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Fire resistance of ITW control joint systems in accordance with AS 1530.4-2014 and AS 4072.1-2005

Assessment Report

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Important disclaimer

Contents

1 Introduction

This report presents an assessment of the fire resistance of ITW control joint systems in accordance with AS 1530.4-2014 and AS 4072.1-2005.

This report is prepared for meeting the evidence of suitability requirements of NCC schedule 5 as appropriate for FRL.

This report reviews and confirms the extent to which the referenced fire resistance tests listed in Section 2 meet the requirements of the standard fire test standards listed in Section 4 of the report. The proposed variations to the tested construction presented in Section 3 are subject to an analysis in Appendix B and the conclusions are presented in Section 5 of this report.

The field of applicability of the results of this assessment report is presented in Section 6 and subject to the requirements, validity, and limitations of Section 7, 8 and 9.

2 Supporting Data

This assessment report refers to various test reports to support the analysis and conclusions of this report. They are listed in Table 1 below;

Table 1 – Referenced tests

Report Reference	Test Standard	Outline of Test Specimen
TE 88551	BS 476: Part 20: 1987	A fire resistance test on three 1000-mm long linear joints in a 200-mm thick lightweight concrete slab system.
TE 88553	BS 476: Part 20: 1987	A fire resistance test on four 900-mm long vertical joints in a 210-mm thick lightweight concrete block wall.
TE 88798	BS 476: Part 20: 1987	A fire resistance test on three 900-mm long vertical joints in a 210-mm thick lightweight concrete block wall.
TE 90158	BS 476: Part 20: 1987	A fire resistance test on four 900-mm long vertical joints in a 100-mm thick lightweight concrete block wall.

The test reported in TE 88551, TE 88553, TE 88798 and TE 90158 were conducted by Loss Prevention Council and were sponsored by Alfas Group Limited, who gave permission for the use of these reports for this assessment.

3 Proposed Variations

The proposed constructions comprise control joints tested in TE 88551, TE 88553, TE 88798 and TE 90158 as summarised in Table 2 below and subject to the following variations:

- Applicability to AS 1530.4-2014 and relevant parts of AS 4072.1-2005 Clause 4.7 is confirmed.
- Increase the length of control joint to 1000mm

Table 2: Summary of test specimens in the reference test reports

Report	Substrate	Seal No.	Width of control joint	Unexposed side	Exposed side
TE 88551	200mm thick Aerated concrete slab (580kg/m^3)	4	20mm	190mm deep Fire Rated Polyurethane Canister Foam	10mm deep Fire Rated Low Modulus Neutral Cure Silicone
		5	20mm	190mm deep Fire Rated Polyurethane Canister Foam	10mm deep Intumescent Acrylic Sealant
		6	20mm	200mm deep Fire Rated Polyurethane Canister Foam	None
TE 88553	210mm thick Aerated lightweight concrete block wall (650kg/m^3)	5	10mm	190mm deep Fire Rated Polyurethane Canister Foam	10mm deep Fire Rated Low Modulus Neutral Cure Silicone
		6	20mm	200mm deep Fire Rated Polyurethane Canister Foam	None
		7	10mm	200mm deep Fire Rated Polyurethane Canister Foam	None
		8	20mm	190mm deep Fire Rated Polyurethane Canister Foam	10mm deep Fire Rated Low Modulus Neutral Cure Silicone
TE 88798	210mm thick Aerated lightweight concrete block wall (650kg/m^3)	1	40	200mm deep Fire Rated Polyurethane Canister Foam	None
		2	60	200mm deep Fire Rated Polyurethane Canister Foam	None
		3	80	200mm deep Fire Rated Polyurethane Canister Foam	None
TE 90158	100mm thick Aerated lightweight concrete block wall (650kg/m^3)	7	10	190mm deep Fire Rated Polyurethane Canister Foam	10mm deep Intumescent Acrylic Sealant
		8	10	200mm deep Fire Rated Polyurethane Canister Foam	None
		9	20	190mm deep Fire Rated Polyurethane Canister Foam	10mm deep Intumescent Acrylic Sealant
		10	20	200mm deep Fire Rated Polyurethane Canister Foam	None

