

Technical Manual

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Section 1 Outline

ALPOLIC[®] is an Aluminum Composite Material (ACM) for the construction industry worldwide. It is not only a reasonable alternative to solid aluminum sheet, but also an individual material characterized by its own unique features. Its lightweight, high rigidity, excellent flatness and long lasting coating qualities are just what the construction industry has been looking for.

ALPOLIC[®]/fr is a fire-retardant ACM which has an improved core, and meets the fire-safety requirements for external claddings in most countries. Today, ALPOLIC[®]/fr is the external cladding material of choice, ensuring fire safety without losing the original features of ALPOLIC[®].

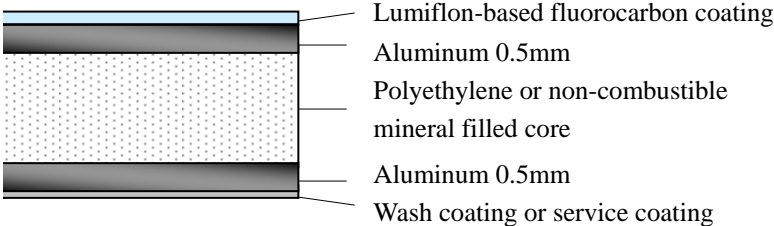
Both ALPOLIC[®] and ALPOLIC[®]/fr are often simply referred to as “ALPOLICs” or “ALPOLIC products” in this brochure, if the context is applicable to both products. We will use the respective ALPOLIC or ALPOLIC/fr, if we need to mention each of them separately.

1. Material composition

ALPOLIC is composed of thermoplastic core of low-density polyethylene sandwiched between two skins of 0.5 mm thick aluminum. ALPOLIC/fr is composed of a non-combustible mineral core with a small amount of low-density polyethylene sandwiched between two skins of 0.5 mm thick aluminum. The core of ALPOLIC is black in color while that of ALPOLIC/fr is white or gray containing a non-combustible mineral. Thus, we can discern each product by appearance. The total thickness is 3, 4 and 6 mm.

Topside of ALPOLICs is finished with a paint called Lumiflon-based fluorocarbon paints as standard and backside is finished with a thin polyester coating (wash coating) or a service coating. The topside is covered with a protective film.

Fig. 1-1 Composition of ALPOLIC and ALPOLIC/fr

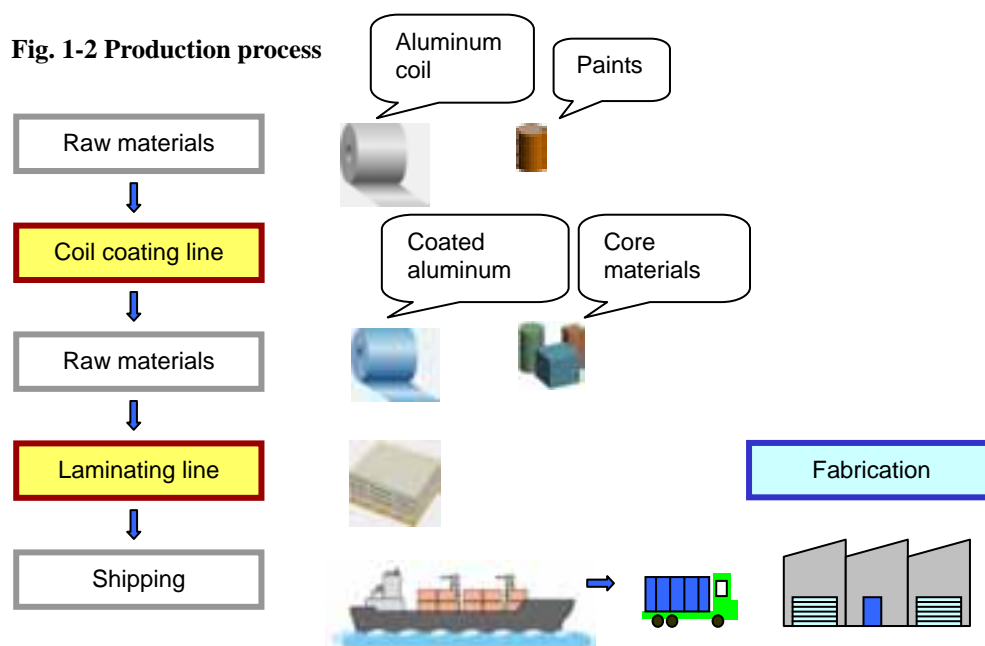


Total thickness: 3, 4 and 6mm

2. Production process

The production process of ALPOLICs consists of two production lines: a coil coating line and a laminating line. In the coil coating line, Lumiflon-based fluorocarbon paints are applied to continuous aluminum coils. In the laminating line, the low-density polyethylene or the mineral-filled core is laminated between two coated coils, resulting in the finished composite material.

