What is F-CLEAN?

• F-CLEAN is the brand name of AGC’s Fluon® ETFE film used for greenhouse coverings.

• Fluon ETFE film is a high-performance film produced using Fluon ETFE resin.

• Fluon ETFE film has excellent features, and is used in many applications.

• AGC produces ETFE resin and film.

**Ethylene-Tetrafluoroethylene copolymer**
The Many Advantages of F-CLEAN Coverings

- Weather resistance
- Chemical resistance
- Heat resistance (-100 C to 180 C)
- Mechanical property
- Nonflammability (DIN B1)
- Anti-stick property (Antifouling)
- Anti-condensation can be added
- Dielectric properties
- Light transmittance
- Light can be controlled by wavelength range

Your Dreams, Our Challenge
Other Applications of ETFE Film

**BUILDINGS AND STRUCTURES**
- Roofs
- Façades

**ENERGY**
- Solar cell protection
- Battery insulation

**ELECTRONICS**
- Release film for FPC
- Release film for semiconductors

**OTHER**
- Protective film surfaces
- Wallpaper surfaces
- Thermo molded parts
Producing F-CLEAN Films

Polymerization of F-CLEAN

Extrusion of F-CLEAN film

Extrusion

Polymerization

Extruder

Anti-drip

Welding Process

F-CLEAN film

Your Dreams, Our Challenge
Benefits of F-CLEAN Greenhouse Coverings

- Easy cleaning
- Long life and durability
- Fire safety
- More light than glass
- Low reflection and refraction rate
- Improved crop quality
F-CLEAN Greenhouse Film Options

- Clear – UV open
- Light-diffusing
- Anti-dripping
- UV blocking – UV cutting
- Light blocking – soft shine
- Thickness variations
Light Transmittance of F-CLEAN*

*60 micron is 94%. Light transmission is measured according to JIS standard.
Aging of Light Transmittance

![Graph showing transmittance over exposure time](chart.png)

- Long life
- PE (150 μm)
- CLEAN (60 μm)

Your Dreams, Our Challenge
Low Reflection

Transmission of Solar Radiation (%)

Incident Angle

Glass (4mm)

F-CLEAN Clear (100 μm)
# F-CLEAN’s Mechanical Properties

<table>
<thead>
<tr>
<th></th>
<th>AGC</th>
<th>AT Plastics</th>
<th>Ginegar</th>
<th>Hyplast</th>
<th>Plastika Kritis</th>
<th>Visqueen</th>
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<tbody>
<tr>
<td><strong>Film Name</strong></td>
<td>F-CLEAN</td>
<td>Dura 3</td>
<td>Sunsaver</td>
<td>HYTILUX</td>
<td>Sunmaster</td>
<td>Luminance</td>
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<tr>
<td><strong>Thickness</strong></td>
<td>100 μm</td>
<td>150 μm</td>
<td>200 μm</td>
<td>200 μm</td>
<td>150 μm</td>
<td>150 μm</td>
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<tr>
<td><strong>Tensile Strength at Break</strong></td>
<td>58 MPa</td>
<td>25.6 MPa</td>
<td>21.2 MPa</td>
<td>23 MPa</td>
<td>22 MPa</td>
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<tr>
<td><strong>Elmendorf Tear Strength</strong></td>
<td>21 N</td>
<td>7.5 N</td>
<td>--</td>
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<tr>
<td><strong>Elongation at Break</strong></td>
<td>400%</td>
<td>658%</td>
<td>--</td>
<td>550%</td>
<td>500%</td>
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</table>
F-CLEAN’s Mechanical Properties

Cutting the film, which is under constant air pressure.

