



LUMIFLON®
FEVE RESIN



• when the standard's just not enough •

AGC Chemicals
Chemistry for a Blue Planet

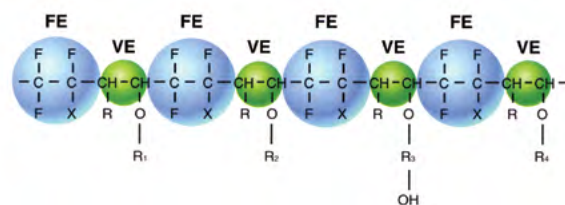
since 1907

LUMIFLON is one of many quality products made by AGC - Asahi Glass Company - established in Japan in 1907. In just over a century, AGC has gone from a small glass company to a diversified, multi-billion-dollar enterprise. AGC first developed its solvent-soluble LUMIFLON fluoropolymer in 1982 - and it didn't take long for manufacturers to discover that this resin was different. LUMIFLON resins allow fluoropolymer coatings to be cured at room temperature. For the first time, the durability, weatherability and long-term cost effectiveness of fluoropolymer coatings were now available for field application. With their superior performance and life cycle cost advantages, it's no wonder fluoro resin paints based on LUMIFLON have since been produced by many manufacturers and applied to more than 150,000 industrial and architectural structures, aircraft and automobiles worldwide.

LUMIFLON is just one of the many innovative products and materials created by AGC, a company that's driven to excel in a high-tech world. But what a difference it makes for manufacturers, designers, and builders who demand the combination of quality and value that only LUMIFLON delivers.

polymer structure of lumiflon

LUMIFLON is known generically as an FEVE resin. Its unique alternating structure is key to its ultra-weatherability.



FE: fluoro ethylene

Durability

VE: vinyl ether

R1=Transparency, Gloss, Hardness

R2=Flexibility

R3OH=Crosslinkability

R4=Pigment compatibility, adhesion

why lumiflon

1 aesthetics:

LUMIFLON-based coatings offer brilliant, long-lasting colors with a wide gloss range. They simply look great - and keep looking great year after year.

2 corrosion prevention:

LUMIFLON's unique chemical structure improves resistance to corrosion from water, oxygen and even chloride ions, ensuring a longer life for industrial structures like bridges with far less need for repainting.

3 sustainability:

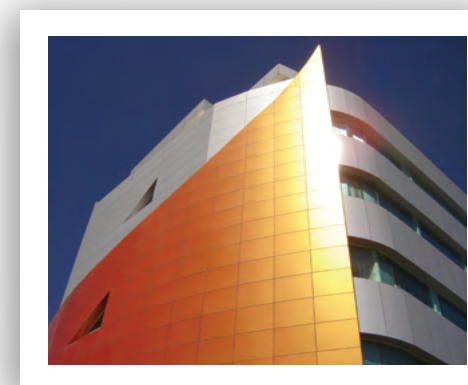
With its long lifespan, LUMIFLON eliminates the environmental impact of repeated repainting and recoating - just one of the reasons LUMIFLON coatings can contribute to LEED certification.

4 outperforms the competition:

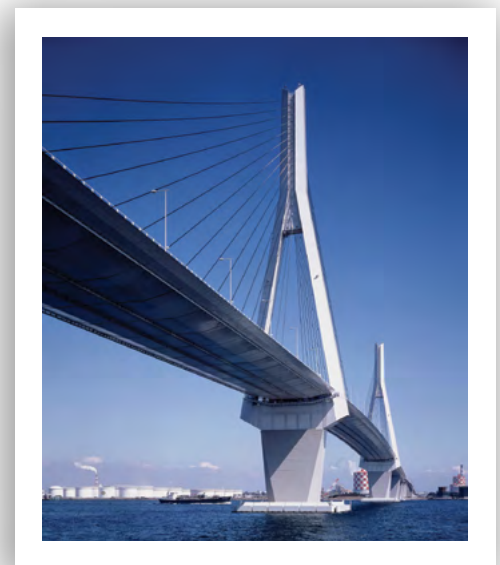
No other coating type can match LUMIFLON's combination of attractiveness, application flexibility and - as tests and studies confirm - long life and weathering resistance.

