

# FAR 2489

## Assessment of the Performance of Metal Clad Expanded Polystyrene Sandwich Panels in the AS ISO 9705 Room Fire Test

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# Assessment of the Performance of Metal Clad Expanded Polystyrene Sandwich Panels in the AS ISO 9705 Room Fire Test

## 1. CLIENT

CSIRO MIT Fire Science and Technology Laboratory  
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Highett  
Melbourne  
Australia

(PACIA, EPS Panel Group, Australia commissioned the CSIRO MIT Fire Science and Technology Laboratory to conduct the fire tests)

## 2. INTRODUCTION

The author was asked by the client to observe a series of AS ISO 9705 room fire tests and independently certify the results in accordance with the criteria set down in Specification C1.10a Clause 3 of the Building Code of Australia 2005.

## 3. BACKGROUND

This assessment report is based on the results of seven room fire tests conducted in accordance with AS ISO 9705 and carried out by CSIRO MIT Fire Science and Technology Laboratory, Highett, Melbourne for the PACIA, EPS Panel Group as follows:

CSIRO MIT Test No.	Test Date	Reference
03/21	15 September 2003	Doc CMIT-(C)-2003-201
04/01	23 January 2004	Doc CMIT-(C)-2004-089
04/02	06 February 2004	Doc CMIT-(C)-2004-089
04/34	06 September 2004	Doc CMIT-(C)-2004-368
04/35	22 September 2004	Doc CMIT-(C)-2004-368
04/36	24 November 2004	Doc CMIT-(C)-2004-469
04/37	06 December 2004	Doc CMIT-(C)-2004-469

A supplementary test was carried out on 19<sup>th</sup> March 2004 similar to Specimen 04/01 except that the room was constructed as a (freestanding) self-supporting structure of similar dimensions to the ISO 9705 room, rather than being constructed within the ISO 9705 room. The structure was located inside a larger room and the ceiling panels were provided with additional support using four mushroom bolts to suspend the ceiling from external supports. The results of this test were not directly applicable to this assessment, however useful information was obtained regarding the performance of the ceiling panels.

The AS ISO 9705 room fire test requires the wall and ceiling panels to be mounted within a test compartment measuring 3.6 m long x 2.4 m wide x 2.4 m high with a single opening 2.0 m high x 0.8 m wide. A gas burner is located in one of the rear corners opposite the opening, and the gas flow controlled to produce a heat output and duration as prescribed by the standard i.e. 100 kW for 10 minutes followed by 300 kW for a further 10 minutes.

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The performance criteria used for the purpose of BCA group number classification is the time-to-reach 1 MW (flashover), and a smoke growth rate index (SMOGRA) index was determined on the basis on light obscuration measurements in the exhaust duct recorded during the test.

The key factors relating to the design, construction and installation of the test specimens were examined for the seven tests and are summarised in Table 1.

Rivet spacings were nominal 300 mm centres. Steel mushroom bolts supporting ceiling panel from external supports in tests 04/01 and 04/02 were spaced at nominal 2.4 m centres.

#### 4. DISCUSSION

Each test was terminated following flashover or after 20 minutes in the event flashover did not occur. This was the case with tests 04/01 and 04/35, which both satisfied the criteria given for Group 1 materials in the BCA specification C1.10a. Flashover occurred for tests 03/21, 04/02, 04/36 and 04/37 in the period between 10 and 20 minutes corresponding to a Group 2 in BCA specification C1.10a. The specimen in test 04/34 reached flashover before 10 minutes corresponding to a Group 3.

Key results are summarised in Table 2.

Class S foam and SL foam (to AS1366.3 - 1992) have nominal densities of 16 and 13.5 kg/m<sup>3</sup> respectively. Panels using Class S foam therefore contain a higher amount of combustible mass for the same panel thickness.

The main effect of the panel thickness on the result of the tests was the potentially larger contribution of combustible material associated with the thicker panels; it was thus considered to represent a worse case.

Varying the metal skin thickness in the range 0.4 – 0.6 mm did not appear to greatly affect the result. A thicker metal skin is considered to be slightly more robust, and less susceptible to distortion.

The use of steel and aluminium angle trim and rivets exhibited clear differences in behaviour. Aluminium materials close to the burner were subject to melting which was not the case with steel.

Two of the tests (04/01 and 04/35) used a steel (stitch) rivet connecting the metal facings on the ceiling panels at approximately mid-span. This rivet had a significant effect on the result by preventing the occurrence of flashover for the duration of the test as illustrated by comparing the results of tests 04/35 and 04/36.

The calculated SMOGRA index was significantly lower for the two tests (04/01 and 04/35) that did not reach flashover.

The AS ISO 9705 fire test evaluates the fire performance of the panel system under a specific set of conditions. This includes the fixed room dimensions of 3.6 m x 2.4 m x 2.4 m. The BCA Specification C1.10a classification is solely based on the performance of the system in the specific fire test. In practice, buildings constructed using the panel system will usually be much larger than the AS ISO 9705 room, and actual time to flashover will be different even for the same burner output regime. By necessity, larger rooms may require different structural support

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systems for the ceiling, than that required for the AS ISO 9705 room, and in practice this is determined on a case by case basis by engineering design for each application.

