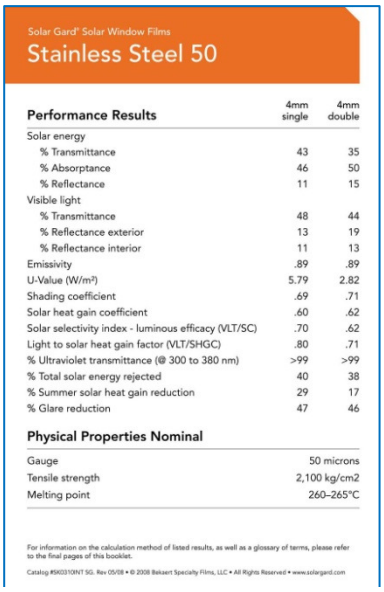
Bulletin #6: Understanding Solar Performance

UNDERSTANDING SOLAR PERFORMANCE

Bekaert solar control window films use advanced technology to benefit consumers with quality solutions that enhance comfort and decrease energy use. By understanding the science behind our window films, you can better communicate with your customers and select the best film for the job. Using Performance Results for Solar Gard® Stainless Steel 50 as an example, this discussion will give you an overview of some of the key values of solar performance.



Solar Gard® Solar Window Films

Stainless Steel 50

Performance Results	4mm single	4mm double
Solar energy		
% Transmittance	43	35
% Absorptance	46	50
% Reflectance	11	15
Visible light		
% Transmittance	48	44
% Reflectance exterior	13	19
% Reflectance interior	11	13
Emissivity	.89	.89
U-Value (W/m²)	5.79	2.82
Shading coefficient	.69	.71
Solar heat gain coefficient	.60	.62
Solar selectivity index - luminous efficacy (VLT/SC)	.70	.62
Light to solar heat gain factor (VLT/SHGC)	.80	.71
% Ultraviolet transmittance (@ 300 to 380 nm)	>99	>99
% Total solar energy rejected	40	38
% Summer solar heat gain reduction	29	17
% Glare reduction	47	46

Physical Properties Nominal

Gauge	50 microns
Tensile strength	2,100 kg/cm2
Melting point	260–265°C

For information on the calculation method of listed results, as well as a glossary of terms, please refer to the final pages of this booklet.

Tables in the sample books, such as the one here, help determine the best film for the job.

What is Solar Control?

When the sun shines through a window with solar control film, the film manages the three distinct zones that make up the solar spectrum: UV (Ultra Violet), VIS (Visible Light) and NIR (Near Infrared).

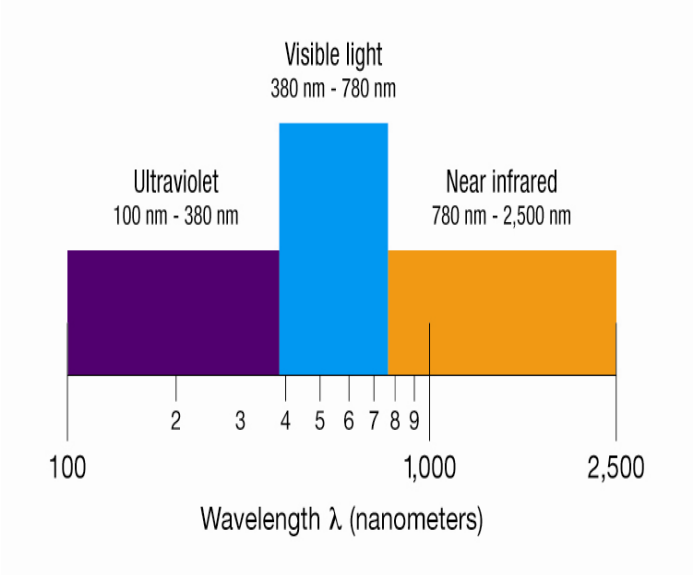
- **Ultraviolet (UV)**, harmful to people and building interiors, makes up 3% of the solar energy. Although we can't see UV rays, we feel them. UV radiation can cause skin damage and can fade and degrade some materials. There are three types of UV:
  - **UV-A** – About 99% of the ultraviolet radiation that reaches the Earth's surface, UV-A contributes to 15-20% of a sunburn.
  - **UV-B** – Sun burn and skin cancer can be caused by UV-B.
  - **UV-C** – Although the highest-energy and most dangerous type of ultraviolet light, UV-C is absorbed by the atmosphere.

- **Visible Light (VIS**) accounts for 47% of solar energy and determines the general look and color of the light you can see, including the glare. Each color has its own wavelength electromagnetic spectrum, with violet as the shortest wavelength. Without VIS, we would be unable to see.

- **Near Infrared (NIR)**, which we experience as heat, is invisible to the human eye and takes up 53% of the spectrum. This radiated energy from the sun represents a majority of the heat you feel in your car on a bright day or in a room that receives direct sunlight through an untreated window.

