EXTRALUM

Technical Bulletin.

Solar Control Glass.

Today, more than ever, there are many glass options for architectural application. Design professionals have a wide variety of products to choose from, which were created to save energy and reduce environmental impact.

Air conditioning in large buildings is a necessity. In addition, in the future, the demand for artificial air conditioning will increase, not only because more and more people are working in large buildings, but also because of the general increase in the outdoor temperature and because the level of comfort requirements is increasing high.

Solar control glass is a high-tech product created by the glass industry to allow sunlight to pass through windows or facades while radiating or reflecting much of the sun's heat to the outside. The interior space remains illuminated and remains much cooler than it would be if conventional glass was used.

It is very important to remember that, as a rule of thumb, it is more expensive to cool a room (using air conditioning) than to heat the same room. For this reason, consideration should be given to factors related to external heat gain, where solar control glass can reduce the amount of solar heat that is transferred within the room.

Solar Control using glass.

In today's architecture, the widespread use of glass is notorious. Houses and offices, flooded with light, play an important role in our quality of life. However, the high degree of transparency of the glass can also lead to unwanted increases in heat and ultraviolet rays.

Traditionally, windows and large glazed areas have been the weaknesses in constructions in terms of thermal insulation. But today, with advances in the manufacture of special solar control glass, high performance can be achieved without sacrificing our liaison point with the outdoor environment.

When solar energy hits the glass, one portion of the total energy is transmitted directly to the interior, another portion is reflected by the glass and the remaining is absorbed into its mass (Figure 1).

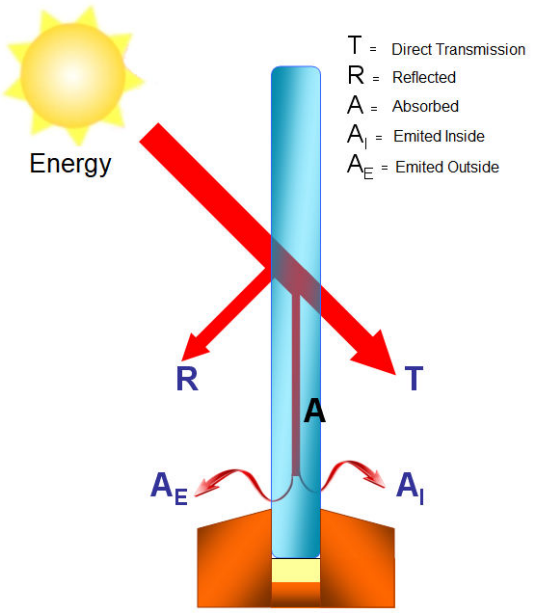

Figure 1. Thermal properties of glass.

Tinted Glass

The solar control properties of tinted glass are the result of two basic laws of physics.

First, dark colors absorb more heat than light colors. For example, on a sunny summer day, a white T-shirt stays colder than a black T-shirt. Both receive the same amount of solar energy; however black one absorbs more heat and therefore radiates more heat.

Second, the Energy Balance Law: all kinds of energy, including heat, constantly try to achieve a state of equilibrium. Energy is constantly moving, from areas of excess heat to areas of less heat.

When solar control glass is exposed to sunlight, a considerable amount of solar energy is absorbed by the glass. The temperature of the glass increases due to the energy absorbed. The temperature of the glass rises above the ambient-outside and indoor temperature. The heat generated tries to find its balance and this is achieved by transfer with the mass of cold air on the outside of the glass. Heat is emitted out of the glass out of the room because there is air movement there, while less heat is emitted inside because there are no currents or air movement inside the room.

In short, tinted glass is used for solar control because it absorbs more heat than clear glass while radiating most of that heat absorbed outward, by natural convection.

Reflective Glass.

Reflective coatings on clear glass or tinted are used for solar control because they literally reflect light and heat to the outside of the room. The use of tinted glass with a reflective coating increases the solar control properties of the glass panel.

However, tinted glasses and reflective glass allow less natural light into the room, which can be an unwanted effect in some common applications.

Low Emissive Solar Control Glass (Low-E)

Modern low-e solar control glass reduces unwanted solar energy input while allowing maximum light transmission for virtually any application.
This technology incorporates invisible coats of special materials that produce a double effect: they allow sunlight to pass through the glass but, instead, prevent the heat of the sun from entering. Solar control glass units are usually equipped with double glazing and, therefore, act as a thermal insulator.

Insulated Glass.

Using solar control glass in an insulate glass (DVH) unit is a good option to reduce the amount of heat that is transferred into the room.
The insulated glass consists of joining two glass by means of a separator. The air chamber formed between the two glasses is hermetically sealed. The separator contains a desiccant that absorbs moisture from the air trapped in the chamber. For this reason, the air is dry and acts as a barrier against heat, making it difficult to transfer heat by convection.
Double glazing is an effective way to control heat input, as the outer glass heats up, the dry (still) air chamber slows heat transfer (by convection) to the inner glass, reducing total solar heat that goes through the glass.

