

WINDOW WISDOM, PART II

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Now that you know more about the properties and installation of acrylic plastic windows from last month's article, it's time to get our hands dirty. We'll jump right in and get started with the removal and installation of the windshield and two most forward side windows.

Since these three windows are the most tedious to remove, fit and install, and are mounted in the same manner, I'm treating them as one group. As we cover the sequential steps of this process, I will call out any technical differences between the windshield and side windows as well as differences between framed and frameless windows.

Here's the best part: We'll reveal all the tricks of the trade that can really save you time, prevent damage to the new windows or the airframe, and enhance the structural quality, durability and aesthetic appearance of the new installation.

Airframe protection outside

An ounce of *protection* is worth a pound of cure. In thinking of the tools and steps required to do this job, it's easy to see how the slip of a tool or the drop of an object could ruin

your day. To reduce the risk of disaster, it is important to protect the exterior of the airplane.

- Put a piece of scrap carpet face down on the cowl. This not only protects the paint but also provides an ideal surface for the resting of tools.
- Cover the upper surfaces of the wings next to the cabin with padded moving blankets.

TIP: Here's a good idea for keeping a blanket from slipping. Plop a quarter-size stone near the edge of the blanket, about dead center just over the leading edge of the wing. Gather the stone in the blanket and tie it off securely using parachute-type cord, forming a knot at the blanket's edge. Tie the other end of the cord to the main landing gear strut; the blanket will no longer tend to slip off. I did my share of wing surfing before I figured this one out!

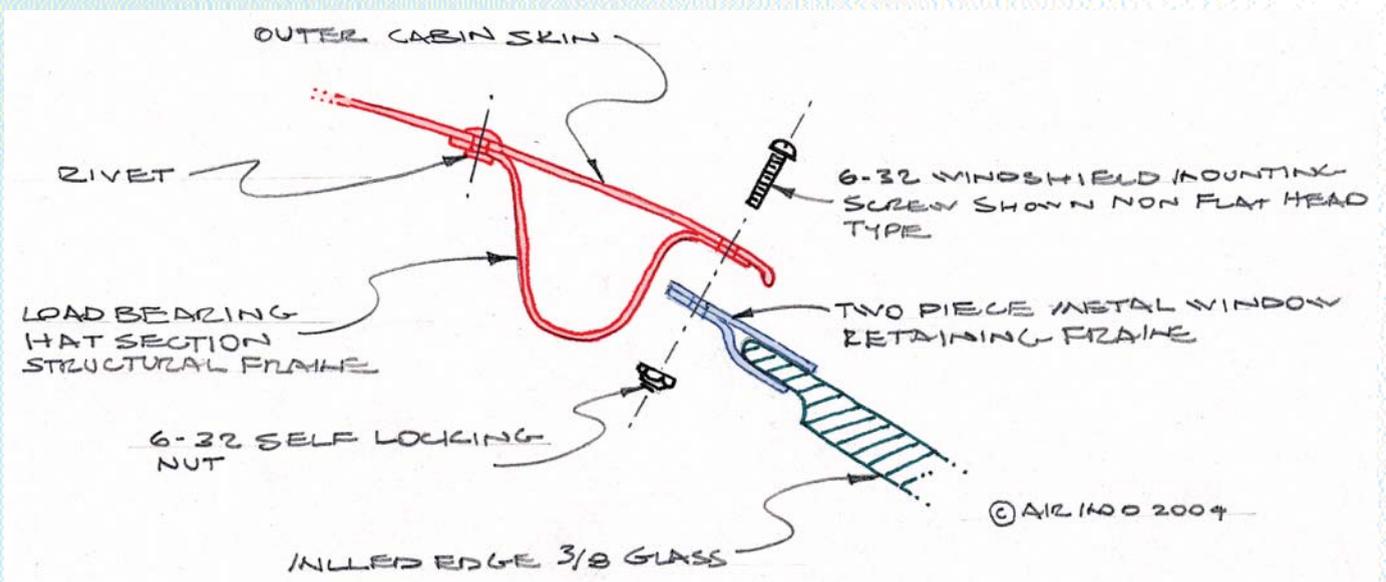
Accessing the outside of the pilot's side window requires walking on the left wing. To facilitate this, we have a 2 ft. x 4 ft. piece of half-inch plywood to which we bonded half-inch soft foam on one side. The plywood is placed foam side down on the blanket-covered wing close to the fuselage. A short step ladder provides handy access.

