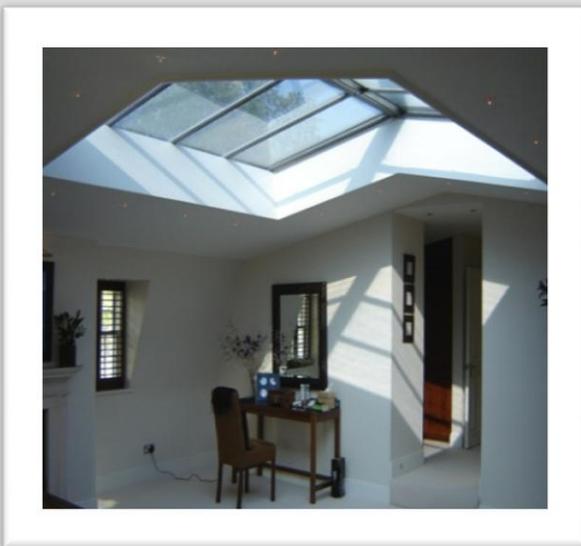




SmartGlass International

SPD SmartGlass™ Overview



Dimmable Windows and Skylights Control Glare and Light, Conserve Energy, and Increase Comfort and Security

SmartGlass International's SPD-SmartGlass can be manually or automatically "tuned" to precisely control the amount of light, glare and heat passing through glass. These products foster innovative building design opportunities never before available.

Glass facades using patented SPD light-control technology reduce the need for air conditioning during the summer months and heating during winter. The ability to instantly switch the glass to maximize daylight when it's really needed and to provide controllable solar shading during peak light conditions is unique.

Would you like the opportunity to regulate the amount of sunlight and glare entering a room without having to adjust blinds or shades that block your view and are hard to clean? Would you like to feel more comfortable and safe in your workplace or home while also enjoying lower heating and cooling costs, and protecting your valuable furnishings from the sun's damaging rays?

With SPD SmartGlass users can instantly "tint" their windows and skylights to select the amount of sunlight they want to let in – from clear to dark, or any shade in between. Controlled electrically, these smart windows are operated manually with a dimmer switch, by remote control and automated smart home technology or automatically using a photocell. Power consumption is minimal. For example, a business or homeowner can operate 15 large SPD SmartGlass windows for less electricity than it takes to operate a night-light, and benefit additionally by reducing heating and cooling costs from the energy saving properties of these smart windows.

- By controlling sunlight, consumers can enjoy an unprecedented combination of glare reduction, UV protection, energy-savings and greater security – benefits that collectively are distinctive to SPD-Smart dimmable windows and skylights.

SPD SmartGlass technology was recently awarded a Best of What's New Award from Popular US Science Magazine for home technology, received the 2007 North American Frost & Sullivan Award for Excellence in Technology for glass, and was also recognized as one of the top technologies by the Society of Automotive Engineers' Aerospace Engineering magazine.

STRENGTH – SPD SmartGlass windows are very strong and durable making them ideal for use in overhead glazing, children's rooms, sun rooms, conservatories, sports halls, swimming pools etc.

NOISE PROTECTION - Protection much improved when compared with normal insulated glass units.

ADVANTAGES OF SPD SMARTGLASS

- Instant and precise light control.
- Energy Savings on cooling & lighting costs.
- Eco friendly.
- Exceptional optical qualities that reduce glare and eye strain.
- Elimination of the need for expensive window dressings like electronic louvers; blinds and shades used in architectural applications.
- High durability, solid-state technology with no moving parts to wear out or break.
- Large sizes of any shape up to 2m * 1m can be produced.
- Stable colour characteristics for the life of the unit.
- Wide working temperature range from -30 to +90°C - Ideal for exterior applications.
- Ambient temperature control.
- Aesthetically pleasing.
- Hygienic low maintenance material.
- Enhanced corporate and domestic image.
- Wide light transmission ranges.
- In an effort to reduce glare the windows of many commercial buildings are permanently tinted, then requires more lighting inside the building than that which is optimally needed. Residential homes using window experience a similar limitation. Natural day lighting, which can be regulated using SPD SmartGlass™ products, has been shown to improve health and well being, and thus its regulation is considered by many to have a strong influence on one's attitude and productivity.
- Reduces uncomfortable "Gold fish bowl" feeling when living or working in high-density buildings such as apartment blocks or office complexes.
- Reducing the fading of carpets, furniture and protect valuable artwork
- Protecting skin from damaging UV rays.
- High UV stability.
- Low working voltage.
- High contrast at any viewing angle and any illumination level.
- Long life - tested to in excess of 100,000 cycles.
- Cost competitive.
- Infinite range of light transmission levels without the blocking of ones view.

