Appropriate glass types for Patent Glazing

In sloping patent glazing situations, it is a requirement to install glass which will either tend to stay in place if it is cracked (Wired and Laminated Safety Glass come into this category) or to fracture into relatively harmless pieces (Toughened Safety Glass comes into this category) which are less likely to cause serious injury, if they fall, than sharp shards of annealed glass.
BS 5516: 2004 'Code of practice for vertical and sloping patent glazing' is the only regulation or standard which gives any recommendations about the type of glass to use in roofs.
For single glazing, either wired, laminated or toughened glass is recommended by BS 5516, while double glazed units should have one of the three types as the lower pane.
With regard to toughened glass, BS 5516 suggests that, if the lower pane of a double glazed unit is toughened, then the upper pane should also be one of the three recommended types of glass.

Note that toughened glass should not be used as single glazing or as a lower pane in double glazed units over swimming pools, where fragments of broken glass can enter the pool pumps and cause serious damage.

Recommendations for the possible types of glass suitable for use in sloping Patent Glazing

Glazing at a height less than 5m above floor level

Single glazing: Toughened Safety Glass, Laminated Safety Glass, or Wired glass.

Double Glazed units: The lower pane should be one of the above types of glass. If the lower pane is Toughened Safety Glass, then the upper pane should also be one of the above types of glass.

Glazing at a height over 5m but less than 13m above floor level

Single glazing: Toughened, Laminated or Wired Safety glass. Toughened Safety Glass may be considered with the following restrictions; not more than 6mm thick and not more than 3m² in area.

Double Glazed units: The lower pane should be Toughened, Laminated or Wired safety glass. Toughened Safety Glass may be considered with the following restrictions; not more than 6mm thick and not more than 3m² in area. If the lower pane is Toughened Safety Glass, then the upper pane should also be one of the above types of glass.

Glazing at a height over 13m above floor level

Single glazing: Laminated or Wired Safety Glass.

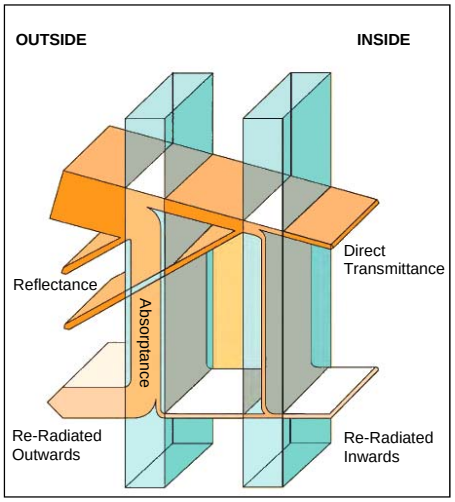
Double Glazed units: The lower panes should be Laminated Safety Glass or Wired glass.

Although it is possible to use wired glass as an inner pane in double glazed units, this is not common practice, due to a significantly higher risk of thermal breakages occurring with this product when combined in double glazed units.

Solar Control Glass

In addition to admitting light, our roof glazing systems also allow the natural heat from the sun to enter a building.
During the winter this can be considered a benefit – offsetting heating costs by providing 'free' heat on sunny days during the heating season.
During the summer months, however, unless some form of solar control is considered, this heat from the sun could be regarded as a disadvantage, necessitating the use of expensive air conditioning to avoid uncomfortably hot conditions.
Various techniques are available to control the amount of solar heat gain (solar heat) coming through roof glazing, including the use of external and internal shading (either fixed or adjustable), and solar control glasses. The following information is intended to provide relevant information concerning the use of glass as a means of solar control.

Basic Principles
Glass transmits solar radiation from the sun by three mechanisms, reflection, transmission and absorption, which for solar control purposes are defined in terms of the following parameters:



pictorial representation of the solar processes in action through a typical double glazed unit.

Reflectance:
The proportion of solar radiation at near normal incidence which is reflected by the glass back into the atmosphere

Absorptance:
The proportion of solar radiation at near normal incidence which is absorbed by the glass.

Direct Transmittance:
The proportion of solar radiation at near normal incidence which is transmitted directly through the glass.

Total Transmittance:
The fraction of solar radiation at near normal incidence that is transferred through the glazing by all means. It is composed of the direct transmittance, also known as the short wave component, and the part of the absorptance dissipated inwards by long wave radiation and convection, known as the long wave component. The proportions of the absorbed energy which are dissipated either inside or outside depend on the glazing configuration and the external exposure conditions (see diagram).
All solar radiant heat properties are angle dependent.

