

The retrofit solution to high performance safety & security glazing

Steve DeBusk, Technical Services Manager, Commercial & Residential Films, CPFilms, Inc.

Safety and Security Films comprise a wide array of glass treatment films that offer numerous benefits: (1) improving personal safety, (2) reducing earthquake hazards, (3) mitigating the hazards of blast events, (4) reducing damage from hurricanes and other wind events, (5) deterring forced entry, and (6) reducing solar heat gain into buildings through the use of combination solar-control safety and security films. This article will discuss the construction and general characteristics of safety and security films, the common uses for such films, related test standards, and test results obtained using LLumar® Safety and Security Films manufactured by CPFilms. The paper will conclude with an overview of energy savings that are possible utilizing combination solar-control safety and security films.

The world of glass treatment films is multi-faceted, with products available for wide-ranging purposes. Glass treatment films, comprised of ultra-thin layers of polyester film with solar reflective metal coatings or heat absorbing dyed layers, can be divided into two main groups: flat-glass and automotive. Flat-glass films are used on commercial buildings and residential applications. These films are used primarily to reduce the transmission of solar heat into these structures to increase occupant comfort and reduce energy costs. In addition, flat-glass films are used to provide protection against harmful UV radiation that can fade furnishings and materials prematurely, and perhaps more importantly shield occupants from unhealthy exposure to such radiation. Flat-glass films also reduce glare for building or home occupants, add privacy, and improve the exterior aesthetics of a building by providing a more uniform exterior appearance. Automotive films are used on all types of vehicles for many of the same reasons.

Safety and Security films belong to the category of flat-glass films, being used on commercial buildings and residential applications, though they are increasingly popular in many world markets for automotive applications to reduce "smash-and-

Safety & Security Film



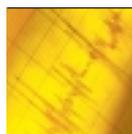
CPFilms recommends compliance with local building and safety glazing codes for all installations. In the absence of the local codes, use this selection chart to determine the best film for your situation. All recommendations are based on film application to 1/4" (6mm) annealed or tempered glass.



PERSONAL INJURY

When the unexpected happens, an accident, vandalism or natural disaster, flying glass fragments can cause personal injury. LLumar safety film helps to hold those glass fragments in place until they can safely be removed. LLumar also blocks up to 99% of the sun's harmful rays, offering extra protection for those you care about.

Recommended Film: SCLSRPS4



EARTHQUAKE

While it's impossible to stop the constant threat of tremors or deadly earthquakes, it is possible to combat some of its most lethal effects: flying glass. With LLumar safety film you get enduring protection. With the highest film durability in the industry and patented scratch-resistant coating, LLumar will help to keep your building safer and more secure.

Recommended Film: SCLSRPS4



BLAST HAZARD

When violent acts shatter your building's windows, flying glass can be responsible for most of the damage, injuries and deaths that occur. Most of this destruction can be controlled, even prevented, in commercial and residential buildings with LLumar safety film. LLumar has been installed on government buildings and military installations throughout the world.

Recommended Film: SCLSRPS4 or SCLSRPS7



WIND/AIRBORNE DEBRIS

LLumar safety film is a heavy duty polyester film bonded by special adhesives. When applied to the interior of glass it forms an invisible force of protection that helps to hold glass in place when it shatters due to lethal winds, dramatically reducing damage or injury from flying glass. Keeping people and premises safer and more secure.

Recommended Film: SCLSRPS11



FORCED ENTRY

LLumar safety film is a powerful deterrent to smash-and-grab thieves. It forms a strong but virtually invisible shield that holds broken glass in place - delaying and deterring perpetrators whose goal is quick entry through shattered windows.

