ASSESSMENT REPORT

THE LIKELY FIRE RESISTANCE PERFORMANCE OF FIRESOUND GREY ACRYLIC SEALANT PROTECTING JOINTS IN A CONCRETE FLOOR SLAB WHEN TESTED IN ACCORDANCE WITH AS1530.4-2014 SECTIONS 2, 4 AND 10 AND AS4072.1-1992 AS APPROPRIATE

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Report Sponsor:

HB Fuller Australia Company Pty Ltd
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Testing. Advising. Assuring.

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1 INTRODUCTION

This report presents a considered opinion on the fire resistance performance of FireSound Grey acrylic sealant protecting joints in concrete floor slabs when tested in accordance with Australian Fire Resistance Test Standards AS1530.4-2014 and AS4072.1-1992 as appropriate.

The tested systems are described in Section 2 and are to be subject to the proposed variations described in Section 3 and tested in accordance with the referenced test method described in Section 4. The conclusions of the report are 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 the Appendices together with a summary of the critical issues leading to the assessment conclusions including the main points of argument.

2 TESTED PROTOTYPE

This assessment makes reference to test WFRA 40869. Refer to Appendix A for summary of the reference test data.

3 VARIATION TO TESTED PROTOTYPE

3.1 PROPOSED SYSTEMS UNDER CONSIDERATION

The following concrete jointing systems will be considered for appraisal in this report when installed in a 120mm thick, 150mm thick and 170mm thick normal weight concrete floor slab.:

Table 1: Proposed concrete jointing systems

Separating element type	Minimum element thickness (mm)	Maximum joint width (mm)	Minimum FireSound depth (mm)	Backing rod depth (mm)	Seal configuration
Solid normal weight/lightweight concrete floors (FRL 120/120/120)	120	20 30 40 50	10 20 20 20	30 30 30 45	Fire side only
Solid normal weight/lightweight concrete floors (FRL 180/180/180)	150	20 30 40 50	10 20 20 20	30 30 30 45	Fire side only
Solid normal weight/lightweight concrete floors (FRL 240/240/240)	170	20 30 40 50	10 20 20 20	30 30 30 45	Fire side only
Solid normal weight/lightweight concrete floors (FRL 120/120/120)	120	20 30 40 50	10 15 20 20	30 30 30 30	Both fire exposed and non-fire exposed sides
Solid normal weight/lightweight concrete floors (FRL 180/180/180)	150	20 30 40 50	10 15 20 20	30 30 30 30	Both fire exposed and non-fire exposed sides
Solid normal weight/lightweight concrete floors (FRL 240/240/240)	170	20 30 40 50	10 15 20 20	30 30 30 30	Both fire exposed and non-fire exposed sides

3.2 SEALANTS CONFIGURATIONS

The following sealant configurations will be considered in this report:

a) Single layered joint finish with the fire exposed side
b) Double layered joint flush with fire exposed and non-fire exposed side

4 REFERENCED TEST PROCEDURES

This report is prepared with reference to the requirements of AS1530.4-2014 and AS4072.1-1992.

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 likely achieve acceptable fire resistance performance results if tested in accordance AS1530.4-2014 and AS4072.1-1992 as appropriate.

Separating element type	Minimum element thickness (mm)	Maximum joint width (mm)	Minimum FireSound depth (mm)	Backing rod depth (mm)	Seal configuration	Likely Fire Resistance Level (FRL) of system	
						Integrity	Insulation
Solid normal weight/light-weight concrete floors (FRL 120/120/120)	120	20 30 40 50	10 20 20 20	30 30 30 45	Fire side only	120	120
Solid normal weight/light-weight concrete floors (FRL 180/180/180)	150	20 30 40 50	10 20 20 20	30 30 30 45	Fire side only	180	180
Solid normal weight/light-weight concrete floors (FRL 240/240/240)	170	20 30 40 50	10 20 20 20	30 30 30 45	Fire side only	240	240
Solid normal weight/light-weight concrete floors (FRL 120/120/120)	120	20 30 40 50	10 15 20 20	30 30 30 30	Both fire exposed and non-fire exposed sides	120	120
Solid normal weight/light-weight concrete floors (FRL 180/180/180)	150	20 30 40 50	10 15 20 20	30 30 30 30	Both fire exposed and non-fire exposed sides	180	180
Solid normal weight/light-weight concrete floors (FRL 240/240/240)	170	20 30 40 50	10 15 20 20	30 30 30 30	Both fire exposed and non-fire exposed sides	240	240

6 DIRECT FIELD OF APPLICATION

This assessment is based on actual test results and associated TASEF modelling results for providing the likely fire resistance performance of the FireSound Grey acrylic sealant necessarily limited to the performance requirement described in Section 5 and the system construction in Section 3 together with referenced test report and discussions in the Appendices.

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 AS1530.4-2014 and AS4072.1-1992 as appropriate..

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 Exova 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 resistance 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, methods of construction and installation, may lead to variations in performance between elements of similar construction.

The assessment can therefore 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

This report may only be reproduced in full without modifications by the report sponsor. Copies, extracts or abridgments of this report in any form shall not be published by other organisations or individuals without the permission of Exova Warringtonfire Aus Pty Ltd.

9.3 AUTHORISATION ON BEHALF OF EXOVA WARRINGTONFIRE AUS PTY LTD

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	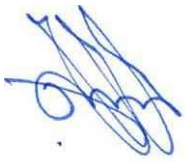
H Wong	O Saad

9.4 DATE OF ISSUE

15/06/2017

9.5 EXPIRY DATE

30/06/2022

APPENDIX A - SUMMARY OF SUPPORTING DATA

A.1 TEST REPORT: WFRA 40869

A.1.1 Test Laboratory

A.1.1.1 Warrington Fire Research (Aust) Pty Ltd, Unit 2, 409-411 Hammond Road, Dandenonon South, VIC 3175

A.1.2 Test Sponsor

A.1.2.1 HB Fuller Australia Company Pty Ltd., -20 Red Gum Drive, Dandenong South, VIC 3175.

A.1.3 Test Date

A.1.3.1 The specimen was tested on 5th September, 2001..

A.1.4 Test Duration

A.1.4.1 The duration of the test was 241 minutes...

A.1.5 Test Summary

A.1.5.1 A report of a fire resistance test performed in accordance AS1530.4-1997 and AS4072.1-1992 as appropriate on a test assembly including four (4-off) control joints in a normal weight reinforced concrete floor slab protected by FireSound grey trial acrylic sealant (Batch No. 36102741). The control joints were designated Control Joints 1, 2, 3 and 4.

A.1.5.2 Control Joint Details

Control Joint Ref.	Description of fire protection system
1	50mm wide x 20mm deep bead of sealant on fire exposed side only
2	20mm wide x 10mm deep bead of sealant on fire and non-fire exposed sides
3	50mm wide x 20mm deep bead of sealant on fire and non-fire exposed sides
4	20mm wide x 10mm deep bead of sealant on fire exposed side only

A.1.6 Test results

A.1.6.1 The control joint systems satisfied the criteria of the standard fire test for the period listed below.

Control Joint Ref.	Structural Adequacy (minutes)	Integrity (minutes)	Insulation (minutes)
Joint 1	N/A	No failure at 241minutes	65
Joint 2	N/A	No failure at 241minutes	145
Joint 3	N/A	No failure at 241minutes	166[1]
Joint 4	N/A	No failure at 241minutes	167[1]

[1]Recorded on unexposed slab surface

Figure A1- Specimen wall layout and thermocouple locations.