4 Referenced Standards

Standards:

AS 1530.4-2014	Methods for fire tests on building materials, components and structures Part 4: Fire resistance tests of elements of building construction.
AS 4072.1-2005	Components for the protection of openings in fire-resistant separating elements Part 1: Service penetrations and control joints

5 Conclusion

On the basis of the analysis presented in this report, it is the opinion of this Accredited Testing Laboratory that the tested prototype described in Section 2 when varied as described in Section 3 will achieve the Fire Resistance stated below when submitted to a standard fire test in accordance with the test methods referenced in Section 4 and subject to the requirements and limitations of Section 7, 8 and 9.

Table 1: FRL of ITW control joint systems

Test No.	Seal No.	FRL
TE 88551	4	-/240/240
	5	-/240/240
	6	-/180/180
TE88553	5	-/240/240
	6	-/240/240
	7	-/240/240
	8	-/240/240
TE 88798	1	-/60/60
	2	-/90/90
	3	-/180/180
TE 90158	7	-/240/120
	8	-/120/120
	9	-/180/90
	10	-/60/60

6 Direct Field of Application of Results

The results of this report are applicable to walls exposed to fire from the tested direction and to floors exposed to fire from below.

7 Requirements

It is required that the supporting construction is tested or assessed to achieve the required FRL up to the required FRL based on the assessed design in accordance with AS 1530.4.

Any variations with respect to size, constructional details, loads, stresses, edge or end conditions that are other than those identified in this report, may invalidate the conclusions drawn in this report.

8 Term of Validity

This assessment report will lapse on 30th June 2024. Should you wish us to re-examine this report with a view to the possible extension of its term of validity, would you please apply to us three to four months before the date of expiry. This Division reserves the right at any time to amend or withdraw this assessment in the light of new knowledge.

9 Limitations

The conclusions of this assessment report 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 and methods of construction, and installation may lead to variations in performance between elements of similar construction.

This assessment report does not provide an endorsement by CSIRO of the actual products supplied to the industry. The referenced assessment can therefore only relate to the actual prototype test specimens, testing conditions and methodology described in the supporting data, and does not imply any performance abilities of construction of subsequent manufacture.

This assessment is based on information and experience available at the time of preparation. The test standards and the assessment methodologies are subject to review and improvement and it is recommended that this report is reviewed on, or before, the stated expiry date.

The information contained in this assessment 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.

Appendix A Supporting Test Data

A.1. TE 88553

On 14 January 1997 the Loss Prevention Council Laboratories (LPC) conducted a fire-resistance test in accordance with the conditions of BS 476: Part 20: 1987 on four 900-mm long vertical joints in a 210-mm thick lightweight concrete block wall referenced as Joints 5, 6, 7 and 8.

- Joint 5 was 10-mm wide and incorporated Fire Rated Canister Foam (5034) installed flush with the unexposed face and a rebated 10-mm on the exposed face of the wall, filling the entire gap, with the rebate filled with Fire Rated Low Modulus Neutral Cure Silicone (3059).
- Joint 6 was 20-mm wide and incorporated Fire Rated Canister Foam (5034) installed flush with the unexposed face and exposed face of the wall, filling the entire gap.
- Joint 7 was 10-mm wide and incorporated Fire Rated Canister Foam (5034) installed flush with the unexposed face and exposed face of the wall, filling the entire gap.
- Joint 8 was 20-mm wide and incorporated Fire Rated Canister Foam (5034) installed flush with the unexposed face and a rebated 10-mm on the exposed face of the wall, filling the entire gap, with the rebate filled with Fire Rated Low Modulus Neutral Cure Silicone (3059).

Joint 6 failed integrity and insulation at 257 minutes while all of the other joints had not failed any criteria for the full 300 minutes duration of the test.