After laminating, the finished products are packed in wooden cases and shipped to customers' workshops. Thus, ALPOLIC products are shipped as flat panels and processed in local workshops according to project drawings.



3. Features

ALPOLICs have a number of unique features:

Flatness: The continuous laminating process results in excellent flatness of the panel.

Color uniformity: The coil coating process ensures complete color consistency.

Rigidity: As one of the attributes of ACM, ALPOLICs are light and strong sheet materials, reducing the weight by 15% (ALPOLIC/fr) to 40% (ALPOLIC) compared to solid aluminum sheets with equivalent rigidity.

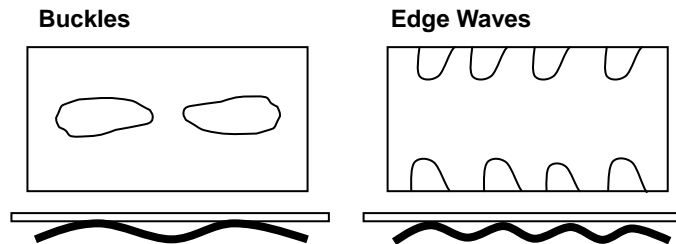
Workability: ALPOLICs are easy to cut, bend, groove and shape with regular aluminum working and woodworking machines and tools.

Fire safety: With its non-combustible mineral-filled core, ALPOLIC/fr meets fire code requirements in most countries including North America and Japan without any restrictions.

(1) Flatness

ALPOLICs are very flat. Generally speaking, ensuring the flatness of sheet materials is not easily realized. Solid aluminum sheet, for example, has a slight distortion stemming from its rolling process: buckles, edge waves and overall warping are common. ALPOLICs are extremely flat due to the thinness of the aluminum sheets (0.5mm) and our lamination process in which most of such distortions are eliminated.

Fig. 1-3 Distortions often found in aluminum sheets (Excerpt from ISO standard)



(2) Rigidity

ALPOLICs are highly rigid compared to solid aluminum metal sheets. As shown in the diagram below, two sheets of aluminum skin behave like a small H-section when pressure is applied on the panel. Consisting of 2 sheets of 0.5mm thick aluminum, ALPOLICs 4mm thick deliver the rigidity equivalent to an aluminum sheet of 3.3mm thick.

Fig. 1-4 Rigidity of ACM

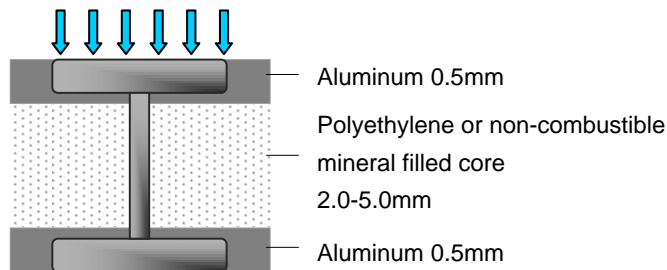


Table 1-1 Comparison of rigidity between ALPOLICs and solid aluminum sheet

Material	ALPOLICs		Solid aluminum sheet		Weight ratio Solid aluminum =100%
	Thickness mm	Weight kg/m ²	Equivalent thickness, mm	Weight kg/m ²	
ALPOLIC/fr	3	6.0	2.7	7.3	82%
	4	7.6	3.3	8.9	85%
	6	10.9	4.5	12.2	89%
ALPOLIC	3	4.6	2.7	7.3	63%
	4	5.5	3.3	8.9	62%
	6	7.4	4.5	12.2	61%

Note 1 How to read the above table: ALPOLIC/fr 3mm is equivalent to aluminum sheet 2.7mm in rigidity. Hence, the weight percent of ALPOLIC to solid aluminum is 82%.

Note 2: ALPOLIC/fr is heavier in weight than ALPOLIC due to the non-combustible mineral content in the core.

(3) Workability

The workability of ALPOLICs is one of its outstanding features. It can be cut with circular saws. It can be folded after grooving with a groove cutter or a router. It can be bent with a 3-roll bender and press brake. For joining, we can choose the most suitable method from several alternatives. For details, refer to Section 3 “Fabrication and installation.”

