SIRIM QAS International Sdn. Bhd. (Company No.: 410334-X)
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TEST REPORT

REPORT NO. 2018CE1583	PAGE : 1 OF 14

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Applicant (Internal)	:	PRODUCT CERTIFICATION & INSPECTION SECTION, Mechanical & Automotive Group, Building 25, (Attn: En. Hasnol Zakaria)
Licensee	:	MBOND MANUFACTURER SDN. BHD. No. 9, Jalan TPP 3, Taman Perindustrian Putra, 47130 Puchong, Selangor Darul Ehsan, MALAYSIA
Manufacturer	:	MBOND MANUFACTURER SDN. BHD. No. 9, Jalan TPP 3, Taman Perindustrian Putra, 47130 Puchong, Selangor Darul Ehsan, MALAYSIA
Product	:	Aluminium Composite Panel
Reference standard / Method of test	:	1) **MS 2571: 2017** – Title: Aluminium Composite Panel for Exterior and Interior Cladding – Specification 2) **MS 2040: 2017** – Title: Aluminium and Aluminium Alloys – Sheets and coiled sheets – Specification (First Revision)
Description of sample	:	Received one (1) sample of **Aluminium Composite Panel** for testing which was identified as: **Sample details : Refer to page 2** **PP2 Ref. : P5-010704 (Dated on: 29/3/2017)**
Date Received of Complete Application	:	20th August 2018
Job No.	:	J20181401618
Description of Overall Test Result	:	The submitted test samples of Aluminium Composite Panel 2 Coats Polyvinylidene Difluoride (PVDF) as described in this test report complied with all the requirements of the above Reference Standard except for Artificial weathering aging resistance test, Cyclic Corrosion test & Thermal distortion temperature which are still in progress.
Issued date	:	29th November 2018

Approved Signatory

(ABDUL AZIZ HARON)
Senior Testing Executive

(HAHNAS MAHBUT)
Head,
Chemical & Consumer Section (CEST),
Testing Services Department.

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DESCRIPTION OF SAMPLES:

Product : **Aluminium Composite Panel**

Brand : **MBond**

Sample selection : **Production Line**

Descriptions	Sizes, mm (W x L)	Alloy type/ Temper grade	Thickness, mm Composite panel/ Aluminium skin	Core materials	Coating types
Metallic Silver (9072)	1250 x 4880	AA3003 / H16	4 / 0.5	3.0 mm PE*	2 Coats Polyvinylidene Difluoride (PVDF)

Note:

** PE indicates Polyethylene core material*

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CHEMICAL & CONSUMER SECTION
Abdul Aziz Haron

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DESCRIPTION OF REFERNCE STANDARD

MS 2571: 2017 – TITLE: ALUMINIUM COMPOSITE PANEL FOR EXTERIOR AND INTERIOR CLADDING - SPECIFICATION

Clause	Scope	Information for result
Clause 4	Classification, specification, dimension and label	
Clause 4.1	Classification	Applicable
Clause 4.2	Size and thickness dimensions	Applicable
Clause 5	Materials	
Clause 5.1	Aluminium material - chemical composition	Applicable
Clause 5.2	Coating	Applicable
Clause 5.3	Core materials	Applicable
Clause 5.4	Adhesive films	Applicable
Clause 6	Requirements	
Clause 6.1	Appearance quality	Applicable
Clause 6.2	Allowed dimension deviation	Applicable
Clause 6.3	Thickness of aluminium material and coating	Applicable
Clause 6.4	Performance	Applicable
Clause 6.4	Table 4a. Performance requirements of coating	Applicable
Clause 6.4	Table 4b. Technical performance requirements	Applicable
Clause 7	Test Method	
Clause 8	Marking, packaging, transportation and storage	
Annex A	Production and lamination of coils	Applicable

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Test Results

Product : **Aluminium Composite Panel**
Brand : **MBond**
Alloy thickness : **0.5 mm**
Alloy type : **3003**
Temper grade : **H16**
Sample selection : **Storage**