A.2. TE 88551

On 22 January 1997 the Loss Prevention Council Laboratories (LPC) conducted a fire-resistance test in accordance with the conditions of BS 476: Part 20: 1987 on three 1000-mm long linear joints in a 200-mm thick lightweight concrete slab system referenced as Joints 4, 5 and 6.

- Joint 4 was 20-mm wide and incorporated Fire Rated Canister Foam (5034) installed flush with the top face and a rebated 10-mm on the exposed face of the slab filling the entire gap, with the rebate filled with Fire Rated Low Modulus Neutral Cure Silicone (3059).
- Joint 5 was 20-mm wide and incorporated Fire Rated Canister Foam (5034) installed flush with the top face and a rebated 10-mm on the exposed face of the slab, filling the entire gap, with the rebate filled with Intumescent Acrylic Sealant (2731).
- Joint 6 was 20-mm wide and incorporated Fire Rated Canister Foam (5034) installed flush with the top face and exposed face of the slab, filling the entire gap.

Joint 6 failed integrity and insulation at 206 minutes. Joint 5 failed insulation and integrity at 244 minutes. Joint 4 failed integrity and insulation at 246 minutes.

A.3. TE 88798

On 2 April 1997 the Loss Prevention Council Laboratories (LPC) conducted a fire-resistance test in accordance with the conditions of BS 476: Part 20: 1987 on three 900-mm long vertical joints in a 210-mm thick lightweight concrete block wall referenced as Joints 1, 2 and 3.

- Joint 1 was 80-mm wide and incorporated Fire Rated Canister Foam (5034) installed flush with the unexposed face and exposed face of the wall, filling the entire gap.
- Joint 2 was 60-mm wide and incorporated Fire Rated Canister Foam (5034) installed flush with the unexposed face and exposed face of the wall, filling the entire gap.
- Joint 3 was 40-mm wide and incorporated Fire Rated Canister Foam (5034) installed flush with the unexposed face and exposed face of the wall, filling the entire gap.

Joint 1 failed integrity at 79 minutes and insulation at 78 minutes. Joint 2 failed integrity at 106 minutes and insulation at 103 minutes. Joint 3 failed integrity and insulation at 181 minutes.

A.4. TE 90158

On 16 December 1997 the Loss Prevention Council Laboratories (LPC) conducted a fire-resistance test in accordance with the conditions of BS 476: Part 20: 1987 on four 900-mm long vertical joints in a 100-mm thick lightweight concrete block wall referenced as Joints 7, 8, 9 and 10.

- Joint 7 was 10-mm wide and incorporated Fire Rated Canister Foam (5034) installed flush with the unexposed face and a rebated 10-mm on the exposed face of the wall, filling the entire gap, with the rebate filled with Intumescent Acrylic Sealant (2731).
- Joint 8 was 10-mm wide and incorporated Fire Rated Canister Foam (5034) installed flush with the unexposed face and exposed face of the wall, filling the entire gap.
- Joint 9 was 20-mm wide and incorporated Fire Rated Canister Foam (5034) installed flush with the unexposed face and a rebated 10-mm on the exposed face of the wall, filling the entire gap, with the rebate filled with Intumescent Acrylic Sealant (2731).
- Joint 10 was 20-mm wide and incorporated Fire Rated Canister Foam (5034) installed flush with the unexposed face and exposed face of the wall, filling the entire gap.

Joint 7 did not fail integrity for the full 240 minutes duration of the test but failed insulation at 175 minutes. Joint 8 failed integrity at 135 minutes and insulation at 132 minutes. Joint 9 failed integrity at 195 minutes and insulation at 105 minutes. Joint 10 failed integrity at 73 minutes and insulation at 69 minutes.