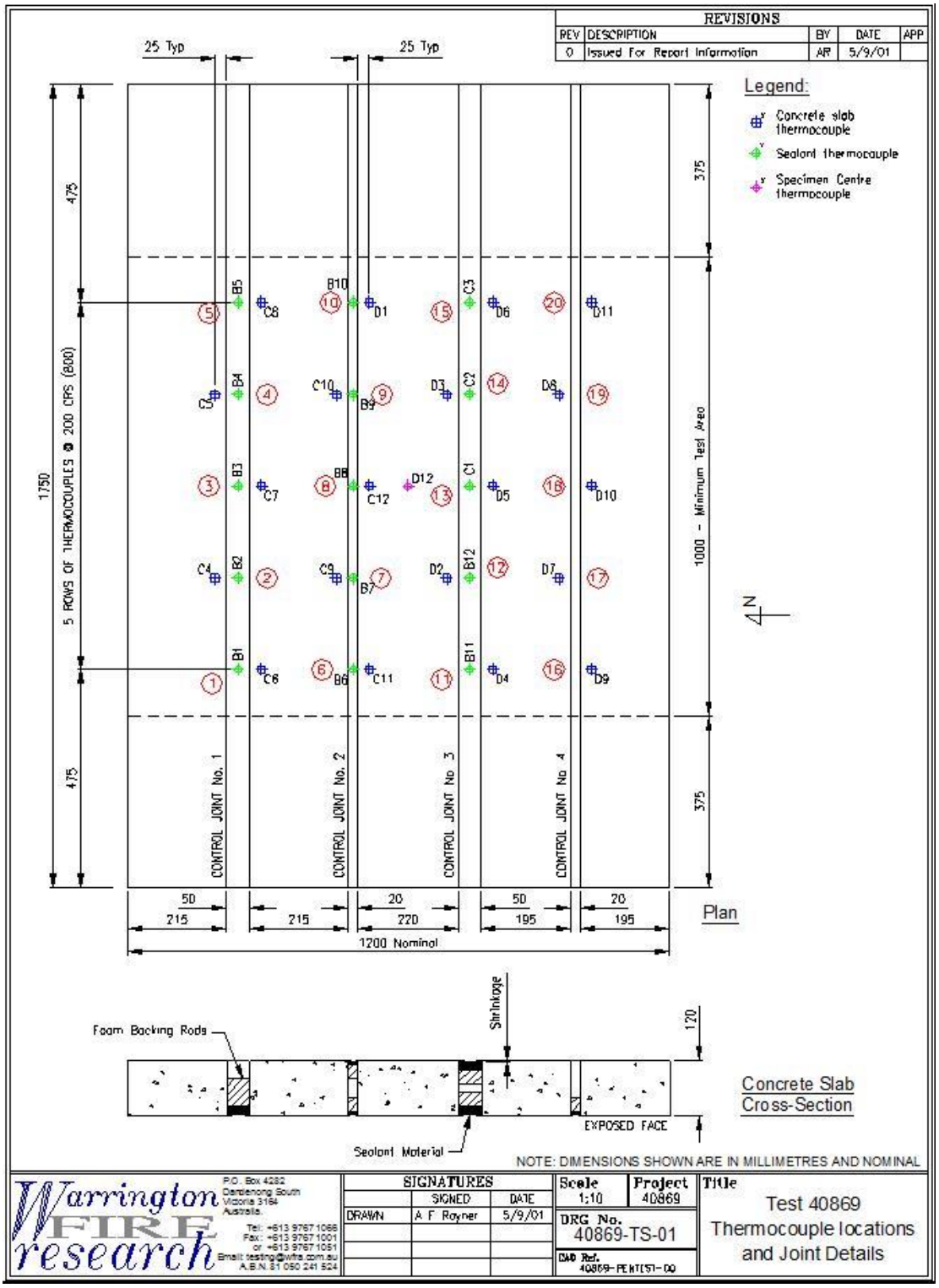

Table A-1 Thermocouple Temperature measurements

Control Joint Ref	T/C No.	Surface	DESCRIPTION	TEMP (°C) at t (minutes)					LIMIT (mins) *
				t=0	t=60	t=120	t=180	t=240	
1	B1	Sealant	200mm from western edge of slab on C/L of backing rod	13	105	#	#	#	75
	B2	Sealant	400mm from western edge of slab on C/L of backing rod	13	120	#	#	#	75
	B3	Sealant	600mm from western edge of slab on C/L of backing rod	13	136	#	#	#	65
	B4	Sealant	800mm from western edge of slab on C/L of backing rod	13	95	#	#	#	76
	B5	Sealant	1000mm from western edge of slab on C/L of backing rod	13	166	#	#	#	66
	C4	Slab	25mm from northern edge of slot, 400m from western edge of slab	12	77	122	185	220	188
	C5	Slab	25mm from northern edge of slot, 1075mm from western edge of slab	12	74	124	190	225	182
	C6	Slab	25mm from southern edge of slot, 475mm from western edge of slab	12	79	127	191	226	180
	C7	Slab	25mm from southern edge of slot, 875mm from western edge of slab	12	79	133	197	231	173
	C8	Slab	25mm from southern edge of slot, 1275mm from western edge of slab	12	78	126	198	234	172
2	B6	Sealant	475mm from western edge of slab on C/L of bead	12	89	137	229	274	147
	B7	Sealant	675mm from western edge of slab on C/L of bead	12	88	138	226	268	147
	B8	Sealant	875mm from western edge of slab on C/L of bead	12	88	146	229	272	145
	B9	Sealant	1075mm from western edge of slab on C/L of bead	12	86	129	220	262	153
	B10	Sealant	1275mm from western edge of slab on C/L of bead	12	87	114	210	250	161
	C9	Slab	25mm from northern edge of slot, 675mm from western edge of slab	12	87	132	229	280	151
	C10	Slab	25mm from northern edge of slot, 1075mm from western edge of slab	12	81	136	228	279	152
	C11	Slab	25mm from southern edge of slot, 475mm from western edge of slab	12	85	133	226	276	153
	C12	Slab	25mm from southern edge of slot, 875mm from western edge of slab	12	85	137	232	281	149
	D1	Slab	25mm from southern edge of slot, 1275mm from western edge of slab	12	86	133	231	284	152

Notes: * Limit time is the time to the nearest whole minute at which the temperature recorded by the thermocouple does not rise by more than 180 K above the initial temperature.
'-' indicates the temperature limit was not exceeded during the test period.
# indicates thermocouple has either detached from the sealant or sealant has moved away from the thermocouple

Control Joint Ref	T/C No.	Surface	DESCRIPTION	TEMP (°C) at t (minutes)					LIMIT (mins) *
				t=0	t=60	t=120	t=180	t=240	
3	B11	Sealant	475mm from western edge of slab on C/L of bead	12	66	87	98	133	-
	B12	Sealant	675mm from western edge of slab on C/L of bead	12	72	87	99	136	-
	C1	Sealant	875mm from western edge of slab on C/L of bead	12	75	90	111	152	-
	C2	Sealant	1075mm from western edge of slab on C/L of bead	12	75	89	110	154	-
	C3	Sealant	1275mm from western edge of slab on C/L of bead	12	75	88	104	143	-
	D2	Slab	25mm from northern edge of slot, 675mm from western edge of slab	11	82	122	206	262	169
	D3	Slab	25mm from northern edge of slot, 1075mm from western edge of slab	12	81	129	211	268	166
	D4	Slab	25mm from southern edge of slot, 475mm from western edge of slab	12	75	116	192	246	180
	D5	Slab	25mm from southern edge of slot, 875mm from western edge of slab	12	76	124	204	255	169
	D6	Slab	25mm from southern edge of slot, 1275mm from western edge of slab	12	79	120	200	256	173
4	D7	Slab	475mm from western edge of slab on C/L of bead	12	75	120	194	235	177
	D8	Slab	675mm from western edge of slab on C/L of bead	12	77	128	197	238	173
	D9	Slab	875mm from western edge of slab on C/L of bead	12	76	130	204	245	167
	D10	Slab	1075mm from western edge of slab on C/L of bead	12	77	121	197	238	175
	D11	Slab	1275mm from western edge of slab on C/L of bead	12	76	128	206	252	167