Shading Coefficient:
The solar radiant heat admission properties of glasses can be compared by their shading coefficients. The shading coefficient is derived by comparing the properties of any glass with a clear float glass having a total solar heat transmittance of 0.87 (such a glass would be between 3 and 4mm). It comprises a short wavelength and long wavelength shading coefficient. The short wavelength shading coefficient (SWSC) is the direct solar heat transmittance divided by 0.87. The long wavelength shading coefficient (LWSC) is the fraction of the absorptance released inwards, again divided by 0.87.
Shading coefficients are calculated for radiation at near normal incidence. For other angles of incidence, the glass is compared with clear glass in the same situation. As a result, the shading coefficients are substantially constant at all angles of solar radiation.

Solar Control for Glass

Solar control can be achieved by the use of:
- Body tinted glasses with increased absorption
- Reflective coated glasses with increased reflection
- Combinations of body tinted and reflective coatings in a single glass
- Special high performance insulating glass units

Body tinted glass

These types of glass are usually tinted grey, green, bronze or blue throughout their thickness. Their solar control properties and colour vary with thickness whilst their reflectances are slightly less than clear float. When used in double glazed units they are best positioned as the outer pane as the heat due to the absorbed radiation is more easily dissipated to the outside of the building.

Coated glass

Solar Control can be increased by the use of coatings which:
- Reduce solar heat gains with a full range of high, medium and low performance options
- Offer a choice of high to low light transmittances
- Provide varying degrees of reflectance including low reflectance
- Are available in a wide range of colours and appearances to meet aesthetic design requirements
- Are available as toughened or laminated options for safety and security
- Offer a comprehensive range of solar control performance options The numerous coating compositions available provide a wide range of performances, which is further increased by their combination with body tinted glasses. Thus, glass with a particular performance may be selected for specific applications.

Design

The design and specification of glazing demand that several (often conflicting) requirements need to be met, and it is impossible to consider any one in isolation. However, when considering the use of solar control glass, it is convenient to

consider the local climate, which in the UK is temperate.

Temperate Climates

Glass performance in temperate climates has to balance the need to provide solar control and reduce summertime overheating against the need to provide high levels of natural illumination and the benefits of passive solar heating. The required total solar transmission and light transmission will not be as low as those demanded in hot climates. To allow for passive solar design, the performance range could be:
Total transmission 20% to 70%
Light transmission 35% to 90%
U value 1.0 to 1.2 W/m² K
These performance parameters for glass need relating to the specific application, since there is no one ideal glazing solution for all applications. However, as a general principle, high thermal insulation with solar control is a requirement for temperate climates, and since some solar control coatings exhibit low emissivity, it is possible to combine these functions in the same glazing solution.

Solar Gain and Comfort

In addition to the general 'building performance' needs outlined above, it is necessary to consider how a solar control glass interacts with the design of air conditioning to provide comfortable working conditions.

Solar Gains

Solar radiation through glass cause the air temperature in a room to rise, and it is the task of the designer to ensure that this temperature does not cause discomfort by specifying comfortable design conditions, and by providing appropriate plant and equipment to meet them. To this end, the designer will have to undertake calculations to assess the effect of various glazing options on the solar heat gains that his ventilation or air conditioning equipment need to cope with, and choose the best solution for the specific application in question. Solar radiation is not the only source of heat which contributes to the 'total heat' within a building.

Other sources include:
- Conduction gains and losses through glazing.
- Ventilation by incoming warm air.
- Internal sources of heat (by lighting, occupants and electrical equipment).

Solar gains into a building can be determined from a knowledge of the following:
- The position of the sun in relation to each elevation of the building. Levels of solar radiation are dependent upon whether or not the sun is relatively high in the sky (altitude) and to the North, South, East or West (azimuth).
- The intensity of The solar radiation incident upon The faces of the building.
- The surface areas exposed to The sun. A large glazed area will potentially allow more solar gains to enter a building than smaller areas of glazing.
- The date and time of day. This is related to the relative movements of the sun and earth.
- Shading effects. Presence of blinds, overhangs, nearby buildings etc., may prevent solar radiation entering a building.
- Type of glass. Different glasses will transmit, reflect and absorb different proportions of the sun's energy.
- Structure of the building. A building constructed of heavyweight materials will heat up and cool down more slowly than one made with lightweight materials.

Direct Radiation and Comfort

Whilst air conditioning can provide comfortable conditions for the building and occupants as a whole, the effect of solar radiation falling directly on people situated close to the glazing needs to be treated separately. An occupant receiving direct solar radiation can feel uncomfortably hot even when room temperatures are being maintained at a comfortable level by means of air conditioning or mechanical ventilation. As a general guide, highly reflective glasses with relatively low direct solar transmittances will be most effective at combating the localised overheating of occupants situated under the glass.