SPD SmartGlass™ Applications & Features

EXTERNAL GLAZING:

- Fixed or casement windows, doors, etc.
- Create comfortable environments in sunrooms and conservatories.
- Curtain walling; include the use of a photocell to automatically protect the interior of a building when the sun's rays shine.
- Can be single, double or triple-glazed including low E glass resulting in improved thermal performance and reduced solar heat gain.

ROOFLIGHTS:

- Skylights.
- Roof-lights – Fixed or opening.
- Commercial / Domestic.

SECURITY AND SAFETY:

- Protect staff and interiors from the effects of harmful UV rays.
- Reduced harmful solar heat gain.
- Reduce the effects of noise pollution.
- Added security and safety due to toughened laminated glass construction.
- Low electric consumption.

EXTERNAL USES:

- Office and commercial building windows and doors.
- Curtain walling.
- Shop and office frontage.
- Roof lights.
- Private residence.
- Sunrooms and conservatories.

SPD SmartGlass™ - Range of Product

Each SPD SmartGlass panel is bespoke manufactured to meet the client's requirement and suitability for purpose.

Minimum Dimension

210 mm * 300 mm

Maximum Dimension

990 mm * 2800 mm. Larger dimensions can be made available upon request.

Standard Thickness

9 – 13 mm in single glazed format

24 mm + in Double Glazed format

We have a large range of thickness available upon request.

Configuration

SPD Smart Film is laminated between 2 pieces of glass.

Glass types can be annealed, Low Iron, heat/chemical strengthened, tempered, fire rated and bullet resistant. Colours and bespoke configuration incorporating laser etching and patterned glasses are available upon request. The primary colour available is an aesthetically pleasing dark blue.