5 lower life cycle cost:

Because they last so much longer, LUMIFLON-based coatings can substantially reduce any project's life cycle costs, including maintenance costs, replacement costs and recoating costs.



name: coss y leon building, mexico
substrate: aluminum composite material
market: architectural



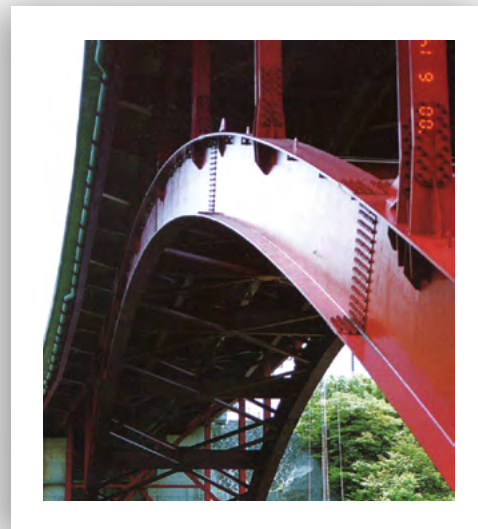
name: tsurumi tsubasa bridge, japan
substrate: concrete, steel
market: industrial maintenance

aesthetics

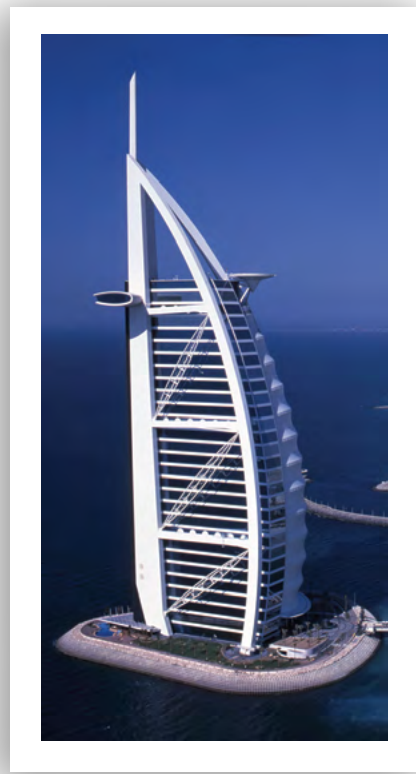
Because LUMIFLON-based coatings offer crisp, clean colors and a wide range of gloss, designers and builders choose them to achieve a superior look from day one. And with LUMIFLON's ability to resist UV degradation, corrosion, and the ill effects of chemical exposure, projects using LUMIFLON continue looking good for years to come with little or no maintenance required. That means markedly less fading, discoloration and chalking for the life of the coating – estimated at up to 60 years! Meanwhile, AGC's research and development team continues to press LUMIFLON's aesthetic advantage with new FEVE resin formulations that add even more improvements, like the ability to resist dirt and grime.

bridge after fourteen years

name: daiichi mukaiyama bridge, japan
 when: 1987
 where: mountain area
 new/repaint: new
 how long: 14 years



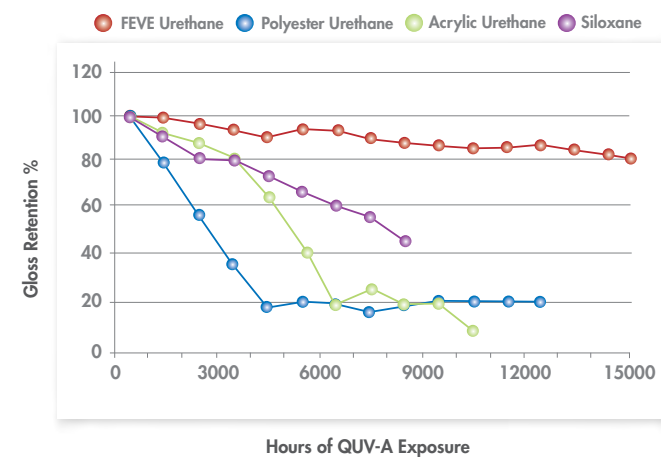
LUMIFLON: gloss retention is still high



name: burj al arab hotel, dubai u.a.e.
 substrate: aluminum composite material
 market: architectural

photo by Satoru Mishima, Nikkei BP

FEVE resin topcoats accelerated weathering QUV-A (ASTM D4587)