Recommended Film: SCLSRPS4 & SCLSRPS15

(exterior) (interior)



Figure 1. the variety of uses for safety and security films

grab" crimes. The most readily apparent difference between standard commercial/residential films and safety and security films is the difference in the film thickness. Most standard commercial/residential films are 25 to 50 microns thick (1 to 2 mil), whereas safety and security films vary in thickness from 100 to 375 microns (4 to 15 mil). This added thickness provides puncture and tear resistance and overall film toughness, while the film's specially formulated aggressive acrylic-based pressure sensitive adhesive firmly holds broken glass together. By holding broken glass shards together, and reducing the likelihood for

Clear Safety Film Construction

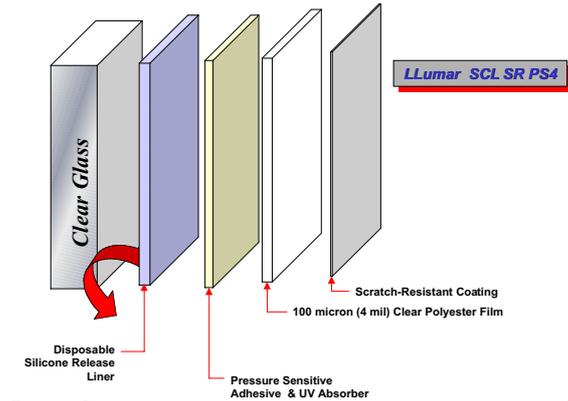


Figure 2

Combination Solar-Control Safety Film Construction

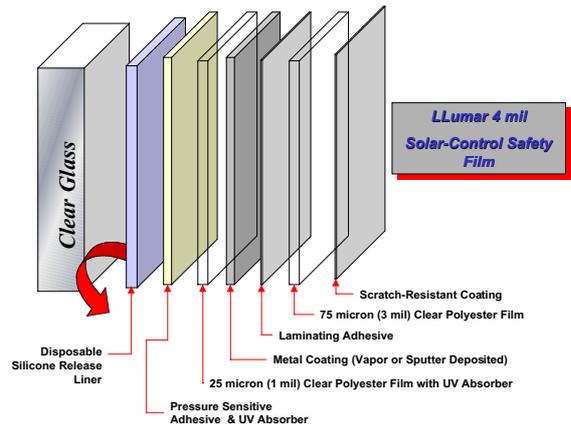


Figure 3

large openings in the film, safety and security films offer a wide variety of end uses: (1) improving personal safety, (2) reducing hazards of falling glass during earthquakes, (3) mitigating the hazards of blast events, (4) reducing damage from hurricanes and other wind events, and (5) deterring forced entry. Figure 1 indicates the variety of uses for safety and security films and shows typical film thicknesses for each use.

Also, safety and security films can be either clear (providing the desired safety or security aspect along with UV protection, but with no other solar control function), or have solar-control

coatings integrated into the film structure to provide the additional benefits of flat-glass films noted above. Figures 2 and 3 indicate common constructions of each type of safety and security film.

IMPROVING PERSONAL SAFETY

The primary danger of broken annealed or heat strengthened glass is the cutting or piercing injuries that can occur due to the breakage pattern of these types of glass. Such glass breaks into relatively large, ragged shards, as opposed to tempered glass that breaks safely into small fragments or "pellets." Based on this well-defined "safe" break pattern of tempered glass, it is used in many locations where "safety glass" is required. These are locations where running, walking or falling into non-safety glass could cause severe injury (e.g., glass doors or areas with floor-to-ceiling glass, etc.). To mitigate these hazards, safety glazings used in these situations include laminated glass with PVB interlayer material, certain types of plastic glazings (including acrylics and polycarbonates) that are extremely resistant to breakage, and glass coated with polyester safety films. Building Code regulations requiring the use of safety glazing are relatively new and therefore large amounts of non-safety glass exist in locations that would now require safety glazing in new construction. Rather than remove the existing annealed or heat-strengthened glass and replacing it with tempered or laminated glass or plastic glazing, a widely used option is to coat the glass with 100 micron thick (4 mil) safety film. LLumar® safety film, manufactured by CPFilms of Martinsville, Virginia in the United States, passes the impact test requirements for safety glazing, including the U.S. ANSI Z97.1 and CPSC 16CFR 1201 tests, the British BS 6206 standard, the Japanese JIS A5759 test method, the Chinese standard GB 9962-88, and the new European EN12600 standard.