Table A-2: Test Observations

Time		Test Observations
Min	Sec	
0	00	Ignition of furnace, commencement of the fire resistance test.
15	00	Moisture patches had formed about transverse surface hairline cracks on unexposed surface.
17	00	There was an increase in the area of the moisture patches that had formed and steam was emitted from Control joints 1 and 4.
20	00	There was a further increase in both water and steam emission. Condensation appeared against the thermocouple pad of D10 which was adjacent to one of the cracks.
30	00	No further changes had occurred other than condensation in the furnace pressure tube was cleared and furnace pressure was found to be correct with no adjustments required.
40	00	Small brown coloured patches had appeared on the surface of the backing rod in Control joint 4. The moisture patches appeared to had dried up slightly. However there appeared to be no reduction in the amount of steam that was emitted from the unexposed surface of the specimen. Maximum furnace pressure developed by the furnace was reading slightly under 20Pa.
50	00	A hole about 50mm in length and of full width had appeared in the backing rod of Control joint 4. The sealant material beneath this hole was visible and was red in colour.

Min	Sec	Test Observations
54	00	The backing rod in Control joint 1 had discoloured.
60	00	Approximately 80% of the backing rod in Control joint 4 had melted or shrunk away exposing the sealant material which was red in colour along its centre. Further browning of the surface of the backing rod in Control joint 1 had occurred. The unexposed surface had dried up but only a slight reduction in the amount of steam emitted was observed.
70	00	A hole about 150mm long by the full width had appeared at about the centre of the backing rod of Control joint 1. The sealant material directly below this hole was grey in colour. The backing rod in Control joint 4 had completely disappeared, forming a white ash along the surface of the mastic material which had a red colour section along the centre.
87	00	Glowing was observed behind Control joint 4.
90	00	The urethane foam in Control joint 1 had blackened and twisted, exposing the backing rod and the sealant behind. No through gaps were evident. Control joint 4 was still glowing red in places.
110	00	No further changes were observed.
115	00	Thermocouples B1, B2, B3, B4 and B5 were removed from the specimen. These thermocouples were in the air cavity of Control joint 1, about 50mm above the mastic sealant material and were only measuring the air temperature.
120	00	All Control joints were intact with no through gaps evident. The mastic material along Control joints 2 and 3 was changing shape from concave to convex. The change in shape was uniform along the full length (1200mm) of the sealant material. This barrelling was about 5mm for Control joint 3 and about 3mm for Control joint 2. There were no splits in the material.
135	00	The barrelling of the material of Control joint 3 had increased to about 10mm above the surface of the concrete and about 5mm for Control joint 2. The sealant material in Control joint 4 was glowing bright red along the full length but there were no through gaps evident. The sealant material in Control joint 1 was still grey in colour except for a couple of short lengths of red lines about 300mm from the cast end of this control joint.
150	00	The barrelling of the material of Control joint 3 was now about 20mm above the concrete surface whereas Control joint 2 was still about 5mm. Control joint 4 continued to glow bright red in colour but there were no through gaps evident. The surface of Control joint 1 was still grey in colour. There were no splits in the sealant material of Control joints 2 and 3 and this material was still firmly in contact with the edges of the concrete sections.
158	00	The material in Control joint 3 was beginning to lose contact along the interface with the concrete slab.
165	00	No further changes were observed.
180	00	No further changes were observed. All control joints were free from cracks or gaps. The barrelling appeared to have stabilized at about 5mm for Control joint 2 and 25-30mm for Control joint 3. Downwards deflection of the slab over a segment of 1300mm at the centre was 25mm.
210	00	No further changes have occurred. All control joints were still fully intact and free of cracks or gaps. The colour of Control joint 1 was still basically grey.
220	00	No further changes had occurred.
230	00	No further changes had occurred.
235	00	No further changes had occurred.
240	00	No further changes had occurred. All control joints were intact with no gaps or cracks visible.
241	00	The furnace was shut down and the fire resistance test was terminated at the request of the test sponsor.

Note: All observations were taken from the unexposed face of the specimen.

Post-test observations-

After the termination of the fire test the specimen was immediately removed from the furnace and the following observations were noted regarding the condition of the exposed face of the specimen.

(i) The mastic material was still in place in each of the control joints with no gaps evident in any of the joints either in the material or the edges.
(ii) Some of the material had flaked off during the test and had fallen onto the floor of the furnace.
(iii) Barrelling of the mastic material had occurred along each control joint about 25 to 30mm for Control joints 1 and 3 and about 6mm for Control joints 2 and 4. About half of this portion of material was still in place with the remaining portion fallen off during the test. The barrelling effect had been caused by the material intumescing.
(iv) The exposed face of the concrete had covered with craze cracking together with transverse full depth cracking across the concrete segments at or about the midspan of the specimen.
(v) Spalling of the concrete had occurred at one spot at about the center of Control joint 2 south edge.

A.1.7 RELEVANCE OF WFRA 40869 TEST DATA TO AS 1530.4-2014 FROM AS 1530.4-1997.

General

A.1.7.1 The fire resistance test WFRA 40869 was conducted in accordance with AS1530.4-1997 and AS4072.1-1992, which differs from AS1530.4-2014 and AS4072.1-2005.

A.1.7.2 The differences in test method considered capable of significantly altering specimen performance are discussed below.

Furnace Temperature measurement

A.1.7.1 The specification for furnace thermocouples in AS1530.4-2014 and AS1530.4-1997 are not appreciably different.

Furnace Temperature Regime

A.1.7.2 AS1530.4-2014 specifies furnace temperature to follow the following trend:

$$T_{AS15304-2014} = 345\log_{10}(8t+1) + 20$$

A.1.7.3 AS1530.4-1997 specifies furnace temperature to follow the following trend:

$$T_{AS15304-1997} = 345\log_{10}(8t+1) + T_o \;\; 10^oC \le T_o \le 40^oC$$

A.1.7.4 The parameters outlining the accuracy of control of the furnace temperature in AS1530.4-2014 and AS1530.4-1997 are not appreciably different.

Furnace Pressure Regime

A.1.7.5 AS1530.4-2014 specifies that a pressure of 20 ± 3Pa shall be maintained in the horizontal plane 100mm below the underside of the slab.

A.1.7.6 Test report WFRA 40869 confirms that the pressure condition adhered to that prescribed by AS1530.4-2014.

Specimen Temperature Measurement

A.1.7.7 AS 1530.4-2014 specifies specimen thermocouples as Type K, MIMS thermocouples with a stainless steel sheaf having a wire diameter not exceeding 0.5 mm and an overall diameter of 3mm. The thermocouples shall be supported by a heat-resisting tube with the measuring junction protruding a minimum 25 mm. Each thermocouple shall have the tail of its measuring junction soldered to the centre of a 12mm diameter x 0.2mm thick copper disc. The disc shall be covered by 30 ± 0.5mm x 30 ± 0.5mm x 2.0 ± 0.5mm thick inorganic insulating pad having a density of 900 ± 100kg/m3.