High Performance Solar Controlled Glass Units

Most high performance glass products are manufactured in Europe and carry significantly extended lead-in times in comparison to other glass products. Some products have lead-in times in excess of eight weeks compared to medium performance solar controlled double glazed units. Because patent glazing is manufactured to unique sizes on every project and builders are generally reluctant to form openings to agreed sizes, careful consideration should therefore be given to their use. If the designer specifies high performance units but the site programme demands a shorter delivery time then there are still options. A very limited range of high performance double glazed units are now available in the UK with more realistic lead-in times and hopefully this range will be extended in the future. Please contact us for further details on this subject.

Product Description

The general characteristic of high performance solar control glass is a three level process of achieving high levels of light transmission through the glass whilst reducing the levels of direct solar heat transmission (summer benefit) and reducing the amount of heat loss from the building (winter benefit). In comparison, today's standard double glazed units will work on two levels. They offer little resistance to the direct solar heat gain factor.

High performance glasses are available in many varieties with different performance levels. The most popular types used on our patent glazing systems are classed as 'neutral' whereby they appear to be very similar in appearance to clear glass but actually have a very slight tint. A typical neutral double glazed unit will achieve 67 % light transmission and 34% solar heat transmission. Compared to a medium performance grey body tinted double glazed unit which would achieve a lowly 38% light transmission and 36% solar heat transmission. Clear low e double glazed units provide 78% light transmission with a 61% solar heat transmission.

It is possible to achieve levels of solar heat transmission as low as 25% in high performance units but this will be at the cost of light transmission values (40%) and a more visible body tint to the glass.

Medium Performance Solar Controlled Glass Units

The most common types of glass offering a medium performance for solar control are body tinted. Standard tints available are grey, green, bronze and blue. The grey and bronze types tend to substantially reduce the light transmission values which is an advantage for reducing glare whereas the green and blue tints have higher light transmission values combined with a reduction in the direct solar heat transmission.

Self Cleaning Glass

Self-Cleaning glass is steadily gaining in popularity. It is effectively the same as conventional glass but with a specially developed coating on the outside that has a unique dual action. Once exposed to daylight, the coating chemically reacts in two ways. Firstly, it breaks down any 'organic' dirt deposits – such as bird droppings and tree sap – and secondly, rainwater 'sheets' down the glass to wash the loosened dirt away.

Product Description

Self-Cleaning glass is a durable, coated, neutral-coloured, self-cleaning glass that requires less frequent cleaning and provides clearer vision during and after rainfall compared to ordinary float glass. It has good scratch resistance and durability and in most circumstances can be treated the same as ordinary float glass.

Under normal conditions the unique coating destroys organic contaminants on the surface and increases the water sheeting action on the coated surface. This allows dirt to be washed easily from the surface and should greatly reduce the need for manual cleaning.

Self-Cleaning glass can be single glazed or incorporated into double glazed units, with the self-cleaning coating positioned on surface #1, the outside of the building. It is important that its handling and processing is carried out in accordance with good practice. It must be glazed following the manufacturers recommendations to obtain maximum benefit from its self-cleaning properties

Self-Cleaning glass is available in a small selection of options. The most common for patent glazing applications are 6mm Clear Toughened, 6.4mm Clear Laminated, 6mm Blue Body Tinted Toughened and also in a small selection of High Performance glases.

High Performance 'Neutral' Double Glazing

Glass Performance Data

The Chart below provides performance data for double glazed units containing 6mm glass products from Pilkington and Interpane with a selection of different external panes of medium to high performance solar control glass combined with a 16mm argon gas filled cavity and an inner pane of 6mm thick super low e glass. (High Performance glass contains a super low e coating within its substrate, so the inner pane in these cases is traditional clear glass).

All of the body tinted options decrease the overall light transmission percentage of the product to some extent in comparison to traditional clear glass, but with the added benefit of reducing the total heat transmission percentage value.

