

# WINDOW WISDOM, PART IV

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**W**ith all the drudgery of removal, cleanup and fitting completed, the fun begins as we actually make this airplane whole again. This article will cover installation of the three groups of Bonanza windows:

- \* Windshields, pilot and copilot windows
- \* Center opening windows
- \* Nonopening center windows and aft windows

Since the installation process is so similar for the windshield and the two front side windows, I will focus on the windshield installation, but will point out any differences that relate to the side windows as we go.

## • WINDSHIELD AND FRONT SIDE WINDOWS

If you are installing a window with its original retainer frame, you can either secure the window-&retainer frame assembly to the structural frame with raised head AN 470-type rivets as originally used by the factory OR you can try my preferred method of using countersunk stainless steel MS246936 x 3/4 in. machine screws and #6 MS21083 low-profile self-locking nuts.

These items are available at Aircraft Spruce & Specialty (877-477-7823). If you choose to use the countersunk screw method, it will be necessary to dimple the structural frame mounting holes. This involves buying a set of \$15 #6 dimpling dies from Air Parts, Inc. (800-800-3229). (See photo)



LP Aero green seal caulk, machine screws and thin self-locking nuts.

A special tool is used with the dimpling die to create a countersunk structural mounting hole, but there's definitely a word of caution. You must be careful to keep the dimpling tool and dies properly aligned when dimpling the mounting holes. Failure to do so will result in a deformed skin.



Dimpling the structural mounting holes.



Homemade dimpling tool.

Also, due to the thin outer cabin skin, it is not a good idea to countersink the mounting holes with a cutting type countersink. Two things can happen:

First, it is very easy to over-cut the chamfered edge of the hole and cause the screw to pop completely through the outer skin. Big mess.

And second, even if the chamfer cut made by the countersink cutter is perfectly sized to the screw head, there is very little purchase surface to support the sheet metal surrounding the screw head.

*A MONEY-SAVING OPTION: You don't have to buy an expensive dimpling tool for this task. As seen in the photo above, a pair of common water pump slip joint pliers, drilled to hold the dimpling dies, works great on the thickness of metal involved here.*

*COUNTERSINKING TIP: Later-model cabin doors are fabricated using much thicker aluminum that requires countersinking with a cutter. The dimpling tools just won't do a good job on these thicker doors.*

Even though Beech installed these windows using raised head rivets, I very much prefer the countersunk screw method. I think it gives you more control in seating the windshield in its structural frame. Also, if a chromate putty-type sealer is being used with a framed windshield, the mounting screw method of installation really helps to squeeze the chromate sealer between the windshield's metal retaining frame and the structural frame of the airplane. No leaks, and it looks good, too!

## SELECT A SEALING SYSTEM

The last preinstallation step is to decide what sealing system you would like to use. With a framed window, you can use the PRC catalyzed sealer to seal the metal retaining frame to the window as well as to seal the window-&frame assembly to the structural frame.

Our preference has been to use the PRC-type sealer to seal the retaining frame to the acrylic window, and use a chromate-type non-hardening caulk (available at LP Aero, 724-744-4448) to seal the window-&frame assembly to the structural frame. This method saves masking time, causes less mess, prevents corrosion and provides a perfect seal. If you're installing drilled frameless windows, PRC sealer is the only one to use.

## PREINSTALLATION PREPARATIONS

Preinstallation masking can save lots of cleanup time and frustration. With the window temporarily installed, neatly mask all edges where PRC-type sealer is to be used. I like to mask right along the edge with 1/4 in. wide curve-friendly paper masking tape. Then come back and remask with 2-inch masking tape.

To keep the tape from becoming trapped under the tapered head of the flush mounting screws, take the aforementioned countersink cutting tool and run it backwards (counter-clockwise) in each dimpled mounting hole. This will neatly remove all of the masking tape in the hole without cutting into the metal.

