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Fire resistance performance of an LAF Foamed Vermitex AF fire protection system for floor ceilings tested in accordance with AS 1530.4-2014

Assessment Report

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Important disclaimer

Contents

1 Introduction

This is a report of the fire resistance performance of an LAF Foamed Vermitex AF fire protection system for floor ceilings tested in accordance with AS 1530.4-2014.

This report is prepared for the purpose of meeting the evidence of suitability requirements of Specification A2.3 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 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.

2 Supporting Data

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

Report Reference	Test Standard	Outline of Test Specimen
FSH 0262	AS 1530.4-1990	3.6m x 4.4m Lath and plaster ceiling system fixed to a timber floor with Foamed Vermitex AF material pumped into the floor/ceiling space to an average thickness of 70-mm.
FSH 0269	AS 1530.4-1990	1m x 1m pressed metal ceiling system fixed to a timber floor with Foamed Vermitex AF material pumped into the floor/ceiling space to an average thickness of 70-mm.
FSH 0270	AS 1530.4-1990	1m x 1m fibrous plaster ceiling system fixed to a timber floor with Foamed Vermitex AF material pumped into the floor/ceiling space to an average thickness of 70-mm.
FSH 0271	AS 1530.4-1990	1m x 1m Radiata pine, tongue and groove board ceiling system fixed to a timber floor with Foamed Vermitex AF material pumped into the floor/ceiling space to an average thickness of 70-mm.
FS 4633	AS 1530.4-2014	1m x 1m timber lath with render pressed into gaps in lath, simulating part of a lath and plaster ceiling. The ceiling was fixed to a timber floor with Foamed Vermitex AF material pumped into the floor/ceiling space to an average thickness of 60-mm.

The test reported in FSH 0262, FSH 0269, FSH 0270, FSH 0271 and FS 4633 were undertaken by CSIRO and sponsored by L & A Fazzini Manufacturing Pty Ltd.

3 Proposed Variations

The proposed construction of the floor system with penetrations shall be as tested in FSH 0262 and subject to the following variations:

- For joists of minimum size 250mm x 50mm, the thickness of protection, above the ceiling, to the side of the joist and extension up the joist shall vary for 60, 90 120 minute applications;
- For joists of minimum size 300mm x 65mm, the thickness of protection, above the ceiling, to the side of the joist and extension up the joist shall vary for 180 minute applications;
- The timber shall vary in density from the density tested to one of the following options a) a minimum of 550kg/m^3 (as tested tested) and b) a minimum of 900kg/m^3.
  - The ceiling shall optionally include, plaster and lath ceilings, pressed metal, fibrous plaster, and timber lining.

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, Section 10 Service Penetrations and Control Joints

5 Conclusion

On the basis of the analysis presented in this report, it is the opinion of this Testing Authority that the tested prototypes described in Section 2 when varied as described in Section 3 will achieve the performance below when submitted to a test in accordance with the test methods referenced in Section 4. It is required the systems described below be fitted to supporting wall and floor construction that has been tested or assessed to achieve the required FRL.

Table 1 - Protection Details

Minimum Joist Size	Reference	Design Thick. T1	Design Thick. T2	Design Thick. T3	d_c (mm) 550kg/m^3 timber	d_c (mm) 900kg/m^3 timber	FRL
250mm x 50mm	Figure 2, 3 and 4	70mm	70mm	-	10	10	60/60/60
250mm x 50mm	Figure 1 Figure 3 Figure 4	30mm	70mm	25mm	25	23	60/60/60
		35mm	110mm	30mm	66	56	90/90/90
		45mm	150mm	40mm	120	105	120/120/120
300mm x 65mm		60mm	180mm	50mm	137	109	180/180/180

Note - Char Depth d_c= Effective depth of Charring in accordance with AS 1720.4-2006 Clause 2.5 and includes the 7.5mm layer.