A.1.7.8 AS 1530.4-1997 specifies specimen thermocouples as Type K, MIMS thermocouples with a stainless steel sheaf having a wire diameter not exceeding 0.5 mm and an overall diameter of 3mm. The thermocouples shall be supported by a heat-resisting tube with the measuring junction protruding a minimum 25 mm. Each thermocouple shall have the tail of its measuring junction soldered to the centre of a 12mm diameter x 0.2mm thick copper disc. The disc shall be covered by an oven-dry

pad, not less than 30mm square, made from material having a value √(kρc) not greater than 600 at 150°C, and of such thickness as will give a thermal resistance (R = t/K) of 0.015 K/W – 0.025 K/W at 150°C.

A.1.7.9 For control joints installed in horizontal separating elements, AS1530.4-2014 requires thermocouples to be located as follows:

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 from each 500mm of the perimeter.

c) On the surface of the separating element 25mm from the edge of opening, with one thermocouple for each 500mm of the perimeter.

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

A.1.7.10 AS 4072.1-1992 requires thermocouples used for the evaluation of the insulation performance of control joints shall be positioned on the unexposed face of the sealing system and adjacent separating element, except where the unexposed face of the seal is within the separating element. Where this occurs, thermocouples shall only be fitted to the seal when the joint width is greater than the distance of the seal from the non-fire side of the specimen.

A.1.7.11 The testing requirement and thermocouple locations for AS 4072.1-2005 are now described in AS 1530.-2014, as outlined in B.1.2.9 above.

A.1.7.12 Control Joints 1 and 4 in test WFRA 40869 where the widths were wider than 12mm and seals recessed on the unexposed face did have thermocouples fitted in the back surface of the seals and therefore complies with the intent of AS 1530.4-2014.

A.1.7.13 Control Joints 2 and 3 in test WFRA 40869 were sealed on the both sides of the wall separating element and the thermocouples were positioned in such a manner that they meet the requirements of AS1530.4-2014.

A.1.7.14 Based on the above discussion, it is considered the insulation performance of specimens tested in WFRA 40869 can be used to assess the performance in accordance with AS1530.4-2014.

Structural Adequacy Performance Criteria

A.1.7.15 Structural adequacy performance is not applicable to control joints.

Integrity Performance Criteria

A.1.7.16 AS1530.4-2014 deems integrity failure to have occurred upon collapse, sustained (10 seconds) flaming, ignition of an applied cotton pad or if a 6mm gap gauge can protrude into the furnace and can be moved 150mm along the gap (not applicable at the sill), or if a 25mm gap gauge can protrude into the furnace.

A.1.7.17 AS 1530.4-1997 deems integrity failure to occur upon collapse, the development of cracks, fissures, or other openings through which flames or hot gases can pass.

A.1.7.18 By inspection of test observation of test WFRA 40869, the sealant along Control Joints 2 and 3 was changing shape from concave to convex whereas there were no splits in the material at 120 minutes and both control joints were intact with no gaps or cracks visible at 240 minutes.

A.1.7.19 It was observed that about 50 % sealants in joints 2 and 4 had barrelled and fell off from the joints but the remaining sealants remained firmly in contact with the edges of the concrete section for the 241 minutes test duration. Data collected from thermocouples located on the seals indicate that surface temperatures did not exceed 275 degrees which is not considered sufficient to cause flaming of a cotton pad.

A.1.7.20 There were no observations made for the specimen relevant to this assessment in WFRA 40869 which are considered likely to have warranted the application of a cotton pad.

Insulation Performance Criteria

A.1.7.21 The insulation criteria specified in AS1530.4-2014 and the same as those specified in AS1530.4-1997.

Application of Test Data to AS1530.4-2014

A.1.7.22 The minor variations in furnace heating regimes and specimen thermocouple specification are not considered likely to significantly affect the behaviour of the specimens relevant to this assessment.

A.1.7.23 In light of the above, it is considered that the integrity and insulation behaviour of the specimens tested in WFRA 40869 can be used to assess the likely performance if the specimen was tested in accordance with AS1530.4-2014.

APPENDIX B - ASSESSMENT OF TEST SPECIMEN

B.1 LIKELY FIRE RESISTANCE PERFORMANCE OF TEST SPECIMEN

B.1.1 General

B.1.1.1 This report considers the likely fire resistance performance of FireSound Grey acrylic sealant protecting joints in concrete floor slabs when tested in accordance with Australian Fire Resistance Test Standards AS1530.4-2014 and AS4072.1-2005 as appropriate.

B.1.1.2 The following sealant configurations will be considered in this report:

a) Single layered joint flush with the fire exposed side.

b) Double layered joint flush with fire exposed and non-fire exposed side..

B.1.2 Discussion

Assessment of single layered systems

B.1.2.1 The following single layered systems are considered in this report:

- 20mm wide x 10mm deep with 30mm deep foam backing rod;
- 30mm wide x 20mm deep with 30mm deep foam backing rod;
- 40mm wide x 20mm deep with 30mm deep foam backing rod; and
- 50mm wide x 20mm deep with 45mm deep foam backing rod.

B.1.2.2 The test assembly in test WRFA 40869 using 50mm wide x 20mm deep head of FireSound Grey acrylic sealant flush with the fire exposed face only with a 45mm deep urethane foam backing rod achieved results as shown in Table 2 after a test period of 241 minutes.

Table 2: Summary of the Performance of the Test Specimen based on the Criteria Specified in AS1530.4-2014

Control Joint Ref.	Description of fire protection system	Structural Adequacy	Integrity (minutes)	Insulation (minutes)
Joint 1	50mm wide x 20mm deep bead of sealant on fire exposed side only with a 60mm wide x 60mm deep urethane foam backing rod	N/A	No failure at 241	65

B.1.2.3 In fire resistance test WFRA 40869, Control Joint 1 satisfied the integrity failure criteria of AS1530.4-2014 for a period of 241 minutes.

B.1.2.4 In fire resistance test WFRA 40869, Control Joint 1 satisfied the insulation failure criteria of AS1530.4-2014 for a period of 65 minutes.

B.1.2.5 It is proposed that the backing rod depth be reduced from 60mm to 45mm thereby increasing the distance to the unexposed face of the seal from 40mm to 55mm.

B.1.2.6 With the changes in AS4072.1-2005 the thermocouple locations are now described in AS1530.4-2014, where control joints 1 and 4 only had seals on the exposed side with joint gaps wider than 12mm, they would have required thermocouples fitted in the sealant on the unexposed side.

Thermocouples were placed at the back of the sealants in all control joints tested and therefore meets with the intent of AS 1530.4-2014..

B.1.2.7 It is therefore considered that the insulation performance of the proposed system with backing rod depth of 45mm would be expected to be as that for the 120mm thick separating element and achieve a fire resistance level if tested in accordance AS 1530.4-2014 and AS 4072.1-2005 of -/240/120.

The test assembly in test WRFA 40869 using 20mm wide x 10mm deep, 30mm wide x 20mm deep, 40mm wide x 20mm deep and 50mm wide x 20mm deep FireSound material installed on fire exposed side only in a 120mm, 150mm or 170mm thick concrete floor slab achieved results as shown in Table 3 after a test period of 241 minutes.

Table 3: Summary of the Performance of the Test Specimen based on the Criteria Specified in AS1530.4-2014

Control Joint Ref.	Description of fire protection system	Structural Adequacy	Integrity (minutes)	Insulation (minutes)
Joint 1	50mm wide x 20mm deep bead of sealant on fire exposed side only with a 60mm wide x 60mm deep urethane foam backing rod	N/A	No failure at 241 minutes	65
Joint 4	20mm wide x 10mm deep bead of sealant on fire exposed side only with a 30mm wide x 30mm deep urethane foam backing rod	N/A	No failure at 241 Minutes	167[1]

[1] Recorded on unexposed slab surface – no failures recorded on sealant material for the duration of the test.

