Root Seal Installation

Intro:

Replacing the wing and stabilizer seals on a plane is not a small job, but it can be done one seal at a time if trying to fit the work into a busy flying schedule. It took us two days to replace one seal. I'm not an expert and made several mistakes on the first try due to a lack of information. I would expect it to take one day or less per seal for the next ones. What follows tries to capture what we learned.

Background:

The wing root seals have a complex cross section with a center root and a wide lip attached to that root. The root and lip essentially grasp the wing skin out-of-sight below the seal. The root and lip must be pushed through the gap between the wing skin and fuselage such that the lip flips back under the skin and the root is trapped between the edge of the skin and the side of the fuselage.

At some point before I owned my Baron, the original seal had been cut off, leaving the root and lip in place glued to the underside of the wing skin. This was a shortcut that is not uncommon but creates later problems. A new seal, after having the center root and lip removed, had been glued to the wing and fuselage using the 3M yellow contact cement. Over time the 3M cement degraded and since there was no root/lip to hold it in place, the replacement seal was torn away by the slipstream. On Barons/Bonanzas, the original seal is installed on the wing before the wing is fixed to the fuselage. I was not interested in removing my wings so the procedure below was done with the wings installed.

Tools and Materials:

- 3M Solvent Based Adhesive Remover (I did not try the new citrus based products)
- Terry cloth towels (white cotton shop towels)
- Paper towels
- 3 in. Blue masking tape
- Wide Gorilla tape
- Saran wrap
- Selection of small hooked picks
- Small long nose needle nose pliers
- Set of O-ring installation tools (probes of various lengths and curvatures with rounded tips for pushing the new seal into place)
- Nitrile disposable gloves (heavy duty from auto parts store)
- Eye protection
- Razor blade knife
- Small files
- Hair dryer
- Dremel tool

- Dremel tool flexible extension ($25 at Lowes)
- Dremel cutting disks (thin, about 1” in diameter)
- Dremel coarse sanding drums
- Plastic putty spatulas or plastic paint scrapers
- Dozen bricks or other solid flat objects for holding the seal in place while the adhesive cures
- Pure Toluene (if using Gee Bee silicone wing seals)
- Bottom halves of several soda cans to use for adhesive mixing cups

3M Adhesive Remover

O-Ring Tools, Knife, etc. 1

Seals:

There are two types of replacement seals: rubber, or silicone from Gee Bee products. I used the Gee Bee seals which are more flexible, easier to install, and are expected to last much longer. When you order the seals from Guy Ginbey you will receive (for a Baron upper wing seal for example):

- The seals
- Small jar of silicone (2.6 oz) adhesive
- Two very small vials of silicone adhesive catalyst
- Acid brushes (for applying the silicone adhesive)
- Pipette (for measuring the catalyst)

Silicone Adhesive and Catalyst Vials

There are no instructions in the kit, but Guy is generally available on short notice to answer questions by phone or email

RECOMMENDATION: Order extra silicone adhesive and double the provided amount of catalyst.

Gee Bee recommends laying down one coat of adhesive on the wing before installing the seal and then the second final coat under the seal against the wing after the seal is in place. Each requires at least 1/3rd or more of the 2.6 oz bottle. If you want to also use adhesive to bond the seal to the fuselage (I did) you will likely need slightly more than one bottle of adhesive.

When we applied the first coat of silicone adhesive the ambient temperature was in the low 70s. We used the recommended amount of catalyst (two small vials to one jar of silicone) but the silicone would not cure fully, even after 24 hours and even after using hair dryers to warm the adhesive on the wing. It was not clear whether the surface had been contaminated or we didn't have enough catalyst. On the next try, we used double the catalyst, and the applied silicone flashed (cured) in about an hour while the silicone mixed in the cup remained workable for at least two hours. This seemed perfect.