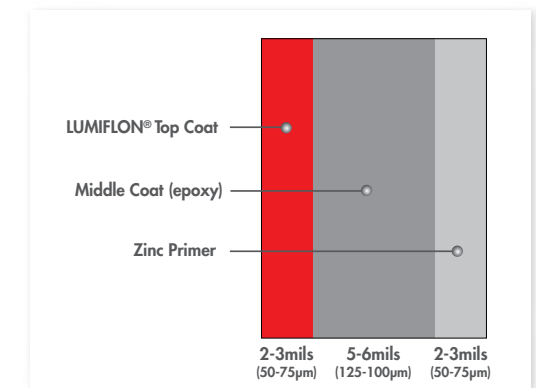
corrosion resistance

Corrosion is a major problem that can dramatically add to a project's life cycle costs, especially for bridges, water towers and other metal structures.

A LUMIFLON-based coating:

- Resists degradation due to weathering and exposure to chemicals
- Over the course of many years, loses little of its thickness
- Keeps corrosion initiators from penetrating the topcoat and degrading the zinc-rich primer underneath
- Has an estimated coating life of 60 years or more

cross section of coating system

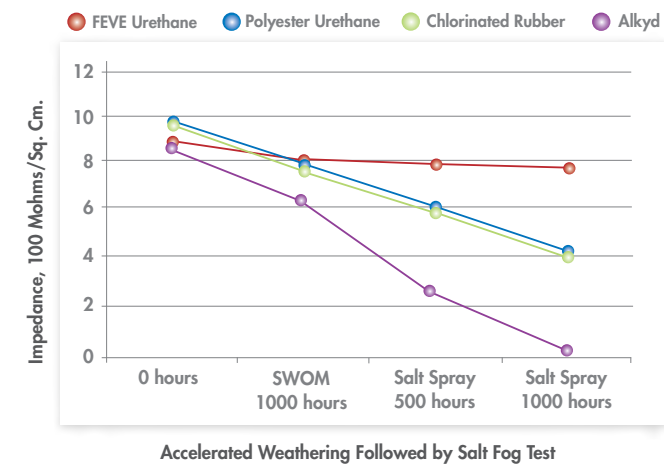


corrosion resistance of LUMIFLON FD-1000: salt fog test

product (NCO index)	LUMIFLON FD-1000 (1.0)	polyurethane dispersion ¹	
		(1.0)	(1.5)
coating system	primer ² /topcoat/topcoat		
salt spray, 1000 hours	good (rating 0)	good (rating 0)	very slight blisters 1mm (rating 1)
salt spray, 1500 hours	good (rating 0)	slight blisters, 1mm (rating 2)	slight blisters 2mm (rating 2)

¹Bayhydrol 145 (Bayer Corp.)
²Waterborne 2K epoxy primer

electrochemical impedance spectroscopy



Corrosion resistance is directly related to the slope of the line. The lower the angle difference from horizontal, the better the corrosion resistance.



name: kiyosu bridge, japan
 substrate: steel
 market: industrial maintenance



name: ntt sekimoku network center, japan
 substrate: steel
 market: industrial maintenance



name: water tower, usa
 substrate: steel
 market: industrial maintenance



name: rosemont water tower, usa
 substrate: steel
 market: industrial maintenance

sustainability

The weatherability, longevity and the ability to formulate low VOC coatings with LUMIFLON resins are all features that contribute to its sustainability, a concept meaning: "to reduce consumption of non-renewable resources, minimize waste, and create healthy, productive environments" (www.gsa.gov).

"Reduce consumption of non-renewable resources"

LUMIFLON coatings can last more than 30 years without fading, reducing life cycle costs related to the maintenance, re-application and/or replacement of underlying surfaces. On existing roofs, a LUMIFLON topcoat can stop the degradation of the underlying reflective coating, thus extending the life and solar reflectance capability of the roof and minimizing the use of raw materials derived from oil.