Airframe protection inside

- Remove the seats, floor carpets, upper side panels, window frames and glareshield. It is very important to control where all of the drilled-out rivets and old window sealer will go during window removal. We always take out the pedestal and all floorboards when we do an interior renovation. It is not uncommon to find old drilled-off rivet heads that have worked their way into the pulleys and cables under the instrument panel. This can be prevented by simply covering the exposed areas behind the panel with a blanket to catch the droppings. I recommend inspecting these areas at your next annual, especially if your airplane has gone through an aftermarket windshield installation.

Before moving on to removal and installation, I would like to eliminate the potential for some almost inevitable confusion regarding the identification of the structural airframe window frame as opposed to the Plexiglas window retainer frame. The accompanying sketch (below) should help clarify things.

WINDOW FRAME: The structural airframe window frame (red), referred to as the structural frame, is a heavy hat-shaped beam-like



structure, riveted to the airplane's outer skin to form the window or windshield opening. This compound-shaped structural component is called a hat section because, if it were cut in two pieces, the cut edge looks like a cowboy hat. This hat section acts as both a major load-bearing support for the cabin structure, as well as a precisely shaped structural window frame to which the window (with or without its own metal frame) is attached.

WINDOW RETAINER FRAME: When we refer to the metal window retainer frame, we are talking about the one-and-a-half inch two-piece frame (blue) that is bonded to the edge of the acrylic window. This "window assembly" is then installed, using rivets or machine screws and nuts, into the airplane's structural window frame (enough frames for you?).

The drawing also helps illustrate some geometry that makes it difficult to install and remove the windshield and forward side windows. To make the load-bearing cabin structure strong, Beech came up with the aforementioned strong but light hat section shape that is riveted at both mated edges to the outer cabin skin.

The down side of this design is that the hat section creates a geometric opening that is smaller than the opening the window sits against when installed. A technician must be very careful in forcing the window assembly past the smaller opening.

Now the real work begins

- Carefully remove the interior window frames. On older models with metal inner window trim pieces, it is very important to number the window trim mounting tabs before removing them so they can be located in their original positions at the time of reinstallation. This will ensure proper fitting of the reinstalled trim strips.

Beech windshields and forward side glass were originally installed employing the framed method which requires drilling out the old windshield/window mounting rivets with a #30 or one-eighth-inch drill. If the airplane has aftermarket drilled frameless windows, all of the 6-32 mounting screws and nuts must be removed.

If a Beryl D'Shannon speedsloped windshield is installed, the riveted cuff located at the forward base of the windshield must also be removed (more about this later).

- Many Beech windows were installed with the very tenacious catalyzed PRC-type sealer, so it will be necessary to cut the sealer between the window and the airframe. The best method I know is to buy a very thin putty knife and sharpen the end and one side of the blade. Using a small mallet, tap the sharpened putty knife between the airframe skin and the outer surface of the window. This procedure is also used to separate the now rivetless cuff of a D'Shannon speedsloped windshield from the airframe.



Using sharpened putty knife to cut sealer loose.

I cannot stress enough how careful one must be not to damage the thin formed metal edge of the airframe sheet metal, as well as to not drive the sharpened putty blade into the structural hat section that forms the window opening.

As a final check to ensure that all of the sealer is cut free, we take a two-foot piece of .040-inch stainless steel safety wire and fish it in between a loose section of the window assembly and the structural window frame.

We then attach a short handle-sized piece of an old broomstick to each end of the wire. You now have a strong cutting tool that

two people, one inside and one outside, can evenly draw around the window's perimeter, ensuring that all of the sealer is cut, facilitating release of the window.

In preparation for pushing the window inward and out of its mounting, it is necessary to remove the tabs that hold the upper side upholstery in place. If the aircraft has plastic window frames, the metal tabs that hold them in place must also go.

A LITTLE TRICK: To make taking out a later-style original sloping Beech windshield a lot easier, remove the instruments located at the left side of the floating flight panel, as well as the three screws holding the floating panel to its shock-mounts. This allows one to pull the floating panel slightly aft, clearing the left side of the lower windshield area for more trouble-free removal of the windshield assembly.

