Eliminating Fear of Composites in Your Metal Kit

The dos and don'ts

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Description

- Many metal builders are using techniques from fellow builders or from the kit manufacturer that are not the best approach resulting in unnecessary added weight and/or coating failure.
- Further, builder groups perpetuate the practice of flawed techniques claiming success. But, we let the data speak for itself.
- We will cover the dos and don’ts and helpful techniques of applying composite laminate to a metal surface for a lightweight and lasting finish.

The Good, Bad & Ugly

We will talk about the bad & ugly first

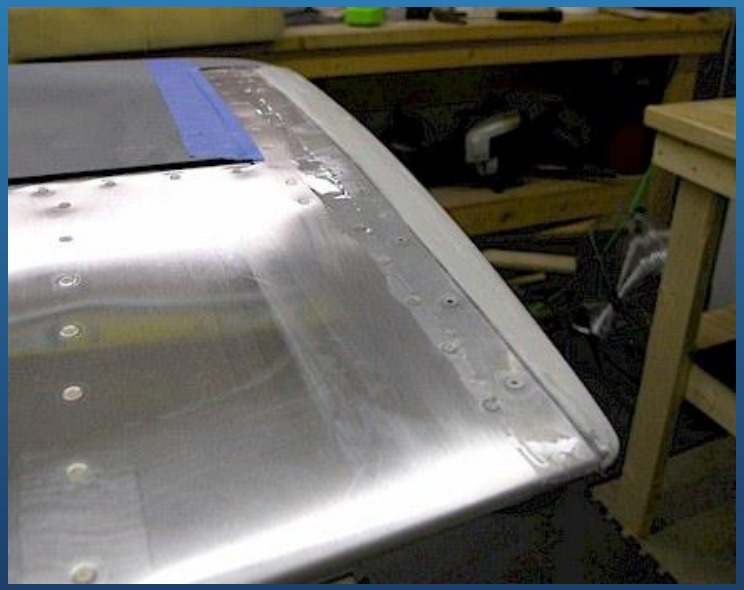
SmittysRV.com Fiberglass 101

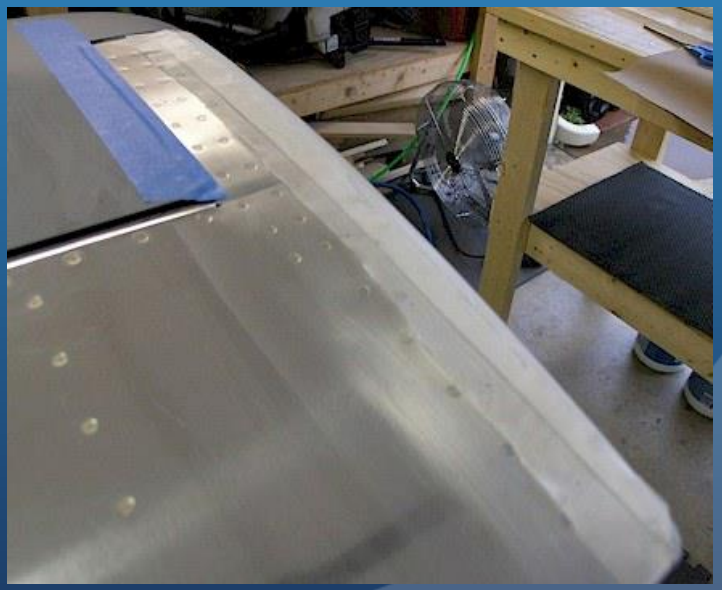
- What not to use:
  - West System Epoxy (unless nonstructural as epoxy has T_g of only 130F)
  - Acetone / Lacquer thinner (possible 5% recycled = bond breakers)
  - Do not use WEST System 410 Microlight as it is a plastic sphere
    - Expands in solar heat if under a dark color

SmittysRV.com Cont.

- “First I scuffed up the surface of the aluminum and fiberglass tips with a scotchbrite pad where the fiberglass tip and aluminum meet and then cleaned it off with lacquer thinner. Then I cut a thin strip of 1.5 oz lightweight fiberglass cloth and layed it over junction between the aluminum and the fiberglass tip.”

- The interface between the fiberglass and the metal will eventually crack





SmittysRV.dot com Cont.

- Do not use polyester or vinyl ester putties /fillers directly over epoxy substrate
  - The amines in the epoxy frustrate the cure
  - Can use over urethane primed surfaces such as PPG K36 or similar
- “Then I used a plastic spreader and put an initial thin coat over the resined area.” Yet the photo on the right shows putty applied over primer.