I also like to apply 2-inch masking tape to the inside edge of the standing portion of the structural frame hat section about 1/2 in. back from the outer mounting surface. The idea behind all this masking is to eliminate having to scrub the surplus and very tenacious PRC sealer off the airplane. Works great!

Remember, an advantage with using the LP Aero green sealer between the retainer frame and the structural mounting frame is the fact that both outside and inside masking (required with PRC sealer) is not necessary.



Cleaning the masking tape out of the dimpled structural mounting holes.



LP Aero green sealer putty applied to the structural mounting frame.

*ANOTHER TIP:* To keep the PRC sealer from getting into the pores of your skin (it will and it's impossible to get off), rub liquid dishwashing detergent into your hands until it is dry. This puts a water-soluble coating on your hands that will go a long way in releasing the PRC sealer when you wash up at job's end. I know, you're going to wear rubber gloves, but one little hole is all it takes to cause a problem. Use the soap – it's cheap insurance.

*A NOTE ABOUT GLOVES.* We've tried every rubber glove known, and the best we have found are purple nitrile gloves, available at medical supply stores.

### Installation process

Starting with the framed windows, remove the now-masked window from both the structural and metal retainer frame. To add both strength and additional seal quality to both framed and unframed windows, use a red Scotch-Brite™ pad and rough up any surface where PRC is to be applied. This greatly enhances its bond to the window.

Mix the PRC sealer and the activator per the manufacturer's instructions and apply a generous, even coat to the outer and inner edges of the window. This sealer is available in both cans and a special caulking tube. The caulking gun set-up is less messy but costs more.

Next, using Cleco temporary fasteners, install the two-piece retainer frame to the window, then permanently rivet together the two halves of the window retainer frame using countersunk hardware-store pop rivets.

Be careful not to install a pop rivet in a previously marked structural mounting hole. Once all of the pop rivets are installed, use a rivet squeezer to flatten out the formed head of the pop rivet on the inside of the retainer frame. This also makes it stronger.

Actually, a big vice grip with two bolt heads welded to its jaws makes an inexpensive and easy-to-use rivet squeezer. Remember, I'm a "found-object" engineer—I just can't help it!

### A WORD ABOUT TIMING

It is very important that when this window is finally installed it is under as little stress as possible. To this end, we like to install the framed window assembly permanently



Homemade vice grip rivet squeezer.

into the structural frame while the PRC sealer is still fluid. The idea here is to allow the window retainer frame and the sealer to freely flex as they take the shape of the structural frame during installation.

Once the sealer cures, the acrylic window is floating stress-free in the retainer frame. To facilitate matters, we use the slow-curing type of sealer, giving us eight hours of working time. Cleanup is easier, too.

Since we like to install the window-&-frame assembly into the structural frame with LP Aero green putty seal, I'll cover that process first.

With the retainer frame mounted to the acrylic window, clean any surplus PRC sealer off the outer surface of the retainer frame with isopropyl alcohol. The drugstore brands aren't strong enough; you need the stuff that is used to de-ice airplanes. It is important to mention here that only nonpetroleum type solvents can be safely used on acrylic windows, and pure isopropyl alcohol is the best cleaning solvent available.

Next, apply a single layer of the green sealer to the cleaned outer surface of the retainer frame, then install the window assembly into the structural frame. Install the 6-32 mounting screws in the same pattern we described for drilling holes in the edge of frameless windows. Start at the center of the top, bottom and sides first, then work to the corners.

*TIP:* Due to the density of the green LP Aero sealer putty, it's a good idea to heat the outside of the structural frame using a 500-watt heat gun (unnecessary on a hot summer day). This will ensure good flow and ooze of the green sealer. (Be careful not to get too much heat on the acrylic window.)



In airplanes with the earlier type of thin metal inner window trim pieces, it is necessary to do the following.

As the mounting screws are being installed, the person on the inside must install the sequentially numbered window trim mounting tabs in their appropriate locations. Remember, they are held in place by the structural mounting screws and nuts.



