

Safety and Security Films

Flat Glass Installation Guidelines



Technical Bulletin TBF-15

April 2005

Updated: November 27, 2007

Global Use

Contents



Document Summary

1. [Things the installation crew should know before beginning](#)
2. [Tools and Equipment](#)
3. [Plan of attack](#)
4. [Setting up base of operations](#)
5. [Handling common obstacles](#)
6. [Cleanliness and Safety](#)
7. [Client Awareness](#)
8. [Preparing the Film](#)
9. [Precutting and Cutting Out-of-Square Windows](#)
10. [Cutting & Slitting Mechanism](#)
11. [Glass Surface Preparation](#)
12. [Final Clean](#)
13. [Liner Removal & Lay-up](#)
14. [Final Installation Step](#)
15. [Inspection](#)
16. [Seaming/Splicing Safety Film](#)
17. [Special Instructions & Notes](#)
18. [Additional References](#)

Document Summary and Special Update Alert

This bulletin fully outlines the basic factory-recommended installation tools and procedures for LLumar safety and security films 7 mils (175 μ) or greater in thickness, in all flat glass applications. The key principles emphasized here are:

1) The **PerforMax Squeegee Handle** with the “**Blue Narrow**” ACT1326 squeegee blade should be used for installation (shown at right). **The use of an extension handle (discussed below) is highly recommended and now widely regarded as essential.**



2) This squeegee assembly (now known as “Thor’s Hammer”)

should be used with very firm slightly overlapping strokes.

3) The first pass of the squeegee should be made as though it’s going to be the ONLY pass, that is, applied with the highest level of consistent force. (Section 14). Entrapment of air or water in the form of hazy “champagne bubbles” is the result of multiple light passes causing partial bonding. A second or third pass is allowed only if no champagne bubbling or contamination is visible after the first firm pass.

4) Safety films 7-mil or thicker are best pre-cut off the glass (on a table) for precise fitting during installation (discussed in Section 9). This includes both edge-to-edge and daylight installations.

5) The concentration of slip solution should be 8-9 ml of Film-On

concentrate per liter of purified water. If Johnson's Baby Shampoo is used, the concentration should be 4-5 ml per liter of purified water.

Special Update Alert (July 2007):

The installation of heavy gauge films, 175-micron (7-mil) and thicker, presents a serious challenge to many installers. These films simply cannot be installed properly with the same tools and methods that are adequate for standard solar control films 25-50 microns (1-2 mils) in thickness. Thicker, stiffer films require enormously greater squeegee pressures to drive out the application solution. Failure to do so will often leave white foam streaks (called "champagne bubbling") and large water pockets that take months to dry out. Even after drying, unsightly bubbles and marks may be left behind. The problem is solved with a powerful new squeegee design, one we are calling "Thor's Hammer." One version was introduced in last month's newsletter for auto safety film use. For flat glass use, the squeegee is similar in concept, but is assembled as follows:

1. The installation squeegee blade is a standard BlueMax Squared, 2"x 5" (5 x 12.5 cm). Cut it down in width to about 1-3/8" x 5" (3.5 x 13.5 cm) order to provide the needed rigidity for maximum application solution removal. (We hope that soon a new, properly sized BlueMax Squared squeegee blades will be available from your Distributor, eliminating the need to trim down the existing version. Part # will be ACT1326, and called the "Blue Narrow").



2. This narrower urethane blade should be mounted in the jaws of a PerforMax Squeegee handle (ACT1224) with the factory edge facing out.

3. Construct an extension handle at least 12" (30cm) long made of fiberglass, aluminum, or other metal, since standard wooden handles cannot withstand the applied pressure needed during installation. The best option we have found is to use a 3/8" galvanized pipe fitting (5/8" [15.8mm] outside diameter), 12 inches (roughly 30cm) in length and threaded at the ends. As an "end handle," screw on a pipe T-joint, capped with end plugs. A vinyl bicycle handle grip can be cut into 2 pieces and slid over the ends as shown here. Insert the pipe, wrapped with tape at the end for a friction fit, into the end of the PerforMax Handle. Gripping the T-handle, twist the pipe into the handle to ensure that the tape-covered threaded end of the pipe bites firmly into handle, forming a solid connection. For aesthetics and a better grip with wet hands, you may want to wrap the pipe shaft with tennis racket grip tape or other adhesive-backed



foam material. All of these additional items can be found in well-supplied sporting goods stores, home improvement centers, or plumbing supply stores.

4. The resulting squeegee assembly provides the needed hand comfort and grip strength to provide unprecedented squeegee pressure, the proven key to success with these safety and security films.