"Minimize waste"

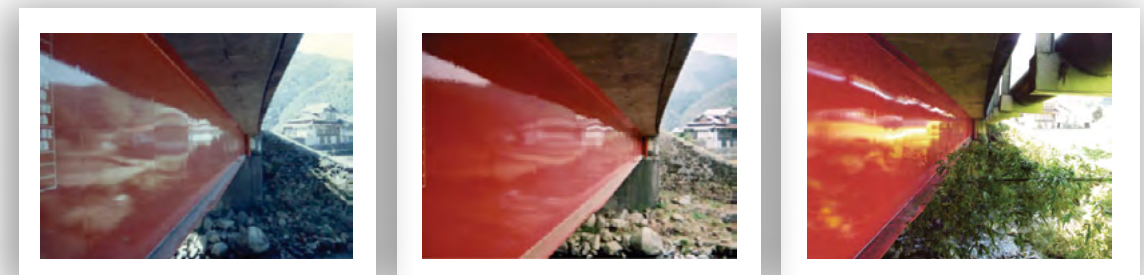
By extending the life of roof and wall systems, LUMIFLON topcoats reduce waste created from disposal of damaged roofing and walls; avoid energy consumption in the production, transportation and installation of new systems; and maintain energy and equipment savings from continued high-performance of the building envelope. In addition, the energy consumed in removing a coating from a building or structure can be avoided through the use of a new paint product containing a LUMIFLON clearcoat with excellent durability and weatherability.

"Create healthy, productive environments"

There are four types of LUMIFLON resins, three of which – solid, powder, and emulsion grades contain either zero volatile organic compounds (VOCs) or can be formulated to contain less than 50 g/L of VOCs, meeting the most stringent green building criteria in the US.

Due to its longevity, LUMIFLON reduces the environmental impact associated with production, transportation (energy consumed, greenhouse gases emitted), and VOCs off-gassed during the repainting/recoating process.

gloss and color retention of tokiwa bridge



october 1988

april 1993

april 2011

initial gloss	final gloss	gloss retention	color change
75	69	91%	$\Delta E=3.5$

outperforms the competition

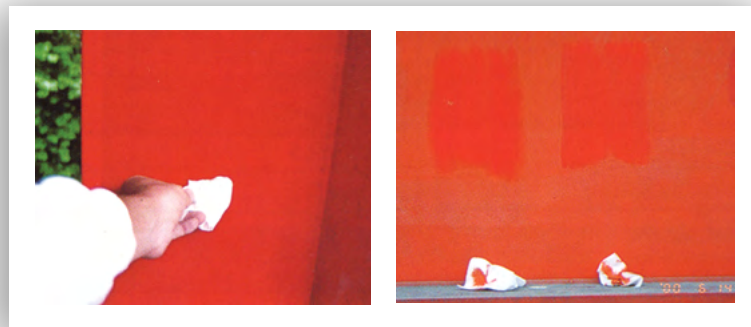
Industry insiders know that, from buildings and bridges to water towers and automobiles, LUMIFLON-based coatings look great. But they look even better when cold, hard data comparing LUMIFLON with high-performance polyesters and other competitors are collected from tests and studies conducted in laboratories, simulators and harsh, real-world environments.

Advantages of FEVE Based Coatings

- Ambient or elevated temperature cure – field or shop applied coatings
- Solvent soluble – clean crisp colors and a wide gloss range
- Versatile – solvent grade, solid, water based and powder coating resins offered
- OH functional – polyurethane chemistry, use standard paint equipment
- Fluoropolymer segments – ultra-weatherable and corrosion resistant
- Longer life cycle – up to 60 years



Alkyd coating is peeling



LUMIFLON coating: no chalking or peeling

Alkyd coating: chalking and color fade have occurred

LUMIFLON vs. pvd f

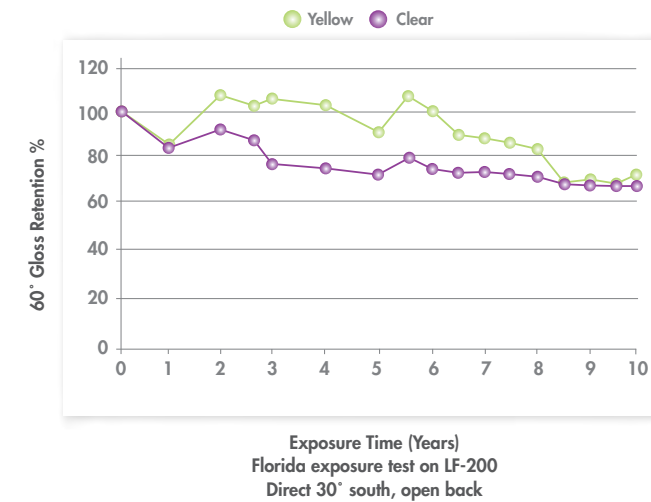
	LUMIFLON	pvd f
resin type	solution	solvent dispersion
curing temperature	room temp. to 230°C	>250°C
60° gloss	5 to 90	5 to 35
color range	>230 colors	color selection is limited
recoatibility	excellent	difficult