A.5. Summary of test data

Report	Substrate	Seal No.	Width of control joint	Unexposed side	Exposed side	Integrity (Min.)	Insulation (Min.)	No. TC
TE 88551	200mm thick Aerated concrete slab (580kg/m^3)	4	20mm	190mm deep Fire Rated Polyurethane Canister Foam	10mm deep Fire Rated Low Modulus Neutral Cure Silicone	246	246	2
		5	20mm	190mm deep Fire Rated Polyurethane Canister Foam	10mm deep Intumescent Acrylic Sealant	244	244	2
		6	20mm	200mm deep Fire Rated Polyurethane Canister Foam	None	206	206	2
TE 88553	210mm thick Aerated lightweight concrete block wall (650kg/m^3)	5	10mm	190mm deep Fire Rated Polyurethane Canister Foam	10mm deep Fire Rated Low Modulus Neutral Cure Silicone	300	300	2
		6	20mm	200mm deep Fire Rated Polyurethane Canister Foam	None	257	257	3
		7	10mm	200mm deep Fire Rated Polyurethane Canister Foam	None	300	300	2
		8	20mm	190mm deep Fire Rated Polyurethane Canister Foam	10mm deep Fire Rated Low Modulus Neutral Cure Silicone	300	300	3
TE 88798	210mm thick Aerated lightweight concrete block wall (650kg/m^3)	1	40mm	200mm deep Fire Rated Polyurethane Canister Foam	None	79	78	3
		2	60mm	200mm deep Fire Rated Polyurethane Canister Foam	None	106	103	3
		3	80mm	200mm deep Fire Rated Polyurethane Canister Foam	None	181	181	3
TE 90158	100mm thick Aerated lightweight concrete block wall (650kg/m^3)	7	10mm	190mm deep Fire Rated Polyurethane Canister Foam	10mm deep Intumescent Acrylic Sealant	240	175	2
		8	10mm	200mm deep Fire Rated Polyurethane Canister Foam	None	135	132	2
		9	20mm	190mm deep Fire Rated Polyurethane Canister Foam	10mm deep Intumescent Acrylic Sealant	195	105	2
		10	20mm	200mm deep Fire Rated Polyurethane Canister Foam	None	73	69	2

A.6. The application of data from BS 476: Part 20: 1987 to AS 1530.4-2014

General

The fire resistance test TE 88551, TE 88553, TE 88798 and TE 90158 were conducted in accordance with BS 476 Part 20: 1987 which differs from AS 1530.4-2014. The differences considered relevant to this assessment as discussed below.

Temperature Regime

The furnace temperature regime for fire resistance tests conducted in accordance with AS 1530.4-2005 follows a similar trend to BS 476: Part 20: 1987.

The parameters outlining the accuracy of control of the furnace temperature in AS 1530.4- 2014 and BS 476: Part 20: 1987 are not appreciably different.

Furnace Thermocouples

The furnace thermocouples specified in AS 1530.4-2014 are type K, mineral insulated metal sheathed (MIMS) with a stainless steel sheath having a wire of diameter of less than 1.0mm and an overall diameter of 3mm. The measuring junction protrudes at least 25mm from the supporting heat resistant tube.

The furnace thermocouple types in BS 476: 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 except that the wires for 25mm approximately from the weld/crimp shall be exposed and separated from each other by at least 5mm (replace or recalibrate after 6hrs of usage).*
- *Nickel chromium/nickel aluminium wire contained within mineral insulation and 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 30s.*

The relative location of the furnace thermocouples to the exposed face of the specimen, for both AS 1530.4-2014 and BS 476: Part 20: 1987, is 100mm +10mm.

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

Specimen Thermocouples

AS 1530.4 – 2014 Section 10.5.1 (i) states for control joints, as follows:

> *(i) At least three on the surface of the seal, with one thermocouple for each 0.3 m^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).*

AS 1530.4 – 2014 Section 10.5.3 states:

> *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 12 mm. Under these circumstances, the size of the pad may be reduced to facilitate the fitting of the thermocouple.*

LPC described all of the referenced tests as ad-hoc tests because BS 476 Part 20 did not have a specific requirement for testing of control joint systems in isolation from the full-scale wall and floor tests. The referenced tests all satisfied AS 1530.4 – 2014 Section 10.5.3.