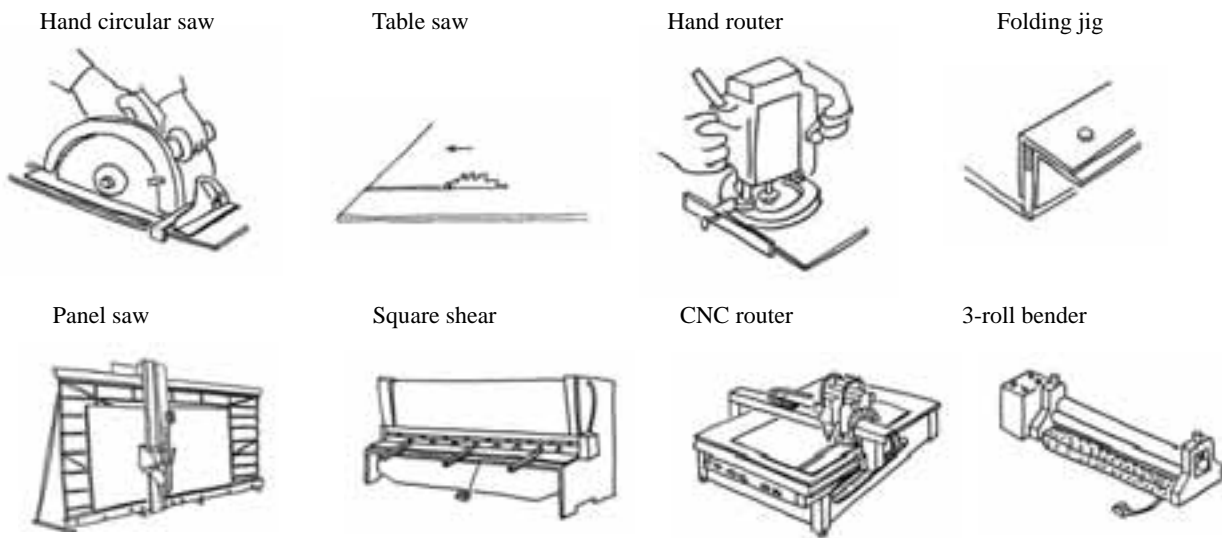


Fig. 1-5 Tools and machines used for processing ALPOLICs

(4) Fire safety

ALPOLIC/fr is a fire-safe material which passes mandatory requirements for exterior and interior in most countries. Though the core material does contain a small amount of combustible polyethylene, the main ingredient of the non-combustible mineral does not permit the proliferation of flame and restricts the development of smoke detrimental to evacuation activities.

ALPOLIC, on the other hand, is composed of two aluminum skins which retard the spread of fire. Extensive fire tests have been performed on both ALPOLIC and ALPOLIC/fr in accordance with requirements in various countries. Refer to Section 2 “Characteristics” for details.

Example of fire test for exterior



Example of fire test for roof



Example of fire test for interior



Fig. 1-6 Examples of fire tests applied to ALPOLIC/fr

4. Surface finishes

(1) Lumiflon-based fluorocarbon coating

ALPOLICs have a coating finish of Lumiflon-based fluorocarbon paint as standard. This paint is known for its high performance in outdoor applications.

Since long ago, polyester, acrylic and polyurethane paints have been popularly used for building industries. These conventional paints are easy to apply and less costly. But if we use these paints for outdoor applications like external claddings, the coatings will show deterioration in appearance during outdoor exposure and will require re-coating every several years.

Fluorocarbon coatings are very durable and they will last much longer time in outdoor applications without such deterioration. In fluorocarbon paints, two types of resins are commercially available: Lumiflon and PVDF. Among the two types of fluorocarbon paints, Lumiflon type is wider in color range, easier to repair, and adjustable in a wider gloss range, between 15 to 80%. The following table shows general comparison between conventional paints, PVDF paint and Lumiflon paint.

Note 1: Lumiflon-based fluorocarbon coating has a coating warranty for 10 years.

Note 2: ALPOLICs are finished with Lumiflon-based fluorocarbon paint as standard, but polyester and other coatings are also available as an option. Refer to “Appendix 2: Optional coatings” in Section 4.

Table 1-2 General comparison between conventional paints and fluorocarbon paints

Paint type	Conventional paints (such as polyester paint)	Fluorocarbon paints	
		PVDF (Kynar)	Lumiflon
Weatherability	3-5 years	20 years	20 years
Gloss	25 - 90 %	25 - 35 %	15 - 80 %
Color Range	Wider	Limited	Wider
Repair coating	Can be done	Difficult	Can be done
Pencil hardness	2H	F	H
Bendability	2T	1T	2T

(2) Consistent coating quality

Consistent coating quality is maintained through the continuous application of paints to the aluminum coil in the coil coating line. The “Die Coating” process that occurs on this line employs a unique technology developed by Mitsubishi Plastics that ensures a smooth, fine coating.