name: ferrari world, abu dhabi u.a.e.
substrate: aluminum
market: architectural

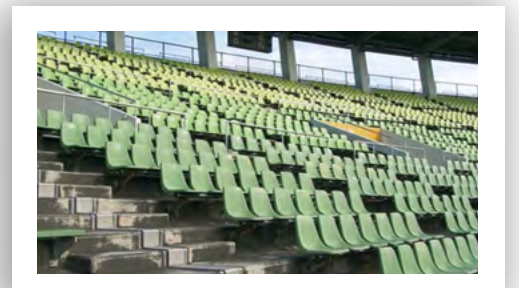
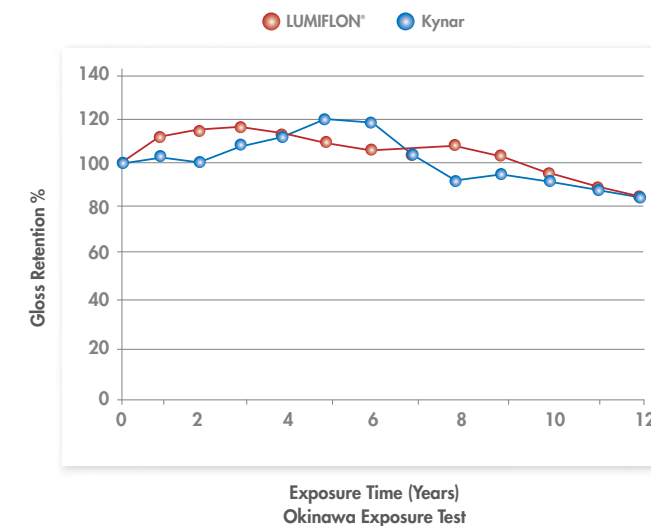
The results confirm what you see with your own eyes every time you look at an attractive, long-lasting LUMIFLON coating all over the world; LUMIFLON outperforms the competition.

natural exposure test on LUMIFLON Miami, Florida (ASTMG7)



name: boeing 777 airplane
substrate: aluminum alloy | composites
market: aerospace
photo by ANA

Okinawa weathering chart



name: stadium seats, japan
substrate: fiberglass
market: architectural

lower life cycle cost

There are those who make buying decisions based on price – and then there are those who are more interested in value. With LUMIFLON, the difference is clear.

- LUMIFLON-based coatings maintain gloss and color when applied to buildings, bridges, water towers, and other structures for between 20 and 60 years – significantly longer than other coating types.
- LUMIFLON resins protect steel, aluminum, fiberglass, concrete, and other materials from corrosion, sun, wind, rain and chemical exposure.

Over time, all that protection also protects your bottom line. Total life cycle costs, factoring in savings on maintenance, recoating and replacement, are much lower with LUMIFLON. Based on results from numerous projects, it's estimated that the life cycle cost of LUMIFLON coatings is only 40-80% of that of polyurethane. Price versus value. Over the course of a project's lifetime, the difference can be monumental.

