

ALPOLIC®/fr TCM
INNOVATION • STYLE • PERFORMANCE

Titanium Composite Material

 **MITSUBISHI PLASTICS**

URL <http://www.alpolic.com>

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Titanium Composite Material

ALPOLIC/fr TCM is a titanium composite panel composed of 0.3mm thick titanium sheet on the topside, a non-combustible mineral filled core and 0.3 mm thick stainless steel sheet on the backside. Titanium metal quickly forms a stable oxide film (called “passivated film”) at room temperature and is known for its unparalleled corrosion resistance. ALPOLIC/fr TCM is suited to the external claddings and roof coverings of buildings located in highly corrosive environments.

1. Features

ALPOLIC/fr TCM has the following features:

- (1) Flatness: TCM panel has the excellent flatness derived from the continuous laminating process.
- (2) Rigidity: As one of the attributes of composite panels, TCM is rigid and lightweight. TCM 4mm is equivalent to titanium 3.1mm thick in rigidity. Titanium is a lightweight metal, but further weight reduction is possible with TCM.
- (3) Corrosion resistance: The topside titanium has the unparalleled corrosion resistance. It will not rust as far as it is used for external claddings and roof coverings, wherever the building locates.
- (4) Fire safety: The core has the same contents as ALPOLIC/fr, and TCM has a fire approval for exterior and interior uses in Japan.



Taipei Arena, Taipei, Taiwan
TCM is used for the external cladding underneath the roof.

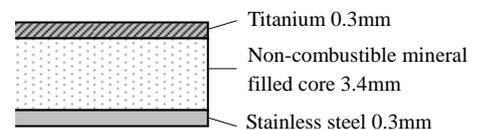
Note on processing method: To cope with the low machinability of titanium and stainless steel, we need special machines and tools for cutting and grooving TCM panels. Refer to “6. Processing method” below.

2. Material composition

ALPOLIC/fr TCM is composed of non-combustible mineral filled core sandwiched between 0.3mm thick titanium on the topside and 0.3mm thick stainless steel on the backside.

- Topside skin: 0.3mm thick titanium sheet, pure titanium for industrial use, JIS Type 1 or equivalent
- Core material: Non-combustible mineral filled core
- Backside skin: 0.3mm thick stainless steel sheet, NSSC220M, a highly rust-resistant ferric stainless steel.

Material composition



Total thickness: 4mm

- 3. Surface finish: Dull Finish

TCM, Dull



4. Panel dimension and tolerance

- Panel thickness: 4mm

Standard panel size Width: 1000mm^{Note}
 Length: Less than 5000mm

Note: 1219mm wide product is available upon request. Contact local distributors or our office.

Product tolerance Width: +/-2.0mm
 Length: +/-4.0mm
 Thickness: +/-0.2mm
 Bow: +/-0.5% (5mm/m) of the length and/or width
 Square-ness (diagonal difference): Maximum 5.0mm

5. Characteristics

(1) Physical properties

	Method	Unit	TCM 4mm
Specific gravity	-	-	2.3
Weight	-	kg/m ²	9.3
Thermal expansion	ASTM D696	×10 ⁻⁶ /°C	10.4
Thermal conductivity	ASTM D976	W/(m.K)	0.40
Thermal resistance	ASTM D976	m ² .K/W	0.16
Deflection temperature	ASTM D648	°C	112

(2) Mechanical properties of composite material

	Method	Unit	TCM 4mm
Tensile strength	ASTM E8	MPa, N/mm ²	69
0.2% proof stress	ASTM E8	MPa, N/mm ²	60
Elongation	ASTM E8	%	11.1
Flexural elasticity, E	ASTM C393	GPa, kN/mm ²	49.0
Flexural rigidity, E×I	ASTM C393	k N.mm ² /mm	265
Punching shear resistance			
Shear resistance	ASTM D732	MPa, N/mm ²	48

(3) Impact resistance by Du-pont method

Steel ball weight, kg	Height, mm	Dent depth, mm
0.3	300	0.5
0.5	500	1.1
1.0	300	1.2
1.0	500	1.6

(4) Mechanical properties of skin metals

	Method	Unit	Skin metals
Topside: Titanium			
0.2% proof stress	ASTM E8	MPa, N/mm ²	162
Flexural elasticity	ASTM C393	GPa, kN/mm ²	106
Backside: NSSC220M			
0.2% proof stress	ASTM E8	MPa, N/mm ²	295
Flexural elasticity	ASTM C393	GPa, kN/mm ²	201

(5) Sound transmission loss

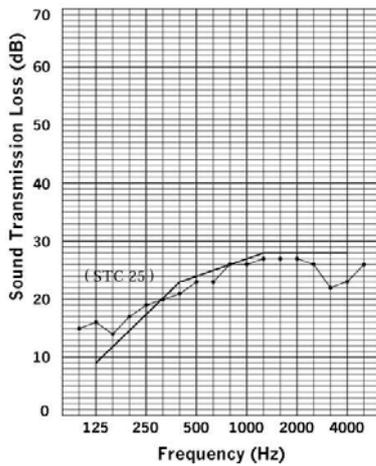
The chart shows the airborne sound transmission loss measured on TCM 4mm. The STC (sound transmission

class) is 25dB in accordance with ASTM E413.