1. Things the installation crew should know before beginning

- What time the customer expects him
- Directions and ample time to arrive punctually
- How to install LLumar safety films on the type of glass system(s) they will be working on, as specified in this document
- Approximately how long the job may take
- Any special obstacles that may require help or additional equipment
- Understand that preparation and skill are direct links to success and will lead to other jobs



2. Tools and Equipment

A separate tool kit of installation tools should be maintained and ready to go out on a job at all times. The following items are essential:

1. Distilled or filtered water
2. Spray bottles (hand-held) (ACT0411, ACT0410, and ACT0406)
3. X-100/DirtOff concentrate (ACT0410)
4. Film-On concentrate (ACT0411)
5. Triumph scraper and replacement blades (ACT0908 & ACT0807)
6. 4" Crane or Hyde scraper (for film removal only) and replacement blades (ACT0903 & ACT0803)
7. 5-way tool (ACT1029 or ACT1100)
8. Roll of 3/4" to 1" masking tape
9. Soft paper towels (i.e., Bounty or Job Squad) or soft cloths
10. Drop cloths
11. Trash bags
12. Measuring tapes
13. Tool apron
14. Olfa Snap-off knife (ACT0610)
15. Olfa stainless replacement blades (ACT0609)
16. PerforMax Squeegee handle (ACT1224), with extension handle described in the document summary above.
17. Blue Maxx Squared replacement blade (ACT1319),
18. Unger "channel" squeegee with 6" and 12" blades and channels (ACT1313-6" & ACT1311-12")
19. Paintbrush with stiff bristles
20. Small supply of 1" single edge blades with holder ACT0801 & ACT0901
21. Ceramic cutting tool (ACT0601 or ACT601C)
22. Auto lock 8-point knife (ACT0602 & ACT0607)
23. Band-Aids or First Aid kit
24. Appropriate stepladder or regular ladders (such as the Little Giant)
25. Cordless driver with assorted drivers or at least a 1/4" nut driver
26. Screwdrivers (slot and Phillips head)
27. Multi-gallon pressure spray tank with extension hose (ACT0403)
28. Portable cutting table or FilmHandler cutting mechanism



3. Plan of attack

Installations should be systematic, working upper to lower, left to right, clockwise around a room, and clockwise around a building. Starting with the upper windows will keep dripping water from spoiling completed installations below.

When possible, try to do shaded windows before sunny ones, both for your own comfort and eliminate problems during installation. For example, do west-facing windows in the morning and east-facing windows in the afternoon. Over-heated windows cause application solution to dry up too quickly, microscopically foaming (sometimes creating milky streaks), or making film difficult to maneuver and apply properly.

You can use a white sheet with suction cups to affix it to the outside surface of the window as a portable shading device (where exterior access is possible).

4. Setting up base of operations

Select an out-of-the-way area on the job site to set up a convenient tool and supply “depot.” Use a large drop cloth to protect flooring, and place upon it everything you’ll need for the installation. This will help keep you organized and keep the job site free of clutter, trash, and avoid misplaced tools—and impress your customer with your desire to be unobtrusive in their home or place of business.



5. Handling common obstacles

Often, there will be obstructions such as furniture, signs, or window treatments, blocking your clear access to the windows.

Prior to your arrival, inform the customer about the need to have clear access to the window areas. Professionally ask customers to move fragile or expensive items out of the way to minimize potential risk.

Use common sense when moving common items. To avoid scratching floors, lift—do not drag—furnishings out of the way. Sales representatives should also inquire about any special care or handling requirements for window treatments and pass this information along to you. Often, you can simply tie back most treatments or remove them prior to film installation.



Use drop cloths to cover all exposed sensitive surfaces to prevent contact with your cleaning and application solutions. Be especially careful using X-100/Dirt-Off during glass surface preparation. This liquid is mildly acidic and may cause slight etching of marble surfaces and minor spotting on delicate furniture finishes.

REMINDER: Factory recommended procedures require Film-On used in conjunction with distilled or reverse osmosis filtered water for installation of LLumar Magnum Safety film products. No other surfactant is acceptable (unless authorized through CPFilms Inc.) and any deviation from this requirement may void all warranty on the product. The concentration of Film-On should be 8-9 ml of concentrate per liter of water (8-9 pumps using appropriate dispensing pump supplied with this product).

6. Cleanliness and Safety

The materials you are working with can be both messy and dangerous in certain circumstances. Film scraps from trimming film material should be regularly picked up and stored in trash bags.

The breakaway knife points you'll be snapping off can easily drop into carpets and cause injury. Dispose of such blades properly, using the special BLADEater tool or enclosing the blade points or other razor blades inside layers of masking tape and placing them in trash bags.

Large sheets of release liner can be slippery, wet or dry. Keep such material out of the paths of passers-by. Dispose of them promptly. Liners can also be used to wrap up and compress large amounts of scrap material, using narrow film scraps as "strapping" to secure these compact bundles, for safety and convenience.

7. Client Awareness

Always be alert to the needs of your customer and accommodating to their schedule and activities. You are there, in their home or business, at their request, and your professionalism and courtesy will be appreciated and rewarded with more referrals to grow your business opportunities.



8. Preparing the Film

If you have accurate window measurements, film can be cut at your shop headquarters or on-site using methods discussed below.

Tabletop: Portable-cutting tables, often used by wallpaper hangers, can be quickly set up. A measuring grid system on its surface will allow you to pull film from the box and slit to the right size quickly.

