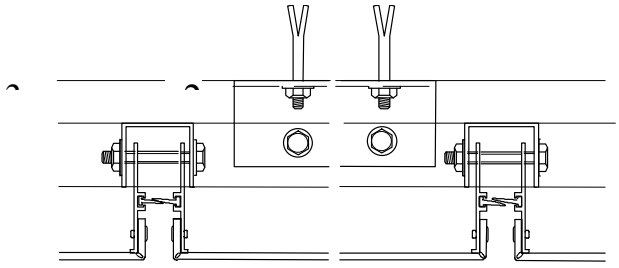
ALPOLIC®/fr

The rigid and bendable composite material with non-combustible mineral filled core

ALPOLIC®/fr for External Cladding



Mitsubishi Chemical Functional Products, Inc.

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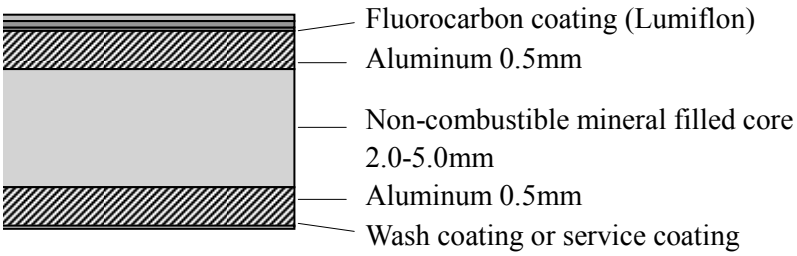
ALPOLIC®/fr is an Aluminum Composite Material (ACM) for construction industry. This brochure was prepared to introduce ALPOLIC®/fr 's unique features as well as furnishing such practical information as fundamentals on design, fabrication method, installation detail and specifications mainly for external claddings for new buildings and retrofit projects.

1. Material composition

ALPOLIC®/fr is composed of core material and aluminum skins. The core material contains a non-combustible mineral and small content of thermoplastic, which ensures high performance of fire safety of this material. The skin is 0.5mm thick aluminum of 3105 H14. The surface is finished with high-performance Lumiflon-based fluorocarbon paint and the back is a wash coating or a service coating.

Composition of ALPOLIC®/fr

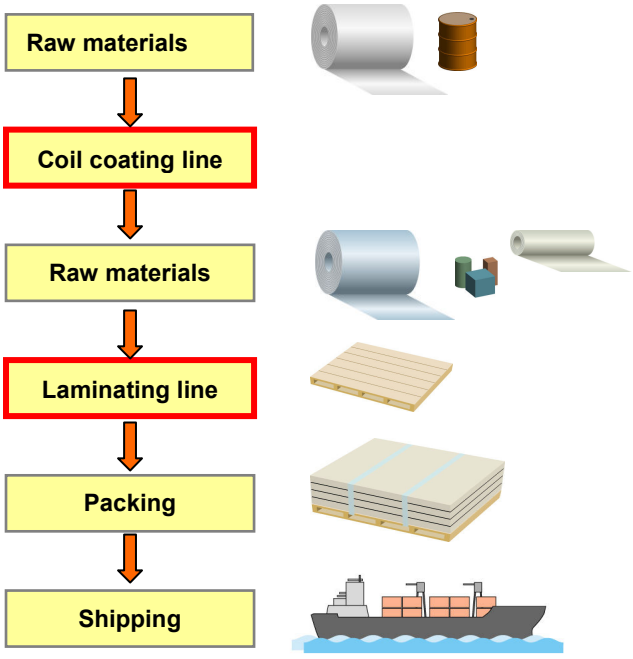


Total thickness: 3mm, 4mm and 6mm

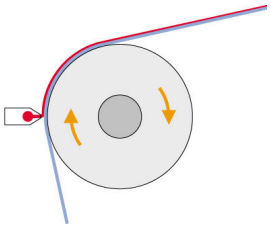
2. Production process

The production process of ALPOLIC®/fr consists of two lines: a coil coating line and a laminating line. On the **coil coating line**, we apply paints continuously to an aluminum coil, permitting consistent coating quality. The "Die Coating" on this line, which is very unique technology developed by Mitsubishi Chemical, ensures a smoother, fine coating. We use high-performance Lumiflon-based fluorocarbon paint for the surface coating, ensuring both high durability and consistent coating quality.

