)
- Option 3: One layer of 13mm thick × 120mm deep CSR Fyrchek plasterboard on each side of the head tracks. (Temperatures recorded by T/C 125 and 126 on the unexposed side.)
- Option 4: Flashing installed on the unexposed side only. (Temperature recorded by T/C 129 and 130 on the unexposed side.)
- Option 5: One layer of 13mm thick × 120mm deep CSR Fyrchek plasterboard on the exposed side only. (Temperatures recorded by T/C 127 and 128 on the unexposed side.)

A.3.6.3 The perimeter framing comprised head and bottom tracks made of 82mm deep × 50mm high × 1.2mm thick galvanised steel C-tracks and side tracks made of 82mm deep × 50mm high × 0.5mm thick galvanised steel C-tracks.

A.3.6.4 The panels were fixed to the top and bottom C-tracks at nominal 400mm centres and fixed to each other at 500mm centres on both exposed and unexposed side with 16mm long flat top self-drilling, zinc coated steel screws.

A.3.6.5 Fire rated acrylic sealant was used to seal any gaps in the construction prior to testing.

A.3.6.6 Details of the doors are not relevant to this assessment report.

A.3.7 Instrumentation

A.3.7.1 The test instrumentation was stated to be in accordance with AS 1530.4-2005.

A.3.8 Test results

A.3.8.1 The test was terminated at 132 minutes.

A.3.8.2 The ambient temperature at the start of the test was 17°C and varied between 17°C and 19°C during the test.

A.3.8.3 The maximum temperature recorded on the unexposed side of head C-track protected by the flashing cap fixed on the exposed side at 120 minutes was 177°C.

A.3.8.4 The maximum temperature recorded on the unexposed side of head C-track protected by one layer of 13mm thick CSR Fyrchek plasterboard fixed on the fire side at 120 minutes was 154°C

A.3.8.5 The maximum temperature recorded on the unexposed side of head C-track protected by one layer of 13mm thick CSR Fyrchek plasterboard fixed on both sides at 120 minutes was 163°C.

A.3.8.6 The maximum temperature recorded on the unexposed side of head C-track protected by one layer of 13mm thick CSR Fyrchek plasterboard fixed on the non-fire side at 120 minutes was 145°C.

A.3.8.7 The maximum temperature recorded on the unexposed side of head C-track protected by flashing cap fixed on the non-fire side at 120 minutes was 177°C.

A.4 Test report – AFTF/080502

A.4.1 Report sponsor

A.4.1.1 TBA Textiles Ltd, PO Box 40, Rochdale, Lancashire, OL12 7EQ

A.4.2 Test laboratory

A.4.2.1 Aycliffe Fire Testing Facility

A.4.3 Test Date

A.4.3.1 The test was conducted on 29th May 2002.

A.4.4 Test Standards

A.4.4.1 The test utilised the heating conditions of BS 476: Part 20: 1987.

A.4.5 General Description of Tested Specimen

A.4.5.1 The test specimen comprised three lengths of single layer of Phoenix Firefly material of 440gsm manufactured by TBA Textiles Ltd.

A.4.5.2 The specimen was 3m x 3m and incorporated vertical joins. The barrier was fixed along all edges within the concrete lined test specimen frame. The barrier edges were clamp-fixed between 50mm studs and 25 x 25x0.5mm galvanised angle, screw-fixed at 250mm centres.

A.4.5.3 Instrumentation and the operation of the test were stated to be in accordance with BS476: Part 20:1987, this is accepted on face value in absence of information to confirm this to be the case.

A.4.6 Test results

A.4.6.1 The test specimen met the integrity requirements of the standard for 113 minutes, at which time holes formed around the staple seams.

A.4.6.2 The fabric otherwise remained intact and showed no sign of impending integrity failure.

A.5 Supplementary Data – Fire Protection LTD. Harlow

A.5.1 Report sponsor

A.5.1.1 TBA Textiles Ltd, PO Box 40, Rochdale, Lancashire, OL12 7EQ

A.5.2 Test laboratory

A.5.2.1 Fire Protection Ltd, Harlow

A.5.3 Test Date

A.5.3.1 The test was conducted on 9th August 2001.