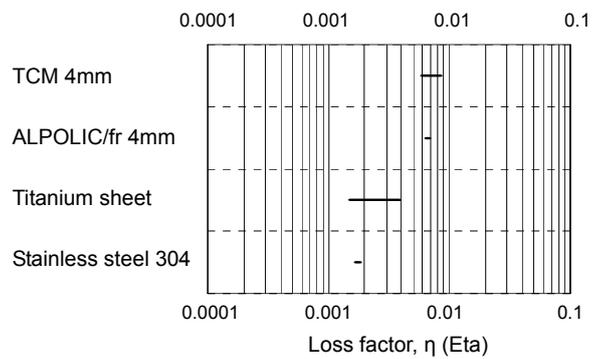
(6) Vibration damping

TCM has a vibration damping effect that absorbs the vibration energy by converting it into thermal energy. The chart shows vibration damping property in accordance with JIS G 0602.

Sound transmission loss



Vibration damping property



(7) Fire performance

In Japan, TCM is approved as a non-combustible material for exterior and interior surfaces, based on the fire test results of the heat release test (ISO 5660-1) and the gas toxicity test. The tests done in accordance with the UK and USA standards are only general tests for building materials, but TCM is virtually approved as an eligible material for external claddings and roof coverings in most countries on the basis of the extensive fire test results on ALPOLIC/fr. TCM 4mm has passed the following fire tests.

Country	Test standard	Result & Classification
U.K.	BS476 Part 6 BS476 Part 7	Class 0 Class 1
U.S.A.	Tunnel test (ASTM E-84)	Class A/Class 1
Japan	Heat release test (ISO 5660-1) & gas toxicity test	Non-combustible material. Certificate No. NM-0229

6. Processing method

The machinability of titanium and stainless steel is low, and we need special machines and tools for cutting and grooving TCM panels. We recommend the following processing methods for TCM:

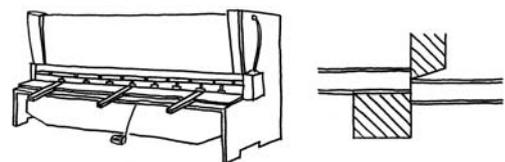
(1) Cutting

Use square shear for straight cutting. Small clearance (0.1mm or less) and 1°30' rake angle is suitable. Comparatively large droop appears at cut edge.

We can also use CNC router for cutting TCM panels.

Complicated cutting as well as straight cutting is possible with CNC router. Use square end mill made of ceramic-coated super hard alloy.

Cutting by shear



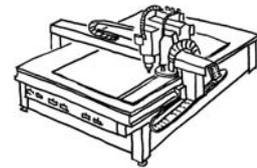
Note: Panel saws and regular circular saws are not suitable for TCM panels.

(2) Grooving

Use CNC router for grooving TCM panels. Firstly, cut the backside skin with square end mill, and secondly, remove the core with regular carbide-tipped bit. And then we obtain the V-shaped groove shown in the diagram. Use a square end mill made of ceramic-coated super hard alloy to cut the backside skin. We can also use V-cut machine (planer) for stainless steel sheet for grooving TCM panels.

Note: Panel saws equipped with V-cutter are not applicable to TCM panels.

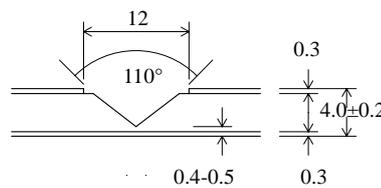
CNC router



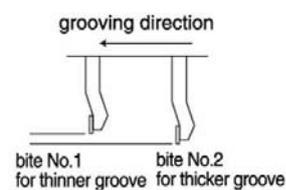
Grooving with CNC router



V-groove by CNC router



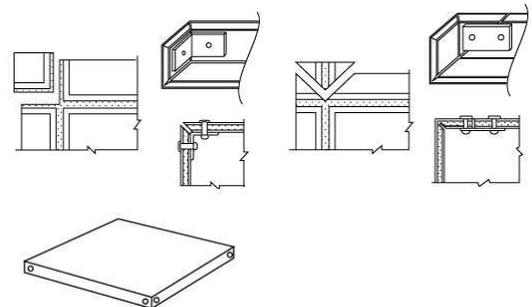
Grooving by V-cut machine (planer)



(3) Folding and assembly

We can fold V-grooved panels with a folding jig in the same manner as ACM panels. To produce a tray type panel (rout & return panel), we normally groove the panel at 25mm from edges, remove the four corners by notching tool and fold the four sides. After assembly, the corners are sealed with sealant from backside to prevent from water penetration, if necessary.

