Fading

Energy from the sun which is transmitted through glass can be categorized into three main regions: ultraviolet (UV), visible (seen by the eye), and near infrared (see figure 1). Ultraviolet (UV) energy spans from 300 to 380 nm. Visible light spans from 380 to 780 nm. Near infrared radiation (or heat energy) spans from 780 to 2,500 nm. There is more energy below 300 nm, but this is effectively blocked-out by all glass products.

Conventionally, it is considered that UV energy accounts for the majority of fading. As a result, many people use the classical UV transmittance (300 to 380 nm) to indicate fading potential and compare products. It has been shown experimentally that fading damage can also occur in the visible light region up to approximately 600 nm (see Figure 1). For this reason, a damage weighted function was developed in Europe by Krochmann. This function attempts to account for the fading potential of all damaging radiation which can be transmitted through glass. It covers a spectral range from about 300 to 600 nm and weights each wavelength in relation to the potential damage it can cause to typical materials. Another method to calculate damage weighted transmittance was developed by the International Standards Organization (ISO), which uses a weighting function recommended by the International Commission on Illumination (CIE). This method assigns a specific damage weighted transmittance to each wavelength of UV and Visible light according to its contribution to the fading of materials and fabrics. Its spectral range is from 300 to about 700 nm.

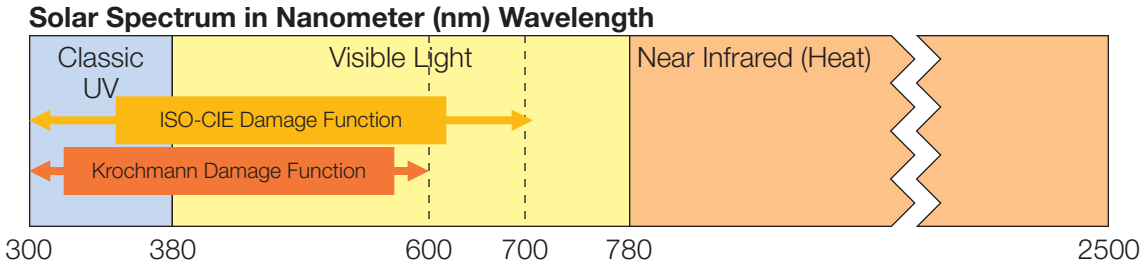

Fig. IG11-1

Cardinal manufactures LoE™ products which reduce the potential for fading of fabrics and materials by reducing the transmission of damaging radiation from the sun. Table 1 below lists Cardinal's products and their relationships to the three different fading interpretations: UV, Krochmann, and ISO-CIE.

It is important to consider the sensitivity of the materials or fabrics to be protected. Some materials are only sensitive in the UV region while others display greater sensitivity to the visible spectrum. Knowing the sensitivity of the material to be protected helps determine how well a particular glass product will protect against fading.

Fading Comparisons

IG Product	UV Transmission (300 to 380 nm)	Krochmann Damage Weighted Transmission (300 to 600 nm)	ISO-CIE Damage Weighted Transmission (300 to 700 nm)
Single Pane 3mm Clear	73%	74%	85%
Single Pane 3mm Bronze	36%	43%	57%
Single Pane 3mm Pyrolytic	49%	56%	71%
Single Pane 7.8L Laminate	<1%	30%	61%
Clear / Clear	58%	61%	75%
Clear / Pyrolytic	46%	51%	65%
Clear / LoE-179™	24%	39%	61%
LoE²-272™ / Clear	16%	33%	55%
LoE²-270™ / Clear	14%	31%	53%
LoE³-366™ / Clear	5%	21%	43%
LoE²-240™ / Clear	16%	24%	35%
Bronze / Clear	31%	37%	51%
Bronze / LoE-179™	14%	26%	43%
Bronze / LoE²-272™	10%	23%	39%
Bronze / LoE²-270™	9%	22%	37%
Clear / 7.8L Laminate	<1%	27%	55%
LoE-179™ / 7.8L Laminate	<1%	23%	50%
LoE²-272™ / 7.8L Laminate	<1%	22%	46%
LoE²-270™ / 7.8L Laminate	<1%	21%	45%
LoE³-366™ / 7.8L Laminate	<1%	16%	39%
LoE²-240™ / 7.8L Laminate	<1%	14%	28%
Triple Pane: LoE²-179™ / Clear / LoE²179™	10%	26%	48%
Triple Pane: LoE²-272™ / Clear / LoE²-272™	5%	21%	40%
Triple Pane: LoE²-240™ / Clear / LoE²-240™	4%	10%	16%

Table 1

NOTES:
(1) Calculations were done using Window 5.2 program with NFRC 100-2001 environmental conditions.
(2) Pyrolytic product: 3mm Pilkington/LOF Energy Advantage Low-E
(3) Laminated configuration: 7.8L (3.1mm / 0.060" PVB / 3.1mm)
(4) IG configurations: 3mm glass thickness, 12.7mm airspace dimension. For two pane IG units the LoE™ coatings were located on surface #2, except when configured with a tinted lite then the LoE™ coating is located on surface #3. For three pane IG units the LoE™ coatings were located on surfaces #2 and #5.