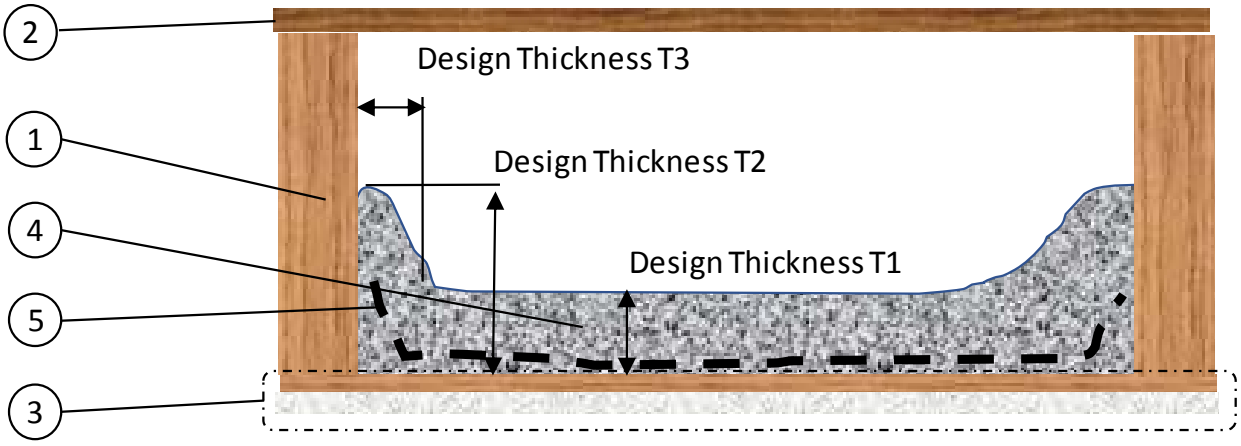


Figure 1 – General Arrangement of Spray Protection for Mesh Systems

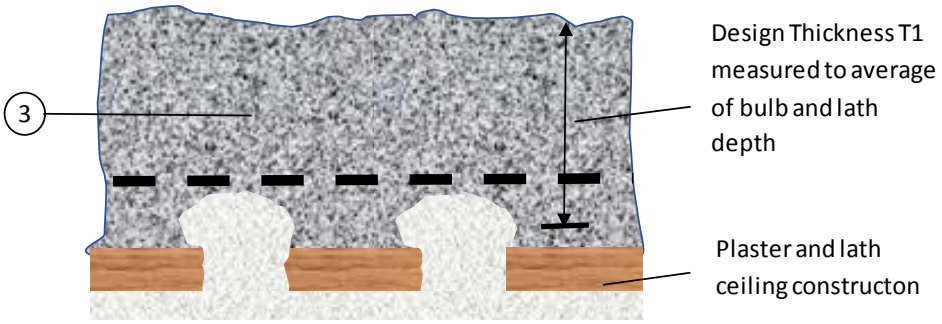


Figure 2 – Measurement of Design Thickness for Plaster and Lath Ceilings

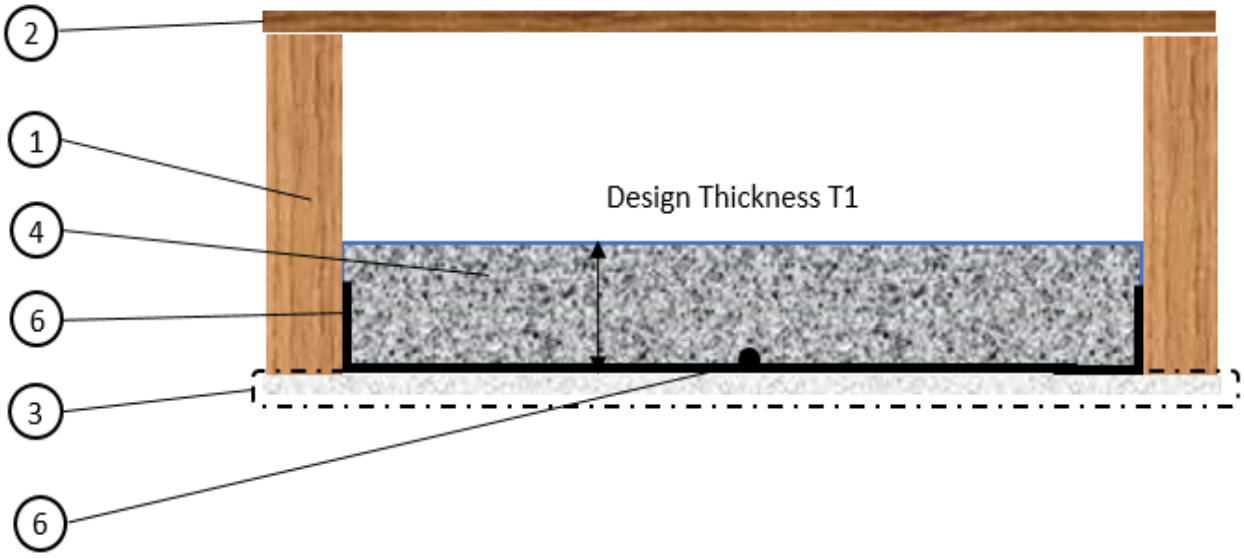


Figure 3 – General Arrangement of Spray Protection for Clip Reinforced Systems

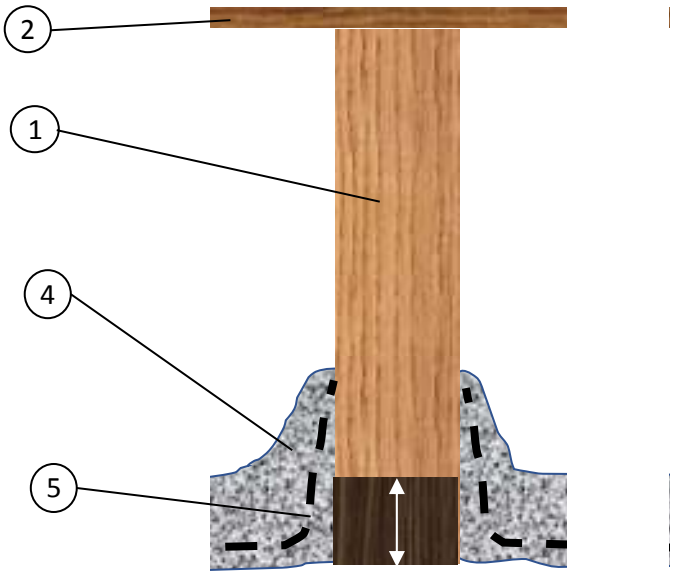


Figure 4 – Measurement of Char Depth for Joist

TABLE 2 – Ceiling Construction

ID	Description	
1	**Name**	**Floor Framing**
	Material	Structural Timber
	Size	Minimum joist size and density shall be as shown in Table 1 *and* The design cross section shall be based on the effective depth of charring as shown in Table 1 and Figure 4. *and* The joist shall be designed for the appropriate loading and span in accordance with AS 1720.1-2010 and AS 1720.4-2006.
	Installation	Systems shown in Figures 1-4 shall be installed between joists spaced up to 450mm centres.
2	**Name**	**Flooring**
	Material	Timber.
	Size	T&G flooring of minimum thickness 19mm.
	Installation	Nail or screw fixed to floor joist (item 1).
3	**Name**	**Ceiling Construction**
	Specification	***Plaster and Lath Ceiling*** Lath – Timber, 11mm thick nailed to joist. Plaster – Optional – The plaster is not required as part of the protection system. The plaster and lath ceiling may be sprayed with "Westox Ceiling Reinstatement System" prior to placing of the protection system. ***Pressed Metal Ceiling, Fibrous plaster or Timber Lining boards*** These elements provide a formwork for the protection system and may be direct fixed to joists or fixed to timber battens.

