HOME IMPROVEMENT

Window Film

New high-tech glass films claim energy savings for your home.

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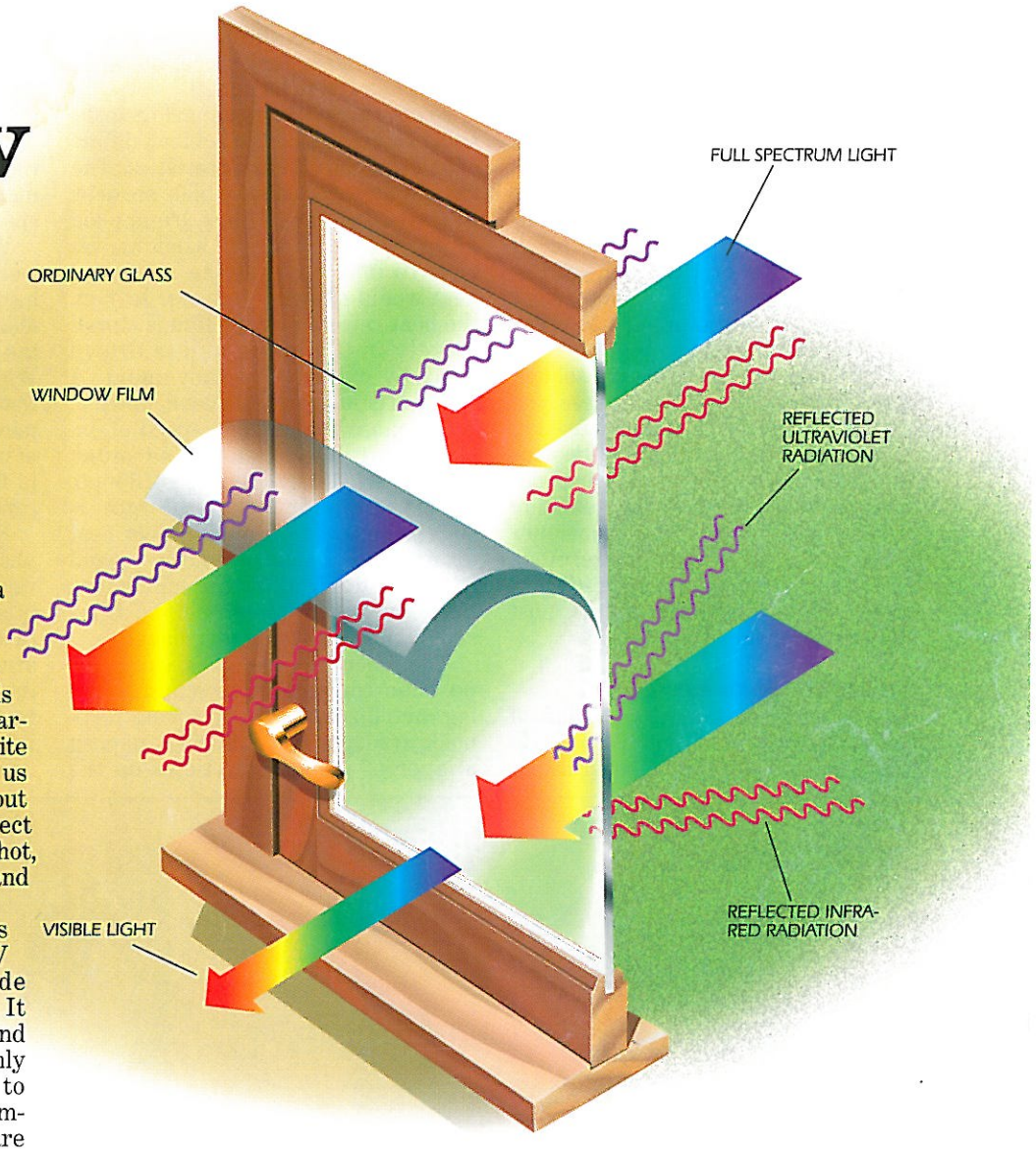


● Few structural features make a house more attractive and livable than windows. In fact, for most of us, the more windows the better. However, window glass is not a particularly good energy barrier. And it's paradoxical that despite all we invest in windows, most of us rush to draw the blinds to block out the summer sun. Not only is direct sunlight often too bright and too hot, it carries too much UV radiation and produces glare.

In fact, single-pane window glass blocks less than 25% of the UV rays that damage skin and fade drapes, carpets and furnishings. It reflects less than 8% of the light and heat that strikes it and absorbs only 5%, while allowing roughly 87% to pass through. The year-round numbers for double-glazed windows are only slightly better.