Installation Procedure

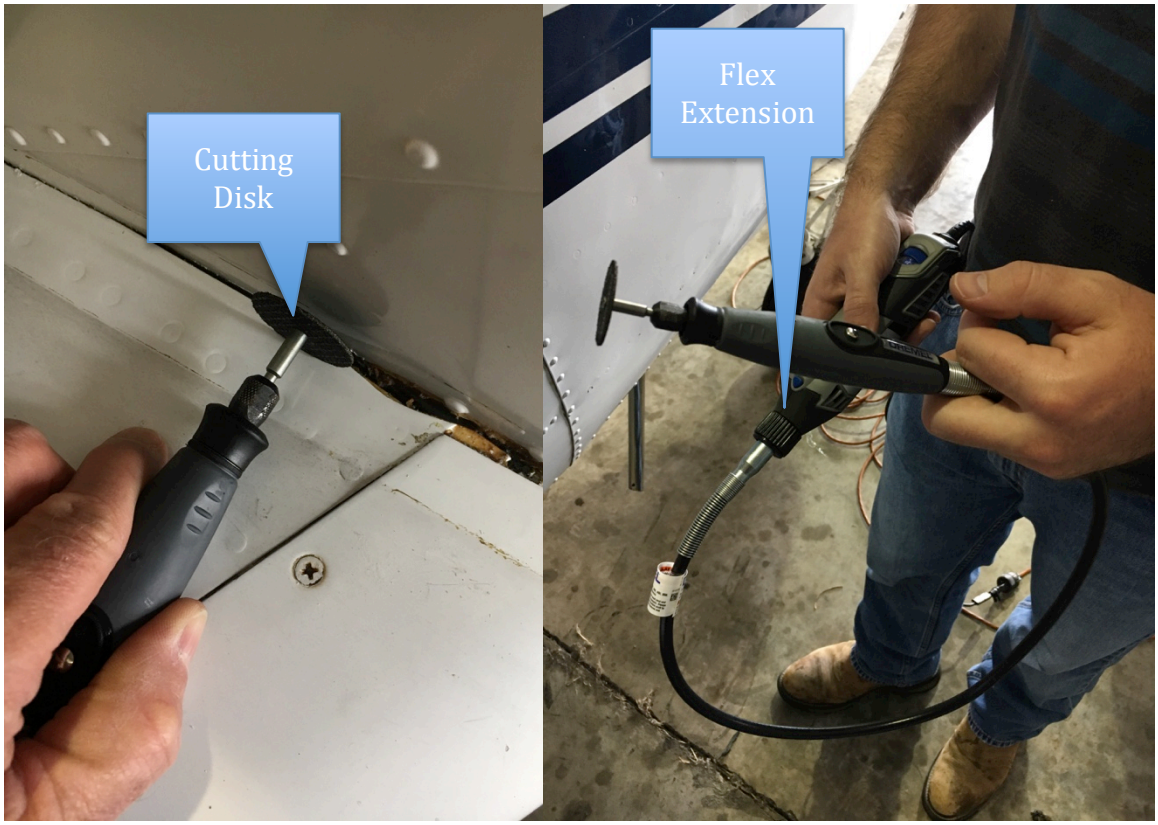
1. Remove old seal

If the old seal is still intact take a hooked probe and slide it under the wing side of the seal so the hook passes under the wing skin edge and between the old seal lip and wing skin. Pull the probe along the wing skin while attempting to break the bond between the old seal and the top wing surface and the old lip and the bottom of the wing surface. If the under-wing lip can be dislodged the lip and seal root can be pulled out from under the wing. This is important because if the old lip remains in place, the new lip will not seat properly locking the seal in place.

If the top seal breaks away from the root and lip, or has been cut (as was my experience) then the old lip must be fished out using the picks and probes. In some cases the old lip can be dislodged and allowed to fall into the wing. This can be a tedious process as you can imagine.

2. Widen the gap if needed – USE EYE PROTECTION

Normally there should be a gap of about 1/4” to 3/16” between the wing skin and the fuselage skin. However in many cases the gap is too small or nonexistent. If so, use the Dremel, Dremel flexible extension, and cutting disk to very carefully cut the wing skin back to increase the gap.



