

## **Best Practices for Preparing Laminated Glass with 3M Dichroic Films**

1. The best appearance will be realized when laminating with SentryGlas® interlayer from DuPont. This has been found to give the flattest, most "mirror-like" final results. Some users have found acceptable results with EVASafe® interlayer from Bridgestone. However, this interlayer material will result in a lamination with "waves" present throughout the surface. It is never acceptable to use Polyvinyl Butyral (PVB) in conjunction with 3M dichroic films.
2. It is critical to prepare the laminations by minimizing the stress on the dichroic film during the laying-up process. The most effective way to do this is to pre-cut the interlayer material to the exact size of the glass before laying up the film. This will minimize pulling or tugging on the dichroic film as it is being trimmed. It is impossible in our experience to cut through two layers of SentryGlas and the film without doing this, so SentryGlas should always be pre-cut to the glass size or to a size which is 1mm smaller than the dimension of the glass before laying up. Some users have found that they can trim EVA/film/EVA successfully but our recommendation is to pre-cut to size when using EVA as well.
3. Cut the dichroic film so that there is an excess of material around all the edges of the lamination. After the lamination is prepared, trim off the excess film using a very sharp blade, being careful to minimize any pulling on the film. Film should be trimmed flush with the glass edge. If vacuum de-airing is to be used, this is absolutely critical. If nip de-airing is used, then there is an opportunity to trim after the de-airing oven.
4. De-airing
  - a. Vacuum-bag de-airing: Trim the excess dichroic film so it is flush to the glass edge. Any overhanging material will be pushed on by the vacuum bag and a wrinkled area will likely form. If tape is being used to hold the glass together prior to de-airing, it is especially important to trim the film close in the taped areas.
  - b. Nip/heated oven de-airing: Run the laminations so the glass surface temperature at the oven exit is approximately 60C (140F). In general, laminations with film should be run at a slightly cooler temperature than laminations with no film. Flush trimming can be done after the de-airing oven, and all exposed film should be trimmed flush to the glass prior to autoclaving.
5. Autoclaving
  - a. **The key to success when autoclaving is to create a condition where the film is fixed in place prior to when it is exposed to high temperatures.** In practice, this means that final autoclave pressure should be reached before the desired soak temperature is reached. This can be accomplished in a couple of different ways:
    - i. If the compressor on the autoclave is very efficient, then the ramp-up time for pressure will be short, and full pressure will be reached before the large mass of air and glass in the oven reaches a temperature of 90C or 195F.
    - ii. If the pressure ramp-up cannot be accomplished before the autoclave temperature reaches 90C, then the autoclave temperature should be set at 90C (195F) during the pressure ramp-up cycle. After final processing pressure is reached, then the temperature can be re-set to the final soak temperature.
  - b. Follow the interlayer manufacturer's recommendations for processing pressure, soak temperature, and soak time.
6. Processing of tempered glass laminates
  - a. Tempered (or heat strengthened) glass poses special challenges when laminating dichroic films because of the relative non-flatness of these glasses compared to annealed float glass.
  - b. It is often necessary to use thicker interlayer sheets in order to "fill in" the waviness of the glass surface.

- c. If thicker interlayers are used, then the de-airing method will need to be changed to ensure that the interlayers flow adequately to insure a good seal around the edge of the lamination. This may mean that the glass surface will have a hotter temperature than the 60C figure mentioned above in 4b.
7. Other considerations
- a. It is typical to see a slight waviness in the appearance of the final construction where the edge of the glass was in contact with the autoclave racks. This is caused by the rack restricting the flow of the interlayer material, which puts a slight amount of pressure on the film in this area. Following are two suggestions to reduce this:
    - i. Use v-shaped supports under the glass edge
    - ii. When preparing the interlayer, cut so that its area is just slightly less than the area of the glass, to allow some "room" for it to flow.
  - b. We have seen in practice that small creases in the film will not be visible after the autoclave. But it is still important to avoid adding creases, dimples, or other defects when handling 3M dichroic films.