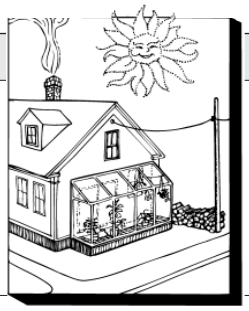
Choosing a Low-E Glazing



by Marc Rosenbaum

Though low-emissivity, or low-e, coatings are now standard fare on many windows, all low-e coatings aren't alike. Different types of coatings transmit varying amounts of visible, infrared (IR), and ultraviolet (UV) radiation. But do these differences really matter? I believe they do. As a designer, I've learned to fine-tune the comfort and energy performance of my buildings by using different windows on different facades. While the effect may be subtle on a small ranch house, the results in a large custom home can be dramatic.

Low-E and R-Value

A low-e coating is like a specialized mirror in that it reflects radiant heat back to where it came from (see illustration below). It can increase the center-of-glass insulating value of a double glazing from R-2 to R-3. Using an inert gas such as argon or krypton between the panes brings the R-value up to around 4. These measures cut heat loss and raise the inside temperature of the glass. This reduces condensation on the surface of the glass, and makes it more likely that people can sit next to the window on a cold day without feeling chilled from radiant cooling or cold convection currents.

Low-e coatings currently come in three forms: soft coat (a metallic oxide applied to the surface of the glass), hard coat (a metallic oxide fused to the hot glass surface during manufacture), and a proprietary product called Heat Mirror (a low-e coating applied to a polyester film that's suspended between two sheets of glass).

Each type has its pros and cons. Soft coats typically provide higher R-values than hard coats, but degrade when exposed to air, so they must be used in a sealed unit. Hard coatings are more durable and can be used in applications like storm windows or Pella's optional energy panel. Heat mirror, because it is a separate film that creates multiple air spaces, can be used to make windows with very high R-values. For example, two layers of Heat Mirror film combined with krypton gas can be used to create glazing with three air spaces and R-values of up to 9. (Heat Mirror films also transmit a much smaller portion of ultraviolet light than either soft- or hard-coat low-e windows.)

Low-E and Visibility

What's as important as R-value is the relative amounts of visible light and heat energy a window lets in. Manufacturers typically publish three numbers for their windows: the R-value, the Visible Light Transmittance, and the Shading Coefficient (SC). The SC is the ratio of total solar heat gain through a given glazing to the total solar gain through a single pane of double-strength glass. Single-pane glass has a SC of 1.0, clear double glass 0.87. The higher the SC, the more solar heat the glass will admit.

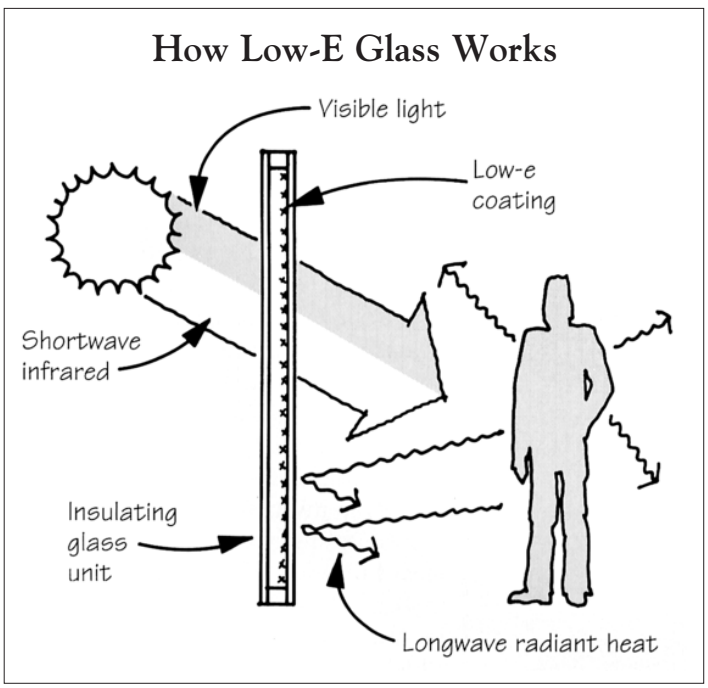
On average, 38% of the solar energy that reaches the earth's surface on a clear day is visible light, 59% is infrared, and 3% is ultraviolet. Visible light is what we perceive, and we want to let as much of it through our windows as possible. Infrared adds heat to a house but not light. Where it's important to maximize passive solar gain, therefore, I try to maximize infrared transmission. Where I want to minimize the cooling load, then I try to block infrared.