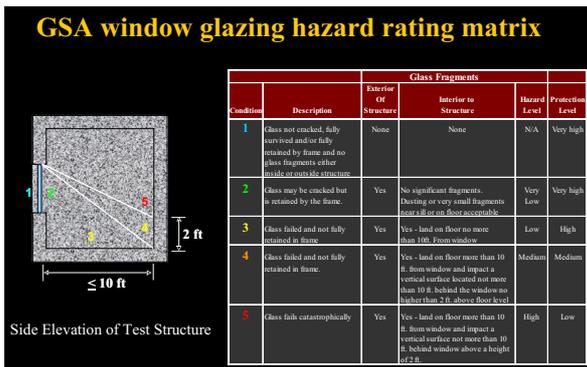


Figure 4

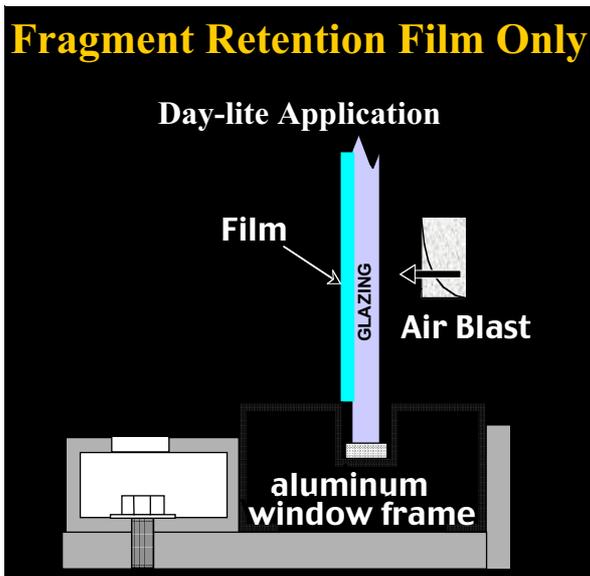


Figure 5

MITIGATING THE HAZARDS OF BLAST EVENTS

Due to the nature of our changing world, the unfortunate reality exists that terrorist activities may, for years to come, continue to cause destruction of property, injury, and death. The main avenue for attack by most terrorist organizations is the use of explosives to damage as much property and cause as many injuries as possible. It is a well-documented fact that in such explosions, most of the injuries are caused by flying glass shards, as was the case in the Oklahoma City incident in which over 80% of the injuries were so caused. An effective method of reducing these lethal shards is by applying 100 or 175 micron (4 to 7 mil) security film to the interior glass surfaces.

The picture and table in figure 4 depicts the U.S. Department of General Services Administration's (GSA) window glazing hazard-rating matrix. The picture shows the concrete blast test structure, with the glazing sample being tested located to the left, the location of the blast, and the subsequent blast pressure wave. The table clearly shows the method for measuring the level of protection for different glazing systems.

Tests conducted by CPFilms, supervised by Applied Research Associates, clearly show the improved level of protection from glass shards in a blast event by the use of either 100 micron (4mil) or 175 micron (7 mil) LLumar® Security Film. These tests were conducted at the Defense Special Weapons Agency, Chestnut Test Site, at Kirtland Air Force Base in New Mexico (U.S.). The tests utilized an explosive equivalent to 227 kg of TNT, the approximate size of a car bomb. The test specimens were: an unprotected 6mm thick glass panel, measuring approximately 114 cm by 160 cm, consisting of tempered monolithic glass, a 6mm annealed glass specimen protected by 100 micron (4 mil) LLumar® Safety Film, and a third 6mm annealed glass sample protected with 175 micron (7 mil) LLumar® Security Film. The specimens protected by the safety and security films had film applied in a "daylight" application.

The results for the unprotected window were a GSA Level 5, or a High Level of Hazard, Low Level of Protection. Both specimens protected by LLumar® film achieved a GSA Level 3, or a Low Level of Hazard and High Level of Protection. Installations such as the one depicted in this test are being utilized around the world at government buildings or for buildings located near government facilities as a reasonable, constant, an unobtrusive way of providing blast hazard protection from flying glass.