However, the referenced tests did not meet the requirement for AS 1530.4 – 2014 Section 10.5.1 (i) as some of the tests only had 2 thermocouples were placed on the surface of each of the seals and were placed to one side of the specimen.

Specimen setup

LPC described all of these tests as ad-hoc tests because BS 476 Part 20 did not have a specific requirement for testing of control joint systems in isolation from the full-scale wall and floor tests. However, section 10 of AS 1530.4 - 2014, Service Penetrations and Control Joints, does detail how to test and evaluated the performance of the joint systems.

AS 1530.4 -2014 Section 10.4.2 specifies that the minimum length of the control joint is to be 1000 mm. The control joint systems reported in TE 88553, TE 88798 and TE 90158 were only 900-mm long.

Furnace Pressure

It is a requirement of AS 1530.4-2014 that for a pressure of 15 ±3 Pa shall be established at the centre of a single horizontal penetration within a vertical separating element that has a maximum height of ≤1 m.

In the referenced tests, the furnaces were maintained at a pressure of 18Pa±2Pa at the level of the top of the seals for wall substrates. Therefore the tested joints in the vertical substrates were subjected to a more onerous pressure condition than that required by AS 1530.4-2014.

It is a requirement of AS 1530.4-2014 for horizontal separating elements, the pressure of 20 ±3 Pa shall be maintained in the horizontal plane 100 ±10 mm below the underside of the supporting construction.

In the referenced tests, the furnaces were maintained at a pressure of 18Pa±2Pa at a position 100mm below the underside of the slabs for floor substrate. Therefore the tested joints in the vertical substrates were subjected to a slightly less onerous pressure condition than that required by AS 1530.4-2014 once gaps formed.

Performance Criteria

Integrity

The integrity criteria differ slightly between AS 1530.4-2014 and BS 476 Part 20 -1987.

For uninsulated specimens or for specimens that have exceeded their insulation criteria performance, the specimen shall be deemed to have failed the integrity criterion in accordance with AS 1530.4-2014 if it sustains flaming for 10 seconds, 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.

The integrity criteria for BS 476: Part 20:1987 are similar to the above.

However due to the length of in control joint in the referenced report been shorter than as prescribed in AS 1530.4 -2014 Section 10.4.2, the integrity performance of the seal will have to be examined on a case by case basis.

Insulation

The thermocouple locations for measuring insulation in AS 1530.4-2014 and BS 476: Part 20: 1987 are different. AS 1530.4-2014 specifically nominates positions for 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 a specified

minimum number of locations, with additional thermocouples fitted at the discretion of the laboratory. Similarly, a roving thermocouple can be applied at any location.

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

Application of the referenced Test Data to AS 1530.4-2014

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 a significant effect on the outcome of the referenced fire resistance tests.

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

However it was confirmed the no gaps were observed for the joints in TE 88551 for the time up to their integrity failure 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 a significant effect on the test results until that time.

The variation in the number of thermocouples required could result in less accurate reading of hot spots in the seal. An examination of the test data confirmed that TE 88798 did comply with 3 thermocouples on each of its joints.

For the control joints in TE 88551, the 20mm joints all had only 2 thermocouples. However, they all failed integrity prior to insulation. Therefore the increase of one thermocouple will not change the outcome of the test results.

For the control joints in TE 88553, the 10mm joints that only had 2 thermocouples did not fail insulation for the 300 minutes duration of the test. It is expected with 3 thermocouples it would have had 60 minutes of margin so as to maintain insulation for up to 240 minutes.

For the control joints in TE 90158, the 10mm and 20mm joints that only had 2 thermocouples.