B.1.2.8 In fire resistance test WFRA 40869, Control Joints 1 and 4 satisfied the integrity failure criteria of AS1530.4-2014 for a period of 241 minutes.

B.1.2.9 As discussed in previously, it was considered that the insulation rating of Joint 1, with the proposed 45mm deep urethane foam backing rod in lieu of 60mm, would be expected to be 120 minutes as that for the separating element (120mm thick concrete floor slab) because of the omission of the thermocouples from the unexposed side of the seal.

B.1.2.10 In fire resistance test WFRA 40869, Control Joint 4 satisfied the insulation failure criteria of AS1530.4-2014 for a period of 167 minutes, measured on the concrete floor slab. Considering that the joint width was less than the distance of the seal from the non-fire side of the specimen no thermocouples were attached to the sealant material and the insulation rating of Joint 4 would similarly be expected to be as that for the separating element (concrete floor slab).

B.1.2.11 AS3600 Concrete Structures Code stipulates that a 120mm thick normal weight concrete slab will provide an FRL of -/120/120, a 150mm thick normal weight concrete slab will provide an FRL of -/180/180 and a 170mm thick normal weight concrete slab will provide an FRL of -/240/240.

B.1.2.12 It is therefore expected that fire-resistance performance for the tested systems (designated Joint 1 and Joint 4) when installed in a 150mm thick and 170mm thick separating element if tested in accordance with AS1530.4-2014 and AS4072.1-2005 is -/180/180 and -/240/240 respectively.

B.1.2.13 Considering that the proposed 30mm wide x 20mm deep and the 40mm wide x 20mm deep seals are less onerous than the 50mm wide x 20mm deep seal due to the reduction in exposed surface area, both are expected to achieve a similar rating to the 50mm wide x 20mm deep seal if tested in accordance with AS1530.4-2014.

B.1.2.14 It is therefore expected that fire-resistance performance for the proposed systems when installed in a 150mm thick or 170mm thick separating element if tested in accordance with AS1530.4-2014 and AS4072.1-2005 is -/180/180 or -/240/240 respectively.

Assessment of double layered systems

B.1.2.15 The following single layered systems are considered in this section of the report:

- 20mm wide x 10mm deep with 30mm deep foam backing rod;
- 30mm wide x 15mm deep with 30mm deep foam backing rod;
- 40mm wide x 20mm deep with 30mm deep foam backing rod; and
- 50mm wide x 20mm deep with 45mm deep foam backing rod.

Calibration of material properties-

20mm wide x 10mm deep FireSound sealant on fire exposed amd mom-fire exposed side of a 120mm thich concrete slab.

B.1.2.16 The likely temperature distribution through a 20mm wide joint (as tested in WFRA 40869) when exposed to a Standard Fire in accordance with AS1530.4-2014 was determined using a finite element heat transfer analysis TASEF-2 as a means of calibration derived material properties

B.1.2.17 The thermal properties were calibrated against test data in full scale fire resistance test WFRA 40869. A comparison between the TASEF model predictions of temperatures on the non fire side of the seal and those obtained in the full scale test WFRA 40869 are shown in Figure 1.

B.1.2.18 The surface temperatures predicted by the model and the test data were considered to be in good agreement. The differences were considered acceptable for the scope of this assessment. The TASEF model temperature predictions are consistently higher for the seal and concrete and afford a reasonable level of conservatism.

With 20mm wide x 10mm FireSound material installed on fire exposed and non-fire exposed side in a 150mm or 170mm thick concrete floor slab.

B.1.2.19 The TASEF model predictions of the likely temperatures on the non fire side of the 20mm wide x 10mm deep seal (with 30mm wide x 30mm deep urethane foam backing rods) when installed within a 150mm thick and 170mm thick concrete floor slab and exposed to a Standard Fire in accordance with AS1530.4-2014 were determined in the following Section and is illustrated in Figures 2 and 3.

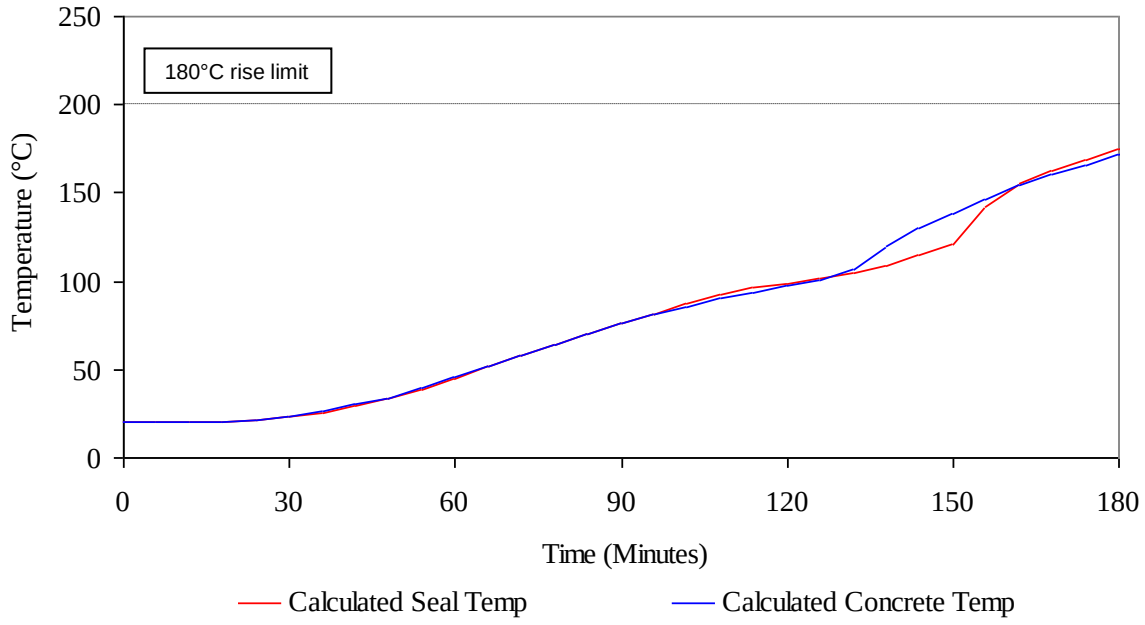

Figure 2: *TASEF model temperature predictions on the non-fire side of a joint in a 150mm thick concrete slab protected by 20mm wide x 10mm deep FireSound backed by 30mm foam rod seal flush with the fire exposed and non-fire exposed side when exposed to a AS1530.4 Standard Fire.*