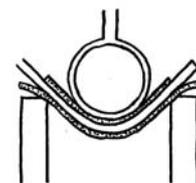
Folding & assembly after grooving



(4) Bending with press brake

We use press brake or 3-roll bender for bending. In bending with press brake, use a top die having almost the same radius as the final bending radius. The smallest bendable limit is approx. 100mmR. In bending with press brake, edges tend to extend like a saddle. Confirm the curved shape with pre-testing.

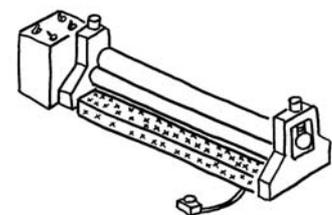
Bending with press brake



(5) Bending with 3-roll bender

We can use 3-roll bender for curving TCM panels. The smallest bendable radius is approx. 200mmR. The gap between rolls should have some allowance (0.3-0.5mm) in order not to constrict TCM panel between rolls.

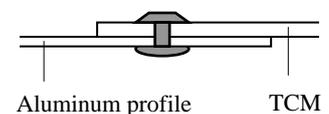
3-roll bender



(6) Joining with accessories - in terms of galvanic corrosion

If dissimilar metals are used for assembly, we have to design the panel detail to prevent the dissimilar metals from galvanic corrosion. Titanium and stainless steel are noble metals in corrosion potential, and it is likely that the less noble metal corrodes with galvanic corrosion in a moist condition. Use rivet and bolt/nut made of stainless steel for joining. Use angle and flange made of stainless steel for accessory, if possible. When aluminum extrusions are used for accessory, insulate the aluminum surface electrically with anodizing or paint coating.

Joining with accessory



(7) Safety precautions on fabrication work

- a. The panel edge is as sharp as a knife. Wear gloves for safety in handling TCM.
- b. During working with CNC router, wear safety glasses for protection of eyes.

7. Cleaning

The topside titanium will not rust as far as TCM is used for external claddings or roof coverings. But staining will be caused by various factors and will accumulate on titanium surface. Therefore, we have to do cleaning with a procedure suitable for each staining. Refer to the separate cleaning manual.

8. General notes

(1) Optical difference by direction

TCM shows optical difference between directions, as metallic-paint colors do. Therefore, it is important to arrange TCM panels in the same direction to avoid the optical (color) difference.

(2) Color variation among production lots

It is possible that the color of TCM slightly varies among production lots and the inconsistent colors are visible after installation. This is caused by a slight color difference between titanium coils. In order to prevent this problem, we recommend placing the total requirement in one order or allotting the panels with a grouping arrangement.

For further information, please contact:

mitsubishi plastics, inc.
Industrial Materials Division
Composite Materials Department
2-2, Nihonbashi Hongokucho 1-chome
Chuo-ku, Tokyo 103-0021 Japan
Telephone: 81-3-3279-3064 / 3065
Facsimile: 81-3-3279-6672
E-mail: mks-ho-alpolic@cc.m-kagaku.co.jp

MITSUBISHI CHEMICAL FP AMERICA, INC.
Composite Materials Division
401 Volvo Parkway, Chesapeake, VA 23320
Telephone (USA): 800-422-7270
Telephone (International): 1-757-382-5750
Facsimile: 1-757-436-1896
E-mail: info@alpolic.com

MITSUBISHI CHEMICAL SINGAPORE PTE LTD
Composite Materials Department
79 Anson Road, #12-01 Singapore 079906
Telephone: 65-6226-1597
Facsimile: 65-6221-3373
E-mail: SIN0027@cc.m-kagaku.co.jp

Distributed by:

MITSUBISHI PLASTICS, INC.
Turkey Liaison Office
Baglarbasi Kisikli Cad., No:4, Sarkuysan-Ak Is Merkezi,
S-Blok, Teras Kat, Altunizade, Uskudar, 34664 Istanbul, Turkey
Telephone: 90-216-651-8670/ 71/ 72
Facsimile: 90-216-651-8673
E-mail: info@alpolic.com.tr

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