4	**Name**	**LAF Foamed Vermitex AF**
	Material	Proprietary gypsum based Fire Spray nominally 200-350kg/m^3 cured and air dried (nominally 240-400kg/m^3 when wet mixed and placed).
	Size	Installed to thicknesses T1, T2 and T3 as shown in table 1 and Figures 1-4.
	Installation	The materials are placed by hand or pumped into position. It is permissible to apply an additional 10mm of dry material over the ceiling to absorb excess moisture from the mix. This thickness of material is not to be considered in the measurements of T1, T2 and T3 as shown in Table 1 and Figures 1-4.
5	**Name**	**Mesh Reinforcement**
	Material	Galvanised Mild Steel.
	Size	50mm x 50mm x 2.0mm.
	Installation	Cut to form a "U" shape and fixed to the side of the joist at the top of the U with stapes at 150mm centres. Staples were 38mm long, 11mm head and 1.6m diameter.
6	**Name**	**Strap and Rod Support**
	Material	Galvanised Mild Steel.
	Size	50mm wide x 0.8mm (nom) steel strap with 100mm upturn spaced at 1400mm maximum centres. 5mm Steel rod located centrally.
	Installation	The straps shall be nail or screw fixed to the joist a minimum of 50-70mm from the bottom of joist with two fixings each end.

6 Direct Field of Application of Results

The results of this report are applicable to floors exposed to fire from the underside as required by AS 1530.4-2014 clause 4.7.

