Bringing the sunshine inside
F-CLEAN® Clear
Bringing the sunshine inside

Function
- F-CLEAN® Clear enables extremely high light transmission.
- It has the highest UV transmission of all greenhouse covering materials.
- It takes the full spectrum of solar light resulting in healthy crops and vivid colours.
- It has excellent light transmission at all angles of incidence.

Performance

Excellent durability

Light transmission for each grade

Angle of Incidence & Solar Light Transmission

Test Method
1. Measure of transmission from light of selected wavelengths (300nm-2100nm).
2. Calculate the rate of light transmission by measuring light of 1% based on JIS P0901.

60μm thick F-Clean® installed in the Aichi region of Japan in 1988 (photographed 2009)
60μm thick F-Clean® installed in the Ibaraki region of Japan in 1988 (photographed 2010)

Applications
- For crops requiring anthocyanin such as aubergines and strawberries
- For greenhouses growing high quality and/or high added value crops
- For compost houses (animal manure and food leftovers)
- For drying houses (e.g. salt, fish and plums)
- To improve honeybee pollination

Projects
For better colour and the prevention of internode elongation.

Double Layer Projects
Provides very high thermal insulation and light transmission.

Energy saving of more than 30%
Coefficient of Heat Transmission 6.6W/m²·K (single layer 100μm)
3.8W/m²·K (double layer 100μm+60μm)

Projects for non-agricultural applications

Fermenting houses for composting
Hothouses for drying fruit
Hothouses for drying plums

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**F-CLEAN® Diffused Series**

A fluorine film which diffuses light evenly

**Function**
- F-CLEAN® Diffused Series diffuses light evenly, eliminating shadows.
- The haze of F-CLEAN® Diffused is extremely high at 60-70%.
- (If condensation appears on the matte surface, the direct light tends to increase.)
- F-CLEAN® Diffused film enables more photosynthesis on every leaf.

**Grades**
- Available in two grades: Clear and GR (mild UV cut)

**Performance**

**Optical Properties**

<table>
<thead>
<tr>
<th>Light Transmission (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
</tr>
<tr>
<td>300</td>
</tr>
</tbody>
</table>

**Relationship between Light Transmission and Haze (rate of diffused light)**

- F-CLEAN® Diffused
- F-CLEAN® (Clear type)
- F-CLEAN® (Diffused type)

**Projects**
- Grade: 60μm Diffused
  - Crop: Strawberries
  - Place: Ibaraki

- Grade: 80μm GR Diffused
  - Crop: Chrysanthemums
  - Place: Tochigi

- Grade: 80μm GR Diffused
  - Crop: Tomatoes
  - Place: Aichi

**Note:** The benefits of F-CLEAN® Diffused may not be maximized with certain conditions or crops. For more information, please contact your local sales office.

**Tests done by independent research institute**

Comparisons between levels of photosynthesis (Crop: Cucumbers)

Greenhouses with diffused film recorded a 4.3% increase in yield and a 7.8% increase in numbers compared to greenhouses with clear film from April to July 2006.

**Location of measurement:** Kochi, Nankoku-shi, Japan  
**Date of measurement:** July 3rd, 2008

**Opinion of diffused film customers**

- Undecided 13%
- Yes 87%

The light from F-CLEAN® Diffused is ideal for crops and humans. As a result, project numbers increase year on year.

**Photometer data**

- Location of measurement: Kochi, Nankoku-shi, Japan  
- Date of measurement: July 3rd, 2008

The photometer results show no difference in photon levels of clear film and diffused film whether the weather is sunny or cloudy.

**Projects**

- Grade: 60μm Diffused
  - Crop: Strawberries
  - Place: Ibaraki

- Grade: 80μm GR Diffused
  - Crop: Chrysanthemums
  - Place: Tochigi

- Grade: 80μm GR Diffused
  - Crop: Tomatoes
  - Place: Aichi

**Note:** The benefits of F-CLEAN® Diffused may not be maximized with certain conditions or crops. For more information, please contact your local sales office.
**F-CLEAN® GR series**

**UV Cut Grades**

**Function**
- There are three types of UV cut film available to suit the needs of different plant types.
- The UV cut grade also helps to protect materials and tools inside the greenhouse from UV damage.
- The UV cut function is long-lasting.