Measuring the Solar Spectrum

This visual representation of the solar spectrum shows the wavelength measurement of each of the three zones of the solar spectrum. A nanometer is a unit of distance in the metric scale, abbreviated as nm. Equal to 1-billionth of a meter, one nanometer is a distance too small to be measured with an optical microscope.



Solar Energy

Energy from the sun is represented by visible light (glare), infrared radiation (heat) and ultraviolet radiation (fading and health hazards). Each form of energy is differentiated by its wavelength.

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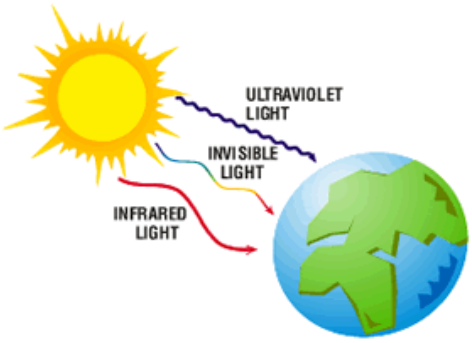
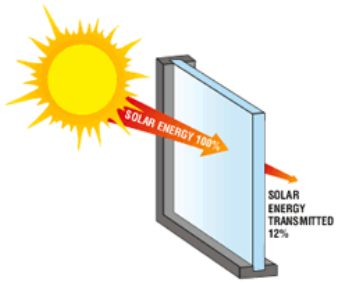
Solar energy consists of:
3% UV Radiation (100 – 380nm)
44% Visible light (380 – 780nm)
53% Near Infrared radiation (780 – 2500 nm)



Solar Transmittance (T)

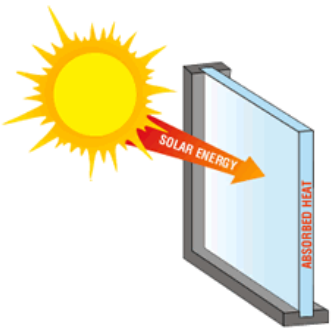
When sunlight strikes glass, solar energy is either transmitted through the pane of glass, absorbed by the glass or reflected away from the glass. Solar Transmittance refers to the amount of solar energy (visible, infrared and ultraviolet) that passes through a glazing system, expressed as a percentage.



Combinations of the type of glass and window film applied result in varying amounts of solar energy entering an environment.

Solar Absorptance (A)

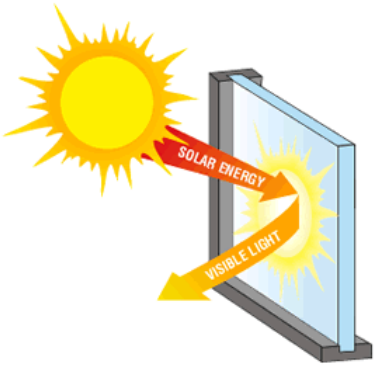
Solar Absorptance (A) is the amount of solar energy that is absorbed by the glazing system, expressed as percentage. Fracture can result when solar absorptance over-heats the glass while the other glazing elements remain cooler.



Uneven temperature distribution across a glazing system can result in fracture from thermal stress.

Solar Reflectance (R)

The Solar Reflectance value is the percentage of solar energy that is re-radiated to the outside by the glazing system.



The type of glass and window film applied causes varying reflectance results, shown as a percentage – this is the amount of solar energy that the glass and film reject away.

Visible Light

Visible Light allows us to see the world around us. Coming through windows, it can result in uncomfortable glare.

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The type of glass and window film applied result in varying transmittance and reflectance results.

Visual Light Transmittance (VLT)

Visual Light Transmittance (VLT) is the amount of visible light that passes through a glazing system, expressed as a percentage of the total solar energy. A lower VLT rating tends to be better for glare control, while a higher rating is preferred for maintaining natural light.

Visual Light Reflection (VLR)

Visual Light Reflectance (VLR) is the amount of visible light that is reflected by the glazing system, expressed as a percentage. A higher VLR rating offers better glare control. Films with higher ratings tend to be more reflective and/or darker.

Visible Light Absorptance (VLA)

Visible Light Absorptance (VLA) is the amount of visible light that is absorbed by the glazing system, expressed as a percentage. The higher the VLA, the higher the amount of solar energy retained by the glass and film.

VLA is calculated as:

100% - VLR + VLT = VLA

Emissivity (E)

Emissivity refers to the measurement of a surface's ability to absorb or reflect radiant energy. The lower the emissivity rating, the smaller the amount of infrared radiation allowed inside through the window and film system.