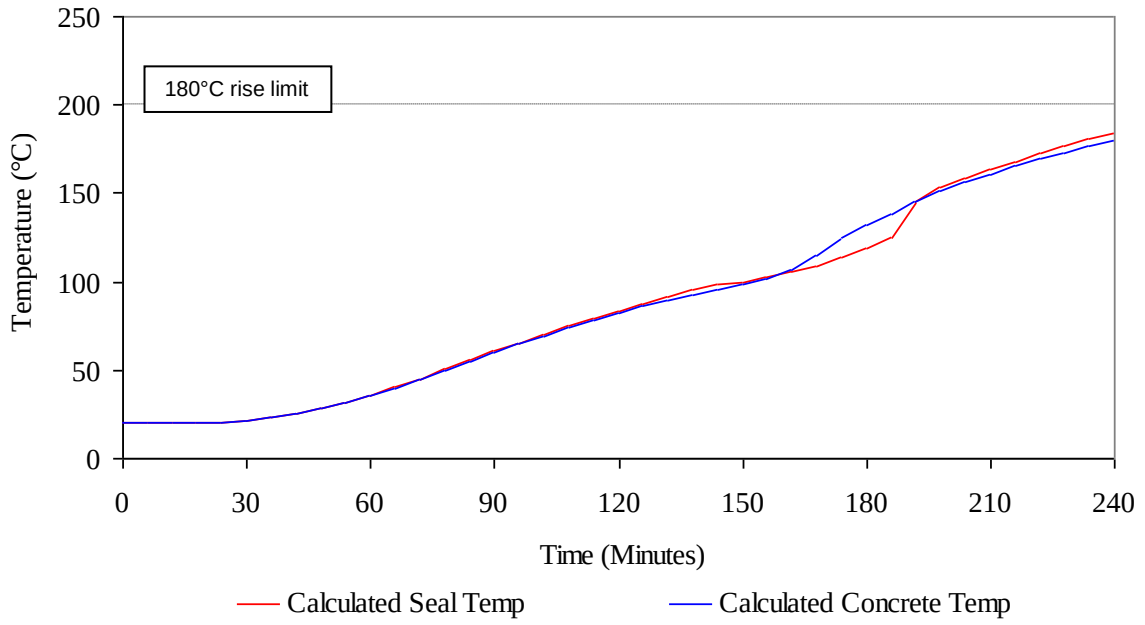

Figure 3: *TASEF model temperature predictions on the non-fire side of a joint in a 170mm thick concrete slab protected by 20mm wide x 10mm deep FireSound backed by 30mm foam rod seal flush with the fire exposed and non-fire exposed side when exposed to a AS1530.4 Standard Fire.*

B.1.2.20 When exposed to a Standard Fire in accordance with AS1530.4-2014the likely surface temperature on the non-fire side of the 20mm wide seal, as installed in test WFRA 40869, but protecting a 150mm thick concrete floor slab in lieu of 120mm thick slab is not expected to increase by more than 180K after 180 minutes (Refer Figure 2).

B.1.2.21 When exposed to a Standard Fire in accordance with AS1530.4-2014 the likely surface temperature on the non-fire side of the 20mm wide seal, as installed in test WFRA 40869, but protecting a 170mm thick concrete floor slab in lieu of 120mm thick slab is not expected to increase by more than 180K after 240 minutes (Refer Figure 3).

With 30mm wide x 15mm FireSound material installed on fire exposed and non-fire exposed side in a 120mm, 150mm or 170mm thick concrete floor slab.

B.1.2.22 A heat transfer model was configured to incorporate a 30mm wide x 15mm deep seal in varying concrete slab thicknesses. The TASEF model temperature predictions, as shown in this Section, were generally higher than those when compared with the full-scale fire resistance tests in accordance with AS1530.4-2014, and therefore affords a reasonable level of conservatism.

B.1.2.23 In the computer model the depth of the 30mm wide seal was varied until the insulation criteria in accordance with AS1530.4-1997 was satisfied for the proposed installation in a 120mm, 150mm and 170mm thick concrete slab. The results are illustrated in Figures 4, 5 and 6.

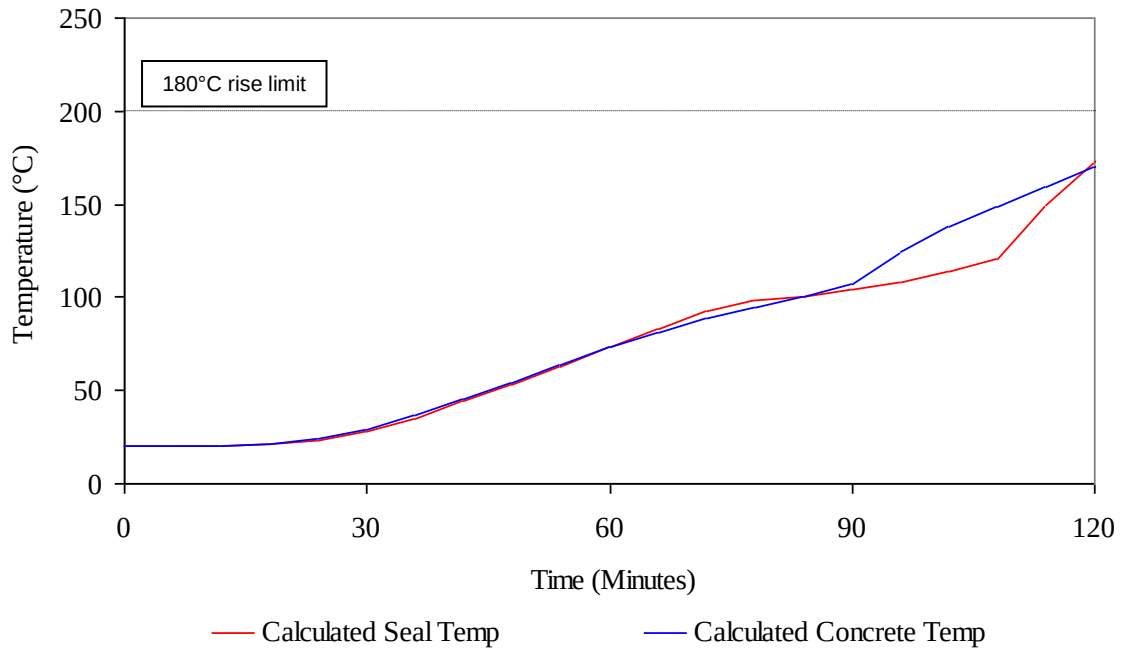

Figure 4: *TASEF model temperature predictions on the non-fire side of a joint in a 120mm thick concrete slab protected by 30mm wide x 15mm deep FireSound backed by 30mm foam rod seal flush with the fire exposed and non-fire exposed side when exposed to a AS1530.4 Standard Fire.*

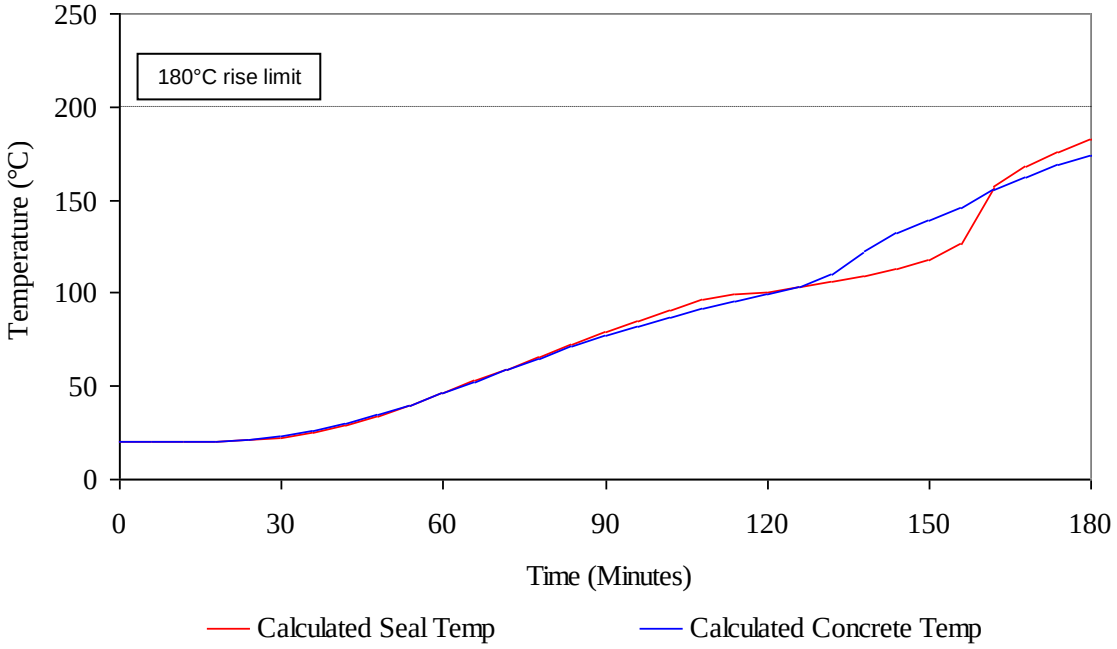

Figure 5: *TASEF model temperature predictions on the non-fire side of a joint in a 150mm thick concrete slab protected by 30mm wide x 15mm deep FireSound backed by 30mm foam rod seal flush with the fire exposed and non-fire exposed side when exposed to a AS1530.4 Standard Fire.*