Removing the windshield

Of the three front windows, the windshield is the most difficult to remove due to the geometry of the hat section structure mentioned earlier. Here is the best way I know of to get the windshield out of its structural frame:

- From the outside of the airplane, start at the lower left corner and push the window inward and out of that area of the structural frame.

- Next push the window out of the lower front part of the structural frame, then out of the left side of the structural frame. Once the window is free from these two sides, it can be moved down to the left, releasing it from the other two sides of the structural frame altogether.

- Now that the windshield is completely free, pull the loosened flight panel aft, rotate the windshield to the left, lift it upward and into the cabin, then out through the cabin door. In some cases, a radio shop will have attached wire clamps to the lower forward structural frame. If so, the clamps and any interfering components will need to be removed to obtain the necessary clearance.

Never try to force a windshield out of its structure top-first. With few exceptions, it will end up jamming against the hat section of the structural frame, making removal impossible.

REMOVING A BERYL D'SHANNON SPEEDSLOPED WINDSHIELD is a little different from removing a Beech factory one-piece sloped windshield.

- First, the lower front cuff must be removed by drilling out the one-eighth-inch mounting rivets that secure the cuff to the upper boot cowl and removing the 6-32 machine screws that secure the cuff to the windshield. The sharpened putty knife is then used to cut the sealer.

A second difference is that the two sides and the top of this frameless speedsloped windshield are mounted inside the structural windshield frame, while the lower forward edge is actually mounted to the outside surface of the original airframe boot cowl via the now-removed cuff.

The good news is that there is usually enough clearance at the lower corners between the frameless windshield and the structural frame to allow the windshield to drop down out of the upper portion of the structural frame. If the clearance is too tight, take a router and trim the windshield away at the lower corners (this windshield is history anyway).

- Force the windshield out of the two sides first, then out of the upper portion of the structural frame. However, due to the shape of the lower corners of this Beryl windshield, and the fact that the original non-sloped structure is still in place, you must pull the windshield forward at the center of the lower front edge, rotate the top inward, and pull it out the front of the windshield opening, not into the cabin.

Two forward side windows

The two forward side windows are unquestionably less tedious to deal with. Due to the geometry of the hat section frame of these windows, they can be pushed out from the bottom first once the sealer is cut loose, and the window assemblies will easily come out of the structural frame. Have someone at the ready on the inside, however, as these babies can pop out quite suddenly.

A LITTLE SIDE NOTE. We will sometimes use a rubber mallet to carefully beat a tight-fitting window out of its structural mounting (sometimes ya gotta do what ya gotta do). Use caution and wear safety goggles, as old Plexiglas can be quite brittle and in rare cases, prone to shattering. I personally have been so desperate on occasion that I've resorted to cutting the Plexiglas completely out of its retain-er frame, then removing the frame separately. Whatever works!

Cleaning up!

Oh, yes, there is always clean-up—a not-to-be-ignored part of the process.

- We remove all of the old PRC sealer right down to bright shiny metal. It's not unusual to find corrosion around the structural perimeter of the window openings. Here's your chance to thoroughly clean it out and treat the metal with zinc chromate. (We like Dupont 215S from the auto body supply store.) If inclined, you can carefully use a stainless steel brush and drill motor to speed things up. Stainless is the only safe kind of brush to use; brass or ferrous steel will leave corrosion-inducing residue behind.

Remember, aluminum is soft, and aggressive power-brushing can cause damage.

Since they are hand-built, no two Beech structural window frames are exactly alike. On top of that, some of the window manufacturers don't provide good trimming patterns. That being the case, it's cheap insurance to assess

the fit of the old windows before they're removed. If any dimensional anomalies exist (gaps at the edges, etc.), I mark the offending area accordingly.

Once the old window is removed, we make a heavy paper pattern of its exact shape and carefully add paper to fill in gaps as necessary.

Despite the fact that these windows are compound in shape, we can make very accurate compound-shape patterns using 2-inch-wide strips of pattern paper taped together. (It doesn't have to be a beautiful work of art, just accurately shaped.) When placed over the outside surface of the new window, be it frame-type or frameless, it will be easy to see a very close approximation of the shape to which that new window must be trimmed.

Thankfully, this step is usually not necessary. The mainstream window manufacturers have the stock window shapes down to a science. But if you are dealing with a nonstandard situation, this pattern process will save some time and frustration. (Remember the old saying, "I trimmed it twice and it's still too short!")