Coated coil



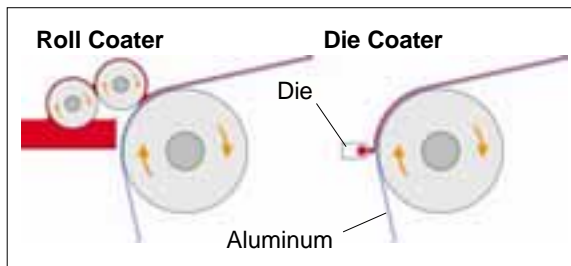


Fig. 1-7 Roll Coater and Die Coater

Roll Coaters are widely used in the aluminum industry and produce an adequate quality with reasonable efficiency. But Die Coater excels Roll Coater, permitting direct coating on aluminum surface that ensures smoother and finer finishes without grain lines.

(3) Color variation

Lumiflon-based fluorocarbon coating has four types of colors: Solid (Enamel) Colors, Metallic Colors, Sparkling Colors, Prismatic Colors, and NaturArt Series like Stone, Timber, Metal, and Abstract images. Refer to the Color Chart for the standard colors. All types of colors are produced in our continuous coil coating line with Lumiflon-based fluorocarbon paints. In addition to the standard colors in the Color Chart, custom colors are available, subject to the minimum quantities and color match. Contact local distributors or our office for custom color request.

Fig. 1-8 Example of each color type



(4) NaturArt Series (Stone, Timber, Metal, & Abstract)

NaturArt Series was developed as an alternative to natural granites, timbers, metals, and abstract images. The patterns are produced with a unique image transfer process. The paints are applied to the aluminum coil in our coil coating line with the Lumiflon-based fluorocarbon paint. While these finishes are highly decorative, they have the same coating performance as that of our plain color products like Solid, Metallic, Sparkling, and Prismatic Colors.

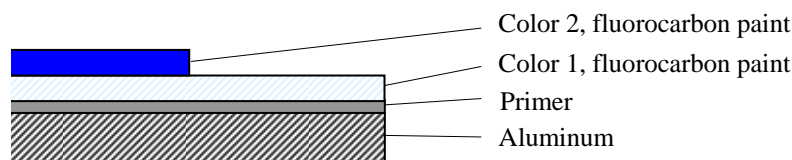
Fig. 1-9 NaturArt Series, Pink Granite



(5) 2 to 3-color coating

2 to 3-color coating is available with ALPOLICs, in which two separate colors are coated on one panel. Clear interface between colors is accomplished in 2 to 3-color coating of ALPOLIC, stemming from Die Coating.

Fig. 1-10 Coating system of 2-Color Coating



(6) Touch-up paint

We can use Lumiflon-based touch-up paints when we need to repair scratches during fabrication and installation. But please be aware that touched-up portions may not completely match the original finish in appearance. Especially in Metallic, Sparkling, and Prismatic Colors, even an exactly matched paint may show a slightly different appearance. In NaturArt Series (Stone, Timber, Metal, and Abstract), we use an intermediate solid color diluted with a clear paint for touch-up. Refer to “9. Touch-up coating method” in Section 3 and “Appendix 9: Touch-up coating method” in Section 4 for details.

(7) Paint options

Apart from the above Lumiflon-based fluorocarbon paints, we can supply ALPOLICs coated with the following distinctive paints as an option. Refer to “Appendix 2: Optional coatings” in Section 4 for details.

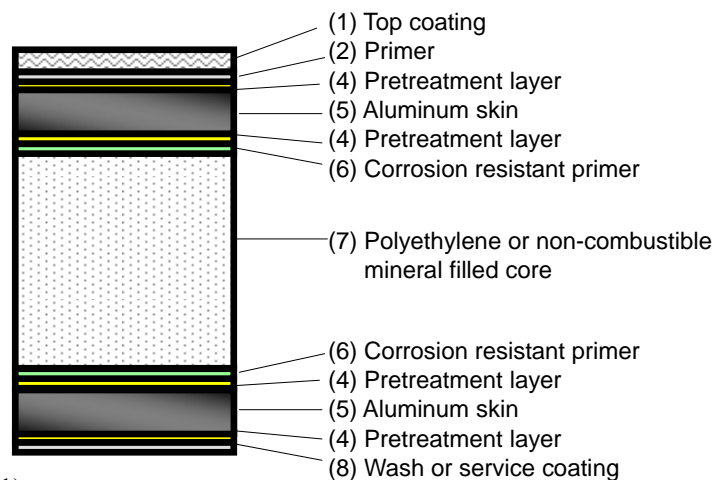
Table 1-3 Paint options other than Lumiflon-based fluorocarbon paints