What we really need is a window that's a little more discriminating—one that lets in as much visible light as we want, while excluding some of sunlight's less desirable characteristics. And because of the advent of window films, we now have a range of products that address this need. However, they're not all alike and the usefulness of any one film is directly related to personal requirements. Window film may give us the best of both worlds, but not always in the best proportions.

Window films were introduced in 1969 to address problems surrounding the control of sunlight in homes and businesses. Although they were fairly effective, they received mixed reviews. The failings were fading film dyes and highly mirrored and easily scratched surfaces. Poor installations also led to blisters, cracks and edge peel.

Within certain limits, most of the problems of older films have been solved. Today's offerings are more attractive (some are virtually invisible), and they deliver improved performance and better durability. These gains are largely a product of advances in technology, nudged along by the market pressures of consumer demand.

Assuming a reasonable compromise of performance and appearance, window films can now block up to 98% of UV radiation and up to 80% of normal heat gain. They can also provide a degree of privacy, and thicker films can turn regular glass into safety glass by increasing strength up to 300%. In the winter, films can decrease emissivity, allowing us to keep more of the heat we pay for. More-

over, they do all this at a fairly reasonable price. Allowing for the odd exception, window films cost between $3 and $7.50 per square foot, including installation. Costs may be even less where utility companies subsidize installations through rebates and allowances. And finally, home centers sell DIY films that range between $1 and $2 per square foot.

If these prices sound a bit steep, they're really not. Industry studies and Department of Energy models predict a payback in energy savings within three to five years. In fact, site studies show that every 100 sq. ft. of window film can reduce the air-conditioning load of a building by as much as 12,000 BTUs, or 1 ton of heat. Because the issue is really summer heat gain, the most dramatic savings occur in the Sun Belt states.

Curiously, window films are seldom installed on factory glass, unless you include the sputtered coatings used in making Low-E glass. Tinted films are almost exclusively aftermarket products, probably because the selection process relies so heavily on consumer tastes, home sites and climate. Also, builders are reluctant to darken show homes when prospective buyers most often prefer bright spaces.

A technical overview

All window films start with the film, of course, which is always polyester, 2 to 7 mils thick. Quite often, several thin layers of film are bonded together. One side is coated with either a pressure-sensitive or water-activated adhesive. The exposed surfaces of most films are also treated with a hard, scratch-resistant coating.

To filter out ultraviolet radiation, chemical UV blockers (cyclic imino esters) are incorporated. If the film's purpose is to provide only UV protection and shatter resistance, no other materials need to be added.

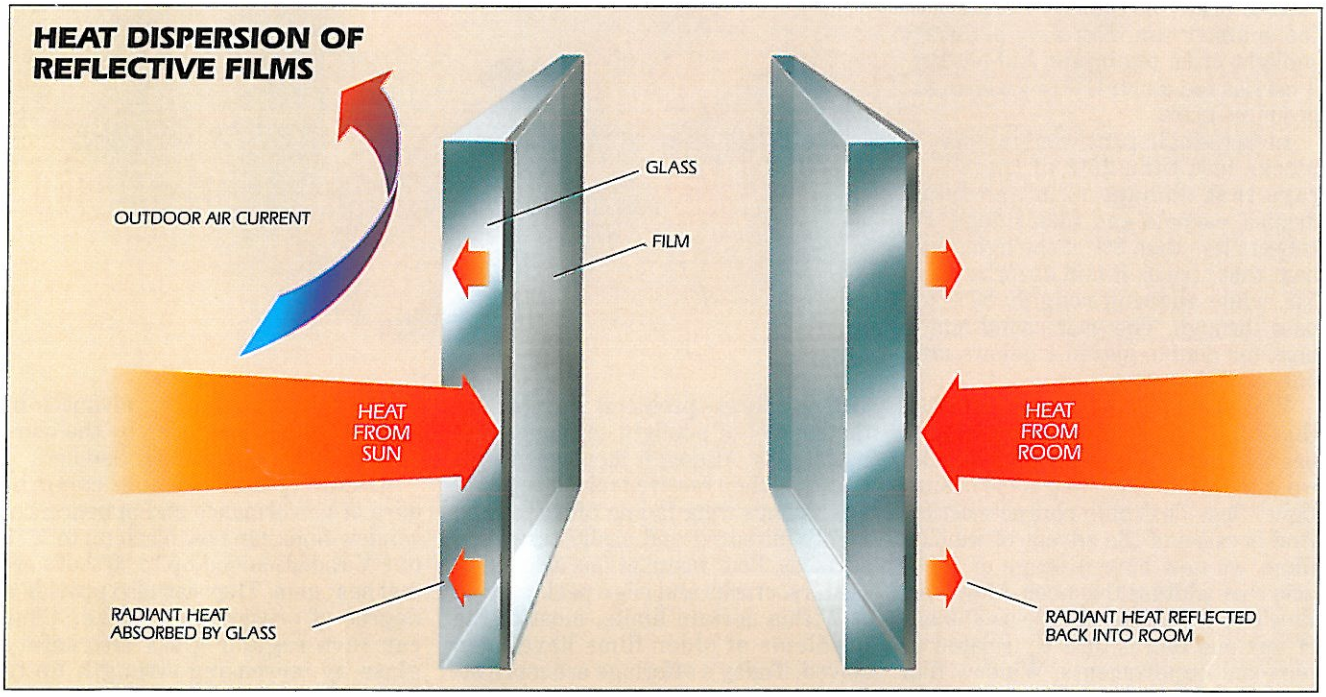
From there, three separate technologies are applied to achieve different performance characteristics. The first is simply a dye, which absorbs heat. Because most films are applied to the inside surfaces of windows, it's easy to imagine that the absorbed heat would disperse indoors. In fact, the heat rejected by the film is stored largely in the glass, and is drawn away by external air movement. A tiny percentage does bleed inward, but because the average speed of external air movement is so much greater—the daily average is 15 mph, versus ½ mph indoors—the ratio is 30:1 or better in favor of outdoor heat dissipation. Because double-glazed windows don't allow air movement between panes, interior-dyed films should not be used on thermal glass.