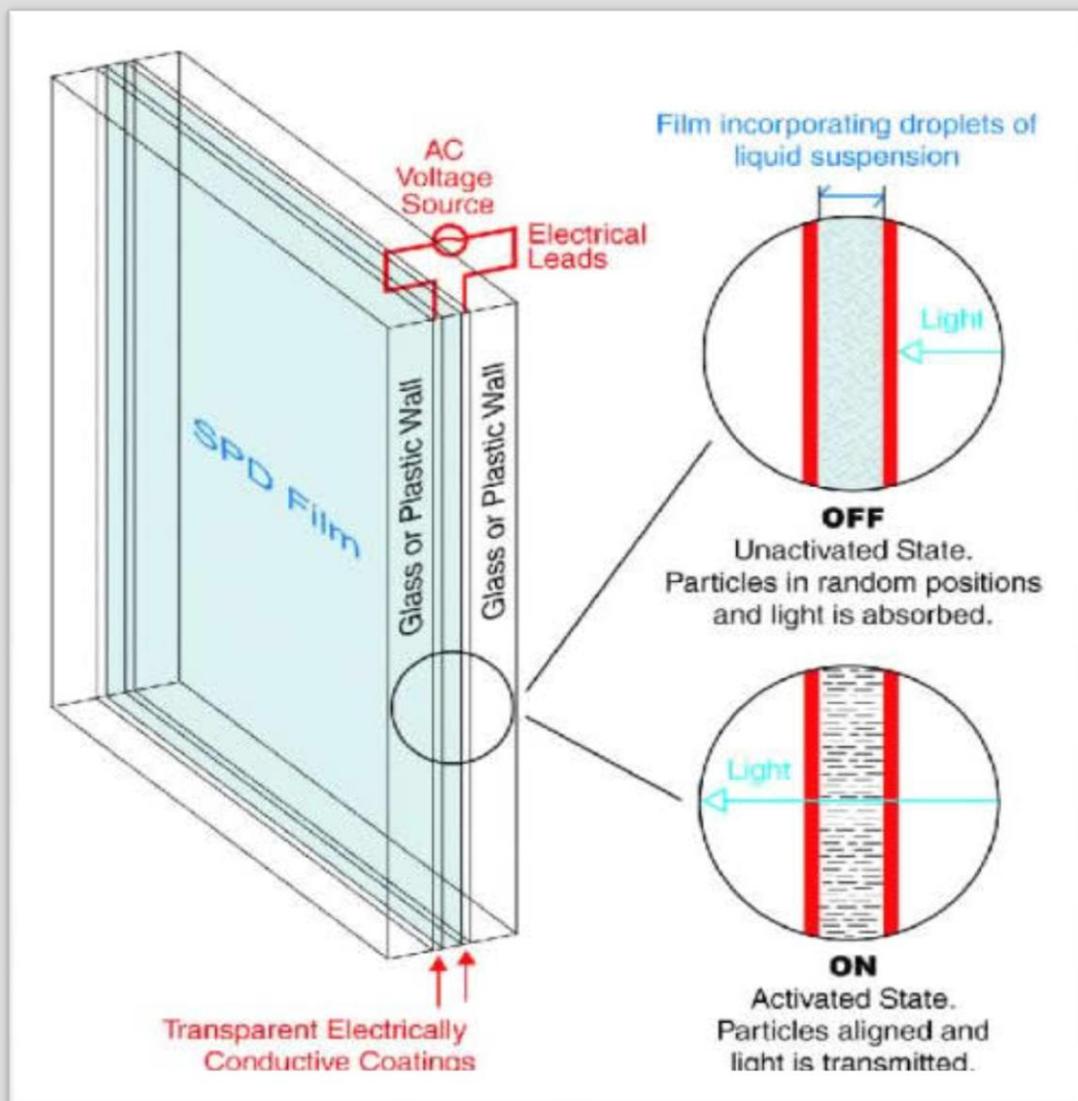
Processing – Available shapes

SPD-SmartGlass™ can be supplied in a range of shapes dependant on customer requirements.

SPD SmartGlass™ Technical Information

In the area of light control, there are three main technologies: liquid crystal devices (LCD), suspended-particle devices (SPD) and Electrochromic devices (ECD). All three may be used to produce "smart" glass, a glass that can change its light transmission when a voltage is applied. For reasons given elsewhere, SPD is the technology of choice for use in external or solar control windows because of its reliability, price, performance, and manufacturing advantages.

SPD THEORY



SPD uses a special kind of film that contains rod-like particles suspended in billions of encapsulated cells (liquid droplets) that are uniformly distributed throughout the film as shown in Fig. 1. Each of the cells contains many smaller rod-shaped particles. With no applied voltage, the particles are randomly oriented and block light. When a voltage is applied, the particles align with the electric field and let light through. By varying the applied voltage, we can vary the tint of the glass from clear to dark, and any shade in between.

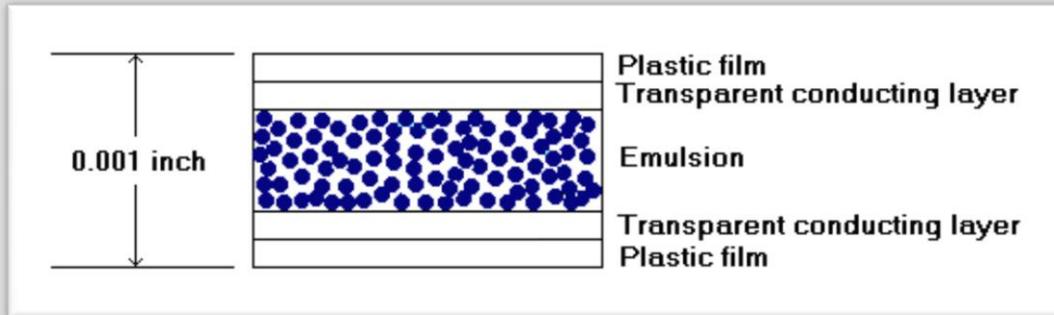


Figure1. Cross section of SPD film

SPD is a film-based technology, meaning that the rotating particles are trapped inside a dual-layer plastic film that consists of two layers of plastic with an emulsion (dielectric) between them. Furthermore, by including conducting layers as shown above, we get a classical parallel-plate capacitor. As discussed in basic electric theory, a parallel-plate capacitor has a uniform electric field. For this reason, SPD film has a uniform response throughout the film. In other words, you do not get the unwanted **iris effect**, so common in Electrochromic devices.

The physical mechanism behind SPD is similar to what occurs inside the dielectric of a capacitor, where the atoms are polarized by the electric field. In an SPD, rod-shaped particles are polarized, which forces their long axes to align with the electric field. This produces a venetian-blind effect which lets more light pass through the spaces between them. When no voltage is applied, the particles are randomly oriented and block light, similar to closing venetian blinds.