Checking for imperfections

The first thing that should be done when the windows arrive is to check for manufacturer defects. Take the window out of the box and remove the protective covering. Have someone hold the window upright on a table, then step back 4 or 5 feet and look through the



Compound-shaped pattern of original windshield, made from strips of pattern paper.

window at something in the background with straight lines in it. Move your head from side to side and up and down, and look for any pronounced waviness in the background objects. This step will expose any optical imperfections in the glass.

In addition, get up close and look for scratches or surface flaws caused by imperfect forming or shipping damage. Just imagine how stupid you will feel after you have spent 20 hours or more installing a windshield only to find a defect upon removal of the protective coating. (This falls under the "live and learn" category.)

Once windows are inspected and found to be OK, re-apply the protective covering to both sides of the glass and cut it back about two inches from the edge. This will protect the main surface of the Plexiglas while you are trimming and fitting the edges.

Here's where the difference between the drilled vs. the metal retainer-frame process really becomes apparent. As we go through the process, I'll try to highlight the differences between these two installation types.

Removing the original two-piece metal retainer frame requires drilling the spot welds used by Beech to hold the inner and outer frames together.

- Locate the center of the spot welds with a center punch, and drill them out with an eighth-inch drill bit. Most of the welds will still be holding slightly after the eighth-inch hole has been drilled, so one must now use the previously mentioned sharpened putty knife and drive it between the inner and outer frames.

- Starting between two spot welds, begin tapping the blade, sharp side first, cutting through the now very weakened welds. As you make your way around the window frame, you will also be cutting the PRC sealer originally used by the Beech factory. When the window frame halves are separated, all sealer should be removed and the bare aluminum should be sprayed with zinc chromate.

IMPORTANT NOTE: There are now two different sets of holes in the window retainer frames. The first set consists of the original structural mounting holes that were used to

hold the framed window in the structural opening of the airframe. These holes will be re-used to screw the windshield assembly back into the airframe.

The second set consists of the new eighth-inch spot weld holes we just made to facilitate separation of the two window frame pieces. To eliminate any confusion, take the time at this point to temporarily place the inner window frame in the airplane and mark the structural mounting holes with an indelible marker.

With the holes identified, countersink the spot-weld holes on the outer side of the outer window retainer frame. Then place the formed inner frame on the new window and check for proper fit between the new Plexiglas and the old frame, particularly in the radiused corners. (I will discuss proper trimming techniques later.)

If no trimming is required, temporarily rivet the inner and outer frames using cheap hardware-store countersunk pop rivets. We like Auveco #8298 – they are inexpensive and easy to install and remove. You only need to install a rivet in every third position of the countersunk eighth-inch spot weld holes, as this fitting is merely temporary.

Remember the compound paper patterns mentioned earlier? Here's where they come into play. Place the pattern over the outer surface of the new window and frame assembly. If the window and frame assembly is more than one-eighth inch larger at any point than the paper pattern, the window

assembly will need to be trimmed or it will not fit in the structural frame.

Trimming will reduce the possibility of having an ill-fitting window jam in the structural frame. It is very possible to force-fit a window assembly into a structural frame, only to find out later that it cannot be removed without damaging something.

Fitting the windows

Putting the window back into the structural frame is almost the reverse of removing it, but the side windows go in fairly easily. Here are a few tricks:

- Start by seating the top first and pushing in the window progressively down the forward and aft sides until you can push the bottom in last. Remember, the window opening gets larger as the window seats into the structural frame. If the window is too tight, the metal frame can be marked and trimmed to fit as necessary.

WINDSHIELD JACK TRICK. Getting the new windshield into the structural frame can be difficult. Some installers will use their feet to force the windshield in. We have developed a controlled method using a hydraulic bottle jack.