Coating type	Characteristics	Suitable application
Conductive fluorocarbon coating	Electrically-conductive ($3 \times 10^{7-8}$ ohms)	Interior walls and partitions in factory
PVDF-based fluorocarbon coating	Ultra-weatherability	Outdoor (external cladding, roof)
Polyester coating	Matte finish	Interior and light outdoor applications
High cross-link polyester coating	High hardness (4H) High reflectivity (80%)	Interior lining of tunnels and pedestrian underpass

5. Prevention from edge corrosion

The integrity of lamination between the aluminum skins and the core is strictly controlled to maintain the adequate value in ALPOLIC products. But, when Aluminum Composite Materials (ACMs) are used in a corrosive atmosphere, corrosion normally takes place at the cut edge and tends to penetrate inside, finally resulting in de-lamination between the aluminum skins and the core material. To protect from this type of corrosion, ALPOLICs feature a corrosion resistant primer (layer (6) in Fig. 1-11) behind aluminum skins.

Fig. 1-11 Cross-section of ALPOLICs



Although protected by the primer, to enhance long-term durability we still recommend that the cut edge is not exposed to corrosive or outdoor atmosphere. If it is likely that the cut edge will be continuously exposed to moist conditions, a suitable corrosion protection will be necessary in the panel design or the fixing detail.

6. Thermal expansion/contraction

ALPOLICs have the same linear thermal expansion coefficient as aluminum metal, so movement will not occur between aluminum accessories and ALPOLICs due to thermal expansion/contraction. But a certain amount of movement will occur with steel and concrete, because the thermal expansion of steel and concrete is smaller than that of ALPOLICs. This movement is normally very small (approx 1.0mm/m), but it should be relieved with a suitable method such as relieving with loose holes.

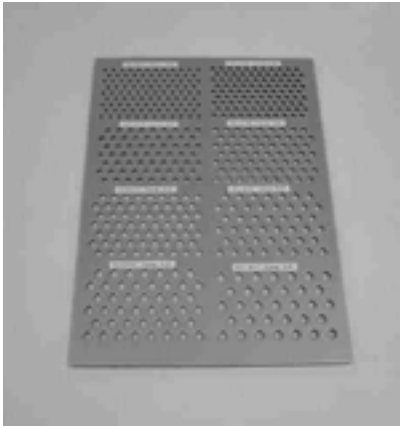
Table 1-4 Thermal expansion/contraction:

Material	Linear thermal expansion coefficient, /°C	Elongation or shrinkage per 1 meter per 50°C
ALPOLIC/fr	24×10 ⁻⁶	1.2 mm
ALPOLIC	24×10 ⁻⁶	1.2 mm
Aluminum	24×10 ⁻⁶	1.2 mm
Steel	12×10 ⁻⁶	0.6 mm
Stainless steel (304)	17×10 ⁻⁶	0.9 mm
Concrete	12×10 ⁻⁶	0.6 mm
Glass	9×10 ⁻⁶	0.5 mm
Acrylic sheet	70×10 ⁻⁶	3.5 mm

7. Perforated panel

Perforated panels of ALPOLICs have a pattern of holes at regular intervals. This provides ventilation and permits vision through the panel. Refer to “Appendix 3: Perforated panel” in Section 4 for details.

Fig. 1-12 Perforated panel and application example



Railway station outside Tokyo

8. Examples of applications

ALPOLIC/fr is widely used for external claddings and some interior surfaces, while ALPOLIC is used mainly for signage. Both materials are also used for civil work and other miscellaneous applications. The following projects are outstanding examples of applications of ALPOLICs.

