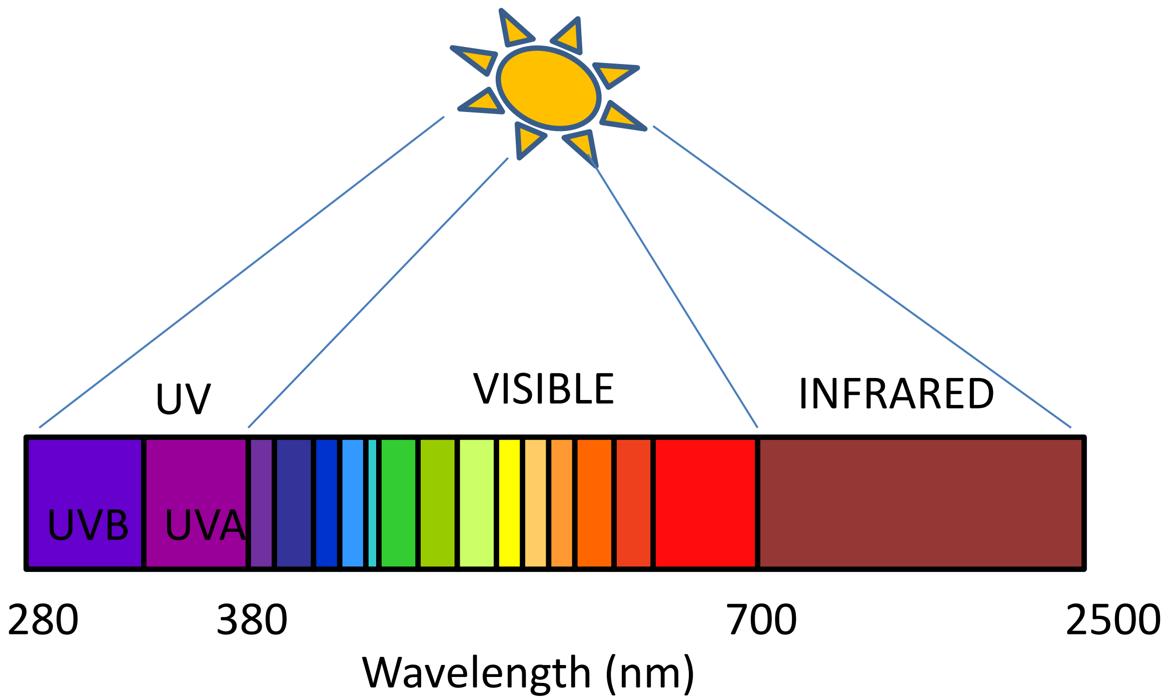
Reducing Fading and Material Degradation of Interior Furnishings Caused by Solar Radiation Exposure



Fading is a change in color with time. It is measured by evaluating the color of a material at two or more points in time. Often it is a loss of color or a reduction in color saturation due to bleaching. For the purposes of this discussion, we are interested in material degradation due to solar exposure, such as embrittlement and cracking as well as fading and the ability to reduce this damage by choosing window glazing that blocks the most damaging solar rays.

It is important to consider the sensitivity of the interior furnishings or materials to be protected. Some are only sensitive to particular wavelengths in the solar spectrum. Knowing the sensitivity of the materials to be protected helps to determine how well a particular glass product will perform to reduce fading or damage.

For decades, the accepted measure for indicating the propensity of glazing to resist fading of home furnishings such as carpeting, drapes, furniture, etc. has been UV transmittance. More recent testing has shown that fading is influenced by both UV waves as well as a portion of the visible light spectrum which can contribute as much as 40% to the fading damage. Of the new measurement factors that have been developed, the International Standards Organization
(ISO) has the most comprehensive factor. It assigns a weight to the transmittance at each wavelength

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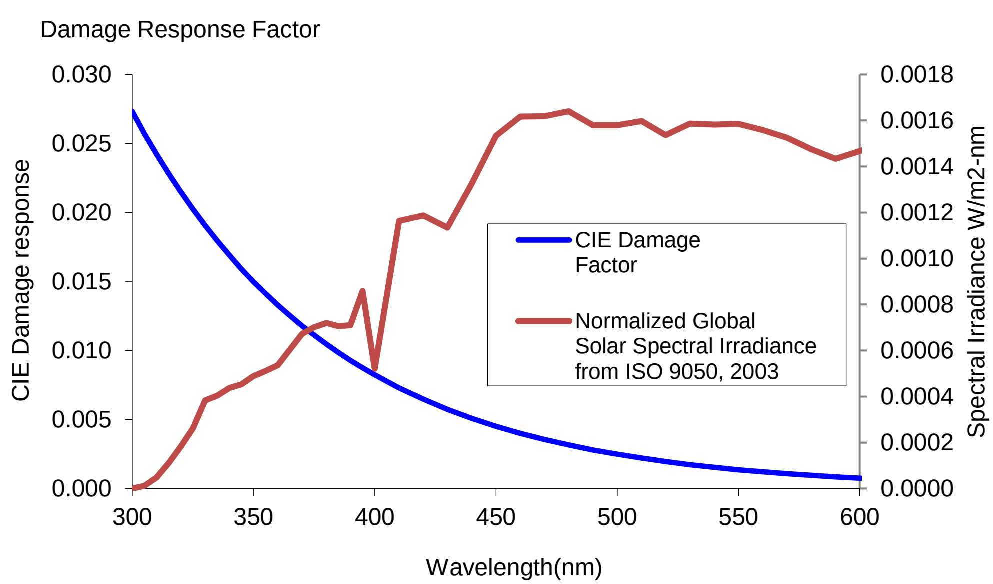
between 300 and 600 nm (the visible spectrum begins at 380 nm) based on the known contribution to material damage as determined by the International Commission on Illumination (CIE). The name of this factor is the ISO Damage Weighted Transmittance (Tdw-ISO) factor.