The other two processes, called deposition technology (vacuum coating/metallizing) and sputtering technology (advanced metallizing), deposit a layer of metallic particles on the film, giving it a reflective coating. In each case, a second layer of film protects the coating. Metallized films reject heat by reflecting it before it can be transferred through the glass.

In deposition technology, the film is drawn through a tank containing metal ingots—usually aluminum or nickel-chrome, and occasionally copper. A vacuum is created by reducing the pressure in the tank, which is then flooded with argon gas and the ingots are heated. The heat causes the metal to give up particles that migrate to the film's surface. The density of the metal deposition is controlled by the speed of the film through the chamber.

While deposition technology works well and is relatively inexpensive, it has its limits. To be effective, the metallized coating must be fairly thick, as the particles are comparatively large. What this means at a practical level is that it produces a darker, more highly mirrored surface. And second, the list of metals that can be deposited evenly is fairly short, which means fewer product options.

Sputtering technology is more complicated. Sputtering is also done in a vacuum chamber, but the metallizing is achieved at the atomic level. In brief, electromagnetic fields direct streams of ions from a chemically inert gas (usually argon) toward the metal. This ion bombardment, which is often described as "atomic billiards," causes groups of atoms to dis-



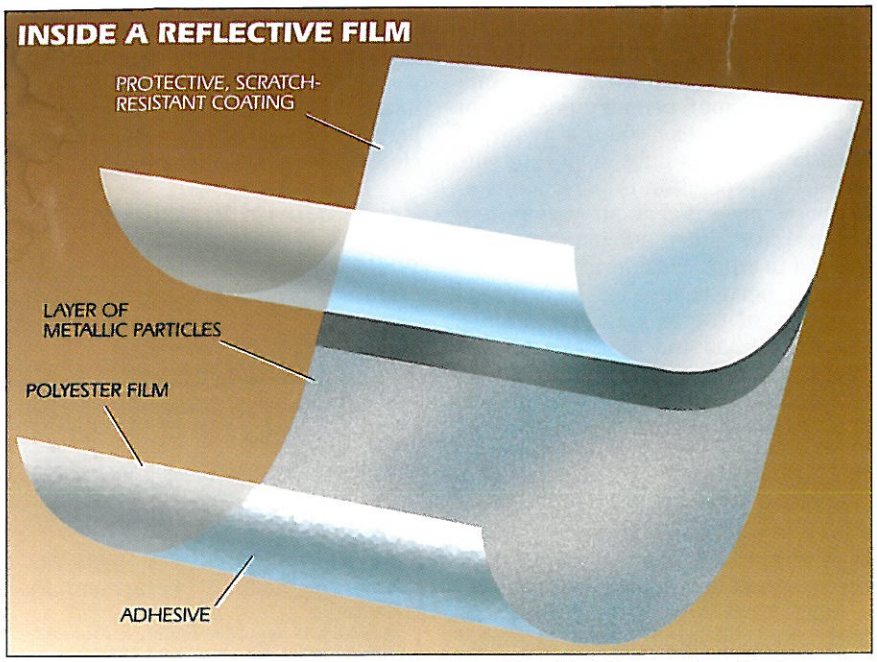
Films that absorb heat from sun transmit heat to glass (left) where outdoor air currents cool glass. Reflective qualities of films not only reject heat from sun, but can reflect radiant heat inside the home back into the living space (right).

lodge in small bursts and scatter uniformly across the film.