**Performance**

**Light Transmission by grade**

**Angle of Incidence and Solar Light Transmission**

F-CLEAN®GR
- UV cut properties similar to Glass (Clear/Diffused)

F-CLEAN®GR80
- Highest UV cut in F-CLEAN series (Clear)

F-CLEAN®GRUV
- Provides low UV cut (Clear/Diffused)

**Example Projects**

- **Cyclamens**
  - GR cuts UV slightly, it encourages the growth of crops (Chiba Prefecture, Japan: potted plants)
  - Growing time is reduced, (Aichi Prefecture, Japan: chrysanthemums)

- **Melons**
  - GR80
  - High light transmission in Winter enables increased yields compared to when other covering materials are used. (Fukui Prefecture, Japan: tomatoes)
  - The UV cut is ideal for both crops and workers.

- **Tomatoes**
  - GR80
  - Increased winter yields (Gifu Prefecture, Japan: roses)
  - Improved rose quality and also increased number of flower heads due to improved shoot growth.

- **Spray Chrysanthemums**
  - GR80
  - Increased winter yields (Gifu Prefecture, Japan: roses)
  - Improved rose quality and also increased number of flower heads due to improved shoot growth.

**Trends**

- Level of F-Clean GR Series use: Low DEN
  - Chrysanthemum
  - Carnation
  - Rose
  - Gerbera
  - Lily
  - Eustoma
  - Cyclamen
  - Moth orchid
  - Tomato
  - Melon
  - Perilla frutescens
  - Gomphocarpus

**Points**

- Honeybees may behave differently under UV cut conditions. Professional beekeeping advice should be sought.
- Care should be taken when using F-CLEAN® GR grade films if the colour of the crop relies on anthocyanin.

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**F-CLEAN® General Properties**

### Mechanical Properties

<table>
<thead>
<tr>
<th>Items</th>
<th>Test Method</th>
<th>Unit</th>
<th>F-CLEAN® Clear 100μm</th>
<th>PET 150μm</th>
<th>Poly Film 150μm</th>
<th>PV 100μm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength</td>
<td>JIS K7127</td>
<td>MPa</td>
<td>60</td>
<td>230</td>
<td>35</td>
<td>25</td>
</tr>
<tr>
<td>Tensile Elongation</td>
<td>JIS K7127</td>
<td>%</td>
<td>406</td>
<td>81</td>
<td>600</td>
<td>340</td>
</tr>
<tr>
<td>Elmdorff’s Tear Resistance</td>
<td>JIS K7128</td>
<td>N</td>
<td>21</td>
<td>1</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Right Angle Tear Resistance</td>
<td>JIS K7128</td>
<td>N/mm</td>
<td>214</td>
<td>387</td>
<td>128</td>
<td>76</td>
</tr>
</tbody>
</table>

*The statements and data given here are presented without any guarantee or warranty by AGC.*

### Properties

- **Chemical Formula:** - (C₂H₄)ₘ - (C₂F₄)n-
- **Chemical Name:** ETFE (Ethylene Tetrafluoroethylene copolymer)
- **Specific Gravity:** 1.75
- **Continuous Service Temperature:** -100°C to +150°C
- **Melting Point:** 260°C
- **Coefficient of Linear Expansion:** 0.01%/°C
- **Fire Proof Test:** JIS A 1322 Class 1 (Flame Proof)
- **Chemical Resistance:** F-Clean is not affected by strong acidity or strong alkalinity.

### Grades

<table>
<thead>
<tr>
<th>Grade Names</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-CLEAN® Clear</td>
<td>Takes full spectrums of solar light and provides light conditions the same as outside the greenhouse.</td>
</tr>
<tr>
<td>F-CLEAN® Diffused</td>
<td>Diffused provides highly diffused light while maintaining high light transmission.</td>
</tr>
<tr>
<td>F-CLEAN® GR series</td>
<td>Offers three grades with different rate of UV cut as required.</td>
</tr>
<tr>
<td>F-CLEAN® GR Diffused</td>
<td>Diffused combines the properties of diffused film and UV cut film.</td>
</tr>
<tr>
<td>F-CLEAN® Grey</td>
<td>Cuts solar light up to 99%.</td>
</tr>
<tr>
<td>F-CLEAN® New Soft Shine</td>
<td>New Soft Shine cuts infrared rays but transmits light.</td>
</tr>
</tbody>
</table>

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Grey film has a high light-filtering function to provide a cool environment in hot weather

**Functions**
- Cuts over 99% of visible light
- Blocks heat energy from solar light and prevents the internal temperature from rising. (solar heat gain coefficient 24%, equivalent to F-CLEAN® New Soft Shine)
- Has excellent weatherability and chemical resistance.
- Absorption of infrared light is extremely high.
- More snow resistant than F-Clean® Clear.