Test clause : **MS 2571: 2017 – Clause 5.1 Aluminium material**
Aluminium composite panel shall be made of 3003 or 3105 or 5005 series aluminium alloy consistent with requirement of MS 2040

Method of test : **MS 2040: 2007 Aluminium and Aluminium Alloys – Sheets and coiled sheets – Specification – Chemical Composition**

No.	Type of Tests	Requirements MS 2040: 2017 – Table 2 Chemical Compositions Alloy type 3003 (% m/m)	Results	Remarks
1.	Silicon as Si	0.60 maximum	0.05	Pass
2.	Iron as Fe	0.70 maximum	0.31	Pass
3.	Copper as Cu	0.05 to 0.20	0.08	Pass
4.	Manganese as Mn	1.0 to 1.5	1.09	Pass
5.	Magnesium as Mg	-	-	-
6.	Chromium as Cr	-	-	-
7.	Zinc as Zn	0.10 maximum	0.01	Pass
8.	Titanium as Ti	-	-	-
9.	Aluminium as Al (calculated as remainder)	Remainder : 96.9 minimum (1)	98.46	Pass
No.	**Type of Tests**	**Requirements MS 2040: 2017 – Table 3 Mechanical Properties for sheet, coiled sheet and circle Alloy type 3003; Temper Grade H16**	**Results**	**Remarks**
10.	Tensile strength, N/mm^2	165 minimum, 205 maximum (Thickness, mm: 0.3 or over, up to and including 0.5)	187	Pass
11.	Elongation, %	1 minimum	7.9	Pass

Note: (1) Calculated based on: 100 – (Si + Fe+ Cu + Mn + Mg + Cr + Zn +Ti)

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Test Results

Product : **Aluminium Composite Panel**
Brand : **MBond**
Descriptions : **Metallic Silver (9072)**
Product thickness : **4 mm**
Alloy thickness : **0.50 mm**
Alloy Type : **3003**
Temper grade : **H16**
Coating type : **2 Coats Polyvinylidene Difluoride (PVDF)**
Core Material : **PE (Polyethylene Core)**
Sample selection : **Storage**

Test clause : **MS 2571: 2017 – Clause 6.1 Appearance quality**
Appearance of aluminium composite panel shall be free of defects as identified in Table 1. Common surface defects

No.	Defects name	Technical requirements MS 2571: 2017 – Table 1 Common Surface Defects	Results	Remarks
1.	Press mark (Indentation)	Not allowed	No press mark was observed	Pass
2.	Print mark (Stain)	Not allowed	No print mark was observed	Pass
3.	Concave-convex	Not allowed	No concave-convex was observed	Pass
4.	Exposed core on front and back	Not allowed	No expose core on front and back was observed	Pass
5.	Uncoated surface on front	Not allowed	No uncoated surface on front was observed	Pass
6.	Wave	Not allowed	No wave was observed	Pass
7.	Bubble	Not allowed	No bubble was observed	Pass
8.	Spot (Blemishes)	Maximum size ≤ 3 mm, less than $3/m^2$	No blemishes spot was observed	Pass
9.	Scratch	Not allowed	No scratch was observed	Pass
10.	Color difference *(Except for decorative pattern and color)*	Not obvious for visual inspection, $\Delta E \leq 2$ for arbitration	0.05	Pass
11.	Delamination between core and aluminium skin	Not allowed	No delamination between core and aluminium skin was observed	Pass

Note: *All of the tests above were conducted on site*
Date of test : *20th August 2018*
Location : *MBOND MANUFACTURER SDN. BHD.*
No. 9, Jalan TPP 3, Taman Perindustrian Putra,
47130 Puchong, Selangor Darul Ehsan, MALAYSIA

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Test Results

Product : **Aluminium Composite Panel**
Brand : **MBond**
Descriptions : **Metallic Silver (9072)**
Product thickness : **4 mm**
Alloy thickness : **0.50 mm**
Alloy Type : **3003**
Temper grade : **H16**
Coating type : **2 Coats Polyvinylidene Difluoride (PVDF)**
Core Material : **PE (Polyethylene Core)**
Sample selection : **Storage**

Test clause : **MS 2571: 2017 – Clause 6.2 Allowed dimension deviation**
Allowed dimension deviation for aluminium composite panel shall be consistent with requirements of Table 2.