Outside person heating the LP Aero Green Sealer as the mountings are being tightened.

A great way to also ensure proper alignment of the original window trim mounting holes is to hold the window trim piece in place on the inside of the partially installed window and mark the exact location of the trim frame holes on the hat section of the structural frame. This makes it easy for the inside person to confirm proper location of the tabs while installing and holding the mounting nuts. You do recall that these were marked earlier so that they can be put back in their original locations. This tab-location process applies to both framed and frameless windshields and windows.

As the outside person is installing the countersunk mounting screws, he should put some green sealer on the threaded shank of the screw before it is pushed into the mounting hole. Again, this helps ensure a good seal.

If PRC sealer is being used between the window assembly and the structural frame,

the best way to go is Lew Gage's method described in the September 2004 *ABS Magazine*. This also works well on frameless windows. Don't forget to put sealer on the threads of the mounting screws *before* they are installed.



Using a putty knife to force sealer between the window and the structural frame. Paint sticks help open the gap to allow the sealer to flow into the structure.

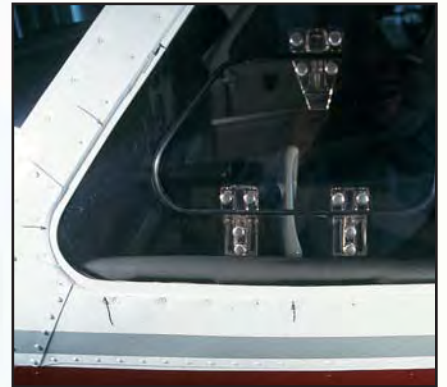
*TIP: To help make the earlier style of thin aluminum window trim strips fit to perfection, throw the original mounting tabs into the garbage and fabricate new .032-inch aluminum hat section tabs that mount at each end. This will help the window frames fit very securely. It also allows you to drill a new mounting hole in exactly the right location for a perfect fit of those pesky window strips. The tighter they fit, the better they look, especially on frameless windows.*



New double mount window frame mounting tabs. Note the radiused corner pieces.



Finish out of the lower corner of the windshield outer trim.



Arrows point to the new forward lower corner outer trim piece required to accommodate the new vent window design.

Moving on to frameless windows that install the same way as PRC sealer installed framed windows, there are a couple of exceptions to note.

First, the flat outer trim portion of the original retainer frame must be fit, masked and installed as mentioned in last month's article. If a speedsloped conversion windshield is being installed, trim the lower corners of the old outer frame as shown in the photo. It will look great and you only need the upper part of the outer trim frame.

The lower front boot cowl where the windshield meets the new black glareshield does not need an outer trim strip to look good.

If you are removing an early-style framed outward-opening vent window and installing either a framed or unframed later-style inward-opening vent window, it is necessary to modify the outer portion of the retainer frame to compensate for the removal of the old outward-opening vent. This is accomplished by fabricating a new lower forward outside corner trim



Sealer on mounting screws – very important!

piece to complete that section of the frame.

Second, it is imperative that the oversized 1/4 in. mounting holes be completely filled with PRC sealer. Any void can hold water, and freezing water is powerful enough to cause a crack at the hole.

Be generous when forcing PRC sealer in between the window and the mounting hole; then put lots of sealer on the threads of the mounting screws. Finally, have the inside person hold a very thin putty knife over the 1/4 in. mounting hole while the outside person forces sealer into the same hole with a smashing action using a thin putty knife.

Install the wet screw and accompanying flat washer and special sheet metal nut. As the screw is nearly seated, sealer should be oozing out of both the inner and outer sides of the fasteners.

