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Fire performance of LAF VERMITEX AF and VERMITEX 7 roof/ceiling system in accordance with AS 1530.4-2014

Assessment Report

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Contents

1 Introduction

This report is an assessment of fire resistance of LAF VERMITEX AF and VERMITEX 7 roof/ceiling system in accordance with AS 1530.4-2014.

This report is prepared for the purpose of meeting the evidence of suitability requirements of NCC Specification A2.3 or Schedule 5 for FRL.

This report reviews and confirms the extent to which the reference 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.

2 Supporting Data

This assessment report refers to various test reports to support the analysis and conclusions of this report.

Report Reference	Test Standard	Outline of Test Specimen
SI 0020	A 30-1958	Roof\Ceiling structure lined with plasterboard and including VERMITX 2
SI 0081	A 30-1958	Floor Ceiling structure lined with plasterboard and including VERMITX 4
SI 1589	AS 1530.4-1975	A full-scale fire-resistance test on roof/ceiling system. The system comprised a ceiling system of expanded metal lath sprayed with 60 mm of Vermitex 7 suspended under a metal deck roof.
FSH 0092	AS 1530.4-1990	The specimen comprised six ducts fabricated from galvanised sheet steel 1.0 mm thick and protected with "Vermitex AF" sprayed fire protection material reinforced with galvanised wire mesh. Each duct was 1200 mm x 600 mm in cross-section
FSH 0230	AS 1530.4-1990	The specimen comprised two steel ducts and two PVC ducts protected with Vermitex "AF" sprayed insulation reinforced with square steel mesh.
FSH 0236	AS 1530.4-1990	The specimen comprised three steel ducts fabricated from 1.0 mm thick galvanised-steel sheet metal and protected with Vermitex "AF" sprayed insulation reinforced with "Spraylok" expanded steel mesh.

3 Proposed Variations

The proposed construction shall be as tested in SI 1589 subject to the variations below:

- The framing construction shall vary to roof ceiling systems based on reference to SI 0020.
- The floor or roof framing shall vary to timber framed systems designed for the appropriate loading and span in accordance with AS 1720.1-2010 or AS1684-2010.
- The spray thickness and mesh requirements will vary and include 1 layer of mesh for 120-minute applications and 2 layers for 180 and 240-minute applications
- The spray may be varied to Vermitex 7 or Vermitex AF based on reference to FSH 0230 and FSH 0236

The proposed construction is summarised below

Table 1 – Construction of Floor ceiling and Roof ceiling systems

item	Description	Specifications
Upper layer	Roofing or flooring	Roof sheeting, tiles or timber flooring
Structure	Roof or floor framing	For timber or steel framing it shall be designed in accordance with AS 1720.1, AS 4100 or AS 4600 as appropriate for the span and applied loads
Ceiling lining and spray specification	Vermitex AF	As tested in FSH 0092, FSH 0230 and FSH 0236
	Vermitex 7	As tested in SI 1589
	Expanded metal lath	FL-13 manufactured by Lysaught big industries.
	Angle Hanger Bracket	Rondo #247
	Bracket screw type	Hex head screw 10g x 65 Type 17 point
	Fitting instruction – Roof ceiling	Steel purlins must not exceed 1200-mm centres or provisions must be made for the primary channel to reduce the span of the secondary furring channel. Fix Rondo furring channel at 300 mm centres by means of Rondo Part No. 332 or similar. Screw fix Lysaght mesh with No. 8 x 12-mm Hex head screws at centres not exceeding 200-mm. Fix Rondo Part No. 247 at required centres with hex head screws type 17 x 10g x 65 mm. Screws must be securely fixed to purlins ie no load must be suspended from the furring channels. The sheets must have a minimum of 38-mm side lap 50-mm end lap.
	Fitting instruction – over fibrous plaster ceiling	Self-furring expanded metal lath attached to timber joist by 75 mm galvanised clouts (hardwood) or 88 mm galvanised clouts (softwood) under an existing fibrous plaster ceiling, with Vermitex 7 or Vermitex AF sprayed to various depths.

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 9 as appropriate for ducts.

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 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 of section 7, validity of section 8 and limitation of section 9.