Use the instructions in Section 9 of this document for precisely cutting safety film using the tabletop method



Safety Film 7mil (175 μ) in thickness and greater is too thick to trim on the glass. It must be cut to the required size before installation. Use the Auto-lock 8-point knife to cut the film; a standard Olfa knife is not strong enough to cut the thick film without risk of breaking knife-points or damaging glass. One can also take advantage of the ceramic cutter (ACT0601) pictured in **Diagram 8** below. See article titled "The Cutter" on www.llumartech.com.

9. Precutting and Cutting Out-of-Square Windows

There are several methods for cutting out-of-square windows:

a) Template Method:

Have a piece of film slightly larger than the window to be installed laying on the cutting table *with its liner side up*. Next, make a template from thin liner material saved from other installations. Apply the liner to the pane as though installing a thin film. Squeegee it flat and trim the borders with an edge tool, leaving a clean 1/16" gap around all the edges. Carefully remove it from the pane and immediately lay it down on the misted surface of the film, *with the surface that was against the glass facing up*. (You must keep the template in the same spatial orientation, so that the film you cut will properly fit the pane.) Squeegee the liner onto the film, making sure the 4 corners are perfectly dry. Use a marking pen to "paint" over the corners and onto the liner of the new film. Remove the liner template and *immediately* label the film's top edge as "Top." You now have the 4 corners clearly marked, and you can cut the four sides with the ceramic cutting tool along the edge of the cutting table, using the simple "connect-the-dots" method.

b) The Mark-and-Trim Method:

The Mark and Trim method is straight-forward, versatile, and fast. It works well with any film thickness, and any sized rectangular window. We begin with a lightly cleaned window, squeegeed clean of surface dust, and a piece of film pre-cut slightly larger than the glass area. The film has a straight left edge.

Spray the pane lightly with Film-On solution. Lay up the film with its liner side against the glass. Line up the left edge to its installed position. Slide the top edge up until either the upper left or upper right corner is in its final installed position. If you are lucky, the top edge will need no further trimming. But often the top edge of the film will not match the frame, and the gap will be uneven. This is easily fixed.

Lock down the film with the Teflon squeegee tool to prevent sliding. Be absolutely sure to mark the top edge of the film with the word “Top” for future reference in the trimming and installation process.

In this example, the left corner has a substantial gap between film and frame. Measure the exact height of this gap. Move to the upper right corner area and mark a point down from the frame the height of this gap.

Now, remove the film from the window and lay it down on the work table. Line up the mark and the upper left corner of the film along the cutting-edge of the table. The work table has been coated with LLumar urethane Paint Protection Film, which both protects the wood surface and grips the film firmly during cutting. Use the Teflon Squeegee Tool to stroke down the film and grip the table surface. Now we can proceed to use the ceramic cutter to slice away the wedge of film, to make a perfect upper fit with the frame.

Return the film to the pre-wet window, sliding the film into a perfect fit along the left and top edges. Line up these two edges to the “installed” position, with a 1/16” gap, a space of about 1-2 millimeters. Lock the film down with the Teflon squeegee tool.

Along the right vertical edge of the window, gently push the film down into a tight radius where it runs up along the frame. With a fine-point marking pen, mark the point on the film where you need to make your cut.

Before marking the edge toward the bottom of the right vertical edge, consider making a diagonal “corner-cut” to allow the film to be pushed inward without kinking or creasing. After this cut, you can easily mark the other point close to the bottom right. Now you have the right edge ready for cutting on the table.

Continue marking the bottom left and right corners in the same manner. Now, with the right and bottom edges marked for trimming, lift the film off the glass and onto the cutting table. Line up the pair of dots along the cutting-edge of the table. Use the ceramic cutter to make the cut. Repeat this process for the remaining edge. Your piece is now tailor-made for the window, and ready for liner-stripping and installation.

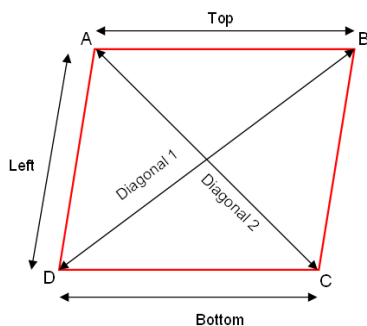


Diagram 1

The window, though, will need to be thoroughly cleaned before actual installation. After glass-preparation, spray the pane with Film-On solution. Use any of the standard installation techniques to be demonstrated in the next sections, such as the reverse roll method, for liner removal and lay-up.

c) Measurement Method:

The method discussed in this section allows you to pre-cut all straight-sided windows, even those that are out-of-square. (The basic concept can be used to pre-cut triangular, 4, 5, and 6+ sided panes.) The object is to geometrically re-create the exact window shape from a series of simple measurements.