*TIP: A word about nuts. Special sheet-metal nuts are used on frameless windows to ensure that the mounting screws are not over-torqued. An over-tightened machine screw and standard machine nut will put too much compression force at the mounting hole of a Plexiglas window, greatly increasing the potential for a crack. The thin sheet-metal nuts will strip out if too much torque is applied to the mounting screw.*

I want to stress a very important point: NEVER, never tighten, loosen or attempt to remove a mounting screw in a frameless window after the PRC sealer has cured. You will be cursed with a stress riser (talked about last month) with resulting crack potential.

If you have a leak at a countersunk screw in a seasoned frameless window installation, here's a trick that will often seal the leaking

screw without the risky attempt of trying to retighten it. I take clear or white candle wax and aggressively rub it into the flush head of the screw from all directions, then use a heat gun to melt the wax into the leaking screw. This has worked for me, so far.

On a frameless installation with an alcohol spray bar mounted at the base of the windshield structural frame, you need to consider that the manifold feed pipe and associated mounting clamps are mounted through the structural mounting holes drilled at the edge of the window. Never disturb these components once the sealer cures, as doing so can start a crack. We've seen this happen more than once.

#### CLEANUP IS UNAVOIDABLE

If LP Aero green sealer was used, take a paint stick and sand a 45° bevel at both ends. Use the beveled stick to scrape the surplus sealer off the edge of the outer skin windshield joint. It will come off easily.

To clean up the obnoxious PRC sealer, take a bondo spreader or the beveled paint stick and scrape off as much of the sealer as possible from both inner and outer surfaces of the window. Then remove the masking tape, which takes most of the remaining PRC sealer with it.

Any remaining sealer can be removed with alcohol and cheap automotive carpet. That's right, carpet. Rags are too finely woven and quickly load up with PRC sealer. Carpet is a lot faster!

*And don't forget to clean your tools. We use lacquer thinner for this. Be careful, some plastic screwdriver handles will be damaged by lacquer thinner.*

Before the PRC sealer sets up, cut down the screw shanks on the inside until two threads are showing free of the nuts. Don't leave any sharp edges. Use a small round grinding stone to knock off sharp corners. Then immediately install the thin metal inside-window trim strips. It is important to do this while the PRC sealer is still fluid, just in case a tab must be moved.

If you choose Beech's original method of installing a framed window with rivets, a fluid sealer must be used, i.e. PRC or RTV silicon. And don't forget to put sealer on the shank of the rivets as they are being installed.

Some of you are probably wondering why I haven't until now mentioned the use of RTV or silicon rubber as a sealer for these windows. The reality of the technology is that silicon is degraded by sunlight. Even though it's covered by the outer flange of the mounting frame and trim, sunlight lenses behind the frame and attacks the silicon sealer.

If you plan to use silicon, use Dow Corning 732 silicon that doesn't cause corrosion in aluminum. Other types can lead to corrosion.

#### • CENTER-OPENING WINDOWS

The actual removal, trimming and installation of standard as well as enhanced-thickness windows is very similar to the processes used to install undrilled windows in their retaining frames. But, of course, there are a couple of exceptions.

First, these window assemblies are secured to the airframe at the top by a piano hinge with a full-length stainless steel wire holding the two halves of the piano hinge together. This wire must be pulled out to remove these windows. Spray the hinge with penetrating oil to allow it to pull out more easily. ACF 50 or Corrosion X work well.

Second, the window frame halves are held together with flush 3/32-inch rivets that can be removed with a #40 drill. It is not necessary to remove the rivets that hold the piano hinge to the top of this window frame because one can easily remove and install the window with the top row of rivets in place. All other removal and cleanup is the same as with the three front windows.

Third, these window frames are quite flimsy, and an ill-formed window will deform the frame, resulting in an ill-fitting installation. Always hold the new window in the window opening of the fuselage and check for compatibility of contour. If it's off, the assembled window and frame assembly will be off. Order



another window! We stick with LP Aero or Beryl D'Shannon and have had great luck so far.

Fourth, you should definitely paint the inner half of the frame while the Plexiglas window is removed. It is really difficult to mask and paint the window frame once that window is installed.