**Performance**

**Properties by Wavelength (Light transmission)**
- UV light: 310nm-400nm
- Visible light: 400nm-700nm
- Infrared light: 700nm-3000nm

**Solar heat gain coefficient (Heat balance)**
- Reflection 33%
- Re-reflection 4%
- Transmission 2%
- Re-reflection 22%
- Solar heat gain coefficient 24%

**Applications**
- Animal housing
- Warehousing
- Pergolas, Shelters
- Mushroom cultivation
- Sports facilities
- Greenhouses
- Sewage disposal facilities

**Specification**
- 100μm x 1300mm x 50m with anti-dripping treatment (Special repair tape is available for Grey film)

**Examples**
- Irrigation room
- Machinery Warehouse
- Animal housing
  - covered with alternating clear and white film
- Fish farm facility
- Mushroom cultivation
- Sewage disposal facility
F-CLEAN® New Soft Shine cuts infrared rays while still transmitting light

**Characteristics**

- Enables light transmission of about 14%, whilst simultaneously blocking heat energy from solar light to prevent temperature build-up inside (Solar heat gain coefficient 24% equivalent to F-CLEAN®Grey)
- Excellent weatherability and chemical resistance
- Cuts UV completely

**Performance**

![Graph showing light transmission and heat balance](image)

**Applications**

- Animal housing
- Sheds/Warehouses
- Pergolas/Shelters
- Mushroom Cultivation
- Greenhouses
- Sports facilities

![Typical application image](image)

**Specification**

- 100μm x 1300mm x 50m with anti-dripping treatment

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**Examples**

- Mushroom cultivation
- Animal housing (covered with alternating clear and white film)
- Shading for stores
- Delivery facility
- Swimming pool (covered with alternating clear and white film)
- Delivery facility (Germany)
F-CLEAN® Handling & Installing

Please read before installing F-CLEAN®

Caution

- DO NOT dispose of F-CLEAN® by burning. This may release hazardous gases and fumes.
- Dispose of F-CLEAN® in cooperation with your local waste processing company. Check disposal methods with the appropriate regulatory authorities.

Pre-installation notice

- The side with the anti-dripping treatment should be installed towards the inside of the greenhouse and is marked with the text “INSIDE”. Please note when installing.
- Do not stand a box containing F-CLEAN® on its end.
- Take personal safety precautions when lifting or moving F-CLEAN®.

1. If F-CLEAN® is loosely fixed over a greenhouse, it may flap in windy conditions and come into repeated contact with the structure of the greenhouse. This may cause tearing after a period of time.
2. Fix F-CLEAN® to fixing profiles stretching the film tightly like the skin of a drum.
3. F-CLEAN® should be applied using very high tension at low temperatures (as film tension may reduce as temperatures rise).
- Any rough or sharp part of structure that comes into contact with F-CLEAN® must be covered to avoid damaging F-CLEAN®.
- Please ask greenhouse constructors about profiles (e.g. aluminium bars, rafters and screws) before making a choice.
- Try to avoid touching the side of F-CLEAN® treated with anti-dripping treatment as it may reduce the anti-dripping properties.
- Do not store flammable materials close to F-CLEAN® due to the possibility of static electricity.

Film maintenance and advice

- Damaged F-CLEAN® can be repaired using F-CLEAN® repair tape.
- Make sure the space around the damage is clean and dry (use a soft cloth) before repairing.
- Heating the area with hot air after applying the repair tape (i.e. using an industrial dryer) could strengthen the adhesivity of the repair tape. (F-CLEAN® Repair Tape Specification: 50mm wide x 10m per roll)
- The anti-dripping characteristics of F-CLEAN® may reduce after years of use. If this happens it is possible to re-treat with a special spray to renew the anti-dripping coating.

Please use five to six 500ml bottles of F-CLEAN® anti-dripping treatment per 1,000m² greenhouse. Soft water is required for dilution. Dilution rate is 1:150.

- Take preventive measures against bird damage.
- F-CLEAN® may need to be cleaned depending on greenhouse location or internal conditions.
- If using spray shading liquid, please contact the manufacturer regarding suitability of use with F-CLEAN®. Attaching could be difficult if shading liquid is applied to F-CLEAN® immediately after installation.
- Materials which contain titanium oxide (TiO₂) have a strong photocatalyst effect which may damage F-CLEAN®.
- Lens effect happens when solar light passes through drops of rainwater on film. This can cause a spark or melting of materials inside. Remove residual rainwater especially on ventilation windows.
- F-CLEAN® was designed for horticultural and industrial use. Please contact us if you are considering the use of F-CLEAN® ETFE film for other applications.

Contact us for further information.

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