Pilkington Clear and Medium Performance Body Tinted Outer Panes												
Product Description	Light		Solar Radiant Heat				Shading Coefficient			U Value (W/m²K)	Sound Insulation	
	Transmittance	Reflectance	Direct Transmittance	Reflectance	Absorption	Total Transmission	Short Wavelength	Long Wavelength	Total	Argon Filled	Rm(dB)	Rw(dB)
6mm Clear (No solar control)	0.78	0.11	0.50	0.21	0.29	0.61	0.57	0.13	0.70	1.2	30	33
6mm 75/59 (Green)	0.66	0.09	0.33	0.08	0.59	0.41	0.38	0.09	0.47	1.2	30	33
6mm 49/58 (Bronze)	0.43	0.06	0.28	0.10	0.62	0.36	0.32	0.09	0.41	1.2	30	33
6mm 45/58 (Grey)	0.38	0.06	0.27	0.11	0.62	0.36	0.31	0.10	0.41	1.2	30	33
6mm 46/58 (Blue)	0.46	0.07	0.25	0.07	0.68	0.32	0.29	0.07	0.36	1.2	30	33
Pilkington Suncool™ High Performance Outer Panes												
6mm 66/33 (Brilliant)	0.66	0.15	0.32	0.30	0.38	0.36	0.37	0.04	0.41	1.1	30	33
6mm 50/25 (Brilliant)	0.50	0.18	0.24	0.32	0.44	0.27	0.28	0.03	0.31	1.1	30	33
6mm 30/17 (Brilliant)	0.30	0.25	0.15	0.37	0.48	0.19	0.17	0.05	0.22	1.1	30	33
6mm 50/27 (Brilliant Blue)	0.50	0.20	0.25	0.35	0.40	0.28	0.29	0.03	0.32	1.1	30	33
6mm 70/40 (Neutral)	0.69	0.10	0.37	0.28	0.35	0.41	0.43	0.04	0.47	1.1	30	33
6mm 53/40 (Neutral)	0.53	0.08	0.35	0.15	0.50	0.41	0.40	0.07	0.47	1.3	30	33
6mm 51/37 (Neutral)	0.51	0.16	0.33	0.19	0.48	0.39	0.38	0.07	0.45	1.3	30	33
6mm 65/41 (Clear)	0.65	0.21	0.39	0.31	0.30	0.44	0.45	0.06	0.51	1.1	30	33
6mm 50/30 (Silver)	0.51	0.36	0.28	0.41	0.31	0.31	0.32	0.04	0.36	1.1	30	33
**6mm 30/23 (Blue)	0.30	0.14	0.15	0.11	0.74	0.23	0.17	0.09	0.26	1.1	30	33
**6mm 28/24 (Bronze)	0.28	0.12	0.15	0.17	0.68	0.24	0.17	0.11	0.28	1.1	30	33
**6mm 43/29 (Green)	0.43	0.23	0.19	0.16	0.65	0.29	0.22	0.11	0.33	1.1	30	33
**6mm 25/24 (Grey)	0.25	0.11	0.15	0.17	0.68	0.24	0.17	0.11	0.28	1.1	30	33
6mm 55/31 (Jade Green)	0.55	0.17	0.27	0.12	0.61	0.31	0.31	0.05	0.36	1.1	30	33
6mm 45/29 (Olive Green)	0.45	0.07	0.23	0.07	0.70	0.29	0.26	0.07	0.33	1.3	30	33
6mm 43/24 (Emerald Green)	0.43	0.27	0.19	0.17	0.64	0.24	0.22	0.06	0.28	1.1	30	33
6mm Activ 53/40 (Neutral)	0.50	0.13	0.33	0.21	0.46	0.39	0.38	0.07	0.45	1.3	30	33
6mm Activ 50/30 (Silver)	0.48	0.38	0.26	0.45	0.29	0.30	0.30	0.04	0.34	1.1	30	33
6mm Activ 70/40 (Neutral)	0.67	0.16	0.35	0.33	0.32	0.39	0.40	0.05	0.45	1.1	30	33
Interpane Ipasol™ High Performance Outer Panes												
6mm 40/25 (Neutral)	0.50	0.10	NS	NS	0.54	NS	NS	NS	0.34	1.1	30	33
6mm 73/39 (Neutral)	0.73	0.10	NS	NS	0.32	NS	NS	NS	0.53	1.1	30	33
6mm 68/34 (Neutral)	0.67	0.10	NS	NS	0.32	NS	NS	NS	0.46	1.1	30	33
6mm 67/34 (Natura)	0.66	0.11	NS	NS	0.34	NS	NS	NS	0.46	1.1	30	33
6mm 52/29 (Neutral)	0.52	0.10	NS	NS	0.46	NS	NS	NS	0.39	1.2	30	33
6mm 47/28 (Platin)	0.46	0.40	NS	NS	0.26	NS	NS	NS	0.36	1.1	30	33
6mm 40/23 (Blue)	0.40	0.10	NS	NS	0.52	NS	NS	NS	0.30	1.2	30	33
6mm 56/45 (Silver)	0.56	0.34	NS	NS	0.11	NS	NS	NS	0.59	1.2	30	33
6mm 55/27 (Green)	0.55	0.09	NS	NS	0.66	NS	NS	NS	0.35	1.1	30	33