Using glass with a lower SC can cut infrared transmission, which lowers the heat gain of the glass. This in turn may reduce the required size of the cooling system. In a large home with a lot of glass, I've been able to save thousands of dollars in capital costs by downsizing or even eliminating the cooling system. (Another way to reduce solar heat gain is to shade the glass using porches, vegetation, awnings, or overhangs.)

Comparing Products

The table on page 92 shows six low-e glazing types and their values. Note that the R-values are very similar for all except the hard-coat LOF Energy Advantage, and that visible transmission is similar for all except Heat Mirror 66 and Cardinal 145. The biggest differences occur in the shading coefficient.

The LOF glass has the highest SC — just the ticket for passive solar buildings. It maximizes solar heat gain at a small penalty in insulating value. The lowest SC values are for Cardinal 145 and Heat Mirror 66. These are good choices in warm climates, or where you have a lot of west-facing or overhead glass, which could cook the occupants in the



Low-e glazing allows most of the visible light and shortwave infrared energy from the sun to pass through, but minimizes heat loss by reflecting much of the radiant heat from people and objects back into the room.

Performance of Low-e Glazings

	R-value (center of glass)	Visible Transmission	Shading Coefficient
Soft Coats:			
Cardinal 178	3.9	0.78	0.75
Cardinal 171 (Low-e squared)	4.2	0.72	0.47
Cardinal 145	3.7	0.44	0.38
Hard Coats:			
LOF Energy Advantage	3.3	0.74	0.83
Heat Mirror:			
Heat Mirror 88	4.0	0.73	0.65
Heat Mirror 66	4.2	0.56	0.43

Note: *Different manufacturers' coatings transmit varying amounts of heat and visible light. Heat gain is expressed as the Shading Coefficient, or SC. The higher the SC, the more solar heat the glass will admit. Carefully choosing between these options lets you maximize solar gain when you want it, and minimize it when you don't.*

summer. Remember, however, that while these glazings reject much of the sun's heat, they also cut down somewhat on visible light transmission.

Heat Mirror 88 and Cardinal 178 glazings are good, all-around glazings for nonsolar buildings in climates where heating loads predominate. Both have good visible transmission and a moderately high SC, although the Cardinal product has a slight edge in both categories.

Cardinal 171, also called "low-e squared," is a more recent, softcoat innovation. It offers a marginally improved R-value, slightly less visible light transmission, and a relatively low SC. This glass is now standard in a number of major manufacturers' low-e windows, including Andersen's, Eagle's, Kolbe and Kolbe's, and Pella's. Windows with 171 glass reject much of the IR. This cuts down on cooling loads, so windows with 171 glass are a good choice for homes in mixed heating and cooling climates, but a lousy choice for solar or sun-tempered homes in the northern tier.

Some manufacturers will substitute high-SC low-e glass upon request, at varying costs. On a recent large job, for instance, Pella and Kolbe & Kolbe both offered to ship windows with LOF Energy Advantage instead of Cardinal 171. Pella wanted an extra $10,000, Kolbe & Kolbe $2,000. My Andersen rep, however, told me that the company would substitute Cardinal 178 at no cost.

Where reducing the cooling load is a priority, most manufacturers offer a low-e product with tinted glass that has an SC of 0.3 to 0.4. There's less heat gain, but visible light transmission also drops significantly. For example, Cardinal 145 has a visible transmission of 0.44, compared with 0.78 for the 178 product.

UV-induced fading is a concern for some people. If you're trying to protect a $10,000 oriental rug, the clear winner is Heat Mirror, which passes less than 1% of the UV. Other low-e products transmit considerably more: Cardinal 178 has a UV transmission of 0.34 and the 171 glazing is rated at 0.18. In any case, you should remind your client that even non-UV light can contribute to fading.

Field Experience

How do I put this information to work? A small institutional building I worked on had 65% of its glass on the south side. By using different types of low-e glazings I was able to design a very comfortable, energy-efficient building. I used LOF Energy Advantage to maximize solar gain on the south side. On the other facades I used Cardinal 171 to keep light levels high while rejecting summer heat. The main benefits were maximum heat gain in winter and minimized cooling loads in summer. ■

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