The practical benefits of sputtering are that 25 to 30 different metals can be used and the metallized coating is much lighter. It's possible to sputter metal in a layer one-hundredth the thickness of a human hair. Different metals are chosen to subtract specific bands of radiation from the solar spectrum. The result is a highly reflective layer with very little mirror effect, heat absorption or color shift. Some of these films, such as Southwall's Solis Line, are virtually invisible, but still offer excellent performance. Because sputtering is more expensive, these films occupy the high end of the price range.

While the performance characteristics of dyed and metallic films are generally distinct, there is some overlap. Heat-absorbing dyed films are somewhat reflective, and metallic films do absorb some heat because of the mass and color of the metals involved.

To further complicate the issue, many films contain both dyes and reflective metals. By combining dyes and metals, the negative effects of each can be reduced without sacrificing performance. A good example is gray dye and titanium coating. If used alone, dye would darken the film significantly, while the titanium would produce a highly mirrored surface. When paired, less of each can be used, resulting in a film that is relatively bright and nonreflective.

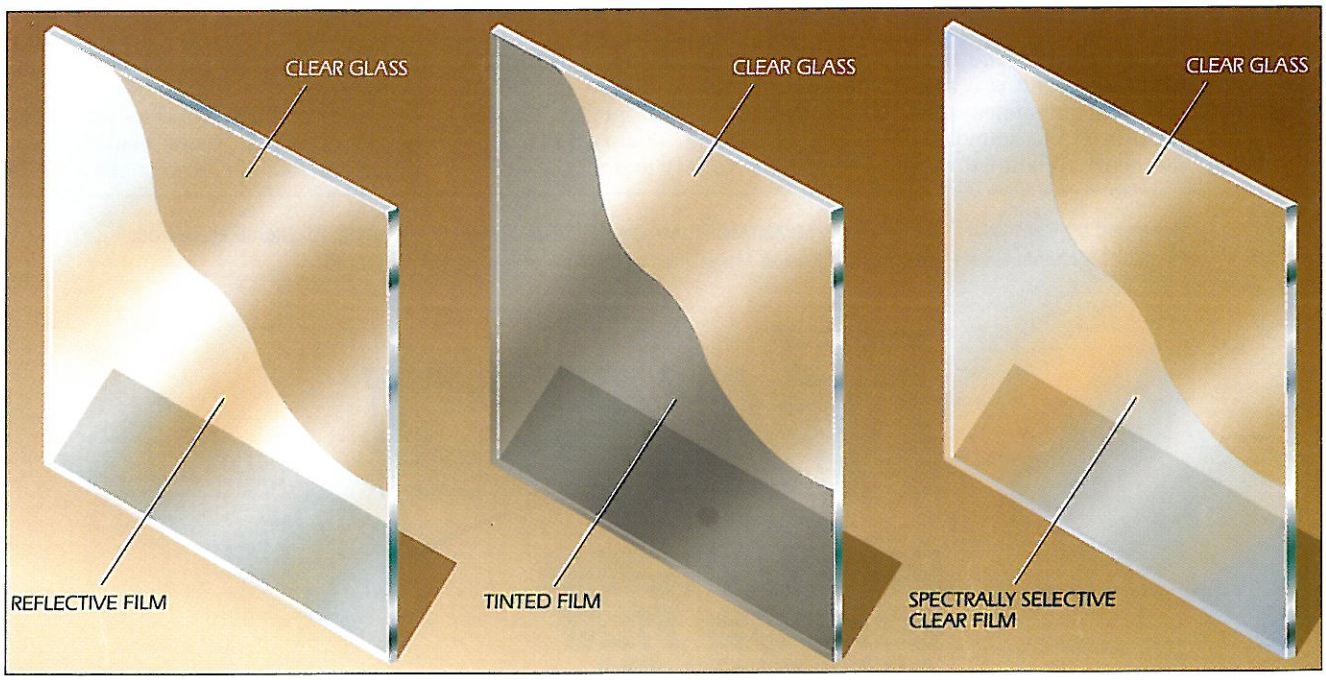


Metallic films control radiation through reflectivity. Simplified film consists of polyester layers, metallic coating, adhesive and scratch-resistant coatings.

This point is significant, if only because it quells the notion that the darkest films reject the most heat. In most cases, dark films are chosen because they offer greater privacy.