Production process



Die coating



On the **laminating line**, we laminate coated aluminum coils and our core material together, creating a very flat panel of composite material. It used to be very difficult to extrude mineral-filled core, but our

advanced technology has enabled us to produce ALPOLIC®/fr as efficient as ordinary core materials.

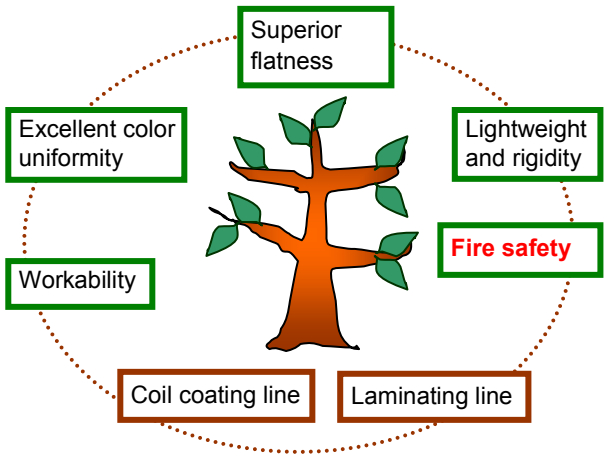
Outline of ALPOLIC®/fr

3. Features

ALPOLIC®/fr has a number of unique features:

Superior flatness: The continuous laminating process results in excellent flatness in ALPOLIC®/fr.
Excellent color uniformity: The coil coating process ensures complete color consistency.
Lightweight and rigidity: A light and strong sheet material with apparent gravity of 1.2 to 1.5, reducing weight by 40% compared with solid aluminum sheets with equivalent rigidity.
Workability: ALPOLIC® is 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 and regions including North America and Japan without any restrictions.

Features of ALPOLIC®/fr

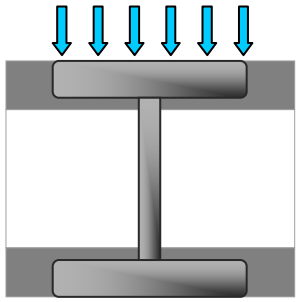


4. Rigidity of ALPOLIC®/fr

ALPOLIC®/fr is highly rigid, especially compared to solid aluminum sheet. Its parallel aluminum sheets behave like a small H-beam when you uniformly distribute pressure loads on the panel. Its tensile strength and rigidity make our aluminum composite material highly attractive to the sign industry.

Compared with solid aluminum panels, the bending strength of ALPOLIC®/fr is high, yet it's lighter by approximately 15% than a solid aluminum panel.

Combined Effect of Aluminum Composite Material



Comparison of flexural rigidity of ALPOLIC®/fr

ALPOLIC®		Solid aluminum		Weight ratio
Thickness (mm)	Weight (kg/m^2)	Equivalent thickness (mm)	Weight (kg/m^2)	Solid aluminum =100
3	6.0	2.7	7.3	82%
4	7.6	3.3	8.9	85%
6	10.9	4.5	12.2	89%