SmittysRV.com Cont.

- Why build in aluminum and want your plane to look like a composite!?

Failed Laminates

Failed Laminates Cont.

Problems with Fasteners

- Mark Beard's Beatiful RV-8

Problems with Fasteners Cont.

- Fasteners pushing through on aft side of canopy

The Good, Bad & Ugly

All good news from here!

The Best Alternatives

- What to use:
  - Recommend ProSet, MGS or PTM&W epoxies
    - Higher temperature tolerance (heat distortion temp or T_g)
    - These epoxies have T_g around 180F
  - +95% isopropyl alcohol (medical and laboratory regulated)
  - Paper towels not cloth rags to eliminate the risk of surface contamination
  - Denatured alcohol for clean up (works very well on epoxy resins)
  - Bonding enhancements to Aluminum surface:
    - Klean-Strip Concrete and Metal Prep from Home Depot
    - 3M Surface Pre-Treatment AC-130-2

Proper Aluminum Prep

- Abrade with 80 or 180 grit sand paper
- Etch with Phosphoric Acid (Klean Strip concrete & metal prep)
  - Dilute 10:1 water for aluminum surfaces
  - 4 minutes with plastic bristle brush (Scotch pad rounds off abraded profile or ‘tooth’
- Rinse well with fresh water and dry quickly
  - Use paper towels not cloth rags (bond breaker)
- Apply 3M AC-130 (Sky Geek has it in stock) IAW technical data sheet
- Let air dry in accordance with instructions
  - Go to lunch or dinner
- Apply resin and fiberglass using common practices

Windshield Installation

- Bonded vs Fastened Windshield
  - Van's Aircraft plans and videos for windshield installation steps through the process of fastening with screws and rivets
  - The leading edge of the canopy utilizes a laminated fiberglass fairing to cover where it meets the fuselage
  - The risk of fiber glassing over the fasteners is seeing the fastener another day as seen in previous photos
- DO NOT FIBERGLASS OVER FASTENERS!!
  - Fasteners will eventually show through
  - Fasteners, like Clecos, may be used to hold windshield or canopy in place while adhesive is curing, then remove them

Windshield Installation

- Initial bonding of windshield
  - Abrade the contact area of the aluminum and steel roll bar
  - Cut back the inside protective film with scissors
  - Sand the contact area of the acrylic with 80 grit about 1 inch from the trimmed edge
  - Wash all surfaces with 98% isopropyl and wipe dry with paper towels
  - Place windshield in place following best fitting and predrill for Clecoes
  - Etch the cowl boot bonding area of aluminum with 10:1 phosphoric acid (recommend plastic taped below the work area to prevent acid on other parts of aircraft)
  - Rinse well and QUICKLY dry with paper towels as oxide forms quickly
  - Treat etched surface with 3M AC-130
  - Apply adhesive to aluminum and steel roll bar (two pairs of hands here)
    - Apply just enough for a squeeze that results in a ¾ inch wide bond line
  - Cleco in place and let cure

Windshield Installation Cont

- Clecoes & clamping windshield
  - Cleco along trimmed edge onto cowl boot
  - Clamp along tubing