A.5.4 Test Standards

A.5.4.1 The test utilised the heating conditions of BS 476 Part 20.

A.5.5 General Description of Tested Specimen

A.5.5.1 The test specimen comprised a single, unjoined section of Firefly Plus 60. Firefly Plus 60 comprises two layers of Phoenix Firefly and two pouches of needlefelt fabric.

A.5.5.2 The specimen was nominally 1m x 1m and was fixed to all perimeter edges of the opening.

A.5.5.3 Instrumentation and the operation of the test were stated to be in general accordance with BS476: Part 20:1987. This is accepted on face value in absence of information to confirm this to be the case.

A.5.6 Test results

A.5.6.1 The specimen temperatures measured by five thermocouples positioned at quarter points and centrally reached average and maximum values of 133^{0}C and 160^{0}C, respectively, at 60 minutes.

A.6 Relevance of BS 476: Part 20: 1987 Test Data to AS15340.4-2014

A.6.1 General

A.6.1.1 The fire resistance tests AFTF/080502, FTC/96/0057, and the ad-hoc test undertaken by Fire protection Ltd on 9/8/01 were conducted utilising the heating conditions of BS 476: Part 20: 1987, which differs from AS1530.4 2014. The effect these differences have on the fire resistance performance of test specimens is discussed below.

A.6.2 Temperature Regime

A.6.2.1 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.

A.6.2.2 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.

A.6.3 Furnace Thermocouples

A.6.3.1 The furnace thermocouples specified in AS1530.4-2014 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.

A.6.3.2 The furnace thermocouple types in BS476: Part 20: 1987 shall be one of the following two types:

- 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).
- 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.

A.6.3.3 The relative distance of the furnace thermocouples from the exposed face of the specimen, for both AS1530.4-2014 and BS 476: Part 20: 1987, is 100mm $\pm$10mm.

A.6.4 Furnace Pressure

A.6.4.1 It is a requirement of AS1530.4-2014 that for vertical elements, a furnace gauge pressure of zero (0) Pa is established at a height 500mm above the notional floor level. For BS 476: Part 20, the neutral axis is maintained at a height of 1000mm.

A.6.4.2 Therefore, based on an average pressure gradient of 8.5Pa/m, at a particular height above the notional floor level, AS 1530.4-2014 requires the pressure to be approximately 4.25Pa higher than BS 476: Part 20.

A.6.5 Performance Criteria

A.6.5.1 AS 1530.4-2014 specifies the following performance criteria for building materials and structures:

- Structural Adequacy – (Not relevant to the referenced test)
- Integrity
- Insulation

A.6.6 Integrity

A.6.6.1 The integrity criteria differ slightly between AS1530.4-2014 and BS 476 Part 20 -1987.

A.6.6.2 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, if a gap forms that allows the penetration of a 25mm diameter gap gauge anywhere on the specimen or, if a gap forms that allows a 6mm x 150mm gap gauge to penetrate the specimen anywhere on the specimen.

A.6.6.3 The integrity criteria for BS 476: Part 20:1987 are similar to the above, except that the 150mm by 6mm gap criterion is not applied at the threshold of doorsets.

A.6.7 Insulation

A.6.7.1 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 thermocouple for maximum temperature rise, though 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.

A.6.7.2 The failure criteria for insulation in AS 1530.4-2014 and BS 476: Part 20: 1987 are not appreciably different except for the positioning of thermocouples as noted above.

A.6.8 Application of Referenced Test Data to AS1530.4-2014.

A.6.8.1 The variations in furnace heating regimes, 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.

A.6.8.2 The variations in furnace pressure conditions can theoretically be more onerous and could affect the performance of the test specimens, in particular, the upper area of the specimen after the formation of gaps cracks or fissures.

