



### **What is Safety Film?**

Safety film is a sheet (or film) of clear or tinted polyester that is laminated to the interior surface of a pane of glass. The film prevents flying shards of glass in the event of glass breakage by holding the broken fragments of glass intact on the surface of the film while the glass remains in its frame.

### **How is Safety Film Constructed?**

It should be noted that virtually all safety films have more adhesive per square foot than conventional window films. It is important to know that there is an extremely aggressive bond between the glass and film. Safety films are constructed with a pressure sensitive acrylic adhesive as opposed to a dry adhesive in order to achieve a high peel strength bond.

Understanding the necessity for a high peel strength bond adhesive is important. There needs to be sufficient adhesive on the safety film to ensure that the glass remains adhered to the film. This is of particular importance in areas where there are high rise buildings.

### **How Does Safety Film Work?**

The primary function of safety film is to hold glass intact in the event of being broken. The likelihood of injury to person and property is great in the course of normal glass breakage. It is proven that the application of safety film to existing glass can reduce damage and injury by up to 80%.

Many different events may occur that result in glass breakage. The nature of the event is likely to determine the type and extent of property damage and personal injury. The manner in which glass breaks is important, as it has a bearing on the above mentioned factors.

Glass breakage occurs in one of the following ways:

1. Thermal stress from absorption of solar radiation
2. Tensile stress from the weight of the glass itself
3. Mechanical flexing stress, i.e. from wind
4. Impact stress from flying objects
5. Twisting stress from building movements



There are many different events that can occur that will give rise to any one of the above conditions, resulting in glass breakage. The following is a list of possible events and their likely results:

### **Human Impact**

One of the major causes of injury is human-to-glass impact. The major cause of injury to the human body when impacting a pane of glass is what is known as the “guillotine effect.” This is where the person walks into or through the pane of glass with great speed. By the time the individual realizes that they have walked into the glass, they are already in a position where they have broken the pane of glass and do not have sufficient time to back track. As soon as the glass is broken, due to the effects of gravity, it falls and injures the person. Statistics reflect that the majority of injuries are to the knee and upper leg portions of the body. The next most likely area of injury is the head, neck and shoulder region. In many cases, these injuries, if not fatal, will lead to severe damage to tendons and possible loss of limb or limb function. At the very least, several operations and several months or years of therapy will be necessary.

The Consumer Product Safety Commission reported that in 1991 there were over 150,000 glass related accidents in the U.S. These statistics are gathered from the emergency rooms of hospitals and doctors throughout the nation.

Safety film decreases and virtually eliminates injury from this type of human impact. The glass, while it may be broken or cracked, remains adhered to the film, and in most cases, is still intact in its frame. The tensile strength of the film coupled with its elasticity and high resistance to shear, greatly removes, if not virtually eliminates the ability of a person to walk through a pane of glass.

There have been several cases where companies have been sued (particularly retail companies) because customers have walked through plate glass windows of shops or in shopping malls. The onus is on the building owner or the lessee of the premises to ensure that the glass is adequately protected or marked clearly to prevent people from walking into it. The application of safety film to existing windows is a quick and economical way to overcome this risk.

This product also can be fitted to residential glass areas, particularly sliding or glass doors. There is a high incidence of people walking through sliding glass doors near swimming pools, caused primarily by surface water glare and the presence of slippery surfaces around a pool.



### Thrown Objects

Many windows are broken either intentionally or unintentionally by thrown objects. Whether this is a child accidentally throwing a baseball through a window or a smash and grab robbery attempt, the results are the same. The projectile hits the glass with some degree of velocity, breaking the glass inward. This causes large dagger-like glass shards to fly into the room. Not only does this pose a risk to property, but it also poses a risk to unsuspecting individuals. Whether at home or in the office, people tend to put furniture near windows in order to enjoy the benefits of the light, warmth and view allowed by glass windows. In the event of a thrown missile, this presents the likelihood of injury.

In the case of retailers, there is a two-fold problem associated with a thrown object. First of all, the resulting glass shards can damage the merchandise on display in their windows, Secondly, because the glass generally breaks and collapses, it gives the robber an opportunity to quickly and easily reach into the window and remove valuable merchandise.