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 2022. 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 industry. The referenced 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 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. Test Report FSH 0262

On 29 September 1993, this Division conducted a fire-resistance test on a lath and plaster ceiling system fixed to a timber floor. Two floor boards were removed every 1200-mm to 1400-mm and the Foamed Vermitex AF material pumped into the floor/ceiling space to an average thickness of 70-mm above the lath and plaster ceiling bulbs. The density of the Foamed Vermitex AF at the time of the testing was 400 kg/m^3.

The tested system achieved a fire-resistance level (FRL) of 60/60/30 due to flaming on the top floor at 58 minutes, as a result of a localised collapse of a section of ceiling at approximately 47 minutes.

Temperatures in the unaffected areas of the floor/ceiling system were well below the failure criterion of AS 1530.4, with the unexposed face approximately 60°C at 60 minutes. When tested the time for the interface temperature of joists and the ceiling lining to reach 300°C was 8 minutes.

A.2. Test Report FSP 0269

On 17 November 1993, this Division conducted a fire-resistance test on a section of floor/ceiling measuring 1160-mm x 1160-mm with a 1000-mm x 1000-mm exposure to the furnace. The size of the specimen was below the minimum size of 3000-mm x 3000-mm required by the standard. The specimen was not loaded during the test.

The flooring consisted of 19-mm thick tongue and groove cypress floorboards over 250-mm deep x 50-mm wide soft wood floor joists set at 450-mm centres with herringbone strutting. The ceiling was a sheet of original circa 1920's 24 gauge galvanised stamped sheet metal.

Floor boards were removed by cutting the tongue with a circular saw as they would be on site, and steel support cleats were nailed or stapled into positions in contact with the metal ceiling. Foamed Vermitex AF made up to the manufacturer's recommendations was pumped into the cavity to a nominal depth of 70-mm.

When tested the time for the interface temperature of joists and the ceiling lining to reach 300°C was 120 minutes.

A.3. Test Report FSP 0270

On 18 November 1993, this Division conducted a fire-resistance test on a section of floor/ceiling measuring 1160-mm x 1160-mm with a 1000-mm x 1000-mm exposure to the furnace. The size of the specimen was below the minimum size of 3000-mm x 3000-mm required by the standard. The specimen was not loaded during the test.

The flooring consisted of 19-mm thick tongue and groove cypress floorboards over 250-mm deep x 50-mm wide soft wood floor joists set at 450-mm centres with herringbone strutting. The ceiling was a sheet of fibrous plaster nominally 13-mm thick.

Floor boards were removed by cutting the tongue with a circular saw as they would be on site, and steel support cleats were nailed or stapled into positions in contact with the upper level of the ceiling battens. Foamed Vermitex AF made up to the manufacturer's recommendations was pumped into the cavity to a nominal depth of 70-mm.

When tested the time for the interface temperature of joists and the ceiling lining to reach 300°C was 60 minutes.

A.4. Test Report FSP 0271

On 19 November 1993, this Division conducted a fire-resistance test on a section of floor/ceiling measuring 1160-mm x 1160-mm with a 1000-mm x 1000-mm exposure to the furnace. The size of the specimen was below the minimum size of 3000-mm x 3000-mm required by the standard. The specimen was not loaded during the test.

The flooring consisted of 19-mm thick cypress floorboards over 250-mm deep x 50-mm wide soft wood floor joists set at 450-mm centres with herringbone strutting.

The ceiling was constructed of Radiata pine, tongue and groove boards 100-mm wide x 10-mm thick.

Floor boards were removed by cutting the tongue with a circular saw as they would be on site, and steel support cleats were nailed or stapled into positions in contact with the ceiling. Foamed Vermitex AF made up to the manufacturer's recommendations was pumped into the cavity to a nominal depth of 70-mm.

A.5. Applicability of referenced test to AS 1530.4-1990 to AS 1530.4-2014

General

The referenced test reports FSH 0262, FSH 0269, FSH 0270, and FSH 0271 describe tests conducted in accordance with AS 1530.4-1990, which differs from the current Standard AS 1530.4-2014.

The potential effect of these differences on specimen performance is discussed below.

Furnace Temperature Measurement

The specifications for furnace thermocouples in AS 1530.4-2014 are similar to that specified in AS 1530.4-1990.