Construction protected	The thickness of Vermitex AF or Vermitex 7	Layers of Mesh	FRL
Refer Table 1	25	1	60/60/60
	25	1	90/90/90
	32	1	120/120/120
	50	2	180/180/180
	60	2	240/240/240

Construction protected	Time (minutes)	Thickness (mm) of Vermitex AF or Vermitex 7 required to prevent the average temperature on the top surface of the ceiling from rising 180K
Refer Table 1	60	25
	90	30
	120	40
	180	63
	240	86

6 Direct Field of Application of Results

The results of this assessment apply to floor ceilings exposed to the effects of fire from below in accordance with AS 1530.4-2014 clause 4.7.

7 Requirements

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 28th February 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 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. CSIRO Sponsored Investigation report numbered SI 0020

The test was conducted on 18th January 1966 to determine the fire resistance of a traditional softwood-framed terra-cotta tiled roof protected with a ceiling of corrugated steel sheeting, fixed to the underside of the ceiling joists, and sprayed with a minimum thickness of 1 inch of 'Vermitex' 2 vermiculite plaster.

The specimen was tested in accordance with A30-1958.

The section of roof as tested was erected in a specimen containing frame and represented a hipped corner with a ceiling area of approximately 15 ft x 12 ft. The roof was a typical traditional frame of Douglas Fir with an approximate 26 deg pitch. The timber members used in the framing were 4 inch x 2 inch joists at 18 inch centres on 4 x 3 inch wall plates, 4 inch x 2 inch rafters at 18 inch centres, 6 x 1 inch hip rafters, 4 x 3 inch struts and purlins, 3 x 2 inch collar ties and 8 x 2 inch hangers. The roof was sarked with a bituminous-type double sided aluminium foil, and clad with Marseilles pattern terra-cotta tiles mounted on 1 ½ inch x 1-inch battens.

The ceiling system was fixed to the underside of the joists of the roof structure as to comply with the specification detailed in Section 6 of this report, with the exception that 2-inch layer of mineral wool insulation referred to in paragraph 6.15 was not incorporated in the ceiling system. The effect of the weight of the mineral wool insulation on the ceiling system was reproduced by the placing of an equivalent weight of gravel on top of the ceiling.

Materials used in Ceiling Construction

Plasterboard sheets. The plasterboard sheets used throughout the ceiling system were standard grade ½ inch plasterboard sheets supplied by a local manufacturer.

Sprayed Cementitious Material. The cementitious material spayed to the underside of the ceiling was 'Vermitex' 2 vermiculite plaster manufactured by L & A Fazzini Pty Limited.

Corrugated Steel sheets. The corrugated steel sheets used in the ceiling system were corrugated galvanised steel sheets, nominally 2 foot in width and the steel was 26-g. The corrugations were at a pitch of 1 inch and had a height of ½ inch.

Results

No appreciable movement of the roof structure was apparent at any time during the test.

No flaming of any timber members was observed during the qualifying period of the test.

The specimen was deemed to have failed 1 hour and 5 minutes after commencement of the test when ignition of the timber joists occurred.

By its performance under test, the system qualified for a 1 ½ hour fire-resistance rating in term of Australian Standard No. A30-1958, Section 4, Fire-resistance Test of Structures.

A.2. CSIRO Sponsored Investigation report numbered SI 0081

Test conducted on 18th October 1966 on hardwood floor supported by steel beam encased in precast cementitious sections and protected with a ceiling system of corrugated steel sheeting fixed to the underside of the floor joists and sprayed with 1 inch of 'Vermitex 4' vermiculite plaster. The structure incorporated a timber beam. The specimen was tested in accordance with A30-1958.

The floor structure represented a 15 ft x 12 ft section of a typical hardwood floor structure. The 10 x 2-inch floor joists were spaced at 18-inch centres and were cross-braced with a 2-inch x 2-inch herring-bone strutting at 6 ft centres. The joists simulated the spanning of a room 15 ft width and were supported by a 10-inch x 4 ½ inch x 25 lb RSJ. The axis of the beam was located 11 ft 10 inch from one wall support and 3 foot 3 ½ inch from the other and spanned a clear opening of 12 ft 1 ½ inch. The floor was nominal 4-inch x 1-inch tongue and groove hardwood boarding (actual thickness approx. ¾ inch).

A 10-inch x 6-inch hardwood beam was located approximately 9 ft from the steel joist and was suspended from the two outside floor joists with a gap of approximately 1 inch between the bottom of the joists and the top of the beam. The timber beam was not supported at its end and did not support the floor system.

The ceiling was fixed to the underside of the floor joists, the steel joist and the timber beam so as to comply with the specification detailed in report numbered SI 0081.