Windshield Installation Cont

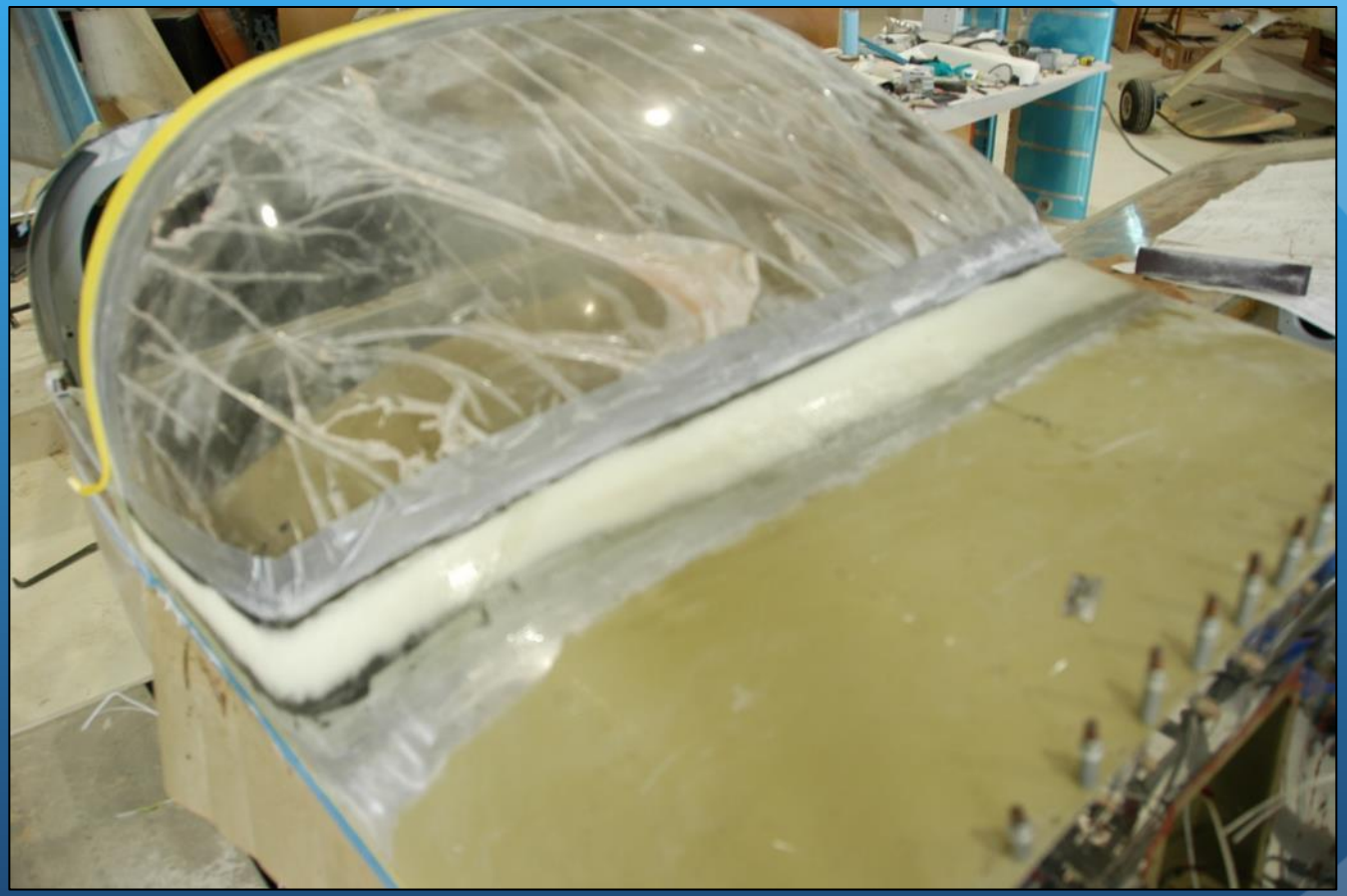
Peel ply applied over epoxy remove lightly sand and apply micro putty

Grind taper on edge and apply epoxy

Windshield Installation Cont

Teflon tape over canopy, laminate and peel ply

Windshield Installation Cont.



Sand micro to contour and apply one layer of epoxy / glass

Windshield Installation Cont.

Using masking tape directly over the roll bar and add one more to provide ¾ inch trim line. Trim edge near net and sand to finish edge. Dry micro fillet above roll bar to new flange and apply one ply of epoxy / glass.

Surface Prep Alternative

- For the cost conscience builder (read cheap)
  - Abrade the surface with 80 grit
  - Wipe the surface with +95% Isopropyl with a paper towel and dry with a paper towel.
  - Repeat with fresh paper towels until there is very little or no grey color on the paper towel used for drying indicating a clean surface
  - Mix epoxy resin and brush onto the abraded and cleaned bonding area surface
  - Using 80 grit sandpaper abrade the whole surface area mimicking wet sanding but having the epoxy resin there instead of water
  - This pulls any aluminum oxide into the resin and basically seals the surface from the local atmosphere so oxides cannot form allowing a tight bond of the subsequent laminate