No.	Measured item	Technical requirements MS 2571: 2017 – Table 2 Allowable dimension deviation	Results	Remarks
1.	Length (mm) [MS 2571: 2017 Clause 7.3.2]	± 3		
1.1	4 mm (0.5 + 3.0 + 0.5)/PE/PVDF			
1.1.1	1250 mm x 4880 mm		-0.3	Pass
2.	Width (mm) [MS 2571: 2017 Clause 7.3.2]	± 2		
2.1	4 mm (0.5 + 3.0 + 0.5)/PE/PVDF			
2.1.1	1250 mm x 4880 mm		0	Pass
3.	Diagonal deviation (mm) [MS 2571: 2017 Clause 7.3.3]	≤ 5		
3.1	4 mm (0.5 + 3.0 + 0.5)/PE/PVDF			
3.1.1	1250 mm x 4880 mm		0.3	Pass

Note: *All tests above were conducted on site*
Date of test : *20th August 2018*
Location : *MBOND MANUFACTURER SDN. BHD.*
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Test Results

Product	:	**Aluminium Composite Panel**
Brand	:	**MBond**
Descriptions	:	**Metallic Silver (9072)**
Product thickness	:	**4 mm**
Alloy thickness	:	**0.50 mm**
Alloy Type	:	**3003**
Temper grade	:	**H16**
Coating type	:	**2 Coats Polyvinylidene Difluoride (PVDF)**
Core Material	:	**PE (Polyethylene Core)**
Sample selection	:	**Storage**

Test clause : **MS 2571: 2014 – Clause 6.2 Allowed dimension deviation**
Allowed dimension deviation for aluminium composite panel shall be consistent with requirements of Table 2.

No.	Measured item	Technical requirements MS 2571: 2014 – Table 2 Allowable dimension deviation	Results	Remarks
4.	Thickness (mm) [MS 2571: 2017 Clause 7.3.1]	± 0.2		
4.1	4 mm (0.5 + 3.0 + 0.5)/PE/PVDF			
4.1.1	1250 mm x 4880 mm		-0.06	Pass
5.	Edge straightness (mm/m) [MS 2571: 2017 Clause 7.3.4]	≤ 1		
5.1	4 mm (0.5 + 3.0 + 0.5)/PE/PVDF			
5.1.1	1250 mm x 3000 mm		0	Pass
6.	Warp (mm/m) [MS 2571: 2017 Clause 7.3.5]	≤ 5		
6.1	4 mm (0.5 + 3.0 + 0.5)/PE/PVDF			
6.1.1	1250 mm x 3000 mm		0	Pass
7.	Flatness (mm/m) [MS 2571: 2017 Clause 7.3.5]	± 2		
7.1	4 mm (0.5 + 3.0 + 0.5)/PE/PVDF			
7.1.1	1250 mm x 3000 mm		0	Pass

Note: All tests above were conducted on site
Date of test : 20th August 2018
Location : MBOND MANUFACTURER SDN. BHD.
No. 9, Jalan TPP 3, Taman Perindustrian Putra,
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Test Results

Product	:	Aluminium Composite Panel
Brand	:	MBond
Descriptions	:	Metallic Silver (9072)
Product thickness	:	4 mm
Alloy thickness	:	0.50 mm
Alloy Type	:	3003
Temper grade	:	H16
Coating type	:	2 Coats Polyvinylidene Difluoride (PVDF)
Core Material	:	PE (Polyethylene Core)
Sample selection	:	Storage

Test clause : **MS 2571: 2017 – Clause 6.3 Thickness of coating**
Thickness of coating for aluminium composite panel shall be consistent with requirements of Table 3a and Table 3b.