Furnace Temperature Regime

AS 1530.4-2014 specifies furnace temperature to follow the following trend:

$$T_{AS1530.4\text{-}2014} = 345_{log}10\,(8t+1) + 20$$

AS 1530.4-1990 specifies furnace temperature to follow the following trend:

$$T_{AS1530.4\text{-}1990} = 345_{log}10\,(8t+1) + T0;\ 10°C<T0<40°C$$

The parameters outlining the accuracy of control of the furnace temperature in AS 1530.4-2014 and AS 1530.4-1990 are not appreciably different.

Furnace Pressure Regime

For floors, AS 1530.4-1990 specifies that the furnace shall achieve a pressure of nominally 20Pa established 100mm below the soffit of the floor.

For walls, AS 1530.4-2014 specifies that the pressure shall be 20Pa 100mm below the soffit of the floor.

The parameters outlining the accuracy of control of the furnace temperature in AS 1530.4-2014 and AS 1530.4-1990 are not appreciably different.

Specimen

AS 1530.4-1990 specifies that floors be tested with two edges unrestrained and simply supported and spanning at least 3m and have area at least 3m x 3m.

AS 1530.4-2014 specifies that floors be tested with two edges unrestrained and simply supported and spanning at least 4m and have area at least 4m x 3m.

The full-scale test referenced FSH 0262 spanned 3.7m and was simply supported. This variation should be considered with regards to any assessment of structural adequacy.

Specimen Temperature Measurement

AS 1530.4-2014 specifies specimen thermocouples as Type K, having a wire diameter not exceeding 0.5 mm. Each thermocouple shall have the tail of its measuring junction soldered to the centre of a 12mm diameter × 0.2mm thick copper disc. The disc shall be covered by 30 ± 0.5mm × 30 ± 0.5mm × 2.0 ± 0.5mm thick inorganic insulating pad having a density of 900 ± 100kg/m^3.

AS 1530.4-1990 specifies specimen thermocouples as Type K having a wire diameter not exceeding 0.5 mm. Each thermocouple shall have the tail of its measuring junction soldered to the centre of a 12mm diameter × 0.2mm thick copper disc. The disc shall be covered by an oven-dry pad, not less than 30mm square, made from a material having a $\sqrt{k\rho C}$ value not greater than 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.

It is considered this difference in the specification is not significant to the determination of the insulation performance.

Temperature Measurement locations

The required locations of thermocouples for the determination of maximum and average temperature rise are not significantly different for AS 1530.4-1990 and AS 1530.4-2014.

The required thermocouples for the determination of resistance to the incipient spread of fire in AS 1530.4-1990 are different to AS 1530.4-2014. AS 1530.4-1990 requires thermocouples at five locations, one at approximately the centre of the area and one at approximately the centre of each quarter-section, at which to position thermocouples on each of-

- the unexposed face of any ceiling material not complying with Item (c) below;
- a superstructure (including the soffits of timber members in contact with the ceiling) not complying with Item (c) below, if any; and
- the underside of sarking, insulation, or any material not complying with Item (c), below, if any.

The required thermocouples for the determination of resistance to the incipient spread of fire are different AS 1530.4-2014 requires thermocouples at five locations, one at approximately the centre of the area and one at approximately the centre of each quarter-section on the non-fire side of the ceiling lining only.

The test was undertaken in accordance with AS 1530.4-1990, therefore, include sufficient thermocouples for the determination of incipient spread in accordance with AS 1530.4-2014.

Insulation Performance Criteria

For floors, AS 1530.4-2014 deems insulation failure to have occurred upon a measured temperature rise of 180K by any of the specimen thermocouples. The insulation failure criterion in AS 1530.4-1990 is the same.

Integrity Performance Criteria

AS 1530.4-2014 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.

AS 1530.4-1990 deems integrity failure to occur upon collapse, the development of cracks, fissures or, other openings through which flames or hot gases can pass. AS 1530.4-1990 differs in that it does not require the application of a cotton pad.

It is noted that for the reference test FSH 0262, FSH 0269, FSH 0270 and FSH 0271 gaps did not form that would warrant the application of a cotton pad prior to insulation failure and therefore the integrity performance from tests undertaken to AS 1530.4-1990 may be used to determine integrity performance AS 1530.4-2014 up to the insulation performance of the specimen.

Application of Referenced Test Data to AS 1530.4-2014

The minor variations in furnace heating regimes and specimen thermocouple specification integrity criteria are considered unlikely to significantly affect the behaviour of the specimens relevant to this assessment.

