SECURITY FILMS vs. SAFETY FILMS

Understanding the Misunderstood Differences

Airborne glass fragments propelled during the failure of windows subjected to explosive effects are known to be a major cause of injuries and death. These incidents can either be accidental or deliberate; i.e. terrorist bomb attacks, accidental chemical or industrial explosive blasts, earthquakes and their subsequent destruction, hurricanes or gale force winds. As buildings are frequently being designed to have large expanses of glass for aesthetic reasons, the risk to life from flying glass fragments has become heightened and of greater concern.

Subsequent to the Oklahoma City bombing, President Clinton directed the Department of Justice to perform a vulnerability assessment of Federal Facilities with the cooperation of the United States Marshals Service. Within this assessment is the use of "Fragment Retention Films" for the protection of hazards of flying glass as a result of impact or explosion.

Security and safety are important to the owners, occupants and visitors of any building or facility. The absence of perceived security in a facility often adversely affects its primary function. For example, businesses or banks which are frequently attacked, robbed or vandalized, are often closed or operate on specifically limited times regardless of their location or the volume of business which they transact. Today, all prudent facility designers pay serious attention to the specific issues of Security and Safety - especially to those issues which are most apparent to the users of the facilities. With respect to safety and security, the two are distinguished by the following definitions.

SAFETY - Provides for the reduction of the risk or occurrence of injury, loss or death from accidental or natural causes.

SECURITY - Provides for the reduction of the risk or occurrence of injury, loss or death from the deliberate or intentional actions of man.

SAFETY FILMS - Consist of a single thin sheet of polyester with either a pressure sensitive or water activated acrylic adhesive. Safety films are a spin off of solar control films generally of 4 to 7 mil or .004 to .007 inches in nominal thickness. Safety films are available in clear, solar control reflective or architecturally tinted, some have Ultra-Violet (UV) radiation protection and some do not.

Safety films are primarily utilized for limited shatter resistance from light load bearing affects which would normally crack, shatter or cause breakage from accidental or limited natural causes. Improper cleaning and techniques can scratch or mar safety films, and some have very poor adhesive capabilities, due to the fact that their adhesives completely harden and dry, and are of minimal thickness, lending the film to a higher probability of delamination (film separating, bubbling or peeling away from the glass).

The testing standard most commonly used for the testing of safety films is the American National Standard - ANSI Z97.1 1984. This testing standard has performance criteria, which are directly related to the reduction of cutting and piercing injuries to persons who impact the glazing.

One important note to make here is that this test is centered around an individual impacting the coated glass and being somewhat assured not to receive extreme amounts of injury in doing so. This test is not designed around objects, blasts or projectiles impacting the glazing and how well that glazing stays intact or precludes the glass from separating and impacting, cutting or impaling those behind it.

TEST STANDARDS - The Federal Uniform Building Code - Safety Standard for architectural Glazing Materials 16 CFR Part 1201 has two impact levels which are the 100 - ft. lb. energy level and the 150 - ft. lb. energy impact level. These are designed for glazing dimensions of 9 square feet or less and greater than 9 square feet. The three impact levels for the American National Standards Institute - Safety Glazing Materials ANSI Z97.1 - 1984 are: The 100 - ft.

lb. energy level, the 150 - ft. lb., energy level and the 400 - ft. lb. energy impact level. Generally, most safety films can pass the 100 and 150 - ft. lb. impact test requirement, without a substantial percentage of glass loss from the specimen being tested. However, very few pass the 400 - ft. lb. impact level, which as quoted by ANSI is: "The 400 ft. lb. impact level was established for relatively unlimited acceleration paths, in which it might be reasonable to expect that an energetic teenager might develop something approaching his full impact velocity".

This is where the safety films start to separate themselves from a tested security film, in that their compositional make-up during the manufacturing process and the adhesives are exceeded beyond their capabilities. Specifically the adhesives, as they harden and dry over time. Adhesives that harden and dry loose their elasticity, a prerequisite for eliminating delamination, bubbling and eventual peeling or separation all together from the glass. Elasticity is necessary and as glass expands and contracts. There are three major factors that accelerate the degradation of non-elastic adhesives: Extreme cold, Extreme heat, and Temperature ranges with a variance of over 50° during the normal course of the day. Examples of adhesive failure are evident in automobiles where the same types of adhesives are used in tinting films. Everyone has seen vehicle tint jobs with bubbles or elongated delaminations in them. Another is to examine windows that have been treated with safety films after an earthquake or hurricane force wind load. Here you will see where the glass is cracked and broken, then shifted or forced inward; how it will slide past the lower pieces and shear off the film by its own weight and separate, thereby falling away or being blown inward.

