WHY ROOF CONSULTANTS SHOULD WORRY ABOUT WINDOWS

By Marty Watts

According to the California Energy Commission, 30% of a building's cooling requirements are a function of heat entering through existing glass. While the roofing industry has been concerned with developing more energy-efficient roof systems – both to insulate against heat loss and to prevent overheating – a building with an energy-efficient roof and energy-deficient windows has only marginally improved its energy efficiency.

While roof consultants may not want to become window and glazing consultants or specifiers, increased knowledge of window-related energy problems will enable them to provide integrated solutions to improve building envelope energy performance. Offering such knowledge to clients may increase the credibility of roof consultants and enhance business opportunities with prospective clients.

Window basics

Stopping heat at the window lowers temperatures and reduces HVAC operating cost. In new construction, reducing heat at the window can allow for the use of smaller and less expensive HVAC systems.

In existing buildings, applied window film is the least expensive solution to mitigate the impact of solar heat gain through windows. The good news is that conventional tinted and reflective applied window films successfully block some solar heat, thereby reducing the use of HVAC systems.

The bad news is that these same films reduce a significant percentage of visible light through the glass. Many of these films are highly reflective in daylight, giving them a mirror-like appearance when viewed externally. In artificial light and at night, internally, reflective films appear mirrored. In the case of retail establishments, visible light is reduced inside the store and shoppers outside cannot clearly see inside.

Most conventional window films transmit less than 40% of visible light. This is 30% less than the 70% necessary for the glass not to appear dark to the naked eye.

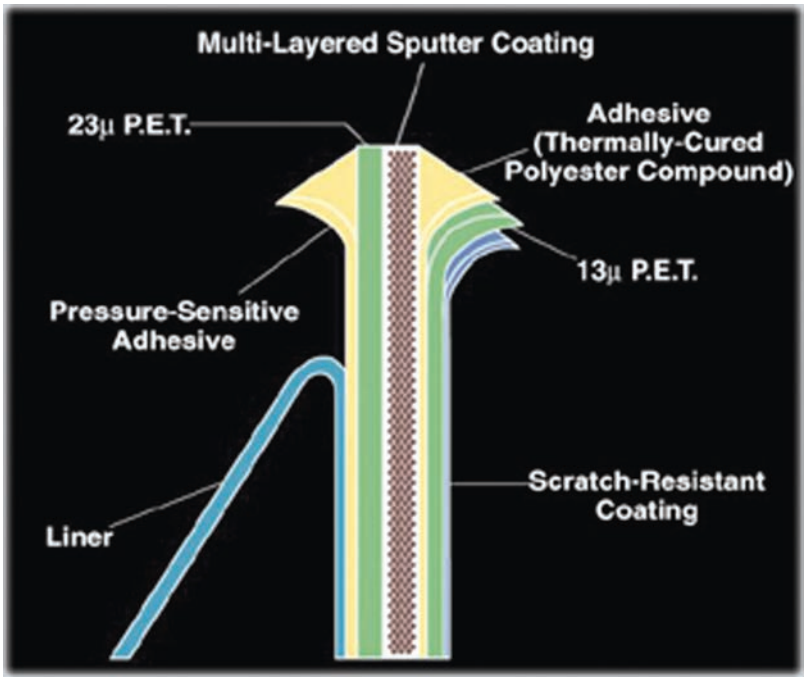

Diagram A

Type of glass or applied film	% of daylight through glass	% of solar energy through glass	Shading coefficient*	Luminous efficacy constant**	% of visible light reflectance interior/exterior
1/4" clear glass	89	77	0.96	.93	7/7
1/4" clear glass with tinted film	37	64	0.74	.50	6/6
1/4" clear glass with reflective film	37	44	0.51	.73	18/28
1/4" clear glass with clear, spectrally selective film	70	45	0.51	1.37	8/8

**The lower the shading coefficient, the lower the solar heat gain.*
***Luminous efficacy constant, a measurement of a window glass or film's ability to simultaneously block heat and yet transmit light (visible light divided by the shading coefficient). The higher the number, the more efficiently the glass or film blocks heat and transmits light.*

Data by Southwall Technologies, Inc., Palo Alto, CA, and Lawrence Berkeley National Laboratory, Berkeley, CA.

Table 1

This results in darkened building interiors that often require the use of increased illumination. The requirement for additional interior lighting may lead to higher electricity consumption and may increase inside temperatures, requiring more air conditioning. Increased utility costs caused by the additional lighting and air conditioning defeat the major benefit of the film: cost savings.

The best solution to overheating – clear, spectrally selective film.

Clear, spectrally selective applied window film offers the best ratio of visible light transmission to heat rejection. Spectrally selective refers to the ability of the film to select or let in desirable daylight while blocking out undesirable heat. (See *Diagram A*, showing how spectrally selective film is constructed.)

While some manufacturers call their films spectrally selective, the definitive test is how much visible light a film transmits. Most so-called spectrally selective films transmit no more than 54% of visible light. If a window film looks tinted and not clear, it is not optimally selective in the all-important category of visible light transmission.

Table 1 shows how different kinds of glass and applied films transmit light and heat and compares the energy performance of spectrally selective film.

Advise clients to consider the following points when evaluating spectrally selective vs. conventional window film:

Photo 1: Conventional reflective window film (left), V-Kool clear spectrally selective film (center), and conventional tinted film (right).

How do they compare in clarity?

The ideal film would be totally clear yet able to significantly block unwanted solar heat and reduce glare.

How do they compare in blocking heat?