No.	Type of Test	Technical requirements MS 2571: 2017 – Table 3a Thickness of aluminium material and PVDF coating	Results	Remarks
1.	Thickness of aluminium material, mm [MS 2571: 2017 Clause 7.4]	Exterior: 0.5 ± 0.02	0.49	Pass
2.	Thickness of coating, µm [MS 2571: 2017 Clause 7.5] *(Except for decorative pattern and color)*	2 coats Prime Coats : Minimum 5 Top Coat : Minimum 18 Total : Minimum 23	 6 20 26	 Pass Pass Pass

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Test Results

Product	:	**Aluminium Composite Panel**
Brand	:	**MBond**
Descriptions	:	**Metallic Silver (9072)**
Product thickness	:	**4 mm**
Alloy thickness	:	**0.50 mm**
Alloy Type	:	**3003**
Temper grade	:	**H16**
Coating type	:	**2 Coats Polyvinylidene Difluoride (PVDF)**
Core Material	:	**PE (Polyethylene Core)**

Test clause : **MS 2571: 2017 – Clause 6.4 Performance**
Performance of aluminium composite panel shall be consistent with requirements of Table 4a and Table 4b.

No.	Test item	Technical requirements MS 2571: 2017 Table 4a: Exterior	Results	Remarks
1.	Surface pencil hardness* [MS 2571: 2017 Clause 7.10.1]	Minimum F	3H	Pass
2.	Gloss deviation of coating (%)* [MS 2571: 2017 Clause 7.10.2]	± 5	2.6	Pass
3.	Flexibility of coating/T-bend [MS 2571: 2017 Clause 7.5.1]	≤ 2 (no tape off)	1 (no tape off)	Pass
4.	Cross hatch adhesion [MS 2571: 2017 Clause 7.6]			
4.1	Dry	100% adhesion	100% adhesion	Pass
4.2	Wet	100% adhesion	100% adhesion	Pass
4.3	Boiling	100% adhesion	100% adhesion	Pass
5.	Impact resistance/ (kg.cm) [MS 2571: 2017 Clause 7.7]	No cracking /100% adhesion	No crack observed /100% adhesion	Pass

Note: *Surface pencil hardness, Gloss deviation of coating and Cross hatch adhesion were conducted on site:*
Date of test : 20th August 2018
Location : MBOND MANUFACTURER SDN. BHD.
No. 9, Jalan TPP 3, Taman Perindustrian Putra,
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Test Results

Product	:	**Aluminium Composite Panel**
Brand	:	**MBond**
Descriptions	:	**Metallic Silver (9072)**
Product thickness	:	**4 mm**
Alloy thickness	:	**0.50 mm**
Alloy Type	:	**3003**
Temper grade	:	**H16**
Coating type	:	**2 Coats Polyvinylidene Difluoride (PVDF)**
Core Material	:	**PE (Polyethylene Core)**

Test clause : **MS 2571: 2017 – Clause 6.4 Performance**
Performance of aluminium composite panel shall be consistent with requirements of Table 4a and Table 4b.