Life Cycle Cost Advantages

- **Initial applied cost of FEVE-based topcoat:**

5-10% higher than standard polyurethane topcoat

- **FEVE-based topcoat life expectation:**

30-60+ years

- **Expected maintenance of standard polyurethane topcoat in this time frame:**

2-3 repainting cycles

- **Additional costs of repainting:**

Asset downtime

Staging costs

Environmental costs

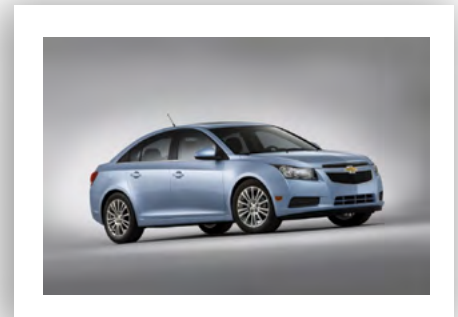
Emissions and CO₂ from equipment



name: bullet train "max"
substrate: steel
market: transportation



name: c-17 airplane
substrate: aluminum alloy
market: aerospace

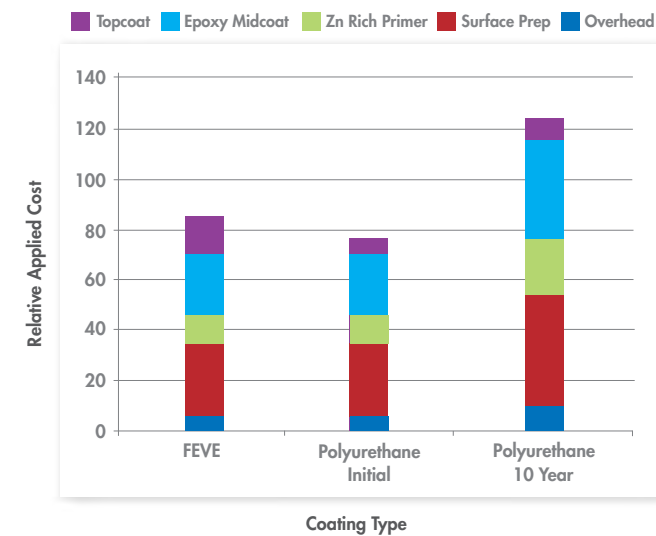


name: chevy cruze
substrate: plastic
market: automotive

comparative life cycle costs: LUMIFLON coating and chlorinated rubber coating

coating type	process	cost, \$/m ²	initial cost ratio	coating life, years	cost/year, \$/m ²
chlorinated rubber	surface preparation	\$10.08	0.19	8	\$6.64
	staging	\$27.48	0.52		
	coating	\$15.53	0.29		
	TOTAL	\$53.09	1.00		
LUMIFLON coating	surface preparation	\$10.08	0.19	>21	\$3.72
	staging	\$35.08	0.66		
	coating	\$32.98	0.62		
	TOTAL	\$78.14	1.47		
	LCC Ratio				

life cycle cost analysis



name: okayama castle, japan
substrate: concrete
market: architectural

solvent grades

LUMIFLON solvent grade typical properties

grade	LF-200	LF-552	LF-600X	LF-810	LF-810	LF-910LM
characteristics	standard	improved flexibility	improved flexibility	single component coatings	single component coatings	lower VOC
application type	field application	factory coil coating	factory coil coating; field application	field application; aerosols	field or factory application; aerosols	field application
markets	architecture, industrial maintenance, transportation, aerospace, alternative energy					energy
substrates	metal-steel & aluminum, plastic, fiberglass, concrete					
molecular weight	moderate	high	high	high	high	low
solid resin, wt%	60	40	50	45	55	66
Tg, °C/F	35/95	20/68	20/68	45/113	45/113	37/99
specific gravity (as varnish), 25° C	1.12	1.06	1.08	0.98	1.04	1.16
OH value, mg KOH/g-polymer	52	52	57	4	4	100
acid value, mg KOH/g-polymer	0	5	0	0.3	0	0
viscosity, stokes, cm ² /s, 25° C	20	4	9	18	19	5
solvent	xylene	aromatic hydrocarbon solvent/cyclohexanone	xylene	mineral spirits	xylene	xylene