The hardwood floor structure, excluding the timber beam, qualified for a 2-hour fire-rating in terms of A30-1958.

The timber beam suspended beneath the floor structure, qualified for a 1 ½ hour fire-rating in terms of A30-1958

A.3. CSIRO Sponsored Investigation report numbered SI 1589

On 14 July 1982, this Division conducted a full scale fire-resistance test in accordance with AS1530.4-1975, on a roof ceiling system comprising a conventional metal deck roof with a suspended ceiling system.

The conventional metal deck roof comprised steel purlins and bracing with metal roof sheeting. The ceiling system was suspended below the roof system on hanger rods and comprised a 60-mm thick ceiling membrane.

The roof-ceiling had approximate plan dimensions of 4600-mm x 3700-mm. The minimum clearance between the underside of the steel purlins and the top of the ceiling membrane was 76-mm along one side and 246-mm along the opposite side.

The ceiling membrane comprised a layer of steel lathe sprayed with a 30-mm thick vermiculite based spray product (Vermitex 7). A second 30-mm thick layer of Vermitex 7 was then applied, reinforced with a layer of galvanised reinforcing fabric fixed to the first layer of spray. The specimen also incorporated various electrical cable penetrations.

Various alternative methods of splicing the separate lengths of steel channel were incorporated into the design of the ceiling system. Alternative details for the junction between the supporting grid of steel channels and the surrounding walls were incorporated into the structure.

The specimen maintained structural adequacy, integrity and insulation for the 242-minute duration of the test. At 240 minutes the average and maximum temperatures recorded on the steel purlins measured 137 deg C and 154 and deg C respectively.

A.4. CSIRO Sponsored Investigation report numbered FSH 0092

On 23 August 1990, this Division conducted a fire-resistance test on a specimen consisting of two vertical and four horizontal ducts protected with Vermitex ‘AF’ sprayed insulation. Each duct was fabricated from 1.0-mm thick galvanised sheet steel and was 1200-mm x 600-mm in cross section. Pins 2.7 diameter and 50-mm long were welded in a grid at 300 mm centres. Speed clips were used to secure the 25-mm x 25-mm x 1-mm thick wire mesh to the pins.

On ducts H3, H2 and V2 the Vermitex 'AF' was sprayed to two third of the final depth before the mesh was fixed. On ducts H4, H1 and V1 the mesh was fixed at two third of the final sprayed thickness.

The duct V1 was 2300-mm long and was fixed vertically into a 650-mm x 1250-mm opening in the 200-mm thick concrete slab with 100-mm of ductwork projecting into the furnace and 2000-mm outside the furnace. The duct was protected on the outside with 97-mm thick Vermitex 'AF' and was exposed to the fire from the inside. The duct failed with respect to insulation at 178 minutes but did not fail with respect to integrity or structural adequacy at the test termination time of 241 minutes.

The duct V2 was 2300-mm long and was fixed vertically into a 650-mm x 1250-mm opening in the 200-mm thick concrete slab with 100-mm of ductwork projecting into the furnace and 2000-mm outside the furnace. The duct was protected on the outside with 68-mm thick Vermitex 'AF' and was exposed to the fire from the inside. The duct failed with respect to insulation between 120 minutes and 180 minutes but did not fail with respect to integrity or structural adequacy at the test termination time of 241 minutes.

The duct H1 was 2400-mm long and was fixed horizontally into a 650-mm x 1250-mm opening in the 230-mm thick brick wall with 100-mm of ductwork projecting into the furnace and 2000-mm outside the furnace. The duct was protected on the outside with 96-mm thick Vermitex 'AF' and was exposed to the fire from the inside. The duct did not fail at the test termination time of 241 minutes.

The duct H2 was 2400-mm long and was fixed horizontally into a 650-mm x 1250-mm opening in the 230-mm thick brick wall with 100-mm of ductwork projecting into the furnace and 2000-mm outside the furnace. The duct was protected on the outside with 71-mm thick Vermitex 'AF' and was exposed to the fire from the inside. The duct failed with respect to insulation at 220 minutes but did not fail with respect to integrity or structural adequacy at the test termination time of 241 minutes.