A.6.8.3 As no gaps formed in the upper area of the specimen described in test AFTF/080502 prior to 113 minutes, and because of the overall absence of combustible material in the test specimen, it is considered in this case the difference in furnace pressure would not have significant effect on the test results until that time.

A.6.8.4 The insulation performance measured in the ad-hoc test undertaken by Fire protection Ltd on 9/8/01 was based on only the five quarter point thermocouples and not the application of a roving thermocouple or fixed thermocouples.

A.6.8.5 The effect the increase in furnace pressure and the position of specimen thermocouples will be discussed on a case by case basis in Appendices B1 and B2 of this report.

A.6.8.6 Based on the above qualifications, and in absence of any foreseeable detrimental effects, it is considered that the results of the referenced test can otherwise be used to assess the integrity and insulation performance in accordance with AS1530.4-2014 for up to 120 minutes and 60 minutes respectively.

A.7 Test report – WARRES 117117

A.7.1 Report sponsor

A.7.1.1 Firetherm Intumescent Ltd., Unit 91, Applegarth Drive, Questor, Hawley Road, Dartford, Kent DA1 1JD.

A.7.2 Test laboratory

A.7.2.1 Warrington Fire Research Ltd., Holmesfield Road, Warrington, UK, WA1 2DS.

A.7.3 Test Date

A.7.3.1 The test was conducted on 19th January, 2001.

A.7.4 Test Standards

A.7.4.1 The test was conducted in general accordance BS476.20- 1987. Additional guidelines were adopted from prEN1366.4.

A.7.5 General Description of Thested Specimens

A.7.5.1 The test specimen comprised four 900mm long linear gap seals formed between 760 kg/m3, 150mm thick AAC blocks. The gap seals were made from Firetherm Intuspan material, being layers of graphite-based intumescent adhered to layers of combustion modified foam, which were friction fitted into the openings. The material was fitted such that it was recessed 10mm from the unexposed face of the wall.

A.7.5.2 The details of the gap seals are summarised below:

Specimen	Gap Size	Intuspan Size
A	100mm wide x 900mm long	114mm wide x 900mm long x 100mm deep
B	75 wide x 900mm long	87mm wide x 900mm long x 50mm deep
C	50 wide x 900mm long	57mm wide x 900mm long x 50mm deep
D	25 wide x 900mm long	25mm wide x 900mm long x 25mm deep

A.7.6 Instrumentation

A.7.6.1 The test instrumentation provided was stated to be in accordance with BS476.20-1987.

A.7.7 Test results

A.7.7.1 The test duration was 183 minutes.

A.7.7.2 The furnace pressure was calculated to be 14 – 16 Pa at mid height of the seals for the test duration.

A.7.7.3 The performance of the gap seals is summarised below:

Specimen	Integrity (minutes)	Insulation (minutes)
A	173	173
B	183	133
C	183	144
D	158	62

A.8 Relevance of BS 476: Part 20: 1987 Test Data to AS15340.4-2014

A.8.1 General

A.8.1.1 The fire resistance test WARRES 117117 was conducted in accordance with BS476.20-1987 in conjunction with additional guidelines from prEN1366.4. These standards differ from AS1530.4-2014. The aspects of the fire resistance test capable of significantly altering the observed specimen performance are discussed below.

Specimen Size

A.8.1.2 AS1530.4-2014 states that the specimen containing control joints shall not be less than 1m x 1m and the length of the control joint exposed to the furnace chamber shall not be less than 1m.

A.8.1.3 prEN1336.4 states that control joints shall be a minimum 900mm in length. The specimens tested in WARRES 117117 were 900mm in length.

Temperature Regime

A.8.1.4 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.

A.8.1.5 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.

Furnace Thermocouples

A.8.1.6 The furnace thermocouples specified in AS1530.4-2014 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.

A.8.1.7 The furnace thermocouple types in BS476: Part 20: 1987 shall be one of the following two types:

- 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).
- 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.

A.8.1.8 The relative distance of the furnace thermocouples from the exposed face of the specimen, for both AS1530.4-2014 and BS 476: Part 20: 1987, is 100mm $\pm$10mm.