Based on the above discussion, it is considered that the behaviour of the specimens relevant to this assessment in tests FSH 0262, FSH 0269, FSH 0270 and FSH 0271 can be used to assess the insulation, integrity and structural adequacy performance if similar specimens were tested in accordance with AS 1530.4-2014 up to insulation failure.

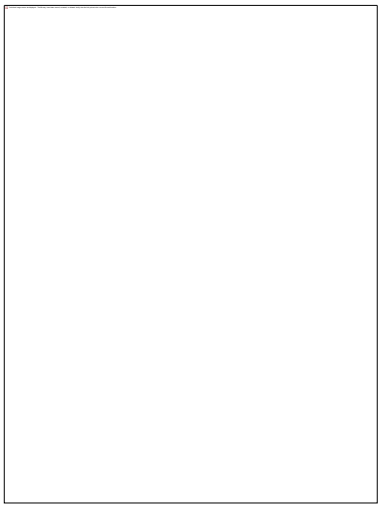
A.6. Test Report FS4633/4065

On 29th of November 2016, this Division conducted a fire-resistance test on a section of floor/ceiling measuring 1160-mm x 1160-mm with a 1000-mm x 1000-mm exposure to the furnace. The size of the specimen was below the minimum size of 3000-mm x 3000-mm required by the standard. The specimen was not loaded during the test.

The flooring consisted of 19-mm thick cypress floorboards over 300-mm deep x 65mm and 75mm wide Douglas Fir floor joists set at 450-mm centres with 50mm x 50mm herringbone strutting.

The ceiling was constructed of timber lath with plaster applied between lath (not below) and the bulb of above was 20mm. The lath was 31mm wide, 10mm thick sawn finish and installed with a 10mm gap.

Mesh reinforcement was fixed to the side of the joist. The mesh comprised 150 x 400 x 150mm and 150 x 200 x 150. The mesh was 10-20mm clear of plaster bulbs.



Prior to Vermitex AF install **After Vermitex AF Installation**

LAF Foamed Vermitex AF made up to the manufacturer's recommendations was pumped into the cavity to a nominal depth of 60-mm.

When tested the following temperature data was recorded.

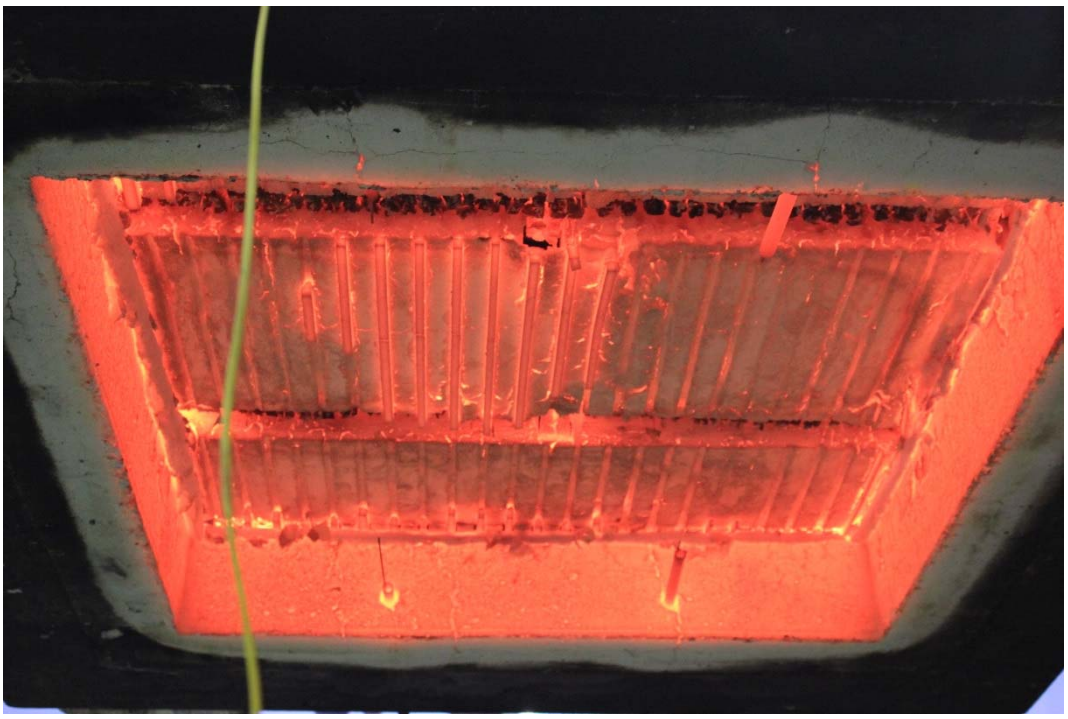
Location	Joist	Time to reach 300°C
Interface	A	10
Interface	B	12
10mm	A	86
10mm	B	81
20mm	A	93
20mm	B	
30mm	A	125
30mm	B	
40mm	A	119
40mm	B	107
50mm	A	160
50mm	B	136