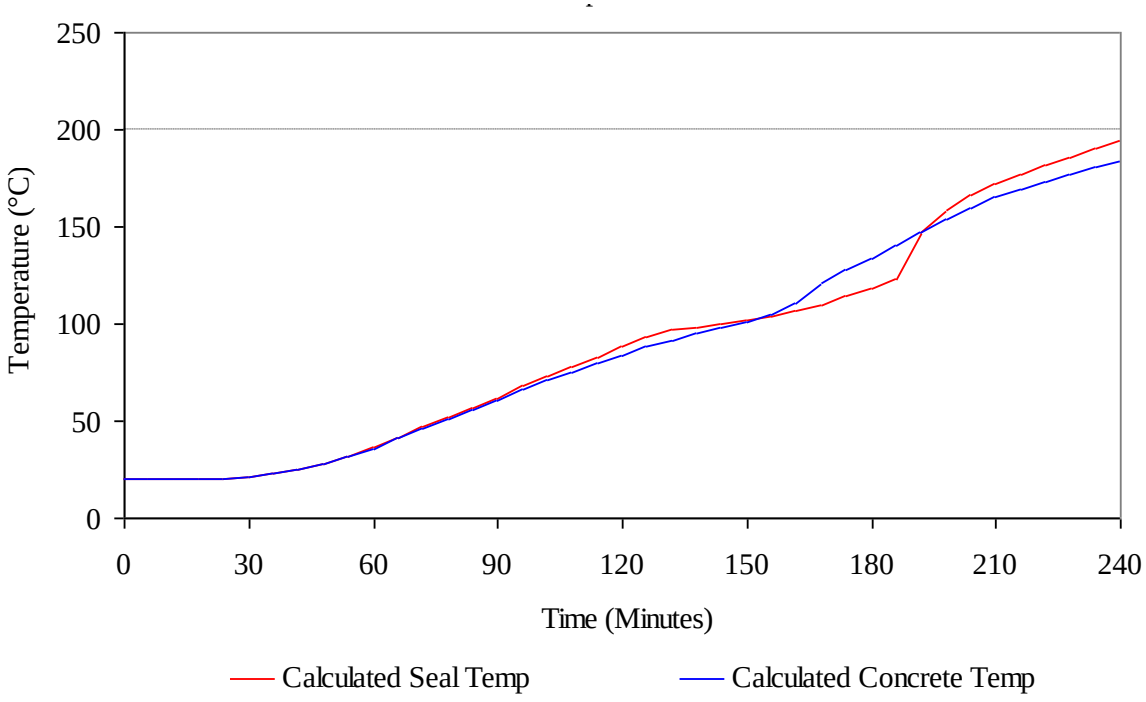

Figure 6: *TAS perature predictions on the non-fire side of a joint in a 170mm thick concrete slab protected by 30mm wide x 15mm deep FireSound backed by 30mm foam rod seal flush with the fire exposed and non-fire exposed side when exposed to a AS1530.4 Standard Fire.*

With 40mm wide x 20mm FireSound material installed on fire exposed and non-fire exposed side in a 120mm, 150mm or 170mm thick concrete floor slab.

B.1.2.24 A heat transfer model was configured to incorporate a 40mm wide x 20mm deep seal in varying concrete slab thicknesses. The TASEF model temperature predictions, as shown in this Section, were generally higher than those when compared with the full-scale fire resistance tests in accordance with AS1530.4-2014, and therefore affords a reasonable level of conservatism.

B.1.2.25 In the computer model the depth of the 40mm wide seal was varied until the insulation criteria in accordance with AS1530.4-1997 was satisfied for the proposed installation in a 120mm, 150mm and 170mm thick concrete slab. The result for the 170mm thick concrete slab was at the approximate point of insulation failure at 240 minutes but because the level of conservatism in the model this result is considered to satisfy the insulation criteria. The results are illustrated in Figures 7, 8 and 9.

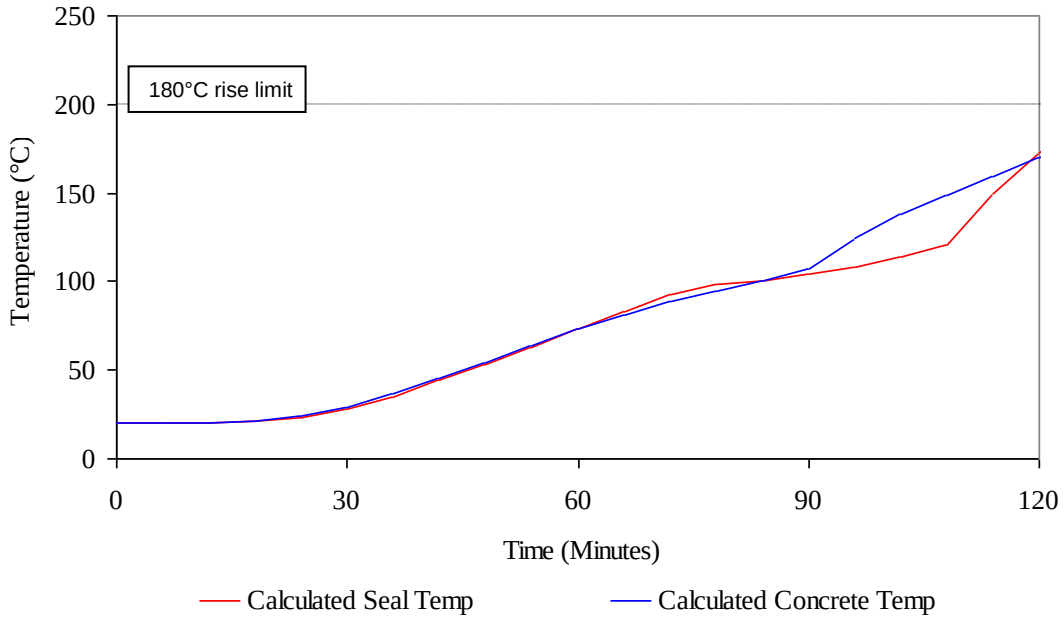

Figure 7: *TASEF model temperature predictions on the non-fire side of a joint in a 120mm thick concrete slab protected by 40mm wide x 20mm deep FireSound backed by 30mm foam rod seal flush with the fire exposed and non-fire exposed side when exposed to a AS1530.4 Standard Fire.*