Most conventional tinted films transmit over 65% of solar energy, giving them an unacceptable shading coefficient of over 0.70. (The lower the shading coefficient, the lower the solar heat gain.) When considering both heat rejection and light transmission, spectrally selective films outperform conventional competitors.

How do they compare aesthetically?

Conventionally-tinted and reflective window film changes the appearance of existing glass, and therefore, the external appearance of a building. Clear spectrally selective film does not change the appearance of existing glass, allowing its application on the entire building or on as few windows as necessary to deal with a localized over-heating problem. (See *Photo 1*, comparing the appearance of spectrally selective and conventional window films.)

How do they compare in price?

The price of dark, tinted, and reflective window film ranges from $4 to $6 per installed square foot. Depending on the particulars of the installation and the geographic area, the best spectrally selective applied window film ranges in price from approximately $9 to $12 per square foot installed. Installed prices are volume-dependent; therefore, on larger projects' films, they may be installed for less.

How do they compare in payback?

Less expensive conventional window films have a shorter payback compared to more expensive spectrally selective films. However, when adding the cost of extra energy used for lighting and HVAC operation (due to conventional films' inability to transmit sufficient visible light), the payback for conventional film and spectrally selective film becomes comparable. Given rising electricity rates, the rate of payback for spectrally selective film is always improving, averaging less than four years.

Where can I find more information on conventional and spectrally selective window film?

The International Window Film Association, Martinsville, Virginia (**www.iwfa.com**), and the Association of Industrial Metallizers, Coaters and Laminators (AIMCAL), Ft. Mill, South Carolina (**www.aimcal.com**), provide a range of information.

Real-life installations of spectrally selective window film.

Spectrally selective window film is saving energy in such landmark buildings as the former headquarters of Montgomery Ward in Chicago, the headquarters of the American Institute of Architects in Washington, DC (*Photo 2*), Encina Hall at Stanford University (*Photo 3*), and in the University Memorial Center, University of Colorado at Boulder (*Photo 4*). Spectrally selective film is also in use in retail establishments such as Quik Trip convenience stores (*Photo 5*).

Left: Photo 2: Headquarters of the American Institute of Architects (AIA) in Washington, DC.

Above: Photo 3: Encina Hall, Stanford University.

Right: Photo 4: University Memorial Center, University of Colorado at Boulder. (Photo courtesy of Casey A. Cass, University of Colorado.)

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Product/Glass Type	Glass Thickness		Transmittance		Reflectance			Absorbance	Solar Heat Gain	Rejection	Winter Nighttime U-Value		Summer Daytime U-Value		Shading
			Daylight	Solar	Daylight		Solar	Solar	Coefficient	Solar					Coefficient
	Eng.	SI	Total %	Total %	Ext. %	Int. %	Ext. %	%		%	Eng.	SI	Eng.	SI	
V-Kool 70 on Single Pane:															
Clear Single Pane	1/8"	3mm	90	93	9	9	9	10	0.85	15	1.11	6.29	1.03	5.85	0.99
Clear Single Pane	1/4"	6mm	89	77	9	9	7	16	0.81	19	1.09	6.19	1.03	5.85	0.94
Clear/V-Kool	1/8"	3mm	71	35	8	8	27	39	0.44	56	0.95	5.42	0.93	5.26	0.51
Clear/V-Kool	1/4"	6mm	69	33	8	8	21	46	0.44	56	0.94	5.69	0.93	5.26	0.51
Green/V-Kool	1/4"	6mm	61	25	7	8	8	67	0.41	59	0.94	5.34	0.96	5.45	0.48
EverGreen/V-Kool	1/4"	6mm	53	20	7	7	6	74	0.38	62	0.94	5.34	0.97	5.51	0.44
Azurlite/V-Kool	1/4"	6mm	57	22	7	7	6	72	0.40	60	0.94	5.34	0.97	5.5	0.46
Blue/V-Kool	1/4"	6mm	44	21	6	7	10	69	0.38	60	0.94	6.69	0.96	6.47	0.44
Bronze/V-Kool	1/4"	6mm	43	21	6	7	13	66	0.37	63	0.94	5.34	0.96	5.45	0.43
Gray/V-Kool	1/4"	6mm	36	18	5	6	10	72	0.36	64	0.94	5.34	0.97	5.49	0.41
V-Kool 70 on Double Pane:															
Clear/Clear Float	1/8"	3mm	81	69	16	16	13	18	0.75	25	0.94	2.79	0.55	3.13	0.87
Clear/Clear with V-Kool	1/8"	3mm	64	31	15	12	25	44	0.50	50	0.45	2.5	0.55	3.13	0.59
Clear/Clear Float	1/4"	6mm	79	61	15	15	12	28	0.70	30	0.48	2.74	0.55	3.15	0.81
Clear/Clear with V-Kool	1/4"	6mm	62	28	15	12	19	53	0.50	50	0.44	2.52	0.55	3.12	0.58

Chart A: Comparison of Spectrally Selective to Conventional Window Film

Photo 5: Quik Trip convenience store.

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Window Film Magazine (**http://www.windowfilmmag.com**) is the only publication written for and about window film manufacturers, distributors, dealers, and installers. It often contains material on the energy benefits and performance of applied window film.

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Marty Watts is president and CEO of V-Kool, Inc., a Houston-based North American distributor of spectrally selective and security applied window films for architectural, automotive, and specialized vehicular applications. Prior to founding V-Kool in 1997, Mr. Watts worked for over 20 years in both window film and in the design and manufacturing of in-store retail signage systems. His writing on window film, energy conservation, and window security has appeared in numerous publications, including *Glass Magazine*, *Energy Optimization News*, *Buildings*, *Facility Management Journal*, and *Architectural West*.