The time to exceed 180K rise on the cavity side of the Vermitex AF protection was 171 minutes

Time of collapse of the protection – No failure at 185 minutes

Time for insulation failure on non-fire side - No failure at 185 minutes

Time for integrity failure - No failure at 185 minutes



Fire side of specimen after test

Appendix B Analysis of Variations

B 1 Variation to Protection Thickness

The proposed construction of the floor system with penetrations shall be as tested in FSH 0262 and subject to the following variations:

- For joists of minimum size 250mm x 50mm, the thickness of protection, above the ceiling, to the side of the joist and extension up the joist shall vary for 60, 90 120 minute applications.
- For joists of minimum size 300mm x 65mm, the thickness of protection, above the ceiling, to the side of the joist and extension up the joist shall vary for 180 minute applications
- The timber shall vary in density from the density tested to one of the following options a) a minimum of 550kg/m^3 (as tested tested) and b) a minimum of 900kg/m^3
- The ceiling shall optionally include, plaster and lath ceilings, pressed metal, fibrous plaster, and timber lining.

Structural Adequacy – Char Depths

With reference to FSH 0262 which comprised a full scale loaded tested of a lath and plaster ceiling system fixed to a timber floor with 70-mm of foamed Vermitex AF above the lath and plaster ceiling bulbs.

The tested system achieved a fire-resistance level (FRL) of 60/60/30 due to flaming on the top floor at 58 minutes, as a result of a localised collapse of a section of ceiling at approximately 47 minutes. Temperatures in the unaffected areas of the floor/ceiling system were well below the failure criterion of AS 1530.4, with the unexposed face approximately 60°C at 60 minutes. The time to reaching 300°C on the underside of the joist was 8 minutes.

The significance of this result is that shows the system maintained integrity and insulation for a period a little more than the integrity of the foamed Vermitex AF protection and the structural adequacy of the joist

With reference to the results from the construction tested FS4633/4065, being a plaster and lath ceiling below Foamed Vermitex AF protected joists 300mm x 65mm.

Table B1 – Time to reach 300°C with Plaster and Lath Ceiling

Location	Joist	Time to reach 300°C (mins)
Interface	A	10
Interface	B	12
10mm	A	86
10mm	B	81
20mm	A	93
20mm	B	-
30mm	A	125
30mm	B	-
40mm	A	119
40mm	B	107
50mm	A	160
50mm	B	136

The significance of this result is the time to reach 300°C on the underside of the joist in this test was 10 minutes and similar to that in FSH 0262, 8 minutes.

AS 1720.4-2006 has a nominal char rate based on density which is shown in Eq 2.1. When the notional char rate is calculated for 550kg/m^3 timber and 900kg/m^3 timber the ratio of these values is 0.75. The significance of this results is that it is considered reasonable to predict the charring rate of 900kg/m^3 timber based on the rate in test FS4633/4065 (550kg/m^3 timber), multiplied by 0.75.

The table below shows the calculated char for the proposed designs for 550kg/m^3 and 900kg/m^3 timber joists with plaster and lath ceiling

Table B2 – Char Rate with Plaster and Lath Ceiling

Char depth (mm)	Time (mins)	Char Rate mm/min 550 kg/m^3 as tested	Char Rate mm/min 900kg/m^3 (75% of the 550kg/m^3 value
0	0	-	-
0	10	-	-
10	81	0.14	0.11
20	93	0.83	0.63
30	100	1.43	1.07
40	107	1.43	1.07
50	136	1.43	1.07

The predicted char is based on the char at a particular time, e.g. 30, 60, 90 minutes plus the char at a rate for the time period from Table B2 plus 7.5mm margin as shown in AS 1720.4-2006.