(1) External cladding

Airport building



Taipei CKS II Airport, Taipei, Taiwan

Commercial building



Bin Suqat Shopping Centre, Dubai, UAE

Factory building



LKT Precision Engineering Factory, Penang, Malaysia

Hospital building



CJW Medical Center-Chippenham Campus, Richmond, VA, USA

Hotel building



Cornelia Deluxe Resort Hotel, Antalya, Turkey

Office building



Shinawatra Building,
Bangkok, Thailand

Office building



126 Philip Street -
Deutsche Bank Place,
Sydney, Australia

Public building



Harbin Science & Technology Hall, Harbin, China

Residential building



Regent Four
Seasons
Apartment,
Jakarta,
Indonesia

School building



Latrobe University, Melbourne, Australia

(2) Interior

Airport interior



Central Japan International Airport, Aichi, Japan

Factory interior



Clean room ceiling system, outside Manila, Philippines

(3) Signage

Petrol service station



Shell Service Station, yellow canopy worldwide

Car showroom



Honda Car Showroom, silver metallic pylon sign, Asian countries

(4) Civil work

Roof of public pathway



Roof of pedestrian passage, Singapore

Bridge cover



Cable cover of bridge, Japan

Underpass



Pedestrian underpass lining, Japan

(5) Housing

Apartment house



Blind panel under balcony handrail, partially perforated panels, Japan

(6) Vehicle

Railway car



Ceiling of a Shinkansen train "Hayate", Japan

Cargo truck



Cargo truck interior wall, Japan

9. Affiliated products

This technical manual pertains to ALPOLIC/fr and ALPOLIC mainly used for external claddings, interior surfaces and signs, but we would like to outline their affiliated products including TCM, SCM, ZCM, ALPOLIC/fr LT, AL-LEADER and A-LOOK. For details, refer to the respective catalogues.

(1) TCM (Titanium Composite Material)

a. General

ALPOLIC/fr TCM is composed of non-combustible mineral filled core sandwiched between 0.3mm thick titanium sheet on the topside and 0.3mm thick stainless steel 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. TCM is suited to the exterior cladding and roofing of buildings located in highly corrosive environments.

b. Product dimension

Thickness:	4mm
Panel width:	1000mm
Panel length:	Less than 5000mm

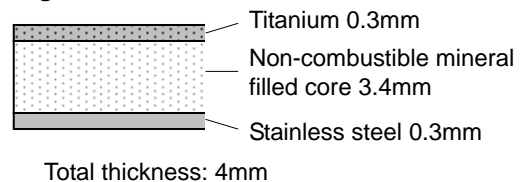
c. Surface finish

Dull finish

d. Notes on processing method

Note 1: To cope with the lower machinability of titanium and stainless steel, we have to use **special cutting and grooving methods** for TCM. We normally use a square shear or a CNC router for cutting,

Fig. 1-13 TCM



Taipei Arena, Taipei, Taiwan

TCM is used for the external cladding underneath the roof.

and a CNC router or a V-cut machine (planer) for grooving.

Note 2: Use stainless steel rivets for assembly. Aluminum rivets, if used for TCM panel assembly, may be corroded with the galvanic corrosion. Refer to the separate TCM brochure for details.

(2) SCM (Stainless Steel Composite Material)

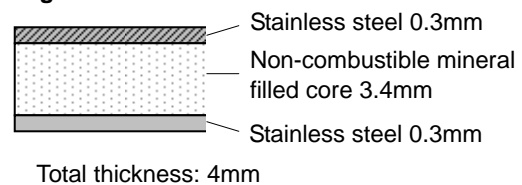
a. General

ALPOLIC/fr SCM is composed of non-combustible mineral filled core sandwiched between two sheets of 0.3mm thick stainless steel. The topside stainless steel of NSSC 220M (similar to SUS445J2, a highly rust-resistant ferric stainless steel) has outstanding rust resistance superior to that of stainless steel 316. SCM is suitable for exterior walls and roofs of buildings.

b. Product dimension

Thickness:	4mm
Panel width:	1000mm
Panel length:	Less than 5000mm

Fig. 1-14 SCM



c. Surface finish

Hairline finish and Dull finish

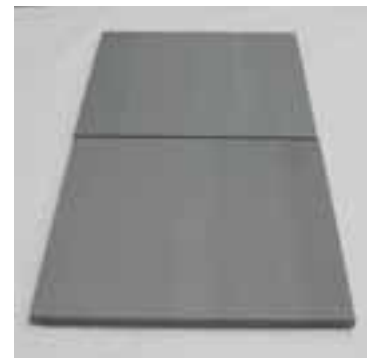
Note 1: (Other surface finishes) For other finishes, please contact local distributors or our office.

Note 2: (Processing method) For processing SCM, use the same methods as those for TCM. Use stainless steel rivets. Refer to the separate SCM brochure for details.

(3) ZCM (Zinc Composite Material)

a. General

ALPOLIC/fr ZCM is composed of non-combustible mineral filled core sandwiched between a chemically-weathered zinc metal on the topside and zinc metal on the backside. The topside zinc alloy is initially weathered with a chemical conversion process, which later develops to a distinctive gray appearance through natural weathering. ZCM is suitable for use in exterior applications such as soffits, awnings, parapets, rain screens, external claddings and roofs.