NOTE: DO NOT CUT DEEPLY, AS THERE CAN BE CABLES, WIRES, ETC. JUST BELOW THE SKIN, AND IN SOME PLACES THERE WILL BE A STRINGER. Also, do not cut close to any skin-rib rivets. These are countersunk in places and painted over and so are not obvious. Use a bright light to trace the line of rivets and make sure the cut can be made. For sections where a gap does not exist, or cannot be created, the root and lip can be cut off the wing seal and for those areas, the adhesive can be trusted to hold the seal in place. FINALLY, WHEN USING THE CUTTING DISK, BE VERY CAREFUL NOT TO LET IT TOUCH THE FUSELAGE SKIN OR THE UPSET FUSELAGE RIVETS. GO SLOWLY, TAKE CARE. The Dremel flexible extension is extremely easy to control. This is not difficult, but it requires care. Also make sure that someone doesn't inadvertently move the Dremel or tug on the cord as this can jerk the cutting head in your hand.

After completing the cuts, de-burr or smooth the edges with a file or the curved hook.

3. Test the gap and practice installing the seal

Cut a short section of seal, 1-2 inches. Insert the seal in various places along the wing to ensure the gap is wide enough and there are no obstructions. (see No. 11 below for installation details).

4. Remove the old adhesive – USE GLOVES and EYE PROTECTION

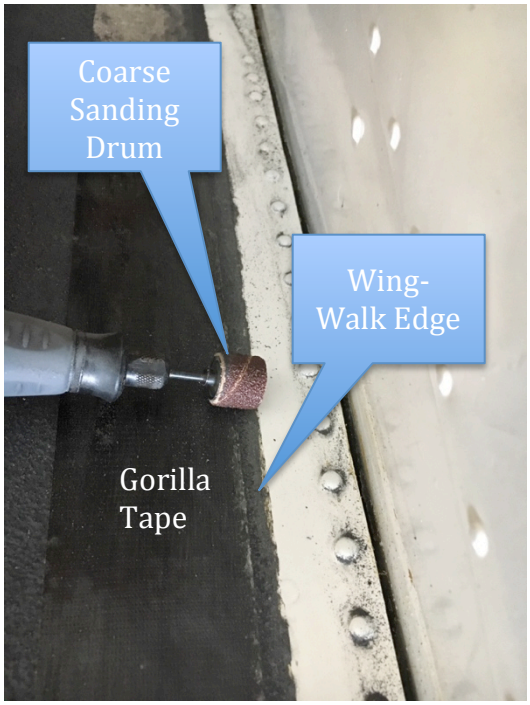
If the old adhesive is the typical 3M contact type, spray the area liberally with the 3M adhesive remover. Then quickly lay saran wrap over the area to slow evaporation. After 3-5 min. the old adhesive will easily wipe off using the cotton terry shop rag. If the old adhesive is silicone, rub with Toluene.

5. Mask the area

Cut a one-inch section of the new seal and remove the lip and part of the root. Hold it in place along the gap and apply masking tape to the wing at the edge of the seal. If you have wing-walk compound, use Gorilla tape instead of masking tape. It will adhere well even to the wing-walk.

6. Feather the wing-walk material

If the plane or wing has a heavy layer of wing-walk grit, use the Dremel, Dremel flexible extension, and a coarse sanding drum to smooth the wing-walk that will be under the new wing seal. The Dremel, set on a fairly low speed, will thin and smooth the material and also feather the edge so the wing seal will lie flat.



7. Prep the wing for the first coat of adhesive – USE GLOVES AND EYE PROTECTION

Wipe the wing surface down with TOLUENE ONLY. Do not use any citrus cleaners, or oil-based solvents such as brake cleaner or adhesive remover. Oil based removers can leave a residue that can interfere with the silicone bonding.