The series of fire tests covered by this assessment attempted to evaluate the fire performance using both a ceiling system supported by the walls (self-supported) and a ceiling system supported externally with steel through-bolts. In the latter case, the spacing between the support bolts was nominally 2.4 m, and was limited by the room dimensions. Again in practice this could be larger as determined by the engineering design. The design of the roof structure when used to provide support for the ceiling suspension system is not considered at all in this assessment. All these factors could affect the behaviour of the actual construction system under real fire conditions. However, for the purposes of complying with BCA Specification C1.10a, this assessment can only consider expected performance/behaviours of the insulated panel system under the specific conditions of the AS ISO 9705 fire test.

## 5. CONCLUSION

Provided that the following construction and installation parameters are followed, the metal-skinned EPS panels are considered to achieve the following BCA classification based on performance in the AS ISO 9705 room fire test in accordance with BCA Specification C1.10a.

**BCA Group 1 Classification** requires the following construction/installation parameters:

- Class S or SL expanded polystyrene foam to AS1366.3 may be used for the panel core when the ceiling is externally supported.
- Class SL expanded polystyrene foam to AS1366.3 only may be used for the panel core when the ceiling is self-supported (by the wall panels).
- Panel thickness to be 250 mm or less
- Metal skins to be 'Colorbond' steel, 0.4 mm or thicker
- Steel angles at junctions fixed to metal skins with steel rivets at nominal 300 mm spacings
- Ceiling panel-to-panel joins to also have steel rivets connecting the metal skins at not more than 1200 mm spacings.
- The panel system is required to be installed in accordance with the manufacturer's panel installation instructions in all other respects and an engineering assessment is required to determine the spacing and size of any external supports (if required) to ensure structural adequacy for each application. Where ceiling panels are required to be supported using mushroom bolts, they must be no less than 10 mm diameter steel mushroom bolts with steel washers.

**BCA Group 2 Classification** requires the following construction/installation parameters:

- Class S or SL expanded polystyrene foam to AS1366.3 may be used for the panel core.
- Panel thickness to be 250 mm or less
- Metal skins to be 'Colorbond' steel, 0.4 mm or thicker
- Steel or aluminium angles at junctions fixed to metal skins with steel or aluminium rivets at nominal 300 mm spacings, except that if the panel thickness is greater than 150 mm and self-supported, then steel angles and rivets shall be used.
- The panel system is required to be installed in accordance with the manufacturer's panel installation instructions in all other respects and an engineering assessment is required to determine the spacing and size of any external supports (if required) to ensure structural adequacy for each application. Where ceiling panels are required to be supported using mushroom bolts, they must be no less than 10 mm diameter steel mushroom bolts with steel washers.

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**BCA Group 3 Classification** requires the following construction/installation parameters:

- Class S or SL expanded polystyrene foam to AS1366.3
- Panel thickness is more than 150 mm and not more than 250 mm
- Metal skins to be 'Colorbond' steel, 0.4 mm or thicker
- Aluminium angles at junctions fixed to metal skins with aluminium rivets at nominal 300 mm spacings.
- The panel system is self-supporting.
- The panel system is required to be installed in accordance with the manufacturer's panel installation instructions in all other respects and an engineering assessment is required to ensure structural adequacy for each application.

### **Smoke Growth Rate Index**

In all cases, the smoke growth rate index as identified in BCA Specification C1.10a, clause 3c is not more than 100, and the product may be used in buildings with or without a sprinkler system complying with specification E1.5, subject to the construction and installation requirements shown above for the required classification group.

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**Table 1 Summary of design, construction and installation parameters**

	Test Specimen						
Test No	03/21	04/01	04/02	04/34	04/35	04/36	04/37
Test Date	15 Sep 2003	23 Jan 2004	6 Feb 2004	6 Sep 2004	22 Sep 2004	24 Nov 2004	6 Dec 2004
EPS foam	SL to AS1366.1	S to AS1366.1	SL to AS1366.1	SL to AS1366.1	SL to AS1366.1	S to AS1366.1	S to AS1366.1
Panel Thickness	100 mm	250 mm	150 mm				
Facing Type	0.6 mm Colorbond steel	0.4 mm Colorbond steel					
Angle trim material	aluminium	steel	aluminium	aluminium	steel	steel	aluminium
Rivet material	aluminium	steel	aluminium	aluminium	steel	steel	aluminium
Mushroom bolts support ceiling	no	yes	yes	no	no	no	no
Rivet in ceiling joint	no	yes	no	no	yes	no	no

**Table 2 Summary of results**

	Test Specimen						
Test No	03/21	04/01	04/02	04/34	04/35	04/36	04/37
Test Date	15 Sep 2003	23 Jan 2004	6 Feb 2004	6 Sep 2004	22 Sep 2004	24 Nov 2004	6 Dec 2004
Time to reach 1 MW (sec)	1100	No failure	785	415	No failure	1140	605
BCA group classification	2	1	2	3	1	2	2
SMOGRA index (m <sup>2</sup> /s <sup>2</sup> x 1000)	14.0	2.4	12.0	13.2	2.1	24.2	18.1