Finishing Techniques

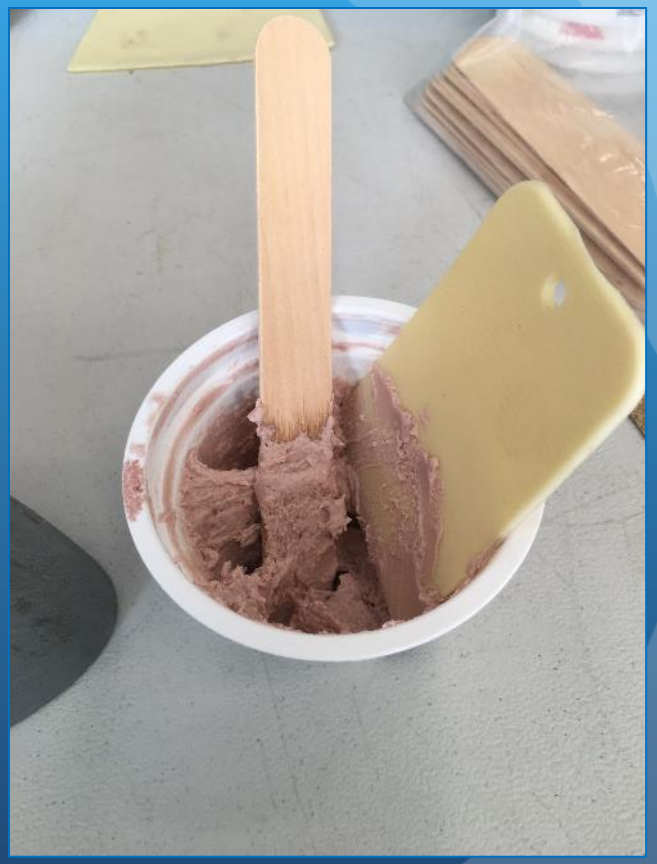
Simple rules for a great finish

Dry Micro Puddy Mix

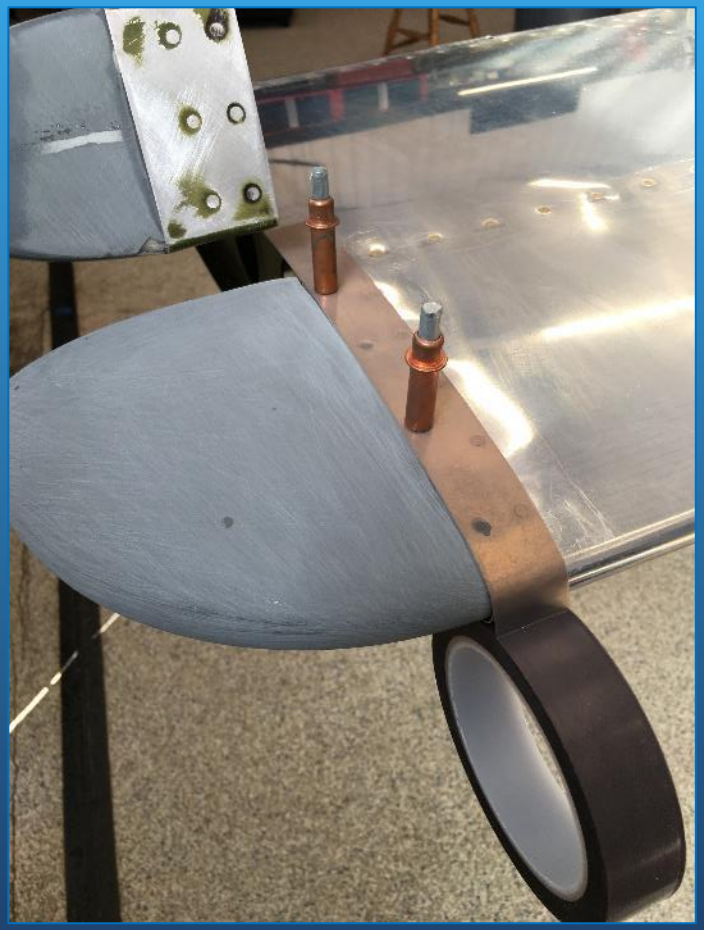
- Needed materials:
  - Epoxy resin Glass microspheres
  - Mixing cups
  - Tongue depressor(s)
- Mix small quantity of epoxy resin (mix thoroughly for ≥ 2 min)
- Add micro-balloon a little at a time with tongue depressor and keep stirring
- Continue adding balloons until peanut butter consistency