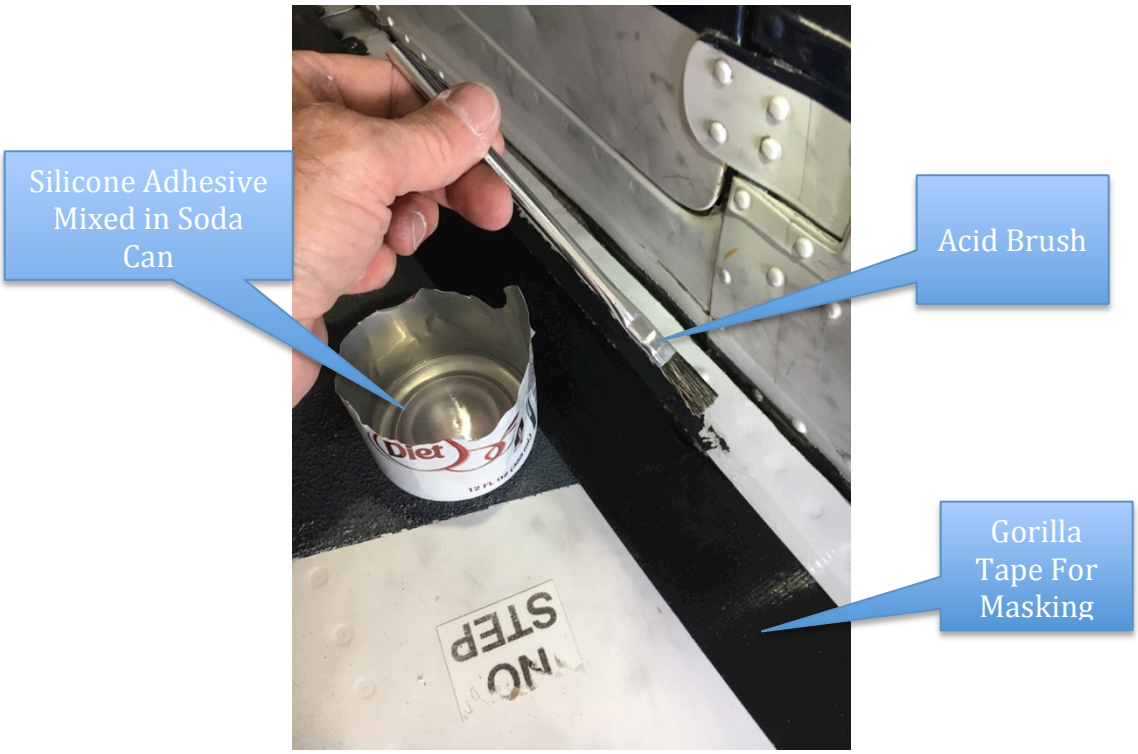
8. Mix the adhesive

On the Baron, and for the upper wing seal, 1/3 of the 2.6 oz bottle of silicone is sufficient for one coat. Pour 1/3 of the bottle into a clean soda can bottom. Add 1 and 1/3 vials of catalyst (this is twice the recommended amount) and mix thoroughly using the provided acid brush. Note: this amount of catalyst was perfect in our case – in the shade, in a hangar, with a temperature of 80 degrees. Our fist try, with half that catalyst and at 72 degrees, was not successful – the silicone adhesive did not cure fully. We were forced to remove the first coat using Toluene and start over.

NOTE: IF IT IS MUCH WARMER OR COLDER THAN 80 DEGREES, OR YOU ARE IN DIRECT SUNLIGHT PLEASE CONTACT GEE BEE (GUY GINBEY) REGARDING THE CORRECT AMOUNT OF CATALYST TO USE.

9. Apply the adhesive

Paint the adhesive onto the wing surface. It will flow on easily and should be the consistency of pancake syrup.



