

**Test Report No. 7191120904-MEC15-LAS**  
dated 21 SEP 2015



PSB Singapore

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**SUBJECT:**

Testing of AL. Composite Panel

**TESTED FOR:**

DEC Engineering Corporation  
4FL. SangHa Building 234-26  
Nonhyun-Dong, Gangnam-Gu  
Seoul, Korea.

Attn: Mr Chung Kyoung-Do

**SAMPLES DESCRIPTION:**

The following AL Composite Panel specimens (as shown below) were submitted by DEC Engineering Corporation on 4 Sept 2015 for testing.

Brand : "ALCOMEX Fr"

S/No.	Test Items	Approximate Dimensions	Quantity	Date Received
1	Linear Thermal Expansion	6mm x 6mm x 6mm	5 pcs	4 Sept. 2015
2	Flexural Strength	200mm x 75mm x 4mm	19 pcs	4 Sept. 2015
3	Drum Peel Strength	Refer to sample (No.9) in the below picture	10 pcs	4 Sept. 2015
4	Flatwise Shear Strength	190mm x 26mm x 0.6mm	7 pcs	4 Sept. 2015
5	Flatwise Tensile Strength	Dia. 38mm x 1.0 (0.5+0.5)mm T	8 pcs	4 Sept. 2015



Photograph of the samples submitted for testing



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**TUV**<sup>®</sup>

**TEST METHOD:**

1. Linear Thermal Expansion

ASTM E831 : 2014

Standard Test Method for Linear Thermal Expansion of Solid Material by Thermomechanical Analysis

Test Condition : Sub-ambient to 50 °C  
Heating Rate : 5 °C/min  
Atmosphere : N<sub>2</sub>

2. Flexural

ASTM C393 : 2011 E1

Standard Test Method for Core Shear Properties of Sandwich Constructions by Beam Flexure

Test specimen dimensions : 250 mm x 75 mm x 4 mm  
Loading : Single-point midspan and two-point quarter-span loading  
Span length : 150 mm  
Crosshead speed : 6 mm/min  
No. of determinations : 5

3. Drum Peel Strength

ASTM D1781 : 1998 (2012)

Standard Test Method for Climbing Drum Peel for Adhesives

Test specimen Dimension : Drum peel strength test piece  
Crosshead speed : 25 mm/min  
No. of determinations : 6 pcs

4. Flatwise Shear (Lap Shear Strength)

ASTM D1002 : 2010

Standard Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens By Tension Loading (Metal to Metal)

Norminal Dimensions : As Received  
Crosshead Speed : 1.3 mm/min  
No. of Determination : 5

5. Flatwise Tensile Strength

ASTM C297/C297M : 2004

Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions

Norminal specimen dimensions : As Received  
Crosshead Speed : 0.3 mm/min  
No. of determination : 5





**TEST RESULTS:**

Characteristics	Units	Results (AL. Composite Panel)	
1. Coefficient of Linear Thermal Expansion a. $\alpha_1$ (10°F to 60°F) b. $\alpha_2$ (130°F to 170°F)	in/in°F	9.1 x 10 <sup>-5</sup> 2.4 x 10 <sup>-4</sup>	
2. Flexural Strength Flexural Strength, average	N/mm <sup>2</sup>	3 Point Bend	4 Point Bend
		133	151
3. Drum Peel Strength Drum Peel Load, average	N	89	
4. Flatwise Shear Strength (Lap Shear Strength) Lap Shear Strength, average	kg/mm <sup>2</sup>	7.3	
5. Flatwise Tensile Strength, average Mode of failure	MPa	3.49 Adhesion failure	

