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**Introduction**

LUMIFLON™ was developed and commercialized by AGC in the early '80s and was the first solvent-soluble fluoropolymer for coatings. LUMIFLON™ FEVE resins exhibit superior resistance to weathering. They are used to formulate high performance coatings that maintain their appearance and protect against corrosion. The use of LUMIFLON™ resins can substantially reduce life cycle costs, including maintenance costs, replacement costs, and re-coating, which leads to conservation of resources and a reduction in the emission of VOCs. The results of long-term testing show the weatherability benefits of LUMIFLON™, but the real proof can be found on all the structures around the world utilizing LUMIFLON™ coatings. LUMIFLON™ FEVE is a fluoropolymer resin that can be used in eco-conscious designs by extending the life span of structures and reducing life cycle costs.

**FUNCTION**

LUMIFLON™ has a performance record of more than 30 years in real world applications

LUMIFLON’s™ reliability has been verified by natural weathering experiments underway for more than 30 years.


<table>
<thead>
<tr>
<th>Fluoropolymer coatings</th>
<th>Epoxy coatings</th>
<th>Zinc-rich primers</th>
<th>Steel Substrate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>[Effects]</strong></td>
<td>4 Outstanding weather resistance</td>
<td>4 Excellent barrier properties</td>
<td>4 Excellent corrosion protection</td>
</tr>
</tbody>
</table>

(from the New Handbook on Painting and Corrosion Prevention of Steel Highway Bridges, March, 2014)

**WEATHERABILITY**

LUMIFLON™ shows excellent weatherability compared to acrylics and polyurethanes and also outperforms other fluoropolymer resins.

**ISO 12944**

ISO 12944 is an international standard for anti-corrosion coating systems. LUMIFLON™ chemical structure, “fluoroethylene vinyl ether copolymer (FEVE)” is described as a “Special type of PUR”

Coatings passed the new ISO 12944-6 standard, category C5 (very high corrosive environment) and ISO 12944-8 test protocols. Under ISO 12944-8, the coatings were tested under categories CX (corrosivity in offshore environments) and IM4 (immersion). Tests were performed by the independent research laboratory, CDT in Haarlem, The Netherlands.

**A special type of PUR is based on fluoropolymers.**

Paints for fluoropolymer/vinyl ether co-polymer (FEVE) coating are two pack coating materials, and both water-borne and solvent-borne types are available. Solvent-borne paints dry by solvent evaporation and cure by a chemical reaction between a base resin and a curing component. Paints for FEVE coatings are ambient curable materials cross-linked with isocyanate hardener. The resin of base component is fluoropolymer with free hydroxyl groups which reacts with suitable isocyanate curing agents. The drying time will depend, among other things, on air movement, relative humidity and temperature.

**Paint system for carbon steel for corrosivity category C5**

<table>
<thead>
<tr>
<th>System No.</th>
<th>Priming coat Type of primer</th>
<th>No. of coats</th>
<th>NDT (µm)</th>
<th>Subsequent coat(s) Binder type</th>
<th>Total no. of coats</th>
<th>NDT (µm)</th>
<th>Paint system</th>
<th>Durability</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS.04</td>
<td>EP, PUR, ESI Misc.</td>
<td>1</td>
<td>80 to 200</td>
<td>EP, PUR, AY</td>
<td>3-4</td>
<td>360</td>
<td>C5.08</td>
<td></td>
</tr>
<tr>
<td>CS.08</td>
<td>EP, PUR, ESI Zn (R)</td>
<td>1</td>
<td>60 to 80</td>
<td>EP, PUR, AY</td>
<td>3-4</td>
<td>330</td>
<td>C5.04</td>
<td></td>
</tr>
</tbody>
</table>


**NOTE2** In addition to polyurethane technology, other coating technologies may be suitable, e.g. polysiloxanes, polyaspartic and fluoropolymer (fluoroethylene vinyl ether co-polymer FEVE).