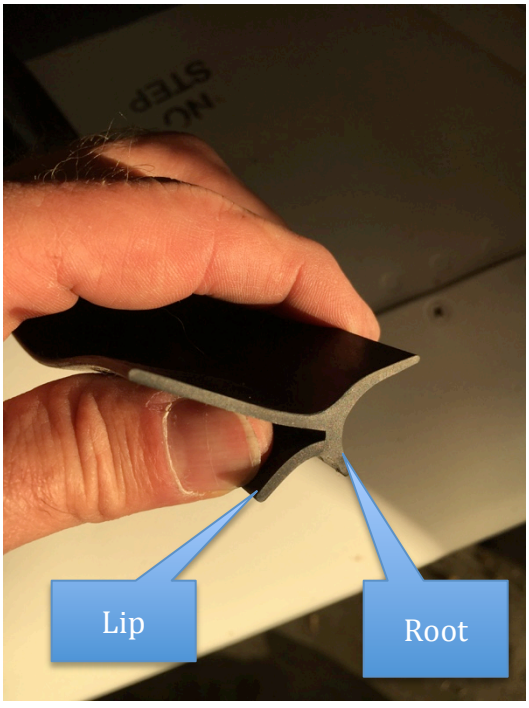
10. Let the adhesive dry/cure

After a few minutes the surface of the adhesive will begin to change from a gloss-clear appearance to a cloudy translucent appearance. Let it continue to cure (about an hour) until it is tack-free (test with your finger where the adhesive has run onto the masking tape). If you wish to speed the curing, apply a hair dryer (not a heat gun) slowly along the surface. Note: our one-hour cure time was at 80 degrees F and with a ration of catalyst of 4 vials to one bottle.

11. Install the wing seal – this works better with two people

Once you are certain the first coat of adhesive has cured, the wing seal can be installed. Start at the front of the plane – on the Baron this is about 2 ft. back from the leading edge, underneath the wing. It is important to start at the front as the wing seal will have to be stretched over the leading edge in order for it to conform to the compound curve. It is almost impossible to both pull on the seal and maneuver it into the gap while working above your head.

The cross section of the seal is very cleverly designed. The lip underneath is long enough that from above and looking down the wing seal can be twisted until the long lip slides into the gap. Then the root of the seal can be pushed into the gap behind the lip, either using your fingers, a plastic blunt paint scraper, or other rounded tool. If the gap is tight, Johnson's No More Tears baby shampoo can be used sparingly to lubricate the seal. The Gee Bee seals are very flexible and can be pushed through a very small gap. The seals are also somewhat fragile and so no sharp tools should be used to try to push them into the gap and IN NO CIRCUMSTANCES USE A SHARP TOOL ON THE OUTSIDE OF THE SEAL.