Furnace Pressure

A.8.1.9 It is the requirement of AS1530.4-2014 that a pressure of 15 ± 3 Pa be maintained at the centre of vertical linear gap seals that are up to 1m in height.

A.8.1.10 In WARRES 117117, the pressure was calculated to be between 14 and 16 Pa at the mid-height of the specimens for the duration of the test.

A.8.1.11 The parameters outlining the accuracy of control of the furnace pressure in AS1530.4-2014 and BS476.20-1987 are not appreciably different.

Specimen Temperature Measurement

A.8.1.12 The specimen thermocouple specification is generally the same for AS1530.4-2014 and BS476.20-1987.

A.8.1.13 BS476.20-1987 has no specific provision for the location of thermocouples on linear gap seals. The reference test thus adopted the provisions from EN1366.4. These locations differ from those prescribed in AS1530.4-2014.

A.8.1.14 prEN1366.4 prescribes thermocouples to be placed on the centre of the seal (not applicable if joint is recessed and less than 12mm wide) and adjacent to the edge of the seal (not more than 15mm from the edge). There is no minimum number prescribed.

A.8.1.15 AS1530.4-2014 prescribes thermocouples to be placed in the following locations:

- At least three on the surface of the seal, with one thermocouple for each 0.3 m2 of surface area, up to a maximum of five, uniformly distributed over the area (one thermocouple being located at the centre of the seal).
- On the surface of the seal 25 mm from the edge of the opening, with one thermocouple for each 500 mm of the perimeter.
- On the surface of the separating element 25 mm from the edge of the opening, with one thermocouple for each 500 mm of the perimeter.
- If the seal is recessed on the unexposed side, thermocouples shall only be fitted to the seal when the joint width is greater than or equal to 12mm.

A.8.1.16 In WARRES 117117, thermocouples were placed in the following locations:

- On the surface of the seal- at mid height and approximately 100mm from the upper and lower extremities of the seal.
- On the surface of the separating element 25mm from the edge of the opening- at mid height and approximately 100mm from the upper and lower extremities of the seal.

Integrity Performance Criteria

A.8.1.17 The integrity criteria for AS1530.4-2014 and BS476.20-1987 are not appreciably different.

Insulation Performance Criteria

A.8.1.18 Apart from the variation in specimen thermocouple locations, the insulation criteria for AS1530.4-2014 and BS476.20-1987 are not appreciably different.

Application of Test Data from WARRES 117117 to AS1530.4-2014

A.8.1.19 The variations in furnace thermocouples specification and responses are not considered to have significant effect on the outcome of the referenced fire resistance test.

A.8.1.20 In regards to furnace pressure, as per the previous discussion, it is confirmed that the specimens in report WARRES 117117 were exposed to pressures within the limits specified by AS1530.4-2014.

A.8.1.21 In regards to specimen thermocouple locations, in light of the previous discussion, it is concluded that the thermocouple locations for the specimens tested in WARRES 117117 differed from those prescribed in AS1530.4-2014 only slightly. Specifically, the tested specimens had one too few thermocouples on the separating element 25mm from the opening. By observation of the chosen thermocouple locations, however, it is considered that an extra thermocouple placed on the separating element would not likely have significantly altered the recorded specimen temperatures.

A.8.1.22 In regard to specimen size, it is observed that the tested seals were 900mm in length – 100mm shorter than the minimum length prescribed by AS1530.4-2014. Under certain conditions it is considered that a longer joint may present additional integrity weakness, caused by cracking and fallout of the seal material.

A.8.1.23 All four gap seal specimens tested in WARRES 117117 maintained integrity in excess of 120 minutes with the lowest integrity result being 158 minutes. Also, by observation, the seal material being considered is intumescent in nature and is not prone to the cracks associated with shrinkage, which often cause hot gas venting In light of this, it is not considered likely that increasing the length of the joint from 900mm as tested to 1000mm would decrease the integrity result of any of the specimens below 120 minutes. It is thus considered that the tested specimens can be considered as complying with the size requirements of AS1530.4-2014.