The small blue dots in the above figure are liquid cells trapped inside a solid. Each of these cells contains a liquid that is full of many rod-shaped particles. To understand the venetian blind effect better, look at the

Fig. 2:

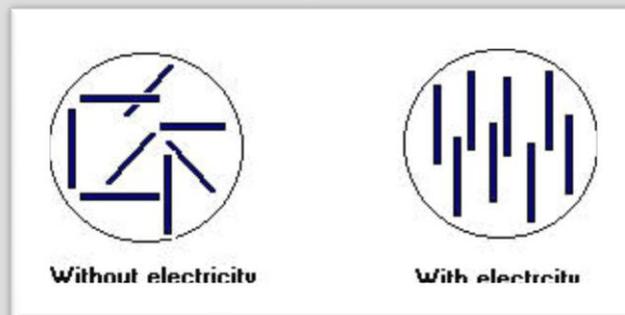


Figure 2. (a) Dark state (b) Clear state

With the no voltage applied as shown on the left, the particles inside the cell are in total disarray. In this state, no light can pass through the device. On the other hand, when a voltage is applied, it sets up an electric field. This polarizes the SPD particles and forces them to align vertically. As a result, light can now pass through the device. By varying the voltage, we can set up the dark state on the left, the clear state on the right, or any shade in between.

Warning

Do not use a dc voltage with SPD. If you use a dc voltage, the SPD will not function properly. The dc voltage will polarize the particles and initially they will let light through. But gradually, the particles will migrate toward one end of the cell and cluster or pile on top of each other. This leads to a gradual darkening of the glass. The only way to avoid this unwanted darkening is to use an ac voltage. With an ac voltage, the tendency to migrate toward either end of the cell is neutralized.

Electrical Characteristics

Besides requiring ac voltage for normal operation, there are a few additional facts you should know about SPD:

SPD has no memory: If you turn off the applied voltage, the device will go to the dark state. In other words, the dark state is the normally off state. For this reason, if you have an application where the dark state must be avoided during a power failure, consider using an uninterruptible power supply (UPS).

SPD are fast because they are field-effect devices. They rely on an electric-field effect, similar to liquid-crystal devices. An SPD window responds in a fraction of a second. Even faster response times are possible. The cycle lifetime of a smart window is defined as the number of times you can cycle it between its clear and dark states without noticeable degradation of its control over light transmission. SPD have a cycle lifetime greater than 100,000,000, which implies no problems will ever be encountered with cycle lifetime.

The operating temperature range is minus 30 to plus 90 degrees Celsius, equivalent to minus 22 to 194 degrees Fahrenheit.

For external use SmartGlass International recommends that windows be made in double or triple glazed unit format. The use of the following configuration will help to either retain or reduce heat as required.

Safety Double Glazed units (DGU) are comprised of:

All tempered glass panes.

Low-E coated outer lights.

Toughened laminated SPD-Smart™ Glass inner light.

Argon gas filled in chamber.

We recommend this configuration to achieve the highest possible thermal, acoustic, and safety performance possible. The Safety DGU has the following performance characteristics:

Glass State	U-Value*	R-Value*	STC*	OITC*	UV Blocking**	SHGC*	VT*	Dividers
On (Clear)	0.24	4.17	34	26	>96.3%	0.43	0.25	N
						0.39	0.22	<1"
						0.35	0.2	>1"
Off (Dark)	0.24	4.17	34	26	>99.2%	0.37	0.01	N
						0.33	0.01	<1"
						0.3	0.01	>1"

SPD SmartGlass™ is supplied using toughened laminate glass providing excellent acoustic insulation, ideal for reducing sound pollution in noisy environments.

SPD SmartGlass™ Installation

While it is relatively straight forward for an experienced contractor to install SPD SmartGlass windows we recommend that the highly experienced SmartGlass International installation team be utilised to install SPD SmartGlass™.

Contractors, Glaziers and electrical contractors installing SPD SmartGlass™ should contact their local SmartGlass International representative to receive a copy of the SmartGlass handbook and to receive on the spot advice.

Contact us at:

[SmartGlass International Ltd](#),
21 Cookstown Industrial Estate,
Tallaght,
Dublin 24,
Ireland.

UK Ph: + 44 (0) 239257 1122
Irl Ph: +353 1 4629945/9

UK Fax: + 44 (0) 239257 1127
Irl Fax: +353 1 4629951

info@smartglassinternational.com

www.smartglassinternational.com