The Tdw-ISO calculation assigns a specific damage weighted factor to each wavelength of UV or visible light, based on its contribution to fading. As the CIE Damage Factor in Graph 1 shows below, it is known that the shorter wavelengths (such as UV) cause more fading damage than the longer wavelengths (such as visible). Consequently, the shorter wavelength will have a higher weighted "damage" factor than the longer wavelength. The sum total of these wavelength specific factors yields the Damage Weighted Transmittance for a specific glass product. Graph 2 shows the resulting Solar Weighted Damage Response by wavelength. By comparing the Damage Weighted Transmittance of various glass types, architects, building owners, homeowners and window manufacturers can more effectively determine the ability to protect interior components from fading. While Tdw-ISO is not currently published on most glass manufacturer data sheets, it is available by request. These values can also be calculated using LBNL's (Lawrence Berkeley National Laboratory) Window 7.4 thermal



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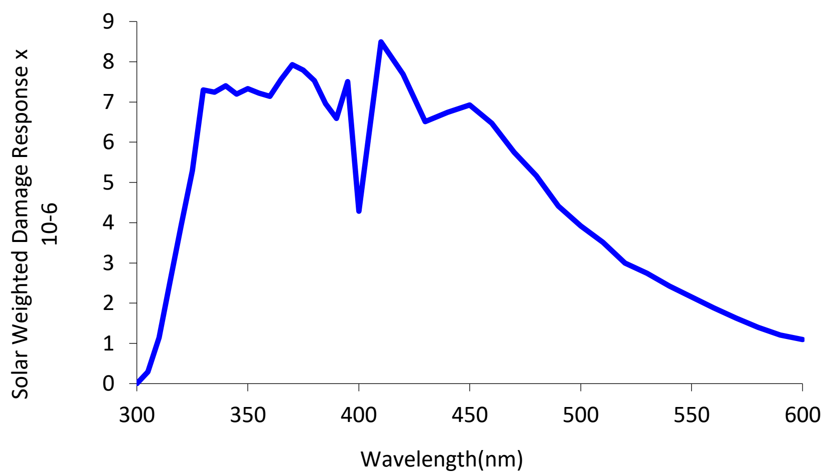
Graph 2. Solar Weighted Damage Response Curve



analysis software.[1] Table 1 shows the Damage Weighted Transmittance for several Vitro glass products in various glazing configurations as well as the older, less comprehensive UV transmittance reading for each product. A lower Tdw-ISO translates into better fading protection. Note that the basic clear/clear monolithic laminate has a UV transmittance of zero and a Tdw-ISO of 0.57. This level of fading protection is due to the UV blocking power of the interlayer itself. Also note that most of the residential and commercial insulated units have even better fading protection performance with Tdw-ISO values that are well below that of the clear/clear laminate. This is due to the blocking power of the low-E coatings at the short wavelength end of the visible spectrum (380 to 700 nm). Some of the best fading protection performance is achieved by combining a laminated lite in an IGU (insulated glass unit) that also contains a high performance low-E coating.

In conclusion, knowing the sensitivity of the materials to be protected and selecting a glass product that reduces transmission at those wavelengths is the ideal situation. Because Tdw-ISO represents damage caused by both UV and visible wavelengths, it is a more accurate tool for assessing potential fade resistance than the total UV transmittance measure that was (and is) traditionally used by many manufacturers.