During the Centennial Olympic Games of the 26th Olympiad, the World of Coca-Cola in Atlanta, State of Georgia, had LLumar Window Film installed throughout its spectacular building. More than 4,057 square feet of LLumar SCL SR-PS7 Clear Film were required to cover the massive, 80 feet high, multi-paned V-shaped edifice. The installation was unusually challenging because of the height of the construction and the shape of the area of window to be treated. Moreover, the emplacement had to be carried out at night, working from specially designed elevators.

The World of Coca-Cola
Atlanta, GA

CASE STUDY

OLYMPIC GAMES SPECTACULAR
PERFORMANCE

In anticipation of the ten thousand athletes from around the world and the hundreds of thousands of visitors to the Centennial Olympic Games, the 26th Olympiad, The World of Coca-Cola in Atlanta, Georgia had LLumar Window Film installed throughout its spectacular building.

More than 4,057 square feet of LLumar Magnum SCL SR-PS7 Clear Film were required to film the massive, 80 feet high, multi-paned V-shaped edifice.

The installation was unusually challenging because of the height of the construction and the shape of the area of window to be filmed. Moreover, the emplacement had to be made at night, working from specially designed elevators.

LLumar

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The nature of certain substrate fabrics and dyes will lead to premature fading regardless of the application of any window film protective treatment.
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It is important to note that the blast events that security films protect against are not limited to blasts from explosive materials such as those used by terrorists. Any location (such as refineries or locations near natural gas pipelines), susceptible to damage from blast events or industrial explosions, can improve the level of protection from flying glass shards with the addition of polyester security film.

REDUCING DAMAGE FROM HURRICANES AND OTHER WIND EVENTS

Security films are also capable of providing protection against flying glass and for protecting a structure's interior space from wind and rain damage in wind events. As evidenced from the

blast testing above, LLumar® film offers a superior ability to hold broken glass together when the window is broken by severe air pressure impulses. The pressures from wind events such as hurricanes are on the order of 10%-20% of those for blast events. Therefore, windows treated with LLumar® film are far more likely to remain within the frame, reducing flying glass, and reducing the inward rush of damaging wind and rain into the building or home.

DETERRENT TO FORCED ENTRY

By providing a resilient, tough barrier, and by effectively holding broken glass together, LLumar® films provide excellent protection against forced entry. LLumar® films are used widely for this purpose and are an excellent security addition for many settings. To provide a significant level of protection, thicker films (375 micron) are recommended with interior film application. For additional protection, a second layer of film should be applied on the exterior of the windows (see Figure 1). While no system is absolutely impenetrable, windows treated with LLumar® film offer much less of a opportunity for easy entrance into a place of business or home.

COMBINATION SOLAR-CONTROL AND SAFETY/SECURITY FILMS

As mentioned previously, safety and security films can be constructed with layers of solar heat-reflecting metal coatings integrated into the film construction (see Figure 3). Such coatings reduce the solar heat gain into buildings through the building's glazing. Solar-control safety and security films are

available which reduce solar heat gain by as much as 79%. These films, therefore, offer the potential to reduce annual energy consumption for cooling by 5% to 10% (or more) and also reduce the summer peak demand by an equal amount. Such results have been independently verified by rigorous energy analysis simulations, using the U.S. Department of Energy's sophisticated, whole-building, DOE-2 Energy Analysis software.

While suitable for new construction, its important to note that safety and security glass treatment films can easily and efficiently be fitted to existing glazing systems. Thus eliminating the high cost and inconvenience of having to remove and replace the current unsafe or insecure glass.

CPFilms Inc., the world's largest manufacturer of glass treatment films, is based in Martinsville, Virginia, United States. The ISO 9001-certified company employs 720 people and has an annual manufacturing capacity of 250 million square feet of film. CPFilms' parent company Solutia Inc. - chemical, fibre and polymer manufacturer - has 35 manufacturing plants employing 8000 people worldwide. ■

Steve DeBusk is the Technical Services Manager, Commercial and Residential Films, for CPFilms, Inc. of Martinsville, Virginia (USA). Steve addresses the technical concerns of distributors, sales managers, and dealers around the world, ensuring that CPFilms products meet or exceed relevant test standards and building code requirements. Steve also recently directed window film industry efforts to develop a method for accurately estimating the energy savings from application of solar film to commercial buildings.