No.	Test item	Technical requirements MS 2571: 2017 Table 4a: Exterior	Results	Remarks
6.	Abrasion Resistance/ (L/µm) [MS 2571: 2017 Clause 7.8]	≥ 40 L/25 µm	More than 40 L/25 µm	Pass
7.	Muriatic acid [MS 2571: 2017 Clause 7.9.1]	No blister, no visual change	No blister, no visual change was observed	Pass
8.	Mortar resistance [MS 2571: 2017 Clause 7.9.2]	No loss of film adhesion, no visual change	No loss of film adhesion, no visual change was observed	Pass
9.	Nitric acid resistance [MS 2571: 2017 Clause 7.9.3]	Color Change $\Delta E < 5$	0.75	Pass
10.	Solvent resistance [MS 2571: 2017 Clause 7.5.2]	No exposure of bottom layer	No exposure of bottom layer was observed	Pass

Note: Solvent resistance was conducted on site:
Date of test : 20th August 2018
Location : MBOND MANUFACTURER SDN. BHD.
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Test Results

Product	:	**Aluminium Composite Panel**
Brand	:	**MBond**
Descriptions	:	**Metallic Silver (9072)**
Product thickness	:	**4 mm**
Alloy thickness	:	**0.50 mm**
Alloy Type	:	**3003**
Temper grade	:	**H16**
Coating type	:	**2 Coats Polyvinylidene Difluoride (PVDF)**
Core Material	:	**PE (Polyethylene Core)**
Test clause	:	**MS 2571: 2017 – Clause 6.4 Performance** Performance of aluminium composite panel shall be consistent with requirements of Table 4a and Table 4b.
Test Method	:	**MS 2571: 2017 Clause 7.10.3** - Artificial weathering aging resistance **ASTM G154 - 12a** Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

Test Exposure Condition:

Lamp used	:	UV–B 313
Irradiance	:	0.62 W/m²
Approximate wavelength	:	313 nm
Exposure cycle	:	20 hours UV at 60 ± 3°C, 4 hours Condensation at 50 ± 3°C (Cycle 5)
Total exposure period	:	5000 hours

No.	Test item	Technical requirements MS 2571: 2017 Table 4a: Exterior	Results	Remarks
11.	Artificial weathering aging resistance [MS 2571: 2017 Clause 7.10.3]			
11.1	Color difference, ΔE	ΔE ≤ 5.0 at 5,000 h QUV-B	*Test in progress*	*Test Results shall be advised upon test completion*
11.2	Gloss retention, %	Minimum 50% at 5,000 h QUV-B	*Test in progress*	
11.3	Chalking, Rating	Minimum 6 at 5,000 h QUV-B for white Minimum 8 at 5,000 h QUV-B for colour	*Test in progress*	

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Test Results

Product	:	**Aluminium Composite Panel**
Brand	:	**MBond**
Descriptions	:	**Metallic Silver (9072)**
Product thickness	:	**4 mm**
Alloy thickness	:	**0.50 mm**
Alloy Type	:	**3003**
Temper grade	:	**H16**
Coating type	:	**2 Coats Polyvinylidene Difluoride (PVDF)**
Core Material	:	**PE (Polyethylene Core)**

Test clause : **MS 2571: 2017 – Clause 6.4 Performance**
Performance of aluminium composite panel shall be consistent with requirements of Table 4a and Table 4b.

Test method : **MS 2571: 2017 Clause 7.10.4 - Cyclic corrosion testing**
ASTM G85-11 Standard Practice for Modified Salt Spray (Fog) Testing

Test exposure condition:

Duration of exposure	:	2000 hours
Cycles	:	2 hours repetitive cycles of 1-hour spray with exposure zone temperature at ambient temperature of 24 ± 3 °C, and 1 hour dry off at 35 ± 2 °C.
Salt solution used	:	0.05% of NaCl + 0.35 % $(NH_4)_2SO_4$
pH of collected solution	:	5.0 – 5.4
Volume of salt collected in ml/h/80 cm²	:	1.2 ml/hr

No.	Test Item	Technical requirements MS 2571: 2017 Table 4a: Exterior	Results	Remarks
12.	Cyclic corrosion testing**, grade [MS 2571: 2017 Clause 7.10.4] Test duration: 2000 hours			
12.1	Blister on cut edges	Minimum Rating 7	*Test in progress*	*Test Results shall be advised upon test completion*
12.2	Blister on test specimen	Minimum Rating 8	*Test in progress*	