The application of safety film to these windows will reduce, if not completely eliminate, both damage to people and property. Because the polyester film has a high degree of elasticity, it is resistant to such breakage. The type of object thrown will determine the chance that the object has of penetrating both film and glass. In most documented cases, the pane of glass itself remains intact in the frame with only a small hole where the object penetrated. This sustained protection serves to thwart the would-be smash and grab burglar. Should the robber persist in the attempt to gain entry into the premises, repeated efforts to smash a hole through the glass and film or to enlarge the existing hole will have to be made. The resultant time delay and noise factor is generally sufficient to scare off most would-be robbers empty handed.

### Explosions

There are many types of explosions which can be accidental or intentional. The majority of accidental explosions are related to industrial manufacturing processes and can result in massive devastation.

Intentional explosions are often motivated by political or revenge motives. Explosions may be caused by specialized explosive devices such as plastic explosives, hand grenades, or in the case of industrial explosions, gas leaks.

Whatever the cause, the results are the same. The explosion, by displacing air, creates a shock wave or otherwise known as an over pressure. This "over pressure" results in a vacuum being created where the blast has pushed air away from the blast center, generating a shock wave. Depending on the size of the shock wave, this could be up to several miles away from the initial explosion.

When the shock wave hits the glass, it causes it to break. The incidental area of damage surrounding the blast center depends upon the amount of energy the shock wave carries with it. The intensity of



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this energy will vary according to the distance of the window from the origin of the blast and the type and nature of the explosive.

This shock wave, with sufficient velocity, can turn the broken pieces of glass into extremely lethal dagger-like missiles. There have been cases where pieces of glass have penetrated right through a human body or have penetrated to the degree that they have caused death to a person.

There are other problems related to glass breakage and explosives. To begin with, if the glass is close to the origin of the explosion, and sufficient explosive is used, the glass is atomized. The shock wave causes the oxygen to be knocked out of the person, and as they resultantly gasp for air, they suck in atomized glass particles.

Another factor that is problematical to treating glass injuries is when glass penetrates the body. The glass assumes the color of the body organs, making it extremely difficult to see. Moreover, the glass particles do not show up on x-rays, making it very difficult for emergency room physicians to find glass on the body.

### **The benefit of safety film applied to windows in these circumstances is a follows:**

First, because the film has the ability to stretch without tearing, it has the ability to absorb a large degree of the shock wave. As this large pressure of air moves towards the glass and pushes the glass inwards, the glass eventually gets to a point where it cracks and breaks. However, the film applied to the rear of this pane of glass continues to absorb the shock wave and stretches until it reaches the point that it can no longer bear the pressure, at which stage it will burst. In some cases, the shock wave, while great enough to break the glass, is not enough to shear the safety film. This results in the pane of glass being broken but held intact by the film. In these cases, not only are there no injuries, but there is no damage to the property inside the building. In other cases, the shock wave is sufficient to break the glass and shear the film. In a majority of these cases, the glass collapses in one pile attached to the safety film with minimal damage and virtually no injuries. In most cases, no less than 95% of the glass remains affixed to the film.

The initial shock wave itself creates a vacuum. Because of the vacuum created by the over pressure of air, an immediate rush of air is back to the origin of the explosion. This causes the glass to be pulled back towards the original direction of the shock wave. This is why after an explosion the glass is in a convex rather than a concave position. This is a major cause of concern because in the event of a skyscraper or multi-story building, the implosion force may be sufficient to pull the window from its frame. When there is a shock wave, the glass breaks, and the resulting implosion sucks it out into the street below, before the glass has had an opportunity to fall into the interior of the building. This causes a rain of thousands of glass shards onto the street below. This could easily occur in a crowded city center at lunchtime, and the injuries to people in the street below could be substantially greater than to the few inhabitants in the building during the day.



In the majority of cases, if these windows had been coated with safety film, a large percentage of the windows would have remained intact in the frame with most of the broken glass shards adhered to the film. There is a far smaller risk when the entire sheet of film and glass is pulled out of the window, rather than having thousands of individual shards of glass falling in to the street below.