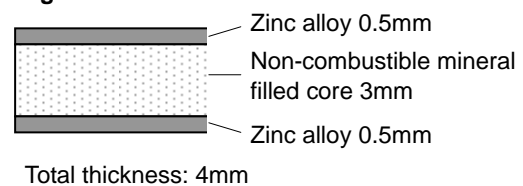


ZCM fabricated samples

b. Product dimension

Thickness:	4mm
Panel width:	965mm
Length:	3708mm

Fig. 1-15 ZCM



c. Composition

ZCM has single grade, namely Z-Z below:

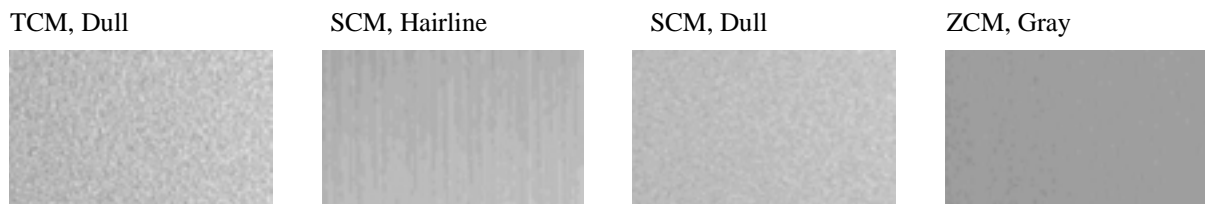
ZCM Z-Z is composed of two pieces of 0.5mm thick zinc alloy and a non-combustible mineral filled core. The core has the same contents as ALPOLIC/fr.

d. Surface finish Gray formed by a chemical conversion in the production line.

e. Note on processing method

We can process ZCM with the same machines and tools that we use for ACM, because the machining performance of zinc metal is quite similar to that of aluminum metal. The working parameters are also the same, as long as the processing method is within the usual range. Please refer to the separate ZCM brochure for details.

Fig. 1-17 Surface finishes of TCM, SCM, ZCM



(4) ALPOLIC/fr LT

a. General

ALPOLIC/fr LT is the new lightweight ACM for use on interior walls, columns, ceilings and partitions in shops, offices and factories, and for such light outdoor applications as soffits, awnings, parapets and signs.

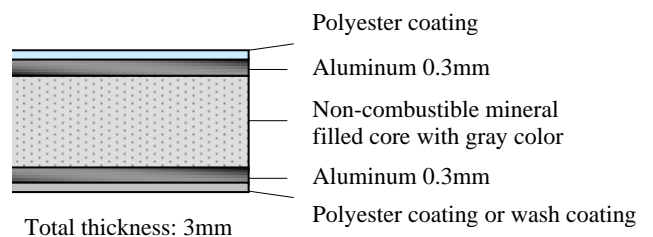
b. Composition

ALPOLIC/fr LT is composed of a non-combustible mineral filled core sandwiched between two skins of 0.3mm thick aluminum. The core, indispensable for fire safety of interior applications, is gray in color, with a touch of carbon black for an aesthetically pleasing cut edge. The effective sides are finished with polyester coatings and covered with translucent protective films.



Keio Railway Shinjuku Station, Tokyo, ceiling

Fig. 1-18 ALPOLIC/fr LT

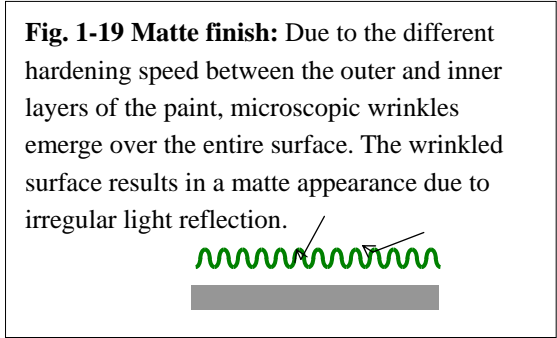


c. Product dimension

- Thickness: 3mm
- Panel size: Panel size: 1220×2440mm in stock
(except Aluminum Hairline P: 914×2438mm)

d. Surface finishes

ALPOLIC/fr LT is available with Solid, Metallic, Stone and Timber finishes. All finishes are polyester coatings produced in our continuous coil coating line. Some of the standard colors are matte finish produced with a new coating technology in which microscopic wrinkles emerge over the entire surface during the baking stage in the coil coating line.



Refer to the separate ALPOLIC/fr LT brochure for details.

Fig. 1-20 Examples of surface finishes of ALPOLIC/fr LT



(5) AL-LEADER™

a. General

AL-LEADER is an ACM that offers a substantial reduction of weight and cost by thinner aluminum skins and the foamed plastic core. It is finished with polyester coatings and has excellent flatness. It is suitable for signboards, guide signs and other facing panels. It is actually used for a wide variety of industrial applications, too.