**WEATHERABILITY**

**Weatherability data**

LUMIFLON™ shows excellent weatherability compared to acrylics and polyurethanes and also outperforms other fluoropolymer resins.

**Sunshine weather meter test**

**Natural exposure test (Florida)**

![Weatherability data graph](image-url)
In the fluoropolymer coating using LUMIFLON™, little wear was observed over the 15 year period. In contrast, wear of 2/unicμm per year was observed in the polyurethane coating.

- **LUMIFLON™ coating:**
  - Good appearance

- **Chlorinated rubber coating:**
  - Rust at the corners

- **Alkyd coating:**
  - Covered with rust

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**Exposure test**

- **Duration:** 5 years
- **Location:** Ocean shore
- **New/Repaint:** Repaint
- **Paint system:** Heavy duty

- **Upper half of the plates are shown after wiping. Bottom half of the plates are covered with salt.**

**Erosion of Coating Over Time**

In the fluoropolymer coating using LUMIFLON™, little wear was observed over the 15 year period. In contrast, wear of 2μm per year was observed in the polyurethane coating.

- **LUMIFLON™ coating:**
  - Film thickness reduction: 0 to 1.1μm/15 years

- **Polyurethane coating:**
  - Film thickness reduction: 22 to 28μm/15 years

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**Coating comparison**

Because LUMIFLON™ topcoats typically utilize the same surface preparation, primers and midcoats as traditional polyurethanes, the initial cost of a fluoropolymer system is only slightly higher than a more traditional polyurethane system.

**Life cycle cost (LCC) composition**

LUMIFLON™ based coatings offer long-term economic benefits as they maintain their appearance significantly longer than traditional systems eliminating one or more repainting costs as well as reducing maintenance costs.

- **Alkyd coating:**
  - Overhead: 60%
  - Surface preparation: 20%
  - Primer: 10%
  - Midcoat: 10%
  - Topcoat: 10%

- **Acrylic silicone coating:**
  - Overhead: 80%
  - Surface preparation: 20%
  - Primer: 10%
  - Midcoat: 10%
  - Topcoat: 10%

- **LUMIFLON™ coating:**
  - Overhead: 100%
  - Surface preparation: 20%
  - Primer: 10%
  - Midcoat: 10%
  - Topcoat: 10%

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**Tokiwa Bridge**

- **(Photo taken)**
- 30 years after painting (November 2016)
- **(Painted)**
- August 1986
- **(Environment)**
- Mountainous area
- **(New/re-paint)**
- Repainting
- **(Original Coating)**
- Chlorinated rubber
- **(Painting Specification)**
- Surface preparation: St 3 (ISO)
- Primer: Modified epoxy coatings
- Intermediate and top coats: LUMIFLON™-based fluourethane

**Daiichi Mukaiyama Bridge**

- **(Photo taken)**
- 30 years after painting (November 2016)
- **(Painted)**
- August 1987 (Fluoropolymer coatings)
- August 1986 (Polyester coating)
- **(Environment)**
- Mountainous area
- **(New/re-paint)**
- New Construction
- **(Painting Specification)**
- Surface preparation: St 3 (ISO)
- Primer: Modified epoxy coatings
- Intermediate and top coats: LUMIFLON™-based fluourethane

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**LIFE CYCLE COST**

- **LUMIFLON™ Resins for Bridges**
  - Gloss retention is almost 100%
  - Frequent use of road salt for de-icing in winter
  - Scenery can be seen reflected in the high gloss of fluourethane coating.

- **(The LUMIFLON™ based coating shows excellent gloss retention and no chalking. Dirt is visible in the photograph but coating quality is not affected.)**

- **(The Alkyd coating were excessively deteriorated after only 16 years.)**
LUMIFLON™ Projects for Heavy duty

The superior durability and weatherability of LUMIFLON™ FEVE resin based coatings are recognized and proven by the projects using these coatings all over the world. LUMIFLON™ will continue to protect and maintain the beauty of structures from the deserts of North Africa to the wet and rainy coasts of the Gulf of Mexico and even to the mountains of Japan.