1. For 4-sided windows, measure precisely FIVE “daylight” (clear glass

- area) distances as shown in **Diagram 1** on the left. The red “square” represents the extreme edges of the clear glass area. The five measurements are: the left side, top and bottom, and the two diagonals.
2. Draw a diagram of the glass panel on a piece of paper and write down the five measurements, noting which edge is the top edge, as in the diagram below.
 3. As shown in **Diagram 2**, cut a piece of film a little larger than required. Include at least one “factory edge” to use as the left vertical edge.
 4. Place the film on a smooth, hard, dust-free surface with the release liner facing downwards.
 5. Put your paper containing your diagram onto the center of the piece of film, oriented so that the “Top” faces the top edge of the film. Subtract 1/8” (3-4mm) from each dimension. Record these new dimensions on your paper diagram. (These measurements will give you the needed 1/16” [1.5-2 mm] clearance all around your finished piece, for “daylight” installations. Daylight installation involves a 1/32-1/8 inch trim border between film and frame, where as edge-to-edge installation requires film be installed to each glass edge—inside the glazing gasket—after removal of the gasket from the frame.)
 6. As shown in **Diagram 2**, measure and mark off the length AD (left vertical edge of glass minus 1/8”) along the left factory edge of the film.
 7. As shown in **Diagram 3**, measure from Point D the precise distance of Diagonal 1 (minus 1/8”), marking the film anywhere approximating the location of what will be the upper right corner of the film. With your marker attached to a string to work like a compass, swing a small radial arc equidistant from point D & intersecting the point you just made on the film. The arc is indicated in red in **Diagram 3**.
 8. Now beginning from Point A measure out the exact length of top edge (minus 1/8”). Mark the film and swing the arc (centered on A) through that point. You should now have 2 intersecting arcs as shown in **Diagram 4**. The intersection point precisely defines the location of point B, the upper right corner of the window.
 9. As shown in **Diagram 5**, from Point A again, measure down the length of Diagonal 2 (minus 1/8”), mark the point, and swing an arc through it, centered on A.
 10. As shown in **Diagram 6**, beginning from Point D, measure out the distance of the bottom edge of the glass (minus 1/8”), and swing another arc through it. The intersection of the arcs locates the final point C.
 11. We now have located all 4 corners of the window, and can cut the film by simply “connecting the dots” (shown in **Diagram 7**). You may use a metal straightedge or the ceramic cutting tool shown in **Diagram 8** (on the left).

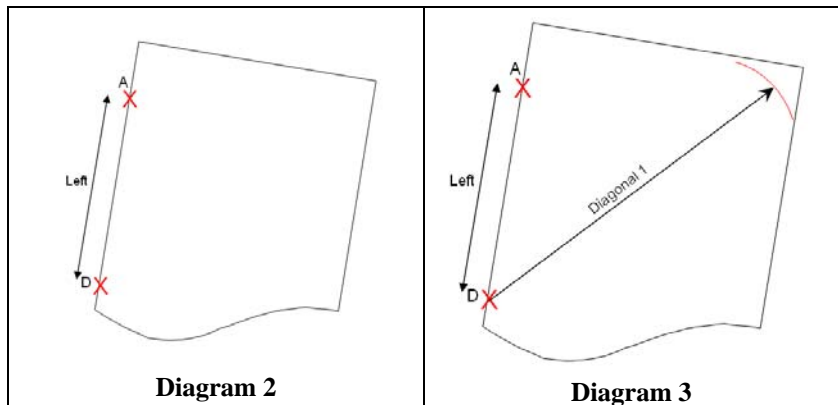
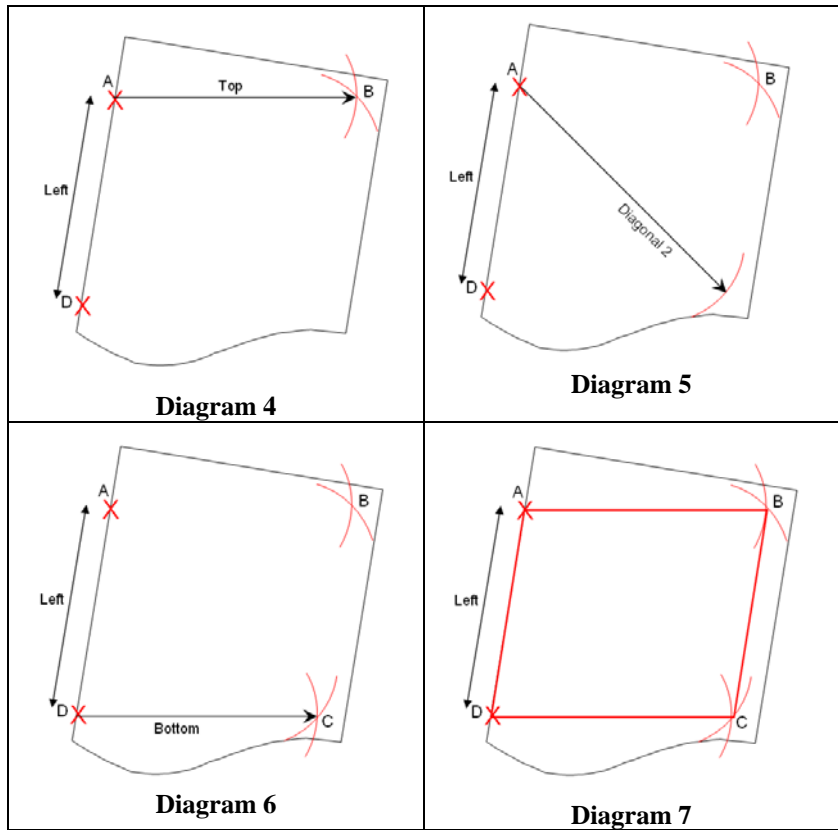