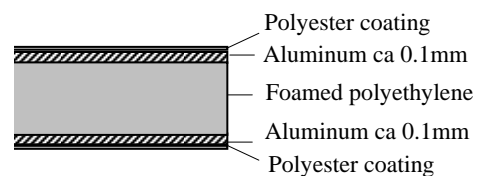


POP indoor sign with AL-LEADER

b. Composition

AL-LEADER is composed of a thermoplastic core of foamed polyethylene sandwiched between two skins of approximately 0.1mm thick aluminum.

Fig. 1-21 AL-LEADER



c. Product dimension

Thickness:	3mm
Panel size:	1220×2440mm

d. Surface finish

EX-White (30% gloss on one surface and 70% gloss on another surface), PC-Black, PC-Silver
All colors are coated with polyester paints in our coil coating line.

Refer to the separate AL-LEADER brochure for details.

(6) A-LOOK®

a. General

A-LOOK is a mirror-effect panel used mainly for interior ceilings. Its mirror effect enables a luminous wide interior space with lightweight and shatterproof panels. For processing, A-LOOK is easy to cut and drill with regular aluminum working and woodworking machines and tools. A-LOOK/fr constructed of fire-retardant core completely meets fire code requirements for interiors in most countries and regions.

Note: We cannot use A-LOOK and A-LOOK/fr in a humid atmosphere like a bathroom and those areas where dew condensation may frequently take place, or areas where cleaning never takes place.

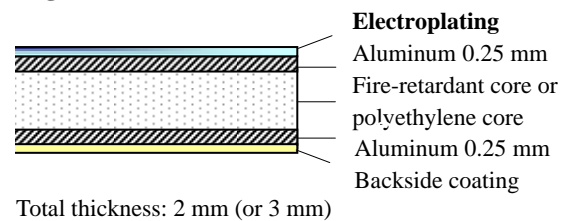


Ceiling in a restaurant

b. Composition

The panel is an aluminum composite material (ACM) composed of two skins of aluminum and the core material. The decorative surface is an electroplating layer.

Fig.1-22 A-LOOK and A-LOOK/fr



c. Product dimension

Thickness: 2mm (or 3mm)

Size: 609×609mm (2'×2'), 609×1219mm (2'×4')

Note 1: 3mm thick is available upon request.

Note 2: 1219×2438mm (4'×8') is available upon request.

A-LOOK Chrome



d. Color Chrome

Refer to the separate A-LOOK brochure for details.

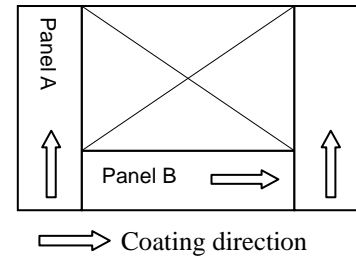
10. Recycling

ALPOLIC and its affiliated materials are 100% recyclable. In our ALPOLIC production plants, we recover both aluminum (and other metals) and the core materials by means of our original recycling system. Furthermore, our ALPOLIC production plants are ISO 14001 approved, and one is designated as a country-wide industrial wastage disposal facility. Therefore, we can take back scraps from customers in Japan for recycling in our facilities under the proper operating standard.

11. General notes (Very important!)

(1) Coating direction

In Metallic Colors, Sparkling Colors, Prismatic Colors and NaturArt Series (Stone, Timber, Metal, and Abstract), slight color differences will be noticeable if the panels are installed in different directions (like Panel A and B in the diagram). Install panels in the same direction as marked in the protective film. In our Solid Colors, any color difference due to coating direction is negligible.



(2) Protective film

The protective film on ALPOLICs consists of two polyethylene layers of white and black. Do not peel off the protective film during fabrication and installation to protect the surface from scratching and soiling. Under normal weather conditions, the protective film will withstand 6 (six)-months of outdoor exposure without losing any of its original peel-off characteristics or causing stains or other damage. However, peel off the protective film as soon as possible after completion.

(3) Gloss increase due to plasticizer

Do not stick, put or apply PVC tapes, polyurethane sealant or modified silicone sealant onto our protective film. The plasticizer contained in these materials can permeate the protective film and cause a gloss change in the coating.

Note: The above precautions pertain to ALPOLIC/fr and ALPOLIC. The affiliated products including TCM, SCM, ZCM, ALPOLIC/fr LT, AL-LEADER and A-LOOK have their respective precautions. Refer to the separate brochure of the respective products for details.

ISO 9001:2008 Certified

The production of ALPOLICs is ISO 9001:2008 compliant throughout the design, development, manufacture and sales.

ISO 14001:

ALPOLICs are produced in plants that have ISO14001 certificate.