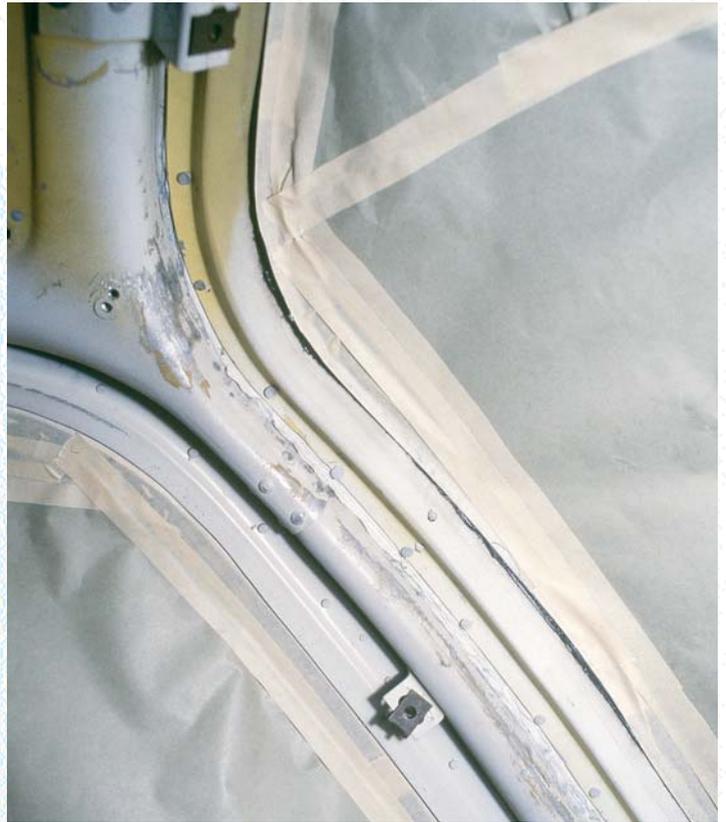
As shown in the photo, the tools required are a small bottle jack, a wood ram with a padded end disk, and a properly contoured wood base to securely hold the bottle jack on the spar at just the right angle to prevent slippage. This method gives you a lot of control in forcing the windshield past the hat section of the structural frame.



Homemade rail and wood base used with the small bottle jack to lift/push the new windshield into place.



Bottle jack and the base and rail tools are used to push the windshield past the hat section of the structural frame with a great amount of control.



Weakened windshield installation, caused by having the rivets installed too close.

It is extremely important to mention at this point that many windshields and front side windows (framed or not) have been over-trimmed by inexperienced installers who undoubtedly held them up to the hat section structural frame and eyeballed a trim line that would allow the window to easily slide past the hat section and seat into the structural frame.

The unfortunate result is a window that is too small to have the proper distance between the mounting holes and the edge of the Plexiglas or retaining frame, with rivets barely securing the window in the metal frame. (I have seen this many times in my 30-plus

years in business.) As this is a fairly common problem in aftermarket installations, it's a good idea on a prepurchase inspection to pull the window frames and have a look.

Also, even when the metal window edge retainer frame is over-trimmed, paint is often scraped off the hat section during installation, proof of just how tightly these windows fit. The photo tells all: an over-trimmed window and still lots of missing paint.

I've had about all of the window business I can stand for this issue. And we're at a good technical breaking point anyway. We will continue next month with final trimming, fit-

ting and installation of both framed and unframed windshields and forward side glass.

We will also get to those back windows. Don't worry, it doesn't involve nearly as much technical information or as many installation woes. Most of the hard part is behind us.

ABS member Dennis Wolter started Air Mod in 1973 to bring innovative design and high quality renovations to the general aviation market. Dennis, his wife Cynthia and 10 dedicated employees complete about 40 renovations each year at their facility on the east side of Cincinnati. Dennis has a degree in industrial design from the University of Cincinnati. He is an A&P, IA and a 3,000-hour instrument pilot.

B P P P S C H E D U L E

| DATE | LOCATION | AIRPORT | | | |
|-------------|----------------------------|---------|---|----------------------------|-----|
| Nov. 5-7 | Norfolk, Virginia | ORF | April 15-17 | Fresno, California | FAT |
| Jan. 21-23 | Phoenix, Arizona | DVT | May 13-15 | Columbus, Ohio | CMH |
| Feb. 4-6 | Melbourne, Florida | MLB | June 10-12 | Colorado Springs, Colorado | COS |
| March 18-20 | San Antonio, Texas | SAT | Bonanzas/Barons/Travel Airs at all locations. Subject to change. Cockpit Companion course available everywhere. | | |
| April 1-3 | Greensboro, North Carolina | GSO | CALL THE BPPP REGISTRATION OFFICE TO MAKE ARRANGEMENTS: 970-377-1877 or fax 970-377-1512. | | |