Diagram 8- Ceramic Cutter



10. Cutting & Slitting Mechanism

The FilmHandler (or similarly constructed devices) offers a means to cut film squarely and cleanly while reducing waste. Accurate lengths and widths can be cut, with edges usable along window frame without trimming. FilmHandler cutting devices are designed for wall or ladder mounting. The cutting heads have been known to shift when cutting 8-mil films and thicker.



CPFilms recommends using two (2) six-foot stepladders for portable operations of the FilmHandler device. The massive weight of thick film rolls creates an unbalanced load on a single ladder and presents a safety hazard. Two ladders should be used for increased stability.

11. Glass Surface Preparation

Examine the window for the presence of any locally heavy accumulations of dirt, paint, silicone or residual adhesive from signs that have been removed. Certain areas may need to be spot treated with a spray of X-100/Dirt-Off and a scraper before systematically cleaning the entire pane.



Spray the entire glass surface area with properly diluted X-100/Dirt-Off solution and use the 6" Triumph scraper to thoroughly scrape the entire window. Be careful

not to jam the blades into window edges, which would risk damaging the gasket system or cracking glass. A

slanting angle with a downward movement will help preserve the edges of your blade and avoid damage to the rubber gaskets.

CAUTION: If you hear a sandy and gritty sound as you scrape the glass surface, STOP! Check to see if you are causing fine scratching. Tempered glass can sometimes have embedded surface contaminants that, when scraped free, cause this fine scratching. If so, you will need to clean the window with the nylon scrub pad only.

Spray pane again, and scour with the nylon pad, including the gasket areas. Spray pane again and use a soft-bladed squeegee (such as Unger 6-10" wide) to stroke dry the entire window in horizontal passes beginning at the top and migrate down the glass.



REMINDER: Never use a film installation squeegee as your cleaning squeegee, nor a soft bladed cleaning squeegee for an installation squeegee. Cleaning dirty glass will rapidly dull hard edges these blades. A hard, sharp edge must be maintained for installing film.

Use a soft cloth or paper towel to wipe continuously around the frame of the window to stroke away excess solution and dirt. Wipe all corners, moldings and sills and inspect your results. Stroke dry the glass edges where the glass meets the gasket with a Teflon edge tool wrapped in a single layer of a paper towel or cotton cloth. This will ensure the removal of any dirt-laden moisture.

12. Final Clean

Timing is important. This method of squeegeeing the window is best done just seconds before the installation of the film to reduce the likelihood of dust settling on your prepared surface. This is why it is best to prepare your film first before the final clean.

Apply a consistent spray mist of application solution on all of the glass. Using the proper width channel squeegee, start from the top corner and move horizontally (across) the window in one continuous sweep of the glass, being careful not to leave “tracks” where the tool has stopped and started again. Since towels were used to pick up dirt around the edges after scraping, you will not need to reintroduce use of paper towels at this stage.



13. Liner Removal & Lay-up

System A: Using Window for a Holding Board

This method is used most frequently on smaller pieces of glass. Spray an adjacent unprepared window and lay the film with the release liner facing you on the adjacent windowpane, using it as a peeling board. Using tape or a fingernail and carefully start the removal of the liner from a corner.

Pull the release liner off gently while spraying the adhesive surface with your application solution. Peel the film off adjacent window (board) and install on the unit you have just cleaned.

System B: Manual 'Reverse Roll' Method

Your film should be rolled onto a tight tube, liner to the inside of the wrap. Unroll the tube a few inches, and with the piece of tape used to hold the roll together, pull away the liner at a corner.

Spray the tube lightly with Film-On and continue the pull away the liner, wrapping it tightly around the main body of the tube. The moisture will cause the liner to adhere well to the film tube during the unrolling process.



Uniformly spray the entire window surface, but avoid heavily spraying the top edge of the pane to prevent any contamination from flowing down from the border. Spray the exposed portion of the film with Film-On and grasp the film tube in preparation for lay up.

Lay up the film to the wet glass. Here, let's assume we've cut the film squarely and that the top of the pane is square and level, too, so we can actually place the top edge of the film on the glass and slide it up into final position.

Place one hand onto the film surface at the top of the windowpane and use the other to carefully unroll the film tube. This allows the liner to be stripped off immediately and transferring it to the backside of the film. As the unrolling progresses double-check its alignment in regards to positioning onto the glass. (For large windows, you may pause after unrolling a 20-30% of the window area, and lock down the film with a few firm squeegee passes. This will prevent the film

from drifting during the remaining unrolling process. Also, ensure the exposed glass surface remains saturated as you unroll the tube.