Performance, appearance and compromise

Manufacturers measure performance in a variety of ways, but the most significant indicator for the homeowner is the film's shading coefficient, expressed as a decimal. Industry experts stress that for a reasonable energy savings and a significant improvement in comfort and other benefits, a shading coefficient of at least .45 is needed. Any number below .45 is better, and any above will be less effective. This does not mean that a .51 won't make a difference—it may in fact be just right for some applications. The most popular choices, however, are in the .35 to .40 range.



Dyed and metallic films have different performance characteristics and appearances. Metallic films can be reflective or, in some cases, virtually clear. Dyed films appear tinted and enhance privacy. Combination films are designed to suit specific goals.

Why would anyone opt for a less efficient film? Film selection should be goal-oriented and may mean a compromise. If your primary goal is not heat rejection—as when a group of windows receives only moderate sun, when UV protection is paramount or if you're concerned about strengthening the glass—then efficiency can give ground to other considerations.

While performance can be achieved with any of the three technologies, site limitations and aesthetic preferences are likely to influence your selection. As mentioned, if your windows are double-glazed, you won't be able to use a highly absorbent interior film, whether that's a dyed film or a combination film. In that case, a metallized film is usually in order. Should that metallized film be highly mirrored, lightly mirrored or nearly clear?

These are subjective judgments with practical implications. A highly mirrored film is not everyone's favorite, but mirrored surfaces provide daytime privacy because they always reflect toward the light source. If daytime privacy is a goal, then why spend the extra money on sputtering technology? On the other hand, if you'd like only a slight mirror effect, but with a bronze cast, you may need to spend more for sputtered metal film. If you'd like a nearly clear film, then your only choice is a sputtered metal film. But if you don't care to spring for the high-end films, then a combination film of a different color may work.

As you can see, external factors and individual tastes have a lot to do with which film you choose. At the most basic level, every selection is a marriage of performance and appearance, with some tradeoffs. If this sounds too confusing, take heart. When we were shown samples of film that would meet our goals, and held them to the glass, we were surprised at how quickly we narrowed the field. A couple of films looked right to us, while the rest were clearly made for someone else.

Professional installers versus DIY kits

While home centers sell quality window films and installation kits, buying from a professional dealer/installer will give you more options. The manufacturers that sell to home centers may make a wide variety of films, but limited floor space usually reduces the selection to just a few types. Moreover, sputtering technology films are sold exclusively through professional dealer/installers. Some DIY films may also lack a high-quality, scratch-resistant coating. When you consider the greater variety and all the technical expertise a professional brings to the table, paying a little more has a lot going for it.

Window Film Manufacturers

- 3M Construction Market Division, 3M Center, Building 225-4S-08, St. Paul, MN 55144.
- Courtaulds Performance Films, P.O. Box 5068, Martinsville, VA 24115.*
- Solar Gard International Inc., 10801 75th St., North Largo, FL 34647.
- IDT Metallized Products, 2544 Terminal Dr., South St. Petersburg, FL 33712.*
- Johnson Window Films, 20655 Annalee Ave., Carson, CA 90746.**
- Madico, 45 Industrial Pkwy., Woburn, MA 01801.
- Southwall Technologies, 1029 Corporation Way, Palo Alto, CA 94303.
- U.S. Lamco Inc., 135 Louis Hurley Rd., El Dorado, AK 71730.

**Products available at home centers and automotive supply outlets.*
***Products available directly from manufacturer for DIY installation.*

However, the do-it-yourself option does make sense for many. While this is work that many homeowners can do, it is exacting. If you're good at hanging wallpaper, you'll probably be able to install window film.

The job requires scraping the windows with a razor blade, then washing them thoroughly. It pays to vacuum before and after cleaning the windows to minimize dust. Then cut the film slightly larger than the glass, peel the protective film from the adhesive side and wet the adhesive with a spray bottle. Press the film to the window, squeegee from the center out in all directions and trim the edges with a razor knife. The adhesive will take a week or so to cure, but after that, consider the film permanent.

Warranties and longevity

Warranties now center in the 5- to 7-year range and cover cracking, blistering, excessive color shift and scratch resistance. When a film is properly installed, it should last 10 to 12 years or more. Most films are replaced, not because they stop working, but because of surface degradation. You can extend the life of your film with careful cleaning, using mild soap and water. Avoid using window cleaners containing ammonia or any activity that could nick or scratch the film.

While most films are installed on the inside of the glass, external films are available. Because these are subject to more surface degradation, however, warranties of only two years are common. When a film does fail, it can be removed with razor blades, soapy water and lots of elbow grease. **PM**