The other type of film failure is from films not being properly or not at all attached to the existing window frames. Typical installations emulate "window tinting" applications where the film is applied to the window unit and cut to the lite opening (viewable area) with a razor blade around the edges. This causes two elements that lead to glazing failure: 1) No edge engagement into the existing frame to preclude pullout or breakage where there is no film, and 2) Cutting the film with a sharp razor blade can score the glazing causing a weakness around all the edges, facilitating in a weaker window just to the inside of the frame should it get attacked.

ANTI-GRAFITTI FILMS **-** Consist of a single thin sheet of polyester with either a pressure sensitive or water activated acrylic adhesive. Anti-grafitti films are a spin off of solar control films generally of 4 to 7 mil or .004 to .007 inches in nominal thickness. Anti-grafitti films are primarily available only in clear, and have Ultra-Violet (UV) radiation protection and some do not. Solar control reflective or architecturally tinted versions fade at exceptionally high rates. Anti-grafitti films are not designed to last a long time. This is due to the exterior exposure. The adhesives which normally have the UV inhibitors in them, is between the film and the glass. This provides no protection to the film itself from the sun's direct exposure. The thicker film provides for greater resistance to gouging and etching of the glazing surfaces. Both thicknesses provide protection against spray paint "tagging". However, the use of paint removal chemicals will also destroy the film. Therefore, once the film has been attacked, the best solution is to have it removed and replaced will new film. Typically anti-grafitti film can be replaced five to seven times, to equal the replacement cost of single pane tempered glass. And seven to twelve times, to equal the replacement cost of and dual pane insulated glazing unit.

SECURITY FILMS **-** consist of multiple layers of polyester film laminated together with a pressure sensitive acrylic adhesive. Security films are more correctly called security laminates. Security laminates are typically made in nominal thicknesses of 10, 12, 14, and 15 mil or .010, .012, .014, .015 inches. Based upon various testing agencies in the United States, as well as internationally the 15 mil or .015 inch nominal thickness security laminates have been proven through testing capabilities and actual attacks, to be the optimum composition. This composition has shown to withstand more than 15 years, without hazing, cracking, peeling, delamination and overall loss of product capabilities. All polyester or "Polyethylene Terephthalates" (P.E.T.) are designed to be applied to the inside or protected side of the window or door glazing units. The technology has not yet been developed for a (P.E.T.) film to be applied to the exterior surface of a building glazing envelope that will withstand more than a year or two, without hazing, cracking, peeling, delamination and overall loss of product capabilities.

The higher technology security laminates provide the following benefits and features of ultra violet radiation control (transmittance reduction) of over 99% - **throughout the laminate** - not just in the layer of adhesive between the laminate and the glass; non-drying, non-hardening adhesives; solar control; architectural tinting and frosting; integrated alarm protection; EMI / RF protection and shielding or a laminate integrating combinations of the above features.

Security laminates are resistant to heat, exhibit no flame front advance, are extremely hard to ignite and are self-extinguishing if removed from direct flame.

Security laminates are the single most cost effective means for the prevention of penetration and resultant injury and damage from forced entry attacks, explosive blasts and projectile entries on retrofit applications. Security laminates do present a delay to forced entry attempts in physical security applications. Multiple blows to the window or door glazing could finally create a hole approximately the size of the tool used; therefore, many blows are required to hack a hole of sufficient size for any entry. This provides for some delay to an intruder, which in most cases deters further efforts, since time and stealth are major factors in thefts and forced entry by intruders. Security laminates can be considered a worthwhile and cost effective security barrier.

Security laminates with non-drying and non-hardening adhesives can be used to withstand explosive blasts, whether deliberate bombing attacks or accidental chemical or industrial explosions. One such security laminate that is used internationally has passed air-blast loading tests on 1/4" annealed glass up to 100 P.S.I. over a positive phase duration of 12.5 milliseconds! Security laminates with elastic adhesives lower the hazard potentials of earthquake induced breakage as well as the effects of severe weather during blizzards, hurricanes and tornadoes.