Once arriving at the bottom end of your film tube, grasp the liner; hold film firmly to the glass while pulling the remaining attached liner material downward and away. Spray the film surface to lubricate the squeegee.

System C: Team installation

This method may be used when installer is unable to implement the reverse roll, which is far superior when well done. It isn't necessary to discuss all aspects of team installation, but as noted below, there are substantial differences when using the two-person technique.



One person can clean the window while the other measures the window and prepares the film. One installer pulls the film from the box and holds it up for the desired length while the other cuts it.

After separating the liner and film at a top corner, installer #1 holds it while installer #2 removes the liner slowly and evenly while thoroughly spraying the adhesive side of the film.

Installer #1 applies the adhesive side of film to the glass. From this point forward, installation is the same.



Two people working together can save several steps. In addition, their speed doesn't allow the application solution time to evaporate on either the window or the film during installation. This advantage reduces the need for frequent spraying, particularly on very hot days.

14. Final Installation Step

There are two approaches for trouble-free installation of LLumar safety and security films. Understanding these two approaches is required of all accredited installers of these products.

Option 1

This option is best used on cool glass surfaces with no direct sunlight.



Wet the *adhesive only*, apply the precut film to dry glass, and aggressively squeegee application solution and air from beneath the film beginning from top center squeegeeing to one side or the other. Use ONE squeegee pass only, not multiple strokes over the same area. A Performax handle with Blue Maxx Squared blade must be used with uniform, very firm strokes. Using minimal overlaps, including the center, work any solution toward one side systematically from top to bottom.

Option 2

This option is used in warm, sun-exposed areas.

Thoroughly saturate *both film adhesive and glass surface*, then apply the pre-cut film piece to the glass. Next, use a 6-10" soft-bladed Unger squeegee (typically used for glass prep) to very lightly squeegee the pane to smooth out all air pockets and excess application solution as if cleaning the film surface. The idea is to evenly create a bubble-free, thin film of moisture beneath the film surface without tacking the adhesive to the glass surface.

Finally, use the Performax handle (with extension handle) with Blue Maxx Squared blade to aggressively squeegee application solution as described in Option 1 in a *single*, slightly overlapping strokes.

Re-squeegeeing or hard carding areas already aggressively squeegeed is only allowed if there are no contaminants that need to be removed and no "champagne bubbling." Such bubbling is made of streaks of microscopic air bubbles (foam) developing in the adhesive, creating a ghosting effect that will not disappear. If there is this kind of bubbling after the aggressive squeegee pass, the film is probably unfit for use. Contaminants can be removed by *first drying the borders thoroughly*, lifting the nearest corner, respraying the adhesive, removing the contaminant, laying the film back down and repeating the aggressive squeegee pass. Failure to dry the borders before lifting will cause dirt-laden moisture to immediately flow in under the film leaving a diagonal grit line.

After using either Option 1 or 2, wrap a 5-way tool (or other hard card of choice) with soft cotton cloth or soft paper towel. With light pressure, about 2-3 inches from the film edge (or frame), wick any remaining moisture from the film's edge. This procedure is called 'bumping,' 'wicking,' 'drying,' or 'finishing out.' As the cloth or paper towel absorbs moisture, continually reposition it for best results and to prevent sand or grit from scratching the surface of the film. Do not attempt to hard card the central areas of the film as this may lead to the creation of foaming streaks in the adhesive.

After all windows have been installed, polish up the windows using a light spray of application solution or approved window film cleaner and a soft cotton cloth.

15. Inspection

If possible, walk outside and examine the installation from the exterior. You'll be able to see things not visible from the inside, such as water 'pools,' places where application solution gravitates to one spot. It is very important to eliminate the existence of water pooling (caused by using low squeegee pressure or inconsistent squeegee strokes). The customer will not be happy with a water spot or cloudy area that takes many weeks to evaporate.

16. Seaming/Splicing Safety Film

When a window is "too big" for your film, the client must be made aware of this prior to the installation. If both dimensions of the window are greater than 72", for example, two pieces will have to be installed and joined in some way. But in the case of safety and security films there are two issues that are of great importance: Performance and aesthetics. In other words, How will the result look and how will this splice affect the safety performance of the film? The central problem is that traditional methods of seaming, while not being a problem for standard solar control films, can dramatically weaken the installation from a security perspective. Secondly, as a matter of aesthetics, very thick films are very difficult to splice together without the joint being a visual distraction.

Given the necessity of a seam, two points need to be made. First, we currently have no *independent* testing as to the safety implications of a splice line, but our own in-house testing indicates severe weakening of the glazing integrity along splice lines in the event of impact.

Second, if splices must be used, the issue is not so much the *kind* of splice, but its location. Any traditional kind of splice (a 1/8-1/4" overlap, an overlap-cut-through, or a factory edge-to-edge joint) will present a roughly equivalent weakness along

that line. Technically, it makes better sense to do an edge-to-edge join and then overlay a 1/2-3/4" clear strip of 7 mil safety film or clear urethane film straddling the seam, to avoid the "shingle effect" with thick films.