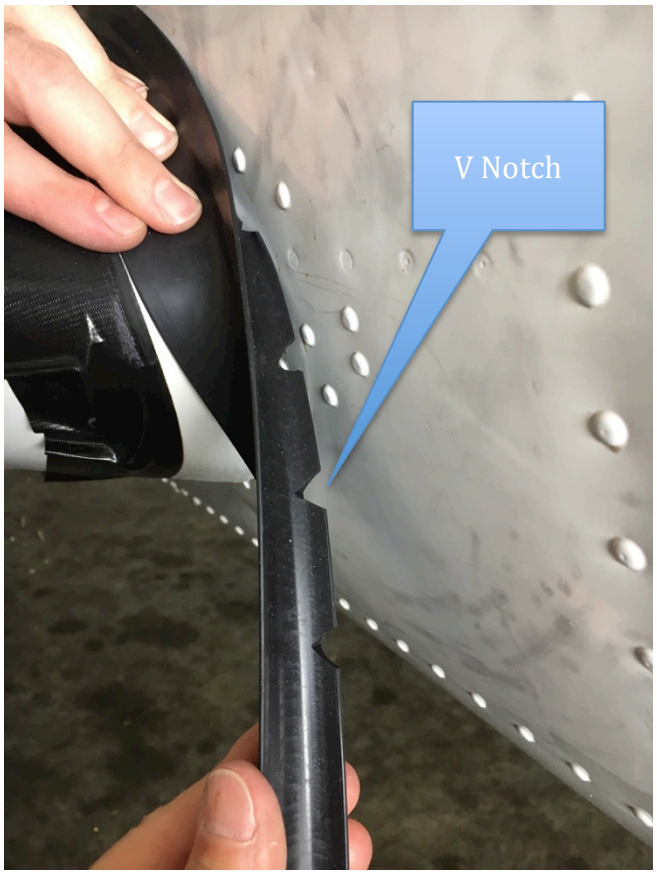


There will be places along the wing where there is no clearance below the wing skin for the seal lip. These include the wing bolt boxes, wherever there is a rib, and where there is a bulkhead penetration just below the wing skin. At each of these locations the lip and root will have to be VERY CAREFULLY trimmed using a razor.

NOTE: SILICONE SEALS ARE VERY SOFT – A RAZOR WILL GO THROUGH IT LIKE BUTTER. USE EXTREME CARE WHEN TRIMMING A SEAL.

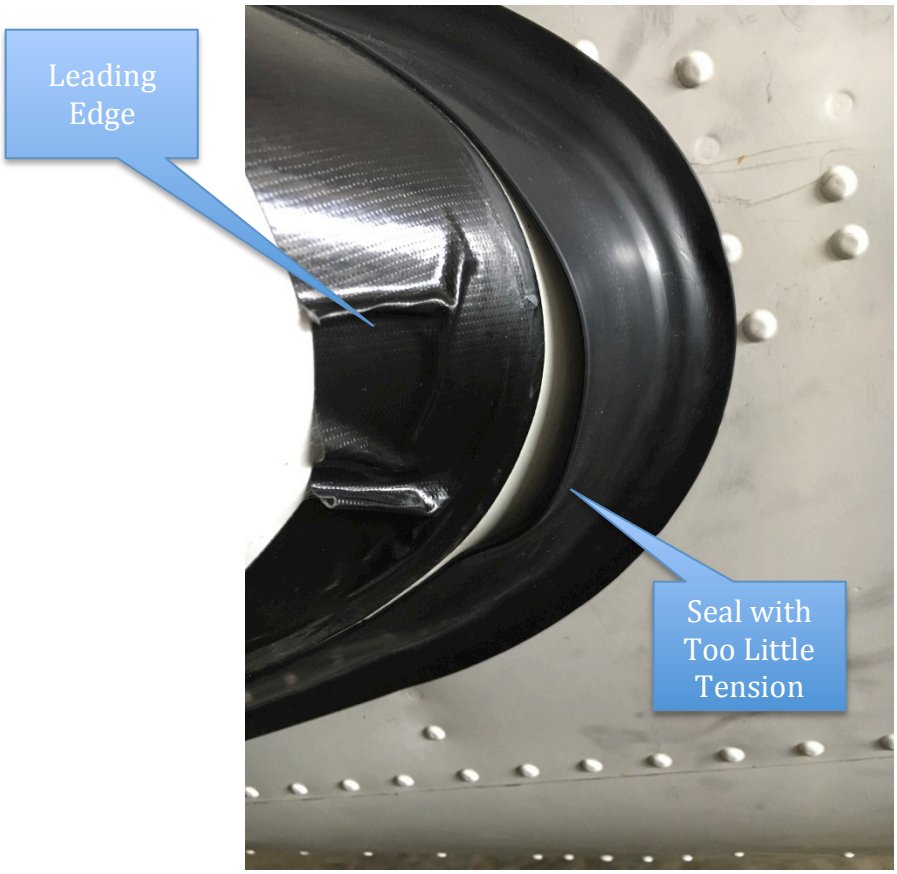
DO NOT TRY TO PRE-TRIM THE SEALS. As the seal is installed it will stretch and so the position of the bolt boxes for example cannot be predicted.

After having started at the front lower side of the wing, install the seal towards the leading edge. Once you reach the leading edge you may need to cut Vs out of the root/lip to allow the seal to curve around the leading edge without buckling.