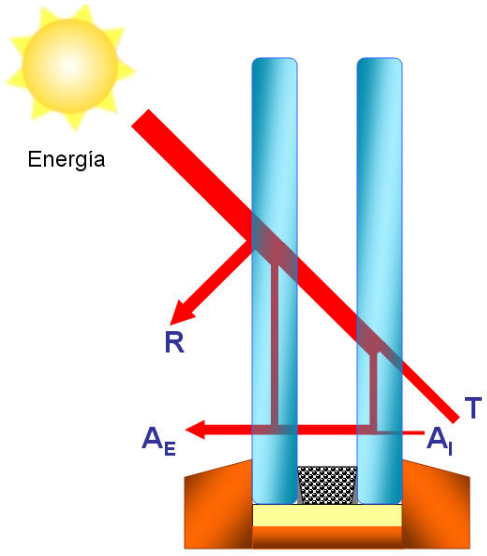

Figura 2. Doble vidriado y control solar.

Solar Control Performance

There are several indices that can be used when comparing the performance of solar control glass. Among the most used are:

- Solar Heat Gain Coefficient (SHGC):is the percentage of the total solar energy that is transferred to the interior (in the form of heat) directly and indirectly. It is the sum of the energy transmitted directly and the energy absorbed and emitted to the interior.

  From Figure 1 we have: $\mathbf{SHGC = T + A_I}$

- Shading Coefficient (SC): is the measurement of heat gain through a glass, relative to the gain of a 3mm thick glass under a normal incidence.

For both cases, in terms of solar control, the better the performance of the glass will be better the smaller the value obtained from the coefficient.

Selection Criteria

Glass selection is not always an easy task. Even if the primary objective is solar control, there are other basic selection criteria that should be considered to achieve the best application:

- Orientation of the facade. This Will determinate the amount of solar radiation the glass will be exposed.
- Natural shading elements, such as trees, which, that can reduce direct solar radiation on the glass.
- Taking advantage of natural light. Some solar control glass reduces heat input but also significantly reduce visible light input.
- Security and safety requirements.
- Reference frame of the facade. Determined by an urban environment where horizontal and vertical straight lines prevail or by a rural environment with predominance of landscape.

When using tinted glass or metal coatings glass, the risk of thermal breakage and the need to heat treat the glass should always be evaluated. The risk of thermal breakage increases directly proportional to the percentage of energy absorbed.

The following table shows the thermal performance indices of several common products in monolithic (single glass) and insulated configuration.

Performance Data in Terms of Solar Control.

Product	Thickness (mm)	Light Trans.	Sun Energy				SHGC	SC
			%Trans.	%Ref.	%Abs.	%Trans. UV		
Monolithic Tinted Glass								
Gray	6	44	41	5	54	21	0.57	0.66
Bronze	6	51	48	5	47	22	0.62	0.72
Blue-Green	6	75	48	6	46	32	0.62	0.72
EverGreen	6	66	33	5	62	14	0.52	0.60
Artic Blue	6	53	33	5	62	20	0.52	0.60
SuperGray	6	9	8	4	88	1	0.35	0.41
Low-E Reflective Glass								
Eclipse Advantage Gray	6	32	29	8	63	10	0.41	0.48
Eclipse Advantage Bronze	6	38	35	10	55	11	0.45	0.53
Eclipse Advantage Blue-Green	6	56	35	11	54	16	0.45	0.53
Eclipse Advantage EverGreen	6	48	23	8	69	7	0.36	0.43
Eclipse Advantage Artic Blue	6	39	23	8	69	10	0.36	0.42
Solar Control Low Emissive Glass								
Solar-E	6	60	46	7	47	44	0.52	0.61
Insulated Glass* Tinted Glass with Low-E Glass #3								
Gray	6	36	27	7	66	13	0.40	0.46
Bronze	6	42	32	8	60	14	0.45	0.52
Blue-Green	6	62	34	9	57	21	0.45	0.52

Evergreen	6	54	24	7	69	9	0.35	0.40
Artic Blue	6	43	23	7	70	13	0.34	0.39
SuperGray	6	7	5	4	91	1	0.15	0.18

* Insulated glass built with equal thicknesses of the glass. Air chamber.12.7 mm

Product	**Thickness (mm)**	**Light Trans.**	**Sun Energy**				**SHGC**	**SC**
			%Trans.	%Ref.	%Abs.	%Trans. UV		
Insulated Glass * Eclipse Advantage #2 with Low-E #3.								
Gray	6	27	20	9	71	7	0.31	0.36
Bronze	6	32	24	11	65	7	0.36	0.41
Blue-Green	6	48	26	13	61	10	0.36	0.41
Evergreen	6	40	18	9	73	5	0.27	0.31
Artic Blue	6	33	17	9	74	7	0.27	0.31
Insulated Glass* Solar-E #2 with Low-E #3								
Solar-E	5	53	36	9	55	34	0.45	0.52
Solar-E	6	53	35	9	56	33	0.45	0.51
Solar-E	8	52	32	8	60	29	0.43	0.49

* Insulated Glass built with equal thicknesses of the glass. 12.7mm air chamber.

To achieve the appropriate technical/economic solution for each case, the study of each project is recommended, combining technical information, specific software and design criteria.

If you have any questions, consult the Sales Department of Extralum, S.A.