But aesthetically and structurally, the best option is to lay down an adhesively mounted muntin across the edge-to-edge seam line, using the same flexible attachment system material you use along the perimeter. If done well and consistently, it is most often found aesthetically acceptable. If the same "muntin" material were applied to the exterior surface of the glass as well, the cosmetic effect would be ideal, giving the windows the proper architectural finish.

Seam location determines both aesthetics and safety. For safety in either blast and forced entry situations, the seam should generally run horizontally, as we analyze the worst case scenarios. For an explosion, if the seam should be as close as possible to the floor, so that any glass spillage through the seam opening would be confined to the "below-the-knees" region. For "forced-entry" concerns, the seam should be as close as possible to the ceiling, out of reach of the probable impact/assault region. Vertical seaming is generally ill-advised because it leaves a vulnerability in BOTH bomb blast and forced entry scenarios, unless one uses the perimeter attachment extrusion as a seam reinforcement muntin.

However, there are three approaches that an installer can take or recommend to the client. Pros and cons of all methods should be discussed and the location of the splice decided upon before going forward with any installation.

Two traditional methods are demonstrated in detail in the LLumar Architectural Films Training Program on CD-ROM [US version: L1594; International version: ACI404]). The third is significant because of its potential to improve the aesthetics of an installation, though no testing has been done to warrant safety claim about the relative strength of the joint created at the seam line with muntin bar attachment.

1. Simple overlap (1-3 mm)
2. Overlap/cut-through (butt splicing)
3. Factory edge-to-edge with adhesively mounted muntin bar.

1. Overlap Method: On overlapped seam can be horizontal or vertical and be located where the client deems best, such as along the top edge of a window, hidden under a valence, for example. Follow normal cleaning and trimming procedures. Apply the uppermost piece of film first if doing horizontal splicing. Use a factory edge for the seam line. Trim the three sides of the film and complete the installation of the first piece. Install the second piece of film so that the two pieces overlap about 1/2" and then slowly slide the second piece away from the first until the overlap width is about 1/16". Squeegee the overlap area carefully, then the remainder of the glass area, using standard installation techniques.

2. Overlap cut-through ("Butt" Splicing): If a customer specifies "butt" seaming, it can be done by overlapping the pieces by about 1/2" (12 mm) and then carefully cutting through both pieces and removing the detached strips. If you use a ruler as a blade guide, a strip of clear polycarbonate sheeting (3" x 60" or longer) makes a good one. Lightly spray the area where the ruler will rest on the pane. The moisture will act to grab and hold the ruler in place while cutting through both layers of film.

A separation of up to 3 mm at the seam is a possibility after the film has completely cured or dried, although this is rare. Often, the film will cure and the seam will be very difficult to detect. It will appear as though a piece of thread has been stretched across the film.

3. Factory edge-to-edge: Rarely, but especially on very thick (7 mils or greater) safety films, one will need to splice film by simply abutting two factory edges of

the film. Cart-wheeling is most assuredly a necessity. This technique should only be used when films are simply too thick to cut through (as described below) or when overlapping is simply too unattractive an option. The splice line may either run horizontally or vertically. The technique simply involves installing two pieces adjacent to either, with the joint being formed by two factory edges placed as close as possible to each other so that both edges fit flat.

Be aware that factory-cut film edges do not always have the cleanest, most straight cut needed to exactly match edges the full length of the seam. You may experience an unevenness in the joint spacing and a separation of up to 3 mm can be expected after the film has completely cured. Adhesively attach a decorative strip (thin aluminum or black vinyl material) straddling the seam, as described in the following paragraphs and warning.

About splices in general, remember: We have no independent testing as to the safety implications of a splice line, but in-house testing indicates severe weakening of the glazing strength along splice lines in the event of impact.

Second, if splices must be used, the issue is not so much the kind of splice, but their location. Either kind of splice (a 1/8-1/4" [3-6mm] overlap vs. a butt splice) will present a roughly equivalent weakness along that line. Technically, it would make better sense to do a butt splice and then overlay a 1/2-3/4" [12-18mm] clear strip of 7 mil safety film or clear urethane film straddling the joint, to avoid the shingle effect with thick films. But aesthetically, a better option would be to lay down an adhesively mounted muntin across the butt seam line, using the same flexible attachment system material you use along the perimeter. If done well and consistently, it might well be aesthetically just fine. If the same "muntin" material were applied to the exterior surface of the glass as well, the cosmetic effect would be ideal, giving the windows the proper architectural finish.

Further, seam location determines both functionality and safety. The seam should generally run horizontally, as we analyze the worst case scenarios. For an explosion (often a primary concern), if the seam is as close as possible to the floor, any glass spillage through the seam opening would be confined to the "below-the-knees" region. For security/forced entry concerns, the seam should be as close as possible to the ceiling, out of reach of the probable impact/assault region. Vertical seaming is ill-advised because it leaves a vulnerability in BOTH bomb blast and forced entry scenarios, unless one uses the perimeter attachment extrusion as a seam reinforcement muntin.