The duct H3 was 5220-mm long and was fixed horizontally at both ends into 650-mm x 1250-mm openings in the 230-mm thick brick wall with 100-mm of ductwork projecting outside and with 4560-mm inside the furnace. The duct was protected on the outside with 64-mm thick Vermitex 'AF' and was exposed to the fire from the outside. The duct failed with respect to insulation at 175 minutes but did not fail with respect to integrity or structural adequacy at the test termination time of 241 minutes.

The duct H4 was 5220-mm long and was fixed horizontally at both ends into 650-mm x 1250-mm openings in the 230-mm thick brick wall with 100-mm of ductwork projecting outside and with 4560-mm inside the furnace. The duct was protected on the outside with 89-mm thick Vermitex 'AF' and was exposed to the fire from the outside. The duct did not fail at the test termination time of 241 minutes.

A.5. CSIRO Sponsored Investigation report numbered FSH 0230

On 20 August 1992, this Division conducted a fire-resistance test on a specimen consisting of three steel ducts protected with Vermitex 'AF' sprayed insulation. Pins 2.7 diameter and 50-mm to 60-mm long were welded in a grid at 300-mm centres. The sprayed insulation was reinforced with "Spraylok" expanded steel mesh fixed at 40-mm from the surface of the duct. Each duct was fabricated from 1.0-mm thick galvanised sheet steel. On ducts H1 the Vermitex 'AF' was sprayed to two third of the final depth before the mesh was fixed. On ducts H2 and V1, the mesh was fixed at two third of the final sprayed thickness.

The duct V1 was 2300-mm long and was fixed vertically into a 2450-mm x 650-mm opening in a concrete slab. The 2400-mm x 600-mm ductwork projected 100-mm into the furnace and 2000-mm above the slab. The duct was protected on the outside with 66-mm thick Vermitex 'AF' and

was exposed to the fire from the inside. The duct failed with respect to insulation at 82 minutes but did not fail with respect to integrity or structural adequacy at the test termination time of 226 minutes.

The duct H1 was 5220-mm long and was fixed horizontally at both ends into 650-mm x 1650-mm openings in the 230-mm thick brick wall with 100-mm of ductwork projecting outside and with 4560-mm inside the furnace. The duct was protected on the outside with 61-mm thick Vermitex 'AF' and was exposed to the fire from the outside. The duct failed with respect to insulation at 138 minutes but did not fail with respect to integrity or structural adequacy at the test termination time of 226 minutes.

The duct H2 had a horizontal leg 2600-mm long and was installed through a 650-mm x 2450-mm opening in the 230-mm thick brick wall. The duct was 2400-mm x 600-mm in cross section and incorporated a right angle bend. The duct was protected on the outside with 63-mm thick Vermitex 'AF' and was exposed to the fire from the inside. The duct failed with respect to insulation at 66 minutes and with respect to integrity at 223 minutes but did not fail with respect to structural adequacy at the test termination time of 226 minutes.

Penetration F comprised Vermitex 'AF' cast in-situ within the slab opening. Spraylok-C mesh was fixed at the bottom of the slab opening by concrete nails. Two Rondo furring channels were placed spanning the 1250-mm side of the opening and supported by Z clips at 300-mm centres. Another layer of steel mesh was placed over the Rondo channel and fixed in place. Vermitex 'AF' was poured into the opening to a total depth of 65-mm.

A.6. CSIRO Sponsored Investigation report numbered FSH 0236

On 18 December 1992, this Division conducted a full-scale fire-resistance test on ductwork protected by Vermitex "AF" sprayed insulation in accordance with AS 1530.4-1997.

Steel duct was fabricated from 1.0 mm thick galvanised sheet steel. Pins 2.7 diameter and 55-mm long were welded in a grid at 300-mm centres. Steel square mesh 25-mm x 25-mm x 1.0-mm thick was held at a distance of 40-mm from the surface and was lapped 100-mm at joints. PVC ducts were installed using a surrounding frame of Rondo 308 furring channels spaced at 380 mm and attached to two Rondo 222 main runners with Rondo 281 clips. The steel square mesh was wrapped around the duct framework and held in place by screws. The mesh was fixed at two-third of the final sprayed thickness.

The duct V1 was 2300-mm long and was fixed vertically into a 2450-mm x 650-mm opening in a concrete slab. The 2400-mm x 600-mm ductwork projected 100-mm into the furnace and 2000-mm above the slab. The duct was protected on the outside with 77-mm thick Vermitex 'AF' and was exposed to the fire from the inside. The duct failed with respect to insulation at 133 minutes but did not fail with respect to integrity or structural adequacy at the test termination time of 188 minutes.