It does not expand further.
Service Life Over 30 Years


F-CLEAN Diffused vs. Clear
Function

F-CLEAN Clear

F-CLEAN Diffused

Shadow
F-CLEAN Diffused

Light transmission (%) vs. Wavelength (nm)

Diffused
Clear

Your Dreams, Our Challenge
Non-Stick Properties

Poly
PVC
F-CLEAN
## Chemical Resistance

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Temp. (℃)</th>
<th>Days</th>
<th>Retention (%)</th>
<th>Elong.</th>
<th>Wt. Gain</th>
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<tr>
<td>Conc. hydrochloric acid</td>
<td>100</td>
<td>10</td>
<td>100</td>
<td>0.0</td>
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<tr>
<td>Sulfuric acid</td>
<td>121</td>
<td>10</td>
<td>100</td>
<td>0.1</td>
<td></td>
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<tr>
<td></td>
<td>121</td>
<td>10</td>
<td>100</td>
<td>0.0</td>
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<tr>
<td>Nitric acid</td>
<td>100</td>
<td>14</td>
<td>100</td>
<td></td>
<td>-</td>
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<td></td>
<td>120</td>
<td>10</td>
<td>100</td>
<td>0.7</td>
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<td></td>
<td>60</td>
<td>60</td>
<td>100</td>
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<td>-</td>
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<td>Sodium hydroxide</td>
<td>120</td>
<td>10</td>
<td>97</td>
<td>0</td>
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<td></td>
<td>120</td>
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<td>Ammonium hydroxide</td>
<td>66</td>
<td>7</td>
<td>98</td>
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<tr>
<td>Chlorine</td>
<td>90</td>
<td>10</td>
<td>94</td>
<td></td>
<td>-</td>
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<td>Water</td>
<td>100</td>
<td>7</td>
<td>100</td>
<td>0</td>
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</tbody>
</table>
Installation Type

Single Layer

Multilayer Cushion

Frame

Fastener

Film

Tension

Tension

Air Pressure
Application Photos
F-CLEAN
Roof bar distance is 2 m

Glass
Roof bar distance is 1 m
Fukuoko, Japan
Crop: Tomato
Area: 85,000 m²
Installed: 2008
Grade: 100 micron/GR 80
Miyagi, Japan
Crop: Paprika
Area: 50,000 m²
Installed: 2010
Grade: 100 mic/Clear + 60/Diffused (double layer)
Germany
Crop: Lettuce
Area: 15,000 m²
Installed: 2006
Grade: 100 mic/Clear
United Kingdom
Crop: Lettuce
Area: 28,000 m²
Installed: 2007
Grade: 100 mic/Clear
The Netherlands
Crop: Potted flowers
Area: 10.000 m²
Installed: 2005
Grade: 100 mic/Clear
Germany
Crop: Potted flowers
Area: 12,000 m²
Installed: 2006
Grade: 100 mic/Clear + 60 Diffused (double layer)
Italy
Crop: Roses
Area: 4.000 m²
Installed: 2001
Grade: 100 mic/Clear
Australia
Crop: Tomatoes
Area: 5,000 m²
Installed: 2003
Grade: 100 mic/Clear
Korea
Crop: Paprika
Area: 100,000 m²
Installed: 1999
Grade: 80 mic/Clear with UV block)
USA
Crop: Potted flowers
Area: 100,000 m²
Installed: 2003
Grade: 100 mic/Clear
China
Crop: Potted flowers
Area: 10,000 m²
Installed: 2010
Grade: 100 mic/Clear+60/Diffused
Russia
Crop: Cucumber
Area: 200,000 m²
Installed: 2011
Grade: 100 mic/Diffused
Taiwan
Crop: Strawberries
Area: 1.600 m²
Installed: 2014
Grade: 100 mic/Diffused (UV Block)
Taiwan
Crop: Orchid
Area: 10,000 m²
Installed: 2014
Grade: 80 mic/GR80
Taiwan
Crop: Orchid
Area: 10,000 m²
Installed: 2014
Grade: 80 mic/Diffused (UV block)
Japan
Crop: Fish
Area: 5,000 m²
Installed: 2012
Grade: 100 mic/Gray
Japan
Crop: Shrimp
Area: 2.300 m²
Installed: 2012
Grade: 100 mic/Gray
Japan
Crop: Mushrooms
Area: 2,000 m²
Installed: 2012
Grade: 100 mic/Gray
Japan
Milking cows
Area: 1,000 m²
Installed: 2012
Grade: 100 mic/Soft-shine
Japan
Food waste compost
Area: 5,000 m²
Installed: 2012
Grade: 100 mic/Clear
So Why Use F-CLEAN Films?

- Self-cleaning
- Long life and durability
- Fire safety
- Lets in more light than glass
- Low reflection and refraction rate
- Improved crop quality and yield
For More Information:

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