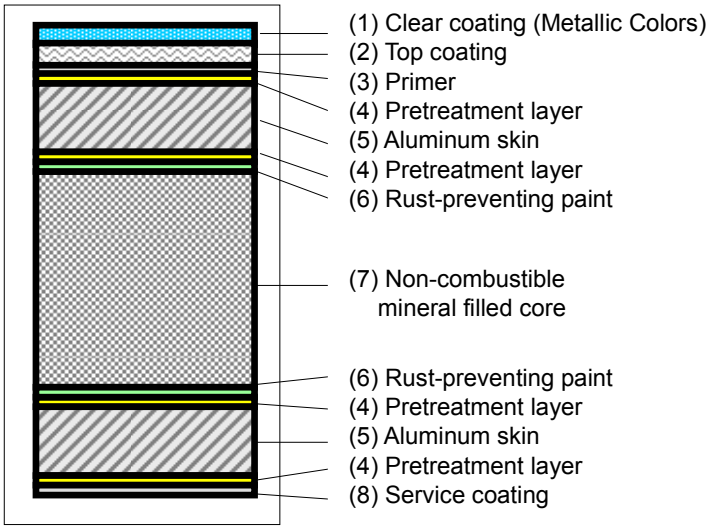
Outline of ALPOLIC®/fr

5. Composition detail of ALPOLIC®

ALPOLIC®/fr is composed of multiple layers. Corrosion normally takes place at the cut edge and tends to penetrate inside. This results in de-lamination between the aluminum skin and core material. To protect the cut edge from this type of corrosion, we apply rust-preventing paint behind the aluminum skins.

We coat the backside with a wash coat or service coat, protecting the backside aluminum from either alkali attack from cement or galvanic corrosion from steel.

Composition detail of ALPOLIC®/fr



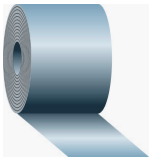
6. Paint finish

(1) Color Variation

The high performance Lumiflon-based fluorocarbon coating for ALPOLIC®/fr is highly resilient. Our four finishes (Solid Colors, Metallic Colors, Sparkling Colors and Stone Series) are available in standard and pre-formulated colors; please refer to our Color Chart for more information. Custom colors are also available for all finish types upon request (subject to respective minimum quantities).

Note: Some custom colors might be very difficult to match due to the availability of paint.

Coated coil



(2) Coating system

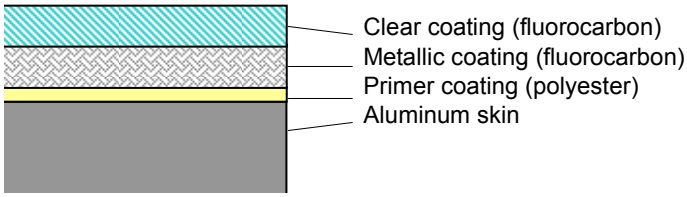
Solid Colors are a two-coat, two-bake system. Total dry film thickness is a minimum of 25 microns.

Metallic Colors and Sparkling Colors are a three-coat, three-bake system. Total dry film thickness is a minimum of 35 microns.

Stone Series is coated with a unique image transfer process. Total dry film thickness is a minimum of 45 microns.

Please refer to “Specifications” for further details.

3-coat, 3-bake system



(3) Coating performance

The Lumiflon-based fluorocarbon paint is known for its high durability. We apply this paint in the continuous coil coating lines for all finish types, and its paint performance complies with the all of the “specifications for coated coil for exterior building applications” issued by both the ECCA (European Coil Coating Association) and the AAMA (American Architectural Manufacturers Association).

(4) Comparison of paint performance

The Lumiflon-based fluorocarbon coating is so durable that it will last much longer with less cleaning frequency under normal atmospheric conditions than such conventional paints as polyester, acrylic and polyurethane paints. Such conventional paints will require re-coating every several years.

Coating warranty:

Lumiflon-based fluorocarbon coating has a coating warranty of 10 years.

7. Stone Series

ALPOLIC®/fr Stone Series was developed as an alternative to natural granite or marble. The stone pattern is produced with a unique image transfer process, and the paints are applied to the aluminum coil in our coil coating line with our Lumiflon-based fluorocarbon paint. While this finish is highly decorative, it has the same coating performance as our Solid Colors, Metallic Colors and Sparkling Series.

ALPOLIC®/fr Stone Series has several unique advantages. Its total weight is only 15% of natural granite. It is both bendable and workable, so curving panels can be produced easily. Available in the same sizes as standard ALPOLIC®/fr, our Stone Series panel size is also superior to natural granite.