The duct H1 had a horizontal leg 2600-mm long and was installed through a 650-mm x 2450-mm opening in the 230-mm thick brick wall. The duct was 2400-mm x 600-mm in cross section and incorporated a right angle bend. The duct was protected on the outside with 68-mm thick Vermitex 'AF' and was exposed to the fire from the inside. The duct failed with respect to insulation at 56 minutes but did not fail with respect to integrity or structural adequacy at the test termination time of 188 minutes.

The PVC duct H2 was 5220-mm long and was installed horizontally through 800 mm x 650 mm opening in the 230-mm brickwork. The gap between the duct and the brickwork was packed using 25-mm thick Bradford Fibretex-350 mineral fibre. The duct was protected on the outside with 78-mm thick Vermitex 'AF' and was exposed to the fire from the outside. The duct did not fail at the test termination time of 188 minutes.

The PVC duct H3 was 750-mm x 570-mm x 2200-mm long and was installed horizontally. It protruded 100 mm into the spray-protected box at the furnace end of the duct and was bolted to a steel elbow at the fluing end of the duct. The duct was protected on the outside with 75-mm thick Vermitex 'AF' and was exposed to the fire from the inside. The duct failed with respect to insulation at 127 minutes but did not fail with respect to integrity or structural adequacy at the test termination time of 188 minutes.

A.7. The relevance of tests in accordance with A30-1958 to AS 1530.4-2014

General

The referenced test reports SI 0020, SI 0081, SI 1589, FSH 0092, FSH 0230 and FSH 0236 are tests conducted in accordance with Australian Standard A30-1958, AS 1530.4-1985 or 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 or more enclosed and thermally responsive to those specified or generally used when conducting tests to Australian Standard A30-1958, AS 1530.4-1975 or AS 1530.4-1990. This variation could make heating exposure for tests undertaken to A30-1958, AS 1530.4-1975 or AS 1530.4-1990 more onerous in some cases. The parameters outlining the accuracy of control of the furnace temperature in AS 1530.4-2014 and Australian Standard A30-1958, AS 1530.4-1975 or AS 1530.4-1990 where specified are not appreciably different.

Furnace Pressure Regime

For floors, AS 1530.4-2014 specifies that the pressure of 20Pa is established at a position 100mm below the underside of the test specimen above that of the laboratory atmosphere.

The test SI 0020, SI 0081, SI 1589, FSH 0092, FSH 0230 and FSH 0236 state the test was in accordance with the Australian Standard A30-1958, AS 1530.4-1975 or AS 1530.4-1990 where the pressure is either not stated (A30) or stated to be at least 20Pa.

The pressure conditions are similar to that prescribed by AS 1530.4-2014 Section 4 for floor elements (20Pa).

Specimen Temperature Measurement

The specimens included resistance to incipient spread thermocouples within the floor cavity. The requirement for resistance to incipient spread have changed since 1990 and is now taken as the time the maximum temperature on the cavity side of the ceiling membrane\spray protection. For this reason the results of these tests should be of this assesmsnet are exp and the differences are not relevant.

Integrity Performance Criteria

AS 1530.4-2014 deems integrity failure to have occurred upon collapse, sustained flaming (10 seconds), 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 1530.4-1997 deems integrity failure to occur upon collapse, the development of cracks, fissures, or other openings through which flames or hot gases can pass.

The integrity requirements for AS 1530.4-2014 are different after the formation of gaps on the specimen that would require the application of the cotton pad tests. Prior to the formation of gaps, the criteria are not appreciably different. The significance of the formation of gaps shall be considered on a case by case basis in regard to the integrity criteria as appropriate to ducts.

In is confirmed the integrity performance of the perimeter seals of specimens tested in SI 0020, SI 0081, SI 1589, FSH 0092, FSH 0230 and FSH 0236 can be used for the purpose of meeting the integrity criteria of by AS 1530.4-2014 as appropriate of the perimeter seal.

Application of Test Data in the referenced tests to AS 1530.4-2014

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

For the specimens tested in SI 0020, SI 0081, SI 1589, FSH 0092, FSH 0230 and FSH 0236 the determination of resistance to incipient spread have changed as such these results are treated as observations rather than a determination of resistance of incipient spread in accordance with AS1530.4-2014

In light of the above, it is considered that the behaviour of the specimens relevant to this assessment in test SI 0020, SI 0081, SI 1589, FSH 0092, FSH 0230 and FSH 0236 can be used for the purpose of determination tempertaures within the cavity and impact that will have on the structural adequacy and integrity in accordance with AS 1530.4-2014.