On Barons, the leading edge of the wing inboard of the engine nacelle is removable to provide access for running wires and engine control cables from the cockpit to the engines. Before applying cement you will have to decide whether you wish to bond the wing seal to the leading edge, as this will make later removal of the leading edge difficult.

As you install the seal up around the leading edge, you will need to begin putting enough tension on the seal to stretch it smoothly over the compound curve. Pull just enough tension so that the seal, after the lip and root are inserted, lays smoothly and tightly over the leading edge. No heat should be necessary at normal temperatures. HOWEVER IN NO CASE SHOULD A HEAT GUN BE USED ON THE SILICONE SEALS - EVER. Continue installing the seal back along the top of the wing towards the trailing edge. After a couple of feet or so additional tension will not be necessary to hold the seal tight around the leading edge.



After the seal is installed, inspect it for areas where the seal lip may not have fully engaged. The top of the seal should run straight, although it will tend to rise up slightly in the areas where there was no wing edge for the locking lip (bolt boxes, ribs, etc.). In these areas make sure the root is trimmed so that if the seal is held down, it will be aligned with the rest of the seal.

12. Clean the seal and seal surfaces

If Johnson's shampoo was used to lubricate the seal, wash under the seal with fresh water until all shampoo is gone. Then dry the seal surface and seal thoroughly using clean cloths and hair dryers.

13. Mix and apply the adhesive – this works better with two people

Make sure the Gorilla tape, hair dryer, and weights (bricks, cans or other) are at hand. Starting at the aft upper end, lift the seal with a paint scraper or other tool and push the brush with adhesive under the seal and wet the entire area. Build up a good layer around rivet heads or the wing-walk compound. Do a 6-8 inch stretch then take a cloth and wipe any excess adhesive that may have extruded out onto the masking tape (or Gorilla tape if you used that for masking). Then lay down a layer of Gorilla tape half over the seal and half over the wing masking. The idea is to pull the seal down tightly onto the wing surface. In our case this didn't work perfectly because some upset rivets wanted to lift the seal and the tape being used to pull it down would not adhere well as the silicone adhesive seemed to release the tape adhesive where it came in contact with the edge of the seal. Therefore we also placed weights along the top of the wing seal as we went. The combination of the tape and weights worked very well.

NOTE: DO NOT APPLY CEMENT AT THE WING BOLT BOXES (OR THE LEADING EDGE IF YOU INTEND TO REMOVE IT LATER AT SOME POINT). If you apply adhesive to the wing bolt box you will not be able to install the bolt covers later.

If there are areas where the lip was removed and the center of the seal does not rest entirely flush down against the wing, apply pressure and use the hair dryer to try to cure the adhesive while the seal is held in the proper place.

Once you work your way around to the underside, you will no longer be able to use weights to hold the seal down securely. We relied on the tape, hand pressure, and the hair dryer and so tried to apply and cure a short section at a time. The additional catalyst is important (we were using a ration of 4 vials per bottle of silicone at 80 degrees) – with that the adhesive became quite tacky in only a couple of minutes.

14. Curing and clean up

Let the adhesive cure for 12-18 hours (we waited 18). Carefully remove the upper tape by pulling away from the spine of the seal, back on itself, without pulling upward. The Gorilla tape separates cleanly from both the seal and the wing surface – we had no problems. If it seems difficult to remove you can heat it with the hair dryer.

If there are any areas where the adhesive spread or spilled, they can be cleaned up with the Toluene (USE GLOVES AND EYE PROTECTION, AND MAKE SURE THE AREA IS WELL VENTILATED).

If there are any areas where the seal did not attach, mix additional adhesive, lift the seal, reapply, re-tape, and replace hold down weights.

15. Fuselage seal

The upper wing of the seal will rest tightly against the fuselage. While it may not be necessary, this portion of the seal can be glued just as the seal on the wing surface. I think this is a particularly good idea at the wing bolt boxes and around the leading edge as it provides additional security.