A.8.1.24 The extra 100mm required is not likely to have contained any thermocouples. Thus, if integrity is maintained, the previous insulation discussion is considered to remain valid.

A.8.1.25 Based on the above discussion it is considered that the integrity and insulation behaviour of the linear gap sealing systems tested in WARRES 117117 can be used to indicate the likely behaviour of similar specimens tested in accordance with AS1530.4-2014 for up to 120 minutes.

Appendix B Assessment of specific variations

B.1 78mm Thick Speedpanel Walls up to 6m High

B.1.1 Proposal

B.1.1.1 The proposed construction is made from 78mm thick vertically orientated Speedpanel as tested in BWA 2286900.5 with consideration given to the following variations:

- The wall shall be up to 6m high.
- Head details shall be as shown in figures 2 to 7.
- The gap at the head shall be constructed as figure 2 for head detail 1 and figure 5 for head detail 2.

B.1.1.2 The performance of this joint shall be considered for all cases where the gap changes prior to the fire by maximum closing 38mm and maximum opening 25mm.

B.1.2 Discussion

Integrity

B.1.2.1 The important aspect of integrity performance of walls of extended height is the potential for greater overall deflection and the greater mass above the critical central section of the wall.

B.1.2.2 The wall system tested in BWA 2286900.5 comprised 78mm thick panels that were tested in a loadbearing configuration 3110mm high and supporting 4.3KN/m reasonably evenly distributed along the lower edge of the wall at 6 locations. The load was then increased gradually to 5.59kN/m at 144 minutes and 8.6kN/m at 160 minutes.

B.1.2.3 When tested, the deflection measured at the centre of the wall was 177mm at 120 minutes and 208mm at 167 minutes.

B.1.2.4 The proposed construction is similar to that tested in BWA 2286900.5, the panels are 78mm thick although extended to 6000mm high.

B.1.2.5 The increase height will tend increase the total deflection of the wall for the same thermal curvature. The thermally driven deflection can conservatively be estimated as being proportional to the overall thickness of the panel, if the surfaces reach the same temperature.

B.1.2.6 The bending stress in the Speedpanel panel itself during the fire exposure is a combination of the thermally driven deflection in addition to the load driven p-Delta effect that amplify lateral deflections after they become apparent.

B.1.2.7 It is expected that the 6m wall will be at the same temperature as the 3m wall at 120 minutes. Therefore it is considered that the wall will have the same or less curvature at 6m as at 3m when tested.

B.1.2.8 Based on this conservative approach for a notional lateral deflection at mid-height of a 6m high wall at the same curvature as the 3m high wall tested could be conservatively estimated as less than 740mm.

B.1.2.9 With reference to test BWA 2286900.5, the applied load was increased gradually to 5.67kN/m at 144 minutes and maintained until 160 minutes. The defection measured at 160 minutes was 200mm. Then the load was increased to 8.6kN/m and was maintained till 169 minutes. The tested wall specimen did not collapse for at least 167 minutes.

B.1.2.10 Intergrity failure in the Speedpanel walls will occur if the walls undergo cracking at mid height due to excessive lateral defelction. The cracks would start to initiate once the stress exceeds the maximum allowable stress of the system and the stress can be considered to be proportional to the bending moment considering the plate bending theory.

B.1.2.11 The bending moments (BM) in the tested panel at 120 and 167 minutes were calculated as following:

Bending moment = Load × Eccentricity (lateral deflection of the mid point)

BM_{120} = 4.3×0.177 = 0.761 kNm/m

BM_{167} = 8.6×0.208 = 1.788 kNm/m

B.1.2.12 Therefore, the above calculation shows that the bending moment of the 78mm thick panel at 120 minutes is at least 43% of that at 169 minutes.

B.1.2.13 The 6m high wall, which is a non load bearing wall will still undergo a bending moment because of the self weight of the system.