Appendix B Analysis of Variations

B.1 Fire performance of spray applied to floor ceilings

The proposed construction shall be as tested in SI 1589 subject to the variations below:

- The framing construction shall vary to roof ceiling systems based on reference to SI 0020.
- The floor or roof framing shall vary to timber framed systems designed for the appropriate loading and span in accordance with AS 1720.1-2010 or AS1684-2010.
- The spray thickness and mesh requirements will vary and include 1 layer of mesh for 120-minute applications and 2 layers for 180 and 240-minute applications
- The spray may be varied to Vermitex 7 or Vermitex AF based on reference to FSH 0230 and FSH 0236

The proposed construction is summarised below

Table 1 – Construction of Floor ceiling and Roof ceiling systems

item	Description	Specification
Upper layer	Roofing or flooring	Roof sheeting, tiles or timber flooring
Structure	Roof or floor framing	For timber or steel framing it shall be designed in accordance with AS 1720.1, AS 4100 or AS 4600 as appropriate for the span and applied loads
Ceiling lining and spray specification	Expanded metal lath	Self-furring expanded metal lath only with Vermitex 7 or Vermitex AF sprayed to various depths.
	Expanded metal lath fixed over fibrous plaster ceiling	Self-furring expanded metal lath attached to timber joist by 75 mm galvanised clouts (hardwood) or 88 mm galvanised clouts (softwood) under an existing fibrous plaster ceiling, with Vermitex 7 or Vermitex AF sprayed to various depths.

On 14 July 1982 CSIRO conducted a full-scale fire-resistance test on a roof/ceiling system SI 1589. The system comprised a ceiling system of expanded metal lath sprayed with 60-mm of Vermitex 7 suspended under a metal deck roof. The system achieved fire-resistance levels (FRL) of 240/240/240. The performance with regard to the incipient spread of fire was not measured at the time of the test although a thermocouple located in the ceiling air space recorded a temperature of approximately 157°C at 240 minutes.

Additional test data relevant to the determination of incipient spread of fire was obtained from the three ductwork tests reported in FSH 0092, FSH 0230 and FSH 0236. The results from this testing are shown in Table B1, below.

Table B1 - Summary of test results on ductwork systems.

Test	Duct Size	Protection Thickness	Fire Direction	Orientation	Fire Performance
FSH 0092	1200 x 600	97	internal	vertical	241/241/178
	1200 x 600	68	internal	vertical	241/241/180
	1200 x 600	96	internal	horizontal	241/241/241
	1200 x 600	71	internal	horizontal	241/241/220
	1200 x 600	64	external	horizontal	241/241/175
	1200 x 600	89	external	horizontal	241/241/241
FSH 0230	2400 x 600	66	internal	vertical	226/226/82
	1600 x 600	62	external	horizontal	226/226/138
	2400 x 600	63	internal	horizontal	226/223/66
FSH 0236	2400 x 600	69	internal	vertical	188/188/133
	2400 x 600	68	internal	horizontal	188/188/56
	750 x 600	78	external	horizontal	188/188/188
	750 x 750	75	internal	horizontal	188/188/127

The important data to be extracted from these results is the thermal conductivity of the sprayed insulation when subjected to the effects of fire. This can be used to assess the potential performance of the ceiling systems when considering the Incipient Spread of Fire criterion of a rise of 180K on the non-fire side of the ceiling\spray construction.

An analysis was undertaken using a regression method on the relevant data resulted in the following table for the thickness required to achieve a rise of 180K.

Time(minutes)	Thickness (mm) of Vermitex AF or Vermitex 7 required to prevent the average temperature on the top surface of the ceiling from rising 180K
60	25
90	30
120	40
180	63
240	86

The proposed systems use various thicknesses of sprayed material to achieve the required fire-resistance levels. These thicknesses range from 25-mm for 60/60/60 to 60-mm for 240/240/240. As stated earlier the system reported in SI 1589 achieved 240/240/240 with the stipulated 60-mm of sprayed material. There was a significant margin of safety in achieving this result. Comparing this result with the results of the ductwork tests shows that there is also a significant conservatism in the proposed systems and the predicted results remain an interpolation of the available results.

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