Comparison between Granite and ALPOLIC®/fr

		Granite 30mmt	ALPOLIC®/fr 4mmt
Weight	Material	81 kg/m^2	7.6 kg/m^2
	Sub-structure	Alpha	4.8 kg/m^2
	Total	81 kg/m^2+ Alpha	12.4 kg/m^2
Panel size		Not so large	Large (1.5×3.0m or larger)
Bendability		Not bendable	Bendable
Cleaning		Not easy	Easy

8. Fire performance of ALPOLIC®/fr

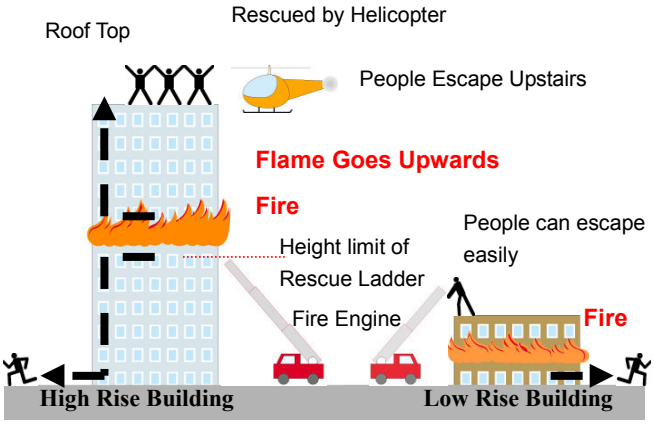
Various types of fire tests are required to examine the fire performance and non-combustibility of building materials. ALPOLIC®/fr has passed the following fire tests around the world:

ALPOLIC®/fr – Summary of Fire Tests

Category	Country	Test Standard	ALPOLIC/fr Specimen	Results & Classification
External Cladding	**United Kingdom**	BS476 Part 7 Part 6	4 mm & 6 mm	Class 0 Class 1
	Germany	DIN4102 Part 1	4 mm & 6mm	Class B1
	USA	British Thermal Unit (NFPA 259-93)	4 mm	Passed
		Climbing Drum Peel Test (ASTM D1781-76)	4 mm & 6mm	Passed
		Tunnel Test (ASTM E-84)	4 mm & 6mm	Class A / Class 1
		Modified ASTM E-108	4 mm	Passed
		UBC 26-9 & NFPA 285, ISMA Test (Intermediate Scale Multi-story Apparatus)	4 mm & 6mm	Passed
	Canada	CAN/ULC-S 134-92, Full-scale Exterior Wall Fire Test	4 mm	Passed
	China	GB8625, GB8626 & GB8627	4 mm	Class B1
	Japan	Heat Release Test for Non-combustible Material (ISO 5660-1)	4 mm & 6 mm	Passed. Certificate No. NE-0001
Roof	**USA**	Fire Test for Roof Covering (ASTM E108)	4 mm	Passed Class A
Fire Resistant Rating Wall	**USA**	1-hr Fire Rating and 2-hr Fire Rating (ASTM E119)	4 mm	Does not impair fire resistant rating wall
Interior	**USA**	Interior Room Corner Test (UBC 26-3)	4 mm	Passed
	USA	Combustion Toxicity Test, New York State Uniform Fire Prevention and Building Code	4 mm	Passed
	Japan	Heat Release Test for Non-combustible Material (ISO 5660-1 & Toxicity Gas Test)	3 - 6mm	Passed. Certificate No. NE-209

(1) Fire tests for external cladding in the U.S.A.

Review the test standards in U.S.A., where material methods have been investigated for years. The greatest concern in external cladding is upward flaming over a vertical exterior wall, particularly in high-rise buildings. US building codes require such tests as the Intermediate-Scale Multistory Apparatus (ISMA) to evaluate fire extension over the external cladding of high-rise buildings in a controlled environment. ALPOLIC®/fr not only passes these tests, but it is also certified to meet US building codes for external cladding without any height restrictions.