B.1.2.14 According to the client, the self weight of the 435 kg/m^3, 78 mm thick wall panel is 10.6 kg/m and the tested system consists of four panels per meter. Therefore, self weight of the 6m high wall can be calculated to be 2.5 kN/m.

B.1.2.15 Based on, the bending moment of the 6m column at 120 minutes can be conservatively calculated as,

BM_{120} = 2.5×(0.740–0.078/2) = 1.75 kNm/m

B.1.2.16 The above calculation shows that the bending moment of the 6m height wall is less than the bending moment of 3m wall at 167 minutes (1.75 kNm/m < 1.788 kNm/m). Because of the fact that the 3m wall didn't undergo integrity failure at 167 minutes with higher bending moments, it is safe to say that the 6m wall will likely maintain integrity until 120 minutes. Also the proposed 6m wall consists of screwed joints at 1000mm centres, which would provide more rigitidy to the system and will result in less deformation than the tested system.

B.1.2.17 This overall deflection of the wall will induce a tendency for the panel joints to open near support walls and will be used to determine if there is a sufficient overlap. When considering the impacts of when the 6m wall is fixed to rigid support wall junction a conservative approach has been used to make sure the transition from a the maximum deflected shape for a long run of wall to the minimum deflected shape for a wall junction is spread over a number of panel joints, so that the panel torsion is similar than experienced in the referenced tests.

B.1.2.18 In this assessment, a conservative approach has been applied to estimate a potential maximum deflection (most likely larger than the actual lateral deflection) and calculate the potential opening of the joints to separate in the transition zone at the end of the wall.

B.1.2.19 Based on the above discussion, it is considered reasonable that the proposed construction would maintain integrity at the joint locations for a period of at least 120 minutes.

B.1.2.20 Additional confidence in the proposed construction is offered by the increased fixing spacing of the panel joins in the vicinity of wall junctions. This will have the added effect of making the joint gap opening more uniform.

B.1.2.21 Based on the above discussion it is considered that the proposed panel construction will achieve an integrity performance 120 minutes if tested in accordance with AS1530.4-2014.

Insulation of Panel

B.1.2.22 The important aspect of insulation performance of walls of extended height is the potential for the joints and track connections to maintain their insulation performance

B.1.2.23 The wall system tested in BWA 2286900.5 comprised 78mm thick panels that were tested in a loadbearing configuration 3110mm high and supporting 4.3KN/m reasonably evenly distributed along the lower edge of the wall at 6 locations.

B.1.2.24 At 120 minutes, two of the unexposed face temperatures in the vicinity of joins had risen above 195^{o}C (rise of 180^{o}K) while others remained at around 100^{o}C and the panel moisture was being driven off. The average and maximum unexposed temperature was 124^{o}C and 310^{o}C at 120 minutes. The temperature recorded on the unexposed side of top C-track at 120 minutes was around 317°C.

B.1.2.25 With reference to FR 3754, which comprised a 78mm Speedpanel system that incorporated panel joints fixings of 1000mm centres, achieved an insulation performance of 123 minutes.

B.1.2.26 With reference to EWFA 2257600, which comprised a 78mm Speedpanel wall with panels orientated horizontally orientated and no screws were fixed into panel joints. The insulation performance of the panel was 117 minutes remote from the perimeter before a hot spot developed on panel joint in the middle of the wall.

B.1.2.27 The proposed construction is to include screws into the panel joints at 1000mm centres similar to that tested in FR 3754 and as such an improvement in the stability and tightness of the joints is expected. The improvement on the joint stability is likely to prevent the local hot spots form occurring until later in the test and this adds confidence that the proposed panel fixing assisting the panel maintain an insulation performance of 120 minutes.

B.1.2.28 Based on the above, it is considered the proposed wall panel construction in figure 1 will likely maintain the insulation performance for a period of 120 minutes.

Insulation of Head Detail – Figures 2-4

B.1.2.29 With reference to test BWA 2289600.5, the temperature recorded on the deflection head of the wall specimen was 317°C at 120 minutes.