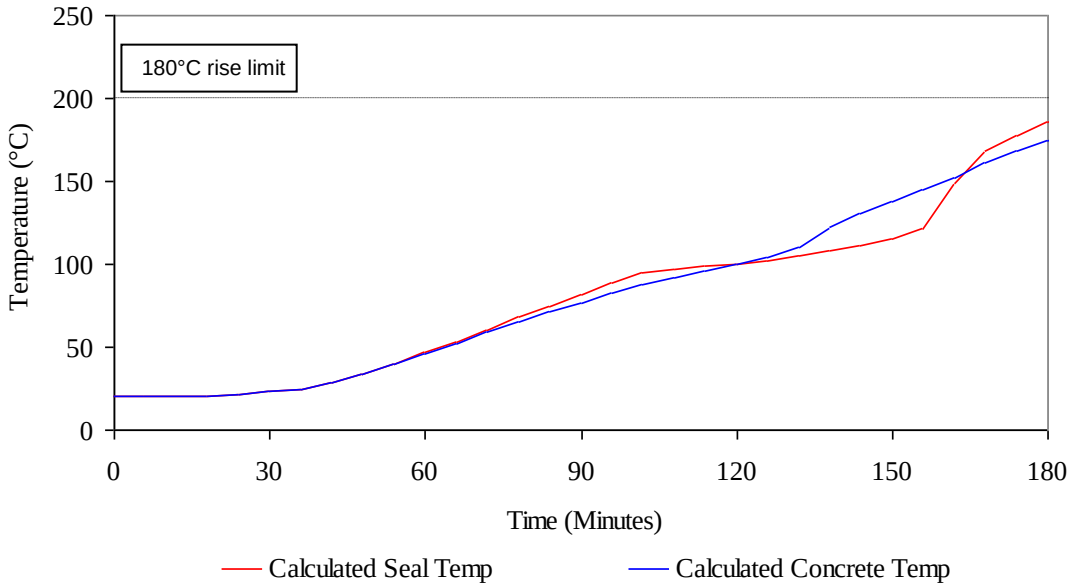

Figure 8: *TASEF model temperature predictions on the non-fire side of a joint in a 150mm thick concrete slab protected by 40mm wide x 20mm deep FireSound backed by 30mm foam rod seal flush with the fire exposed and non-fire exposed side when exposed to a AS1530.4 Standard Fire.*

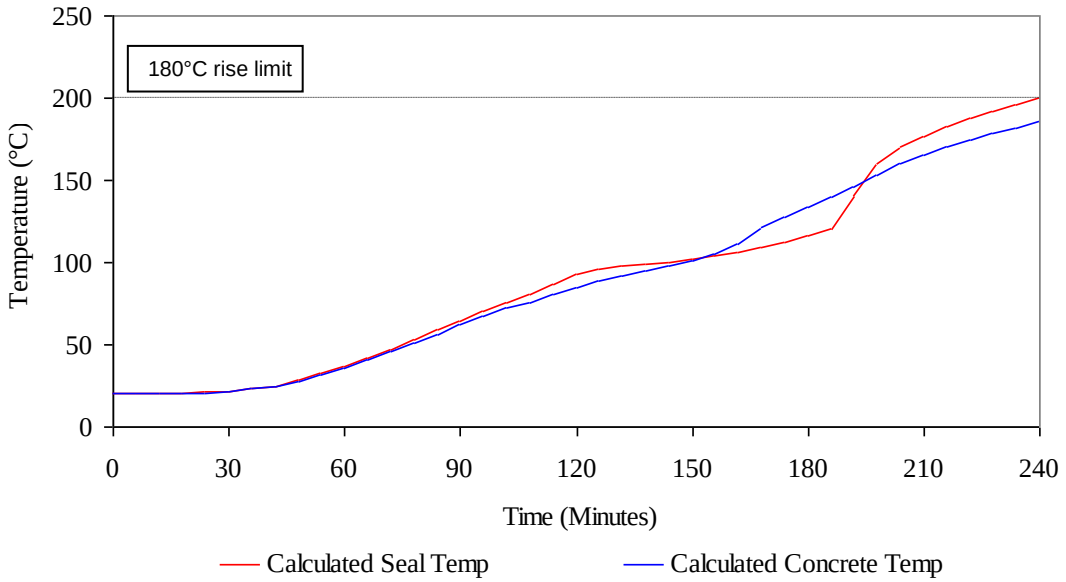

***Figure 9**: TASEF model temperature predictions on the non-fire side of a joint in a 170mm thick concrete slab protected by 40mm wide x 20mm deep FireSound backed by 30mm foam rod seal flush with the fire exposed and non-fire exposed side when exposed to a AS1530.4 Standard Fire.*

With 50mm wide x 20mm FireSound material installed on fire exposed and non-fire exposed side in a 120mm, 150mm or 170mm thick concrete floor slab.

B.1.2.26 The test assembly in test WFRA 40869 achieved the results as shown in Table 4 after a test period of 241 minutes.

Table 4: Summary of the Performance of the Test Specimen based on the Criteria Specified in AS1530.4-2014

Control Joint Ref.	Description of fire protection system	Structural Adequacy	Integrity (minutes)	**Insulation (minutes)**
Joint 3	50mm wide x 20mm deep bead of sealant on fire and on-fire exposed sides with a 60mm wide x 30mm deep urethane foam backing rod	N/A	No failure at 241 minutes	166[1]

[1] Recorded on unexposed slab surface – no failures recorded on sealant material for the duration of the test.

B.1.2.27 In fire resistance test WFRA 40869, Control Joint 3 satisfied the integrity failure criteria of AS1530.4-2014 for a period of 241 minutes.

B.1.2.28 In fire resistance test WFRA 40869, Control Joint 3 satisfied the insulation failure criteria of AS1530.4-2014 for a period of 166 minutes, measured on the concrete floor slab. Considering that the sealant material did not fail insulation for the duration of the 241 minute test it is concluded that the insulation rating of Joint 3 would similarly be expected to be as that for the separating element (concrete floor slab).

B.1.2.29 AS3600 Concrete Structures Code stipulates that a 120mm thick normal weight concrete slab will provide an FRL of -/120/120, a 150mm thick normal weight concrete slab will provide an FRL of -/180/180 and a 170mm thick normal weight concrete slab will provide an FRL of -/240/240.

B.1.2.30 It is therefore expected that fire-resistance performance for the tested system (designated Joint 1) when installed in a 150mm thick and 170mm thick separating element, with a 30mm deep foam backing rod, if tested in accordance with AS1530.4-12014 and AS4072.1-1992 is -/180/180 and -/240/240 respectively.

B.2 CONCLUSIONS

B.2.1.1 On the basis of the test results in the referenced tests and the discussion in Section B1.3 of this report, the likely fire resistance performance of the Control Joints, protected by FireSound grey acrylic sealant, when tested in accordance with Australian Fire Resistance Test Standard AS1530.4-2014 and AS4072.1-2005 as appropriate was determined as shown in Table 5.

Table 5: The likely fire resistance performance of FireSound grey acrylic sealant protecting joints in a concrete floor slab when tested in accordance with AS1530.4-2014 Sections 2, 4 and 10 and AS4072.1-2005 as appropriate.

Separating element type	Minimum element thickness (mm)	Maximum joint width (mm)	Minimum FireSound depth (mm)	Backing rod depth (mm)	Seal configuration	Likely Fire Resistance Level (FRL) of system	
						Integrity	Insulation
Solid normal weight/light-weight concrete floors (FRL 120/120/120)	120	20 30 40 50	10 20 20 20	30 30 30 45	Fire side only	120	120
Solid normal weight/light-weight concrete floors (FRL 180/180/180)	150	20 30 40 50	10 20 20 20	30 30 30 45	Fire side only	180	180
Solid normal weight/light-weight concrete floors (FRL 240/240/240)	170	20 30 40 50	10 20 20 20	30 30 30 45	Fire side only	240	240
Solid normal weight/light-weight concrete floors (FRL 120/120/120)	120	20 30 40 50	10 15 20 20	30 30 30 30	Both fire exposed and non-fire exposed sides	120	120
Solid normal weight/light-weight concrete floors (FRL 180/180/180)	150	20 30 40 50	10 15 20 20	30 30 30 30	Both fire exposed and non-fire exposed sides	180	180
Solid normal weight/light-weight concrete floors (FRL 240/240/240)	170	20 30 40 50	10 15 20 20	30 30 30 30	Both fire exposed and non-fire exposed sides	240	240