Forced Entry capabilities - The only realistic testing standard for security rated glazing products and films to resist forced entry attacks not requiring sustained attack or multiple implement usage, is the Underwriters Laboratories - Burglar Resistant Glazing Standard U.L. 972-1984 test. This test has two major impact tests and two major thermal conditioning impact tests. The multiple impact tests - The specimen treated on one side of a 1/4" thick 2' x 2' glass pane held horizontally shall withstand five - ft. lb. impacts by dropping a 3-1/4" hard polished steel ball weighing 5 lbs., through a vertical distance of ten (10) feet. The high impact test - utilizing the same ball, but this time dropped from a vertical distance of forty (40) feet without penetration. The thermal conditioning test for exterior glazing material consisting of five (5) 40-ft. lb. impacts utilizing the same steel ball through a vertical distance of eight (8) feet; and the thermal conditioning test for interior glazing material consisting of five (5) 50-ft. lb. impacts through a vertical distance of ten (10) feet. All the multiple impact tests require the steel ball to be released so as to strike each sample successively at five (5) different locations within a five (5) inch diameter circle, the center of which is to be located at the approximate center of the sample for various temperatures. Any security laminate should be verifiably proven to have passed this test (U. L. 972-1984). This test is the closest test to actual smash & grab and short term forced entry attacks.

There are currently numerous safety films being represented as security laminates that cannot pass this test standard. **BUYER BEWARE!**

Explosive Blast capabilities - The only test that is utilized to test glazing and glazing systems for resistance to explosions is the Air-Blast Loading test. The air-blast loading test is usually conducted in a shock tube, but can also be in an open-air arena capable of accommodating the detonation of the required amounts of explosives, peak positive pressures and positive phase durations. One thing to note here is that - there are not easily reproducible exacting results with the open air arena, as the variables such as wind, temperature, density altitude, humidity, etc., cannot be controlled. The shock tube test provides for more replication of results from test to test, and can also utilize a double rebounding, to emulate those conditions where other rebounded shock waves will be present.

However, as of the printing of this article, no set explosion charge ratings, stand off distances, explosive types, peak positive pressures or phase durations are established for standardization - the end users must specify their requirements have samples tested according to the parameters acceptable to themselves. Currently ASTM is being balloted for such test standards.

Ballistic capabilities – The thicker multi-ply laminates will offer some resistance to small caliber handgun bullets when-and-only-when there is enough glazing substrate to impart bullet destruction, damage and increased frontal surface area. P.E.T. films by themselves offer no ballistic resistance. However, when films in excess of 12 mil are applicated to glazings comprising of at least a nominal thickness of ½", then it is possible to defeat .38 caliber round nose lead projectiles at standard velocities, .45 caliber jacketed hollow point bullets at standard velocities, and 9mm jacketed hollow point bullets at standard velocities. But there is a catch. These impacting bullets have to be typical of random "drive-by" shootings. This means at a stand-off distance in excess of 25 feet and impact points of no closer than 12" from shot impact to shot impact. The use of tempered glass mitigates the glazings capabilities by breaking into small ¾" pieces, (not desirable for resistance to projectiles). The larger the non-impacted glass area, the better to resist projectile performance by providing a solid resistance. Variables that can mitigate this limited ballistic capability are, decreased stand-off distances, closer impact points, glazing selections, glazing mounting techniques, glazing compositions such a laminated or air gap double insulated units, bullet configurations, velocities, etc.

When choosing a safety film or security laminate for new or retrofit applications, insist on written verification that the product has passed the required tests equivalent to your needs and requirements.

Consider the following checklist:

1. Insist on proper certifications - Safety films do not meet burglar resistant standards or blast capabilities.
2. Insist on non -drying non-hardening adhesives of 20+ microns in thickness.
3. Insist on U. V. inhibitors with an absorption rate of at least 99%. On security laminates insist that it be throughout the lamination, not just in the adhesive between the glass and film.
4. The films should have a zero (0) grade rating for optical clarity, no yellow hues or distortions. Having a visual light transmission of 94% minimum.
5. Safety films at least 7 mil or .007 inches in nominal thickness. Security films of 15 mil or .015 inches in nominal thickness.
6. Only a single one sided application should be required - for your application and to pass the testing requirements.
7. Insist on only films with surface hardeners for durability of the application.
8. Insist that all security film applications have the edges engaged into the existing window framing, to preclude glass failure around the edges where the film is cut, but not attached.

Safety and security films are not “the end all”, as no safety or security measure is. Rather, they are one part of an overall system. Proper selection of glazings and the proper selection of films, whether it be for safety, security or as an anti-spall protection on ballistic glass, will provide the best overall protection solution for decreasing the destructive capability of glass fragments and improving their retention in windows and glass doors.