Expert Series:

Energy Performance and Low-E coatings

GUARDIAN® GLASS
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Energy Performance and Low-E Coatings

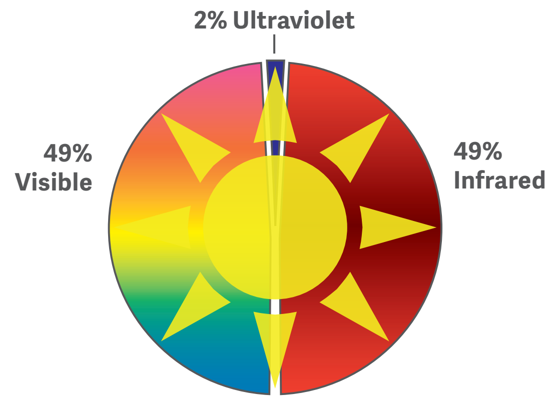
Overview

Architectural glazing with high-performance low-e coatings enables building occupants to visually engage with the external environment from a comfortable indoor setting. Low-emissivity (low-e) coatings are a critical component of the glazing, providing natural light transmission while limiting heat gain and thermal energy transfer. Low-e coatings are microscopically thin to provide transparency for visible light while simultaneously reflecting direct solar radiation as well as energy in the far infrared part of the electromagnetic spectrum.

Energy Performance

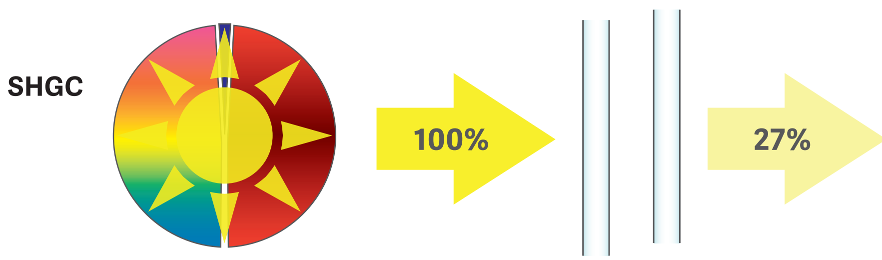
The energy efficiency of a glazing composition can be condensed to two key metrics: the ***SHGC*** (solar heat gain coefficient) and the ***U-value***.

Components of Solar Energy



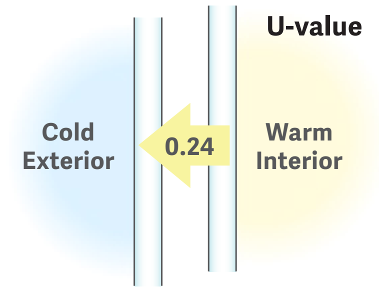
The term "solar energy" refers to the full range of the sun's electromagnetic energy that reaches the Earth, which is comprised of ultraviolet (UV), visible, and infrared wavelengths. Approximately half of this energy is in the visible range, approximately half in the infrared range, and a small balance in the UV range.

The ***SHGC*** is the decimal share of the solar energy that is transmitted through a glazing composition. For instance, if 27% of the incoming solar energy passes through a composition, the SHGC is 0.27.



In most geographic locations, especially those in warm climates, a lower SHGC is desired to block heat and reduce the need for air conditioning. In colder climates, a high SHGC may be desired to take advantage of passive heat gain, lowering building heating costs.

The ***U-value*** describes the energy transfer caused by an air temperature difference between the inside and outside of a building. It is expressed as the energy transfer per unit time, per unit surface area of the glazing, and per degree of temperature difference. As an example, a U-value of 0.24 in imperial units indicates that 0.24 British thermal units of energy are transferred per hour, per square foot of glazing area, and per Fahrenheit degree temperature difference between the indoor and outdoor conditions.



Because of the heat transfer driven by the buoyancy of warm air, overhead glazing exhibits a lower level of insulating performance (and therefore a higher u-value) than does glazing installed in a vertical wall, with everything else being equal.

As with the SHGC, a lower U-value is typically advantageous in minimizing the energy needed to condition the space within a building.

Glass manufacturers and fabricators typically express these metrics in the context of ***center-of-glass (COG)*** performance, excluding the variable influences of IGU spacers and framing systems. Energy efficiency codes, on the other hand, typically reference ***overall assembly (OA)*** performance, which encompasses perimeter elements such as the metal system, window type, etc. The OA SHGC is typically lower than the COG SHGC due to the effect of the framing system. Conversely, the OA U-value is typically higher than the COG U-value because of heat transfer (thermal conduction) at the edge of the IGU, through the framing system. The framing system supplier should be consulted during the design process to understand the framing options and their impact on overall façade energy performance.

Low-e coatings are typically critical to meeting design and energy code solar and insulating performance objectives. Tinted float glass in conjunction with low-e is another available solar control option, as a low-e coating on tinted glass will typically have a lower SHGC than the same low-e coating on clear glass. However, the appearance of the building will change and the transmittance of daylight will be reduced. Argon gas fill, warm-edge spacers, thermally-broken frames, and triple-pane glazing configurations are additional approaches to improving the overall insulating performance of architectural glazing.