B.1.2.30 The proposed head detail incorporates 15mm Firefly Titan blanket at one side of the head C-track and wrapped around the steel angle mechanically fixed to the surround.

B.1.2.31 The construction tested in AFTF/080502 comprised a single layer of Phoenix Firefly of 3mx 3m in size with a mass of 440gsm. The fabric was supported for a period of at least 113 minutes.

B.1.2.32 With reference to the ad-hoc test undertaken by Fire protection Ltd on 9/8/01 on Firefly 60 Plus barrier, the fabric temperatures measured by five thermocouples positioned at quarter points and centrally reached average and maximum values of 133°C and 160°C, at 60 minutes respectively.

B.1.2.33 With reference to the test under taken by Fire Protection Ltd on 9/08/01 on Firefly 60 Plus barrier, it was observed the Firefly 60 Plus generally rises in temperature somewhat linearly.

B.1.2.34 The heating regime in AS1530.4-2014 is an expression of the temperature rise in the furnace above an initial ambient temperature. The amount of heat at 120 minutes is 2.25 times of the heat amount at 60 minutes.

B.1.2.35 It is therefore expected that the temperature on the unexposed side of tested Firefly 60 Plus blanket at 120 minutes would be 360°C.

B.1.2.36 The tested fabric construction was two layers of Phoenix Firefly and two layers of needlefelt blanket, compared to the 4 layers of Phoenix Firefly and three layers of needlefelt fabric of the proposed construction.

B.1.2.37 The proposed head detail incorporates two layers of Firefly Titan blankets wrapping around the steel angle and fixed to the Speedpanel panels as in Figure 2. All gaps are sealed with fire rated sealant.

B.1.2.38 It is therefore expected that the overall specifications of Phoenix Firefly and needlefelt making up the thickness of the proposed one layer barrier are effectively increased, respectively, by 400% and 300%. The proposed thickness of 2 layers Firefly Titan is 3 times thicker than the tested Firefly 60 Plus.

B.1.2.39 It is therefore conservatively expected that increasing 400% of the thickness of Phoenix Firefly will likely have the effect of at least halving the rate of temperature for the tested blanket.

B.1.2.40 It is considered on balance the additional contributions of C-track and steel angle will reduce the non-fire side temperature rise to a maximum of 180K with some margins.

B.1.2.41 Based on the above, it is considered the proposed construction is capable of maintaining insulation performance for a period of 120 minutes.

Insulation of Head Detail – Figures 5-7

B.1.2.42 The proposed head detail in Figure 5 comprise a 87mm deep × 50mm wide Firetherm Intuspan material fitted into the gap between the Head C-track and Speedpanel panels.

B.1.2.43 The proposed maximum gap between head C-track and Speedpanel panel is 87mm high and the 87mm Firetherm Intuspan would fully fill the gap.

B.1.2.44 Reference test WARRES 117117 included linear gap seals 50mm, 75mm and 100mm wide made from Intuspan material friction fitted into openings in a 150mm thick AAC wall. When tested, each seal maintained integrity and insulation well in excess of 120 minutes.

B.1.2.45 As concluded previously in Section A.8, it is considered that the integrity and insulation behaviour of the linear gap sealing systems tested in WARRES 117177 can be used to indicate the likely behaviour of similar specimen tested in accordance with AS1530.4-2014 for up to 120 minutes.

B.1.2.46 The proposed gap seals are continuous, potentially having lengths much greater than those tested. The proposed seal materials are intumescent-based, meaning that shrinkage effects which can accompany seals of increased lengths are not expected, specifically the formation of gaps at joins/splices in the seal material.

B.1.2.47 In addition, the proposed gap seals are captured within the head C-track of the wall and installed into the opening in a compressed state, it is considered the gap seals not directly exposing to the heat source would likely slow the activation of the intumescent layers.

B.1.2.48 The presence of the steel flashing on one side of the head C-track will likely to reduce the temperature measured on the unexposed side of the track with a small margin.

B.1.2.49 Based on the above, it is considered the proposed construction is capable of maintaining insulation performance for a period of 120 minutes.