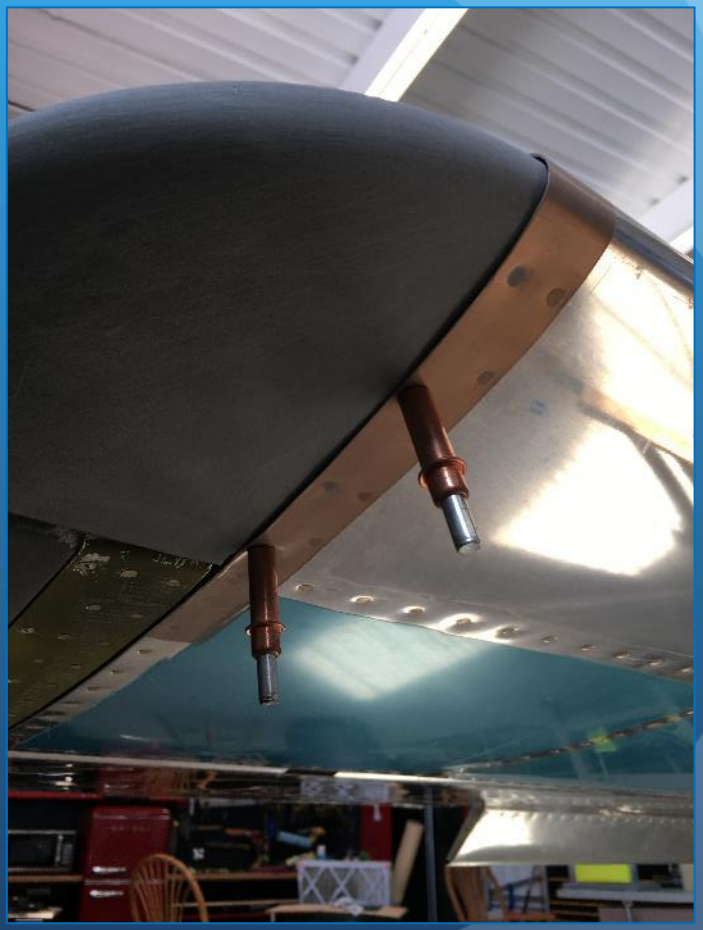
Dry Micro Mix Cont.

- Checking mix consistency:
  - Make peaks of micro by pulling up with tongue depressor
  - Tip of peak should stand up and not curl over
  - When getting close to this consistency add very little balloons at a time as it changes over quickly
  - Don’t want to have dry mix and have to add more epoxy



Epoxy Putty Approach



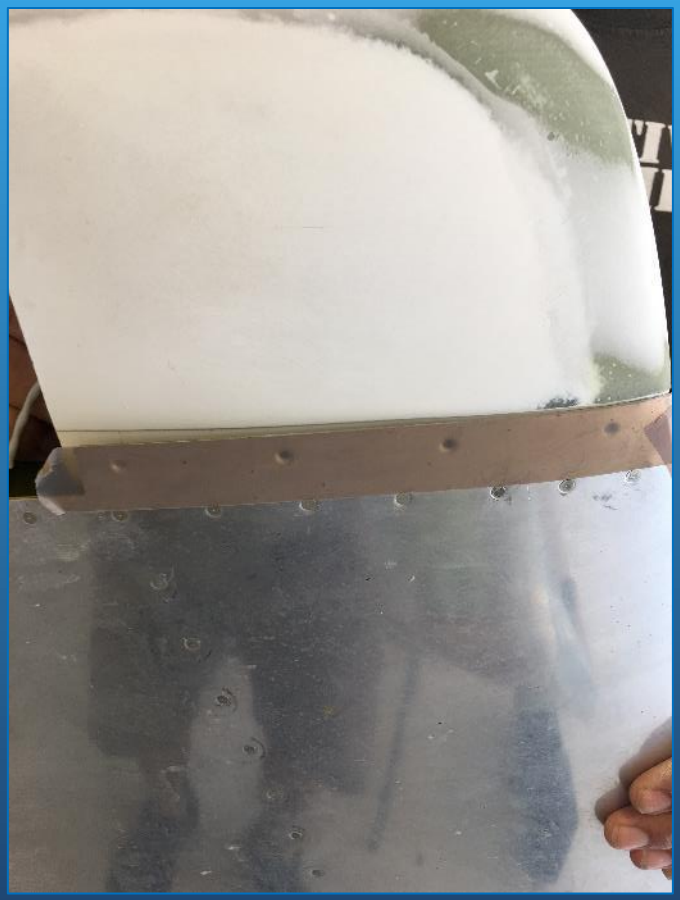


Epoxy Putty Approach

Multiple Steps Required

- 2nd Coat

Brad Berry's RV-7



Brad Berry's RV-7 Cont.

Preparing the Seam on Wing Tips

- Common for seam to be raised
  - Need to sand flush
  - There is a technique for this (see below)
  - Assured you will go through gel coat, not a problem
  - Voids will be exposed as a result
- Sand with 80 grit paper & flexible sanding pad
  - Sand to the edges
  - Sand at plus-minus 45^0
  - Don’t hesitate to expose voids
  - Pick off the ‘skin’ over hidden void (could blister later)

Sanding on Seam ± 45⁰

Sand to the edge using a proper sanding pad.

RV-10 Wingtip Bubble Buster

Voids

Pick

‘Popped Bubbles’