LUMIFLON aerospace resins typical properties

grade	LF-9716	LF-9721	LF-910LM
markets	aerospace, other military		
substrates	aluminum, composites, steel		
solid resin, wt%	70	70	66
specific gravity, 25° C	1.25	1.26	1.16
OH value, mg KOH/g-polymer	170	160	100
gardner color	<1	<1	<1
viscosity, stokes, cm ² /s, 25° C	35	30	5
solvent	ethyl 3-ethoxy propionate	ethyl 3-ethoxy propionate	xylene

solid grades

LUMIFLON solid grade typical properties

grade	LF-200F	LF-916F
markets	architecture, industrial maintenance, transportation, aerospace, alternative energy	
substrates	metal-steel & aluminum, plastic, fiberglass, concrete	
appearance	pale yellow flake	
solid resin, wt%	>98	>99
OH value, mg KOH/g-resin	49	100
Tg, °C/F	35/95	34/93
Density, glcc, 25° C	1.42	1.39
softening point, °C	119	117

water emulsion grades

LUMIFLON emulsion grade typical properties

grade	FE-4300	FE-4400
characteristics	low OH value/low Tg one component	high OH value/high Tg one or two component
markets	architecture, industrial maintenance, transportation	
substrates	metal-steel & aluminum, plastic, fiberglass, concrete	
solid resin, wt%	50	50
specific gravity, 25° C	1.13	1.16
OH value, mg KOH/g-polymer	10	49
pH	7-9	7-9
average particle diameter, µm	0.1-0.2	0.1-0.2
ionic character	Anionic	Anionic
minimum film forming temperature, °C/F	30/86	55/131

water dispersion grade

LUMIFLON dispersion grade typical properties

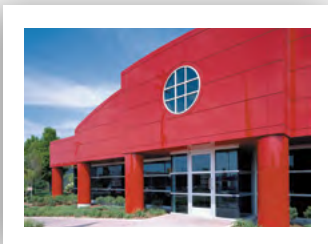
grade	FD-1000
markets	architecture, industrial maintenance, transportation, aerospace
substrates	metal-steel & aluminum, plastic, fiberglass, concrete
appearance	milky white liquid
solid resin, wt%	40
specific gravity, 25° C	1.13
OH value, mg KOH/g-polymer	85
acid value, mg KOH/g-polymer	15
pH	7-9
average particle diameter, µm	0.05-0.15
ionic character	Anionic
minimum film forming temperature, °C/F	29/84

powder coating grades

LUMIFLON powder coating grade typical properties

grade	LF-710F
markets	architecture, transportation
substrates	metal-steel & aluminum
solid resin, wt%	>99
Tg, °C/F	51/125
OH value, mg KOH/g-polymer	46
softening point, °C/F	90/194
solvent	none

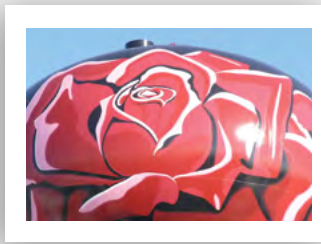
solvent grades



name: spectrum building, usa
substrate: aluminum composite material



name: akashi straits bridge, japan
substrate: steel

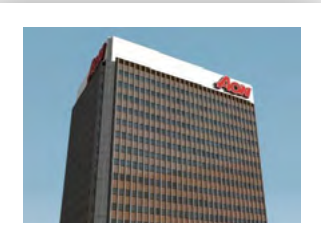


name: rosemont water tower, usa
substrate: steel

solid resins



name: twin dragon towers gateway, usa
substrate: steel



name: aon center, usa
substrate: aluminum composite material

water emulsion resins



name: stadium seats, japan
substrate: fiberglass



name: mihama estate, japan
substrate: fiber reinforced concrete

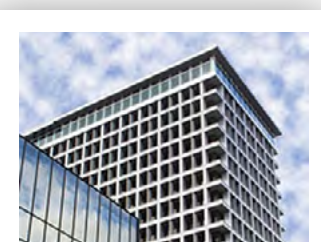


name: okayama castle, japan
substrate: concrete

powder coating



name: the birmingham news, usa
substrate: aluminum



name: richmond city hall, usa
substrate: aluminum composite material

Superior durability and weatherability. More brilliant, longer lasting colors and a far wider gloss range. And the toughest, most durable finish ever with the industry's leading longevity record. Add LUMIFLON's unique capabilities for field application and you have an end product that looks better, longer - and ultimately costs less. Longer life is also a formula for sustainability, which is good chemistry for a blue planet. For more information on LUMIFLON's applications worldwide, please call 800-424-7833, 610-423-4300 or visit www.lumiflonusa.com. Discover for yourself how good your bottom line looks when you raise your own standards with LUMIFLON.



For additional information please visit www.lumiflonusa.com.

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