Note: *** The grade of failure rating is based on MS 2571:2017 Clause 7.10.4.2 Table 5 & 6*

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Test Results

Product	:	**Aluminium Composite Panel**
Brand	:	**MBond**
Descriptions	:	**Metallic Silver (9072)**
Product thickness	:	**4 mm**
Alloy thickness	:	**0.50 mm**
Alloy Type	:	**3003**
Temper grade	:	**H16**
Coating type	:	**2 Coats Polyvinylidene Difluoride (PVDF)**
Core Material	:	**PE (Polyethylene Core)**
Test clause	:	**MS 2571: 2017 – Clause 6.4 Performance** Performance of aluminium composite panel shall be consistent with requirements of Table 4a and Table 4b.

No.	Test item	Technical requirements MS 2571: 2017 Table 4b: Exterior	Results	Remarks
1.	Flexural strength, MPa [MS 2571: 2017 Clause 7.10.5]	≥ 100	224.81	Pass
2.	Bending elastic Modulus, MPa [MS 2571: 2017 Clause 7.10.5]	≥ 2.0×10^4	11.7×10^4	Pass
3.	Breakthrough resistance, kN [MS 2571: 2017 Clause 7.10.6]	≥ 7.0	9.3	Pass
4.	Shear strength [2], MPa [MS 2571: 2017 Clause 7.10.6]	≥ 22.0	74.0	Pass
5.	Peeling strength, Nmm/mm [MS 2571: 2017 Clause 7.10.7]	Minimum Peeling Strength: ≥ 110	124.28	Pass
6.	Effect of differential temperature [MS 2571: 2017 Clause 7.10.8]			
6.1	Reduction rate of peeling strength, %	≤ 10	[3] – 1.8	Pass
6.2	Adhesion force of coating grade:			
6.2.1	Grid test	0	0	Pass
6.2.2	Circle test	0	0	Pass
6.3	Appearance	No change	No visual change on appearance was observed	Pass

Note: [3] Minus (-) indicates loss of peeling strength; plus (+) indicates gain of peeling strength

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Test Results

Product	:	**Aluminium Composite Panel**
Brand	:	**MBond**
Descriptions	:	**Metallic Silver (9072)**
Product thickness	:	**4 mm**
Alloy thickness	:	**0.50 mm**
Alloy Type	:	**3003**
Temper grade	:	**H16**
Coating type	:	**2 Coats Polyvinylidene Difluoride (PVDF)**
Core Material	:	**PE (Polyethylene Core)**

Test clause : **MS 2571: 2017 – Clause 6.4 Performance**
Performance of aluminium composite panel shall be consistent with requirements of Table 4a and Table 4b.

No.	Test item	Technical requirements MS 2571: 2017 Table 4b: Exterior	Results	Remarks
7.	Thermal expansion coefficient, $°C^{-1}$ [MS 2571: 2017 Clause 7.10.9]	$\leq 4.00 \times 10^{-5}$	0	Pass
8.	Thermal distortion temperature [3], °C [MS 2571: 2017 Clause 7.10.10]	≥ 95	*Test in progress*	*Test Results shall be advised upon test completion*
9.	Boiling water resistance [MS 2571: 2017 Clause 7.10.11]	NA	-	-
10.	Fire rating performance grade [MS 2571: 2017 Clause 7.10.12]	The FR composite panel shall comply with the fire rating requirements as specified in the Uniform Building By Laws	Not applicable to PE core (Polyethylene core material)	
11.	FR panel with 0.4 mm aluminium skin, kg/m^2	Minimum 6.8	Not applicable to PE core (Polyethylene core material)	

Note: [3] Thermal distortion temperature test was conducted by Plastic & Composite Section (PCST) SIRIM QAS Int. Sdn Bhd

SIRIM QAS International Sdn. Bhd.
CHEMICAL & CONSUMER SECTION
Abdul Aziz Haron