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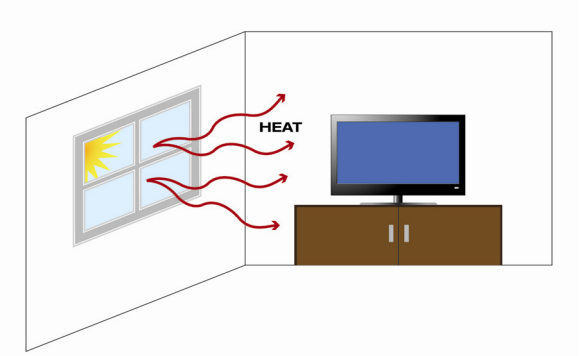
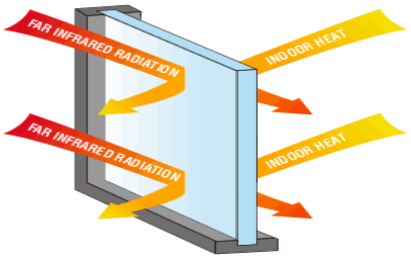
U-Value (W/m²)	5.79	2.82
Shading coefficient	.69	.71

For windows with film, emissivity refers to the heat reflected into the room.



Low-Emissivity (Low-E)

Low-Emissivity, or Low-E, refers to a coating on glass or window film that reduces heat loss. The lower the emissivity rating, the better the insulation capabilities of the glazing system in regard to heat loss. Low-E, or low emissivity, film was originally used exclusively in cold climates to prevent heat loss, but it is now used extensively for solar heat control, to prevent heat build-up inside.



Low-E coating reduces heat loss. The lower the emissivity rating, the better the window is insulated in regard to heat loss. More infrared radiation reflects out and more indoor heat reflects back into the room.

U-Value

The U-Value is the measurement of heat transfer through film due to outdoor/indoor temperature differences. The lower the U-value, the less heat transfers through the glazing surface.

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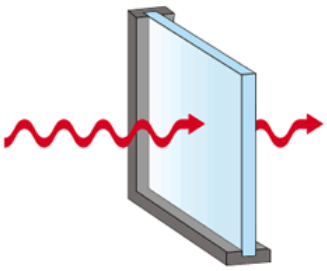
Solar heat gain coefficient	.60	.62

When using performance data, a lower U-Value is desirable for heat management.



Shading Coefficient (SC)

The Shading Coefficient, or SC, is the ratio of solar heat gain passing through a glazing system to the solar heat gain that occurs under the same conditions if the window was made of clear, unshaded double strength glass. The lower the SC number, the better the solar control efficiency of the glazing system. This measures the efficiency of glass-to-glass only.

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Solar selectivity index - luminous efficacy (VLT/SC)	.70	.62

The lower the Shading Coefficient, the better the solar control efficiency of the glazing system.

Ultraviolet Light (UV) Transmittance

Invisible, powerful wavelengths (shorter than light but longer than X rays) emitted by the sun separate into three types: UV-A, UV-B and UV-C. UV-B causes sunburn, and prolonged exposure can cause damage to health, fading and discoloration. Window films block nearly 100% of ultraviolet light from passing through glass.

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% Ultraviolet transmittance (@ 300 to 380 nm)	>99	>99
% Total solar energy rejected	40	38
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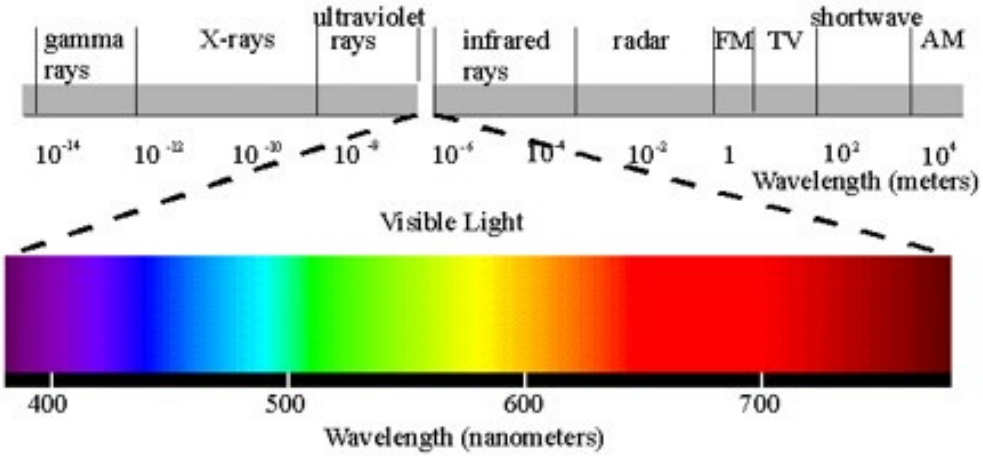
The Performance Results for Stainless Steel 50 show that the percentage of Ultraviolet Light blocked at 300-380 nm is more than 99% for both 4mm single pain and double pain glass.



Here, the entire electromagnetic spectrum is represented, illustrating where solar energy fits.