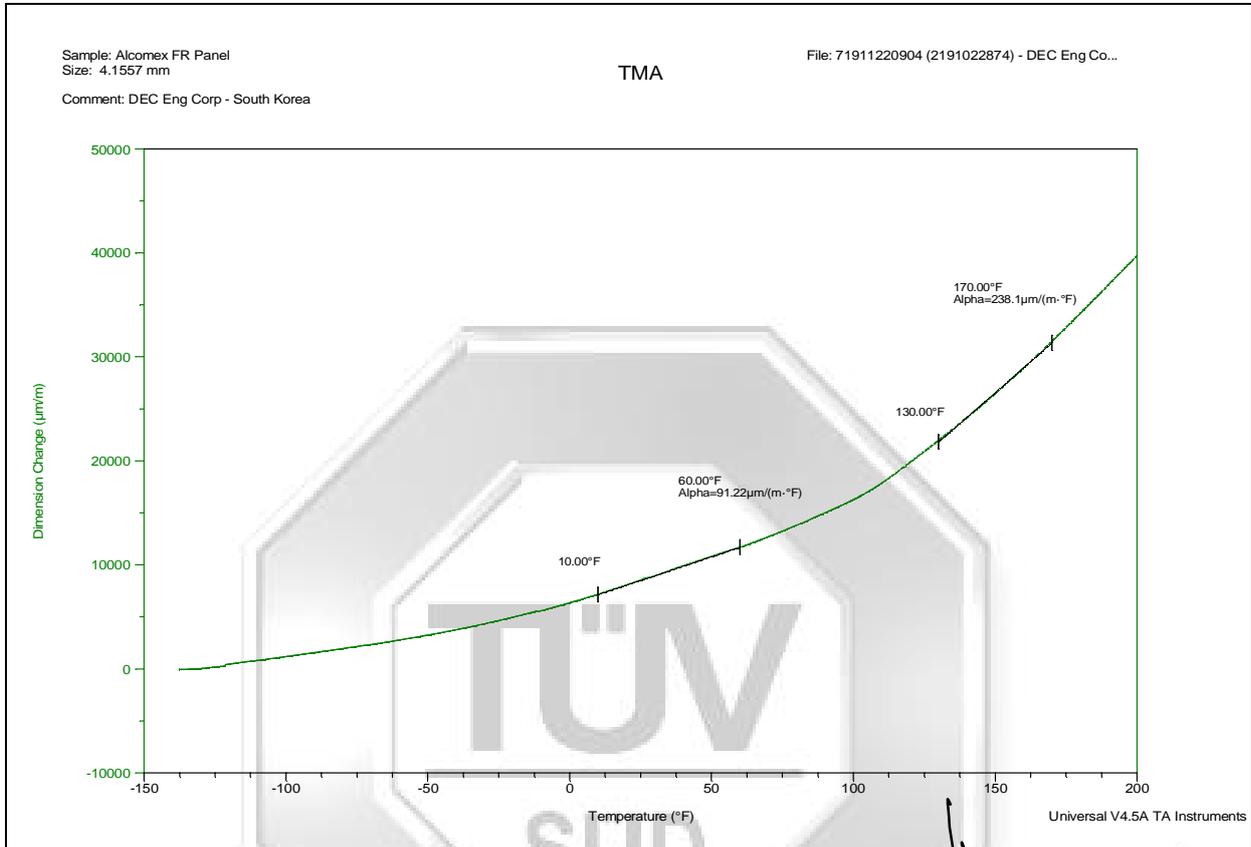
**NOTES:**

1. TMA thermogram was showed in Figure 1 and the instrument is calibrated with Indium and Zinc as standard reference materials.
2. For Flatwise Tensile Strength test, the readings obtained were the bonded strength between the dolly and the Al composite panel instead of the bonded strength between the two Al composite panels.

  
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Leong Ann Seow  
Higher Associate Engineer

  
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Dr Hu Guang Xia  
Senior Consultant  
Polymer Products  
Mechanical Centre

Figure 1 : TMA Thermogram of sample labelled as "AL. Composite Panel"



*Handwritten signature and name: Han Gwanseon*

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July 2011