Low-E Coatings

Low-e coatings significantly improve energy efficiency while providing transparency and a wide variety of aesthetic options. There are two general types of low-e coatings: sputter coatings, also known as soft coats, which are applied to the glass in a large magnetron sputter vacuum deposition (MSVD) machine; and pyrolytic coatings, also known as hard coats, which are deposited during the float glass manufacturing process.

Sputter deposition enables the configuration of a nanotechnologically-precise coating. Consequently, sputter coatings can deliver high levels of visible light transmission (VLT) while restricting overall solar energy transmission (lowering SHGC values). In other words, sputter deposition enables the attainment of high light-to-solar gain (LSG) ratios (LSG = VLT / SHGC). Sputter deposition also facilitates a broad range of aesthetics.

While some sputter coatings can withstand permanent exposure to the elements or to the space within a building, many require protection by containment within an IGU or embedment within a laminated pane. Pyrolytic deposition, on the other hand, delivers coating durability that generally supports direct exposure to the elements.

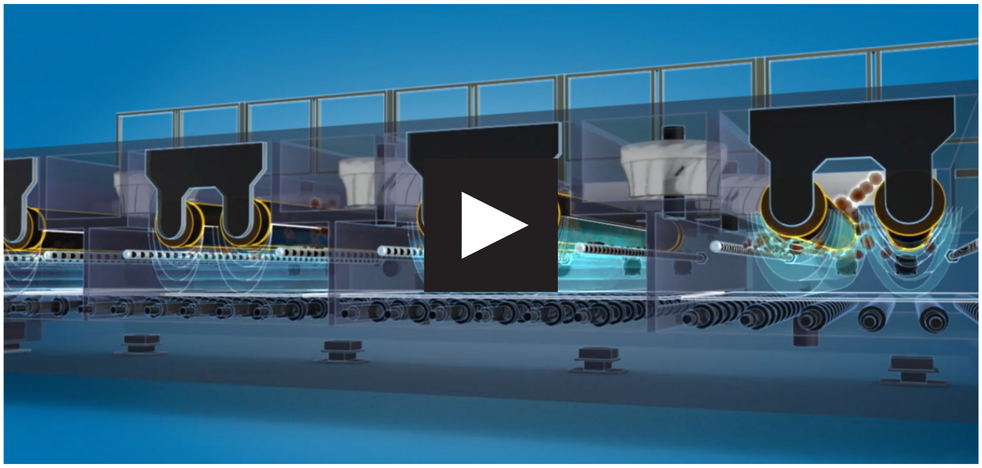
Sputter deposition involves the sequential application of layers of material that together measure only approximately 1/500th of the thickness of a sheet of paper. Among these layers, silver is central to the attainment of strong LSG ratios. Other layer materials generally contribute to aesthetics and durability.

The sputter coating process involves a conveyor system, along which the glass is first washed and dried. Pressure locks then lead into the coater. The coater interior is maintained at a vacuum of only several millionths of an atmosphere, amidst carefully-proportioned gases. As the glass passes through the coater, it proceeds under a range of targets, each comprised of one of the materials to be deposited onto the glass surface.

A strong negative charge is applied to the targets, attracting the nearby gas ions. As the ions strike the target, their impact energy releases target material that then deposits onto the glass surface. Magnetic fields concentrate the sputtering process.

After the glass proceeds through the coater, having accumulated a layer of each of the target materials, it passes through pressure locks back to normal room conditions. Careful controls confirm the uniformity of the coating.

Sputter Deposition Animation



The alternative pyrolytic deposition process takes place as the float glass is made. As the newly-formed molten glass floats across the tin bath, its upper surface is sprayed with material, typically tin oxide. As the glass subsequently cools, the surface bond solidifies.

Coating Considerations

All Guardian architectural low-e coated products are applied through sputter deposition, and are offered to fabricator customers in the form of large sheets, ranging from 8'x 12' to jumbo sizes of 11' x 17' or in some cases, 11' x 20'. Six float glass production and sputter coating deposition facilities across the United States expediently supply Guardian customers with large volumes of architectural glass, locally processed through Guardian-certified fabricators.

Heat treatment is a key fabrication operation, involving exposure of the glass to extreme heat and then sudden cooling, to create a combination of tension and compression in the glass. The result is glass that is either heat-strengthened or fully tempered, depending upon the application need. It is important to note that once heat-treated, glass can no longer be cut. Guardian's coated products are specifically designed to withstand the heat-treatment process, enabling fabricators to seamlessly deliver cut-to-size, heat-treated high-performance low-e coated glazing.

Several SunGuard® coatings can be embedded in direct contact with a PVB interlayer, and many coatings can be hot- or cold-bent to deliver distinctive aesthetics. Specialty sputter coatings are also available for innovative insulating performance (IS 20), reduced reflectivity (Clarity™), and bird collision deterrence (Bird1st™).

Learn More About Energy Performance and Low-E Coatings

If you need more information, Guardian's Technical Services group is available to assist with questions about energy performance and low-E coatings. Please contact Guardian at https://www.guardianglass.com/us/en/contact or call 855-58-GLASS (45277).

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