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Table 1. Comparison of UV to Damage Weighted Transmittance for Various High Performance Glazing Constructions

Product Description	Visible Light Transmittance (VLT)	Solar Heat Gain Coefficient (SHGC)	Total Ultraviolet Transmittance (UV)	Damage Weighted Transmittance (Tdw-ISO)
Typical Residential Insulated Vision Unit - 3/4" (19mm) unit with 1/2" (13mm) airspace and two 1/8" (3mm) lites; interior lite clear				
Clear + Clear	81	0.76	59	**0.74**
SUNGATE®400 (2) + Clear	78	0.64	32	**0.64**
SUNGATE®400 (3) + Clear	57	0.68	32	**0.64**
SOLARBAN®60 (2)Solargray + Clear	49	0.31	12	**0.38**
SOLARBAN®60 (2) + Clear	72	0.40	20	**0.55**
SOLARBAN®60 (3) + Clear	72	0.48	20	**0.55**
SOLARBAN®70XL (2) + Clear	64	0.28	6	**0.43**
SOLARBAN®90 (2) + Clear	52	0.23	8	**0.37**
Typical Commercial Insulated Vision Unit - 1" (25mm) unit with 1/2" (13mm) airspace and two 1/4" (6mm) lites; interior lite clear				
Clear + Clear	79	0.70	50	**0.70**
SOLARBAN®60 (2)Solargray + Clear	35	0.25	8	**0.28**
SOLARBAN®60 (2) + Clear	70	0.39	18	**0.53**
SOLARBAN®67 (2) + Clear	54	0.29	11	**0.40**
SOLARBAN®70XL (2) + Clear	64	0.27	6	**0.43**
SOLARBAN®90 (2) + Clear	19	0.23	7	**0.36**
SOLARBAN®z50 (2) Optiblue + Clear	51	0.32	14	**0.42**
SOLARBAN®z75 (2) Optiblue + Clear	46	0.23	5	**0.34**
SOLARBAN® R100 (2) + Clear	42	0.23	12	**0.34**
Typical Monolithic Laminates - 5/8" (14mm) overall thickness with 0.090" (2.3mm) thick clear PVB and two 1/4" (6mm) lites: interior lite clear				
Clear/Clear	86	0.70	0.0	**0.57**
SOLARBAN®60 (2)Solargray* / Clear	36	0.41	0.0	**0.24**
SOLARBAN®60 (2)* / Clear	72	0.45	0.0	**0.46**
SOLARBAN®67 (2) */ Clear	52	0.36	0.0	**0.31**
SOLARBAN®70XL (2)* / Clear	60	0.32	0.0	**0.37**
SOLARBAN®90 (2)* / Clear	45	0.31	0.0	**0.28**
SOLARBAN®z50 (2) Optiblue*/ Clear	52	0.42	0.0	**0.36**
SOLARBAN®z75 (2) Optiblue*/ Clear	47	0.35	0.0	**0.32**
SOLARBAN®R100 (2)* / Clear	42	0.31	0.0	**0.27**

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Table 1. Comparison of UV to Damage Weighted Transmittance for Various High Performance Glazing Constructions (cont'd)

Product Description	Visible Light Transmittance (VLT)	Solar Heat Gain Coefficient (SHGC)	Total Ultraviolet Transmittance (UV)	Damage Weighted Transmittance (Tdw-ISO)
Typical Commercial Insulated Vision Unit with Laminated Inboard Lite - 1 5/16" (32mm) overall thickness with ¼" (6mm) outboard lite, ½" (12mm) airspace and two 1/4" (6mm) clear inboard lites laminated with 0.090" (2.3mm) thick clear PVB:				
Clear + Clear/Clear	76	0.66	0.0	**0.51**
SUNGATE®400 (2) + Clear/Clear	74	0.58	0.0	**0.48**
SOLARBAN®60 (2)Solargray + Clear/Clear	34	0.25	0.0	**0.22**
SOLARBAN®60 (2) + Clear/Clear	68	0.38	0.0	**0.43**
SOLARBAN®67 (2) + Clear/Clear	52	0.29	0.0	**0.33**
SOLARBAN®70XL (2) + Clear/Clear	62	0.27	0.0	**0.38**
SOLARBAN®90 (2) + Clear/Clear	49	0.23	0.0	**0.30**
SOLARBAN®z50 (2) Optiblue + Clear/Clear	49	0.32	0.0	**0.34**
SOLARBAN®z75 (2) Optiblue + Clear/Clear	45	0.22	0.0	**0.29**
SOLARBAN®R100 (2) + Clear/Clear	40	0.23	0.0	**0.27**

*Only Vitro Certified Laminator Program Members in good standing may laminate the Solarban coating in direct contact with a compatible interlayer material

[1]The Lawrence Berkeley Laboratory (LBL) Window 7.4 software calculates total weighted damage using two methodologies. The first, Tdw-K, created by German researcher Jurgen Krochmann, covers the UV and visible parts of the spectrum up to 500 nanometers. Tdw-ISO is regarded to provide a more accurate assessment, however, because it includes the visible range up to 700 nanometers. According to LBL, "Tdw-ISO is weighted using a function recommended in the CIE standard which also derives from the work of Krochmann, but is considered to have more general validity.

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HISTORY TABLE		
ITEM	DATE	DESCRIPTION
Original Publication	1/14/2009	TD-148
Revision #1	10/4/2016	Updated to Vitro Logo and format
Revision #2	1/28/2019	Updated the Vitro Logo and format
Revision #3	6/27/2019	Updated and added Configurations
Revision #4	7/10/2019	Added 2 Configurations to Residential