Notes:

a. In splicing, match the same machine-cut edges for best color and density by "cart-wheeling" second piece of film (turning film top to bottom). In effect, you align the right edge of one piece to the right edge of your second piece (or left edge to the left edge).

b. Film may at times display a mild variation in visible light transmission (VLT) its factory edge in comparison to the main body of the material. This area may be present from film edge inward as much as 50 mm along the length of each factory edge, right and left. This is usually unnoticed in one-piece installations because the human eye cannot detect the gradual and small variation in visible light transmission. An overlap-cut-through seam is the easiest way of eliminating factory edge and "seam-area" VLT variation. This is achieved by using a wide overlap at the seam before the cut-through is performed. Alternatively, any edges being used at the seam can have 50 mm cut away prior to installation.

c. Again, both butt-seam methods (factory-edge-to-edge and overlap-cut-through) can expect a final possible separation distance of up to 3 mm after curing or drying is completed.

d. When multiple windows need seaming, complete each pane before going to the next.

17. Special Instructions & Notes

1. Generally, film can be applied during the winter, even with very low outside temperatures. However, if solution should freeze on the window, naturally, do not apply film.
2. Regarding alarm tape on glass: It is not likely that the alarm tape will be damaged merely by the installation of film, but extra care must be taken while cleaning the window. The use of razor scrapers is dangerous since the tape is so fragile. It is likely that the installation of a window film over alarm tape can reduce its effectiveness, given the manner in which this tape functions. The material is quite friable (meaning that it is very easily crumbled or broken by bending or other stresses). Since the film will bond very well to both the tape and the glass, the tape will be less likely to break when the glass does, maintaining a current flow and thus preventing an alarm from sounding. Where such "old-fashioned" alarm tape is still present, it is often dysfunctional but kept in place as an additional visual deterrent. Always check with the building owner about the status of the alarm tape "system." You'll save yourself much grief by asking a few questions, and perhaps learn that the system was deactivated decades ago. The good news is that almost all such alarm systems are obsolete, having been replaced by far more effective acoustical, shock, infrared, and other such electronic sensors, many of which can be *surface-mounted on film after installation without impacting their performance*.
3. Wherever possible, scrape off decals from the glass surface prior to film installation. Advise the customer.
4. Don't apply safety film to a window that has a painted sign or picture on the inner side of glass, unless you're sure you can install it correctly the first time. Removal of film normally will remove the picture with it. Application solution may damage the sign.
5. There are some limitations as to the proper applications to various glass types. Refer to your distributor for information regarding the factory film to glass recommendation guidelines.
6. Safety Film should not be applied to rough, frosted-type glass, and is not recommended for acrylic or polycarbonate plastics.
7. REMEMBER: SAFETY FIRST.

**CPFilms Inc. is not liable for damage to alarm systems due to film application or removal.*

18. Additional References

Installers should be familiar with the following technical bulletins and documents that relate to safety and security film installation, all of which are found on www.llumartech.com.

1. **TBF-44 LLumar Edge Grip™ Installation Instructions**
2. **TBF-53 Dot Point Installation**
3. **TBF-54 Structural Silicone Attachment for Blast Hazard Mitigation**
4. **The Cutter: Ceramic Safety Film Cutter**

IMPORTANT NOTICES:

CAUTION: Tinted motor vehicle windows must comply with local laws. Dark tinting may reduce outward visibility during poor lighting conditions. Use care to avoid accidents.

CAUTION: Do not apply residential / commercial film to plastic surfaces such as acrylic (Plexiglas™) or polycarbonate (Lexan™) sheeting (unless the film is designed specifically for that purpose) or to motor vehicle windows.

CAUTION: Always test glass surfaces for susceptibility to scratching before cleaning with metal tools. Soft glass, some types of tempered glass, and sputtered/low-e coatings may be damaged by defective, rusty, or nicked blades, or by applying excessive force to scraping tools. Be prepared to use non-scratching fabrics/pads for window preparation.

CAUTION: Always use absorbent dropcloths to protect sensitive surfaces from overspray, drips, or runs when cleaning windows and installing films.

All statements and recommendations in this document are based on tests and information the CPFilms Inc. believes are reliable and are offered in good faith. CPFilms Inc. cannot warrant or guarantee the accuracy or completeness of this information nor its relevance for a particular user's situation. It is essential that the user evaluate this information to determine its suitability for a given application.

For inquiries outside the US and Canada:

CPFilms Inc.
International Division
P.O. Box 5068
Martinsville, VA 24115 USA
Phone: 276-627-3324
Fax: 276-627-3008
www.llumar.com

For inquiries inside the US and Canada:

CPFilms Inc.
P.O. Box 5068
Martinsville, VA 24115 USA
Phone: 1-800-2LLUMAR
Fax: 276-627-3032
www.llumar.com