Be careful to apply PRC sealer to only the outer part of the opening window frame. Proper masking is also a must.

Finally, if thicker-milled windows are being installed, be very careful not to get sealer on the inner milled surface of the new window. Apply sealer only to the backside of the outer frame. The whole idea here is to not allow any oozing sealer to become trapped between the very inaccessible edges of the inner frame and the inner corner of the milled window edge. Mask the window the same way as described for the front three windows.

The best way to install the flush 3/32-inch rivets securing the opening window frame halves is to use a rivet squeezer. The fancy professional one is great, but the home-made vice grip version will do the job (photo on page 8821).

As many of you know, these center-opening windows are notorious for air and water leaks, even though you may have installed new rubber window seals. The problem is a misfit between the window and the airframe window opening.

Very few people know that the inner flange of this fuselage opening is designed to be adjusted to fit the precise contour of these opening windows. Adjusting the contour of this inner flange is easily accomplished by using a mallet and a leather-tipped wood drift. I know it sounds brutal, but it works. Do open

the window before you start adjusting the frame with the mallet. (One of my guys once forgot this step, and we ended up buying a new window.)

Use a business card to check for closure between the *new* seal and the opening window assembly. Note the word "new." New seal equals cheap insurance. The true test of the seal of these windows is a garden hose to check for water leaks and a test flight to check for air leaks.

For the in-flight air-leak test procedure, take a three-foot piece of windshield wiper hose and, using it like a stethoscope, run one end along the seam with the other end in your ear when at cruise speed. You *will* find the leaks. (Someone else should be flying the airplane!)

## • FIXED REAR WINDOWS

Okay, the gravy train has arrived! Fixed rear windows are very easy to remove and install. Long third windows installed after the early '60s are easily removed by taking out the inner retainer angles and pushing the window inward.

Basically, the removal, cleanup and trimming technologies already discussed apply to these third windows. The same applies to the short triangle third windows, fixed nonopening center windows in 33 Series airplanes, and all third and fourth windows in 36 and 58 series airframes. The only difference is that this type of window is held in with either a formed inner frame or four separate formed edge strips that are secured with through-the-airframe rivets.

It's quite acceptable to seal these windows with laborsaving LP Aero green sealer tape. Use a heat gun to flow the sealer during final assembly. I think you'll find that these aft windows are so installation-friendly that there's no need for me to expound any further.

## LEGAL MATTERS

In wrapping up this series on windows, we need to don our legal hats briefly and cover some installation do's and don'ts from the perspective of the FAA.

There is a section in Part 43 of the FARs

that covers owner-performed preventive maintenance. It clearly states that an owner is permitted to install and remove standard components, *provided this endeavor does not involve complex assembly or disassembly, riveting or welding*. This means that some Bonanza side windows can be replaced by an owner if they are identical to the original factory windows and are installed using screws as the mounting components. Long third windows, pilot side windows and cabin door windows can meet this requirement.

Since windshields are so critical to the aerodynamics of the airplane and center-opening windows require riveting, those installations require that the installer have a repairman's certificate or an airframe mechanic's license, or that the owner's work is supervised, inspected and signed off by a certificated mechanic.

All new windows, even if they are identical to the original Beech windows, require an FAA PMA approval (parts manufacturing authority), guaranteeing that materials and processes used in production meet FAA standards. Windows that deviate from the original design—due to thickness, mounting method or function—require an STC (supplemental type certificate). They must be installed by a repairman or an airframe mechanic and include a signed Form 337. All of these installations require a logbook entry and weight & balance change, if applicable.

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Well, that pretty much covers it all. I think by now you can see how something that seems so simple can actually be quite complex. I don't know about you, but I've had about all the complexity I can stand on one subject.

While I search for something less complicated to write about, I hope you enjoy installing your new windows. Fly safely!

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*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.*