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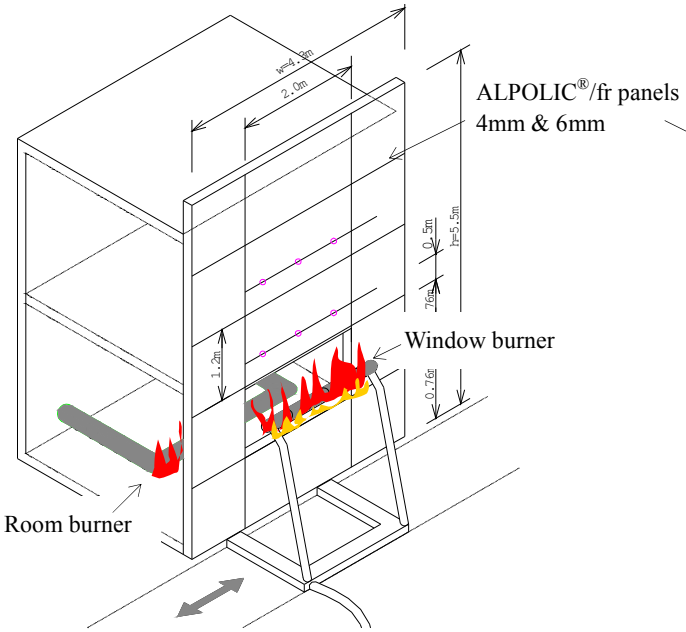
Intermediate-scale Multistory Apparatus (ISMA)

ISMA test apparatus



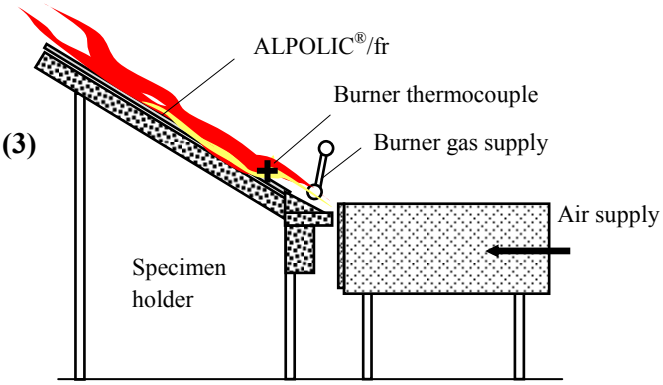
25 minutes after ignition

(2) Fire test for roof covering

ALPOLIC®/fr passes Class A of the ASTM E108, a fire test to examine the non-combustibility of roof coverings. It consists of a burning brand test, an intermittent flame test and a spread of flame test.

Intermittent flame test & spread of flame test

(3)

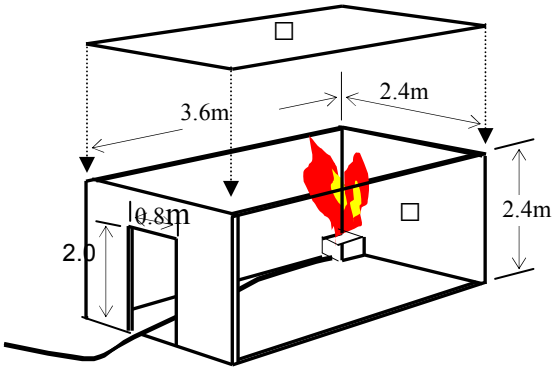


Burning brand test

Fire test for Interior

ALPOLIC®/fr passes the UBC26-3 Room Corner Test, a fire test to verify the hazardous flashover of interior finishing materials.

UBC26-3 Room corner test



Heater: Gas burner or 30lb wood crib
Time: 15 min
The interior is finished with the testing material
(1) Side wall: The area close to the opening can be exempted
(2) Front wall
(3) Ceiling: It is optional

(4) Fire approval in Japan

ALPOLIC®/fr passes Japan's new cone calorimeter test ISO5660-1, a standard fire test for building material classification. It is also approved as a non-combustible material for external cladding, roof covering and interior with Certificate Nos. NE-001 and NE-209.