### **Natural Catastrophes**

Hurricanes are a climatic or geographical condition that can put stress on glass. They produce intense winds which, as in the case of explosions, create over pressures or pressures great enough to break glass. There is a difference between hurricanes and explosions. In the case of most explosions there is a single blast, whereas hurricanes sustain winds over several hours. This continuous buffeting of the glass may well result in breakage. Again, as in explosions, this over pressure of air bursting into the building is capable of creating a large degree of damage which is somewhat intensified by the addition of flying glass fragments, wind and rain.

Another important consideration in the case of hurricanes is that the windows often form one of the weakest points of a building envelope. In the case of houses, the wind gets through the windows and into the structure where pressure accumulates and often results in the roof being blown off the house. This was particularly evident in the case of Hurricane Andrew in Miami during August 1992. In fact so much attention was drawn to that single factor that Dade County changed the building codes so that the windows would be more adequately protected.

Safety film offers a high degree of protection in the case of such sustained winds. Should the winds get to the point that the glass can no longer hold the pressure, in many cases, the glass will break and the film will shear to some degree. The film and glass will often remain intact in the frame, preventing wind and rain from entering the building. At a minimum, it will prevent flying glass shards. This alone should be sufficient to justify the expenditure.

The percentage of injuries that are caused by flying glass is roughly equal to the percentage that is caused by falling glass. Therefore, these two factors constitute virtually 95% of all glass related injuries.



### Will Window Film Reduce Fading?

Safety film, by virtue of its pressure sensitive acrylic adhesive with ultraviolet screeners included in its construction, offers a fade reduction feature. There are many causes of fading, the most prevalent being infrared radiation or solar heat. Other causes could be light bulbs that generate a large degree of ultraviolet light and heat, dyes and pigments used in materials and furnishings that are not well stabilized and naturally fade with time. Safety film does, however, significantly reduce fading and consequently renders a far greater life expectancy to fabrics and furnishings within a room or a store front.

Tinted safety films offer heat and glare reduction benefits coupled with fade reduction. These tinted films with high visibility light transmissions are particularly suited to shop front applications. By virtue of the amount of infrared radiation that they limit, along with the inclusion of ultraviolet screeners in the adhesive system, fading caused by infrared radiation is virtually eliminated.

In many cases, there are other factors that need to be taken into consideration such as overall heat reduction, privacy, improved comfort levels for the occupants of a building and the general aesthetics of a building.

On a large commercial building, the building owner and/or his tenants stand to save considerable amounts of money on their heating and cooling utility bills by applying a tinted solar film. In most cases, there will be a payback period within two or three years of the purchase date. Other benefits are the improved comfort levels for the occupants of the building, decreased glare and the reduction of ultraviolet light. Not only will the purchaser have all these benefits, but they will have the benefit of protected windows with safety film. At the end of the day, the owner has saved money, improved the tenants comfort level, increased the life of the contents of the building and assured the safety of its occupants.

### Are There Film Testing Standards?

There are two major tests which establish the credibility of safety and security film products in the United States. One is the American National Standards Institute Z97.1, or the “American National Standards for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Method of Test.” The second is the Consumer Product Safety Commission Federal Regulation Title 16 CPSC 1201, or “Safety Standard for Architectural Glazing Materials.”

Architects, engineers and safety and security specialists determine the suitability for safety glazing materials based on the results that manufacturers achieve with these two tests. **Glass-Gard Safety and Security Film** passes all sections of both of these tests. The criteria for approval of CPSC Category II is that the glass can survive an impact with a force equivalent to 400 lbs. of pressure per square foot.



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Included you will find a copy of the following test results:

1. ANSI Z97.1
2. CPSC 1201 Federal Regulation Title II

Anyone who wants to be protected from injury due to flying glass shards from acts of terrorism, vandalism, smash and grab burglaries and natural disasters should consider the application of safety and security film to your commercial facility or residential living space. It is the most economical, passive form of protection you could provide your employees, customers or family members.