The above calculation is the effective depth of charring in accordance with AS 1720.4-2006 Clause 2.5 and includes the 7.5mm layer and when undertaken for the values in Table B2 the results are shown in Table B3.

Table B3 – Predicted Char Including 7.5mm Margin with Plaster and Lath Ceiling

Time (mins)	Design Section Loss (mm) for min 550 kg/m^3 Timber including 7.5mm margin	Design Section loss (mm) for min 900 kg/m^3 Timber including 7.5mm margin
60	10	10
90	25	23
120	66	56
180	120	105

The significance of the above calculations that it indicates the maximum char depth expected at each 60, 90, 120 and 180 minutes.

Structural Adequacy – Protection Depths Figure 1, 2 and 4

With reference to the ability of the foamed Vermitex AF to stay in position between the joists, the result in FS4633/4065 confirmed that 60mm of protection has sufficient thickness to maintain insulation on the back of the protection.

A critical part of the observed performance was due to the extension of the protection up the side of the joists, termed design thickness T2 and shown in Figures 1, 2 and 4.

The effectiveness of the additional protection up the side of the joist is reduced by the herringbone strutting that interferes with the protection and allows gaps to form, accelerating char after 30mm char.

Based the design thickness, T2 is a minimum of 70mm to provide a significant margin over the depth of char and the height of protection. For 90, 120 and 180 minute applications the value of T2 is increased in a pro-rata manner from 70mm for 60 minute applications to 180mm for 180 minute applications. On this basis, there is always 60mm of protection on the side of the joist above the char line as for the construction tested in FS4633/4065.

The value of design thickness T3 is 50mm for 180 minute applications and reduces to 25mm for 60 minute applications where the char is relatively small.

It is considered due to the mesh reinforcement the Vermitex AF at a thickness of 25mm will remain in place, and based on the large of insulation for the tested 60mm thickness at 180 minutes exposure it is expected the insulation performance on the back of the protection layer.

With reference to the proposed ceiling lining option in Figure 1 the ceiling may be plaster and lath as tested in FS4633/4065 and FSH 0262, or pressed metal and timber linings as tested FSP 0269 and FSP 0271 respectively.

Structural Adequacy – Protection Depths Figure 3

With reference to the ability of the foamed Vermitex AF to stay in position between the joists at a depth of 70mm with only angle brackets tested in FSH0262, the result confirmed that 70mm of protection has sufficient thickness to maintain insulation on the back of the protection, though prone to integrity failure at 47 minutes.

The proposed variation is to include a continuous strap between the joists and have a rod centrally positioned to restrain and support the protection material in a similar manner to the mesh system tested in FS4633/4065.

Based on the significant increase in the integrity performance of the protection material observed in FS4633/4065 it is considered safe and reasonable that the introduction of the steel strap and rod system described in Figure 3 will provide sufficient support to the protection to increase the integrity performance from 47 minutes to 60 minutes with some margin.

The results of FS4633/4065 confirm that while the protection thickness remains 70mm, the char and potential burn through around the joist and herringbone struts will be minimised up to 60 minutes.

Based on the above discussion it is confirmed the proposed construction will achieve a structural adequacy of 60 minute for Figure 3 and 60, 90, 120 and 180 minutes for Figure 1 and 2 based on designs in Table1.

Integrity and Insulation Performance

Based on reference to FS4633/4065 and FSH0262 the fire resistance behaviour was general characterised as maintaining structural adequacy, integrity and insulation until:

a) the fire bypassed the protection between the joist and frame and spread to the cavity, or
b) The protection fell away and the fire spread to the cavity, then
c) Integrity and insulation failure occurred very soon after these events.

With reference to the proposed designs it is confirmed that the temperature on the back on the protection material is expected to remain below 200°C for the required FRL period.

Based on the above it is considered that by design the integrity and insulation performance can be conservatively estimated as the time the protection material falls away or the time the char is sufficient to get past the protection on the side of the joist.

Based on the discussion of structural adequacy above it is confirmed that the proposed designs provide for a distance of protection of at least 70mm above the depth of any char to the underside and this was sufficient to prevent fire spreading to the cavity in the system tested in FS4633/4065.

Based on the above it is considered that the integrity of the floor cavity protection provided by the proposed LAF Foamed Vermitex AF protection system will maintain the integrity and insulation of the proposed floor ceiling systems in accordance with AS 1530.4-2014 for 60, 90, 120 and 180 minutes based on design.

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