- For seal 7, it did fail insulation at 175 minutes. It is expected with 3 thermocouples it would have had 55 minutes of margin so as to maintain insulation for up to 120 minutes.
- For seal 8, it did fail insulation at 132 minutes. It is expected with 3 thermocouples it would have had 12 minutes of margin so as to maintain insulation for up to 120 minutes.
- For seal 9, it did fail insulation at 105 minutes. It is expected with 3 thermocouples it would have had 15 minutes of margin so as to maintain insulation for up to 90 minutes.
- For seal 10, it did fail insulation at 69 minutes. It is expected with 3 thermocouples it would have had 9 minutes of margin so as to maintain insulation for up to 60 minutes.

Based on the above, and in absence of any foreseeable detrimental effects, it is the expected that the control joint systems as reported in TE 88551, TE 88553, TE 88798 and TE 90158 would be capable of achieving the following insulation performances if tested in accordance with AS 1530.4-2014.

Test No.	Joint No.	Insulation (minutes)
TE 88551	4	246
	5	244
	6	206
TE88553	5	240
	6	257
	7	240
	8	300
TE 88798	1	78
	2	103
	3	181

Test No.	Joint No.	Insulation (minutes)
TE 90158	7	120
	8	120
	9	90
	10	60

Appendix B Analysis of Variation

B.1 Control joint length

The proposed construction comprises the control joints as tested in TE 88551, TE 88553, TE 88798 and TE 90158 and subjected to the following variation:

- Increased length of control joint to 1000mm
- Applicability to relevant parts of AS 4072.1-2005 Clause 4.7 is confirmed

With reference to AS 4072.1 – 2005 Clause 4.7.1 which states:

A formal opinion of the performance of a control joint sealing system by a registered testing authority may be based on tests on representative lengths of joints, provided that the following conditions apply:

(a) The length of any specimen control joint complies with AS 1530.4.

(b) There is no change in the cross-section of the joint over the tested length (that is, joints of varying widths or varying depths of fire-stopping materials shall not be tested and the data used to assess a range of configurations). Where a range of configurations is to be assessed, a series of tests shall be carried out.

(c) At least one test in a horizontal orientation is carried out to examine the ability of a joint-sealing system to remain in place during fire conditions.

(d) When testing a series of joints in a particular floor or wall construction, each joint is separated from the next by a suitable distance agreed between the testing authority and the applicant, to minimize interaction between adjacent systems. NOTE: A nominal separation of approximately 200 mm is normally sufficient.

With reference to TE 88551, TE 88553, TE 88798 and TE 90158 it was confirmed that all the tested joints complied with AS 4072.1 – 2005 Clause 4.7.1 (b), (c) and (d). However TE 88553, TE 88798 and TE 90158 did not comply with AS 4072.1 – 2005 Clause 4.7.1 (a).

The minimum 1000mm length of control joint as specified in AS 1530.4 -2014 Section 10.4.2 and AS 4072.1-2005 Clause 4.7.1 (a) allows the material shrinkage over the length of the joint to be examined when exposed to fire.

With reference to TE 88553, TE 88798 and TE 90158 the control joint systems reported in were only 900-mm long. No shrinkage of the foam material was observed in any of the joints for the duration of their test period.

The mode of integrity failure is due to the charring of the foam from the fireside until it degrades through the foam to form gaps on the unexposed face allowing cotton pad failure or flaming to occur.

Based on the modes of degradation described above it is considered that the tested seals 900mm long will perform similarly if 100mm longer. Further confidence in the performance of the seals is offered by the integrity margin most of the seals have to the integrity performance proposed in Table B1 below.

Based on the above, and in absence of any foreseeable detrimental effects, it is the expected that the control joint systems as reported in TE 88551, TE 88553, TE 88798 and TE 90158 would be capable of achieving the following integrity and insulation performances if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005.

Table B1: Expected performance of the tested joints

Test No.	Joint No.	Integrity (minutes)	Insulation (minutes)
TE 88551	4	246	246
	5	244	244
	6	206	206
TE88553	5	240	240
	6	240	257
	7	240	240
	8	240	300
TE 88798	1	60	78
	2	90	103
	3	180	181
TE 90158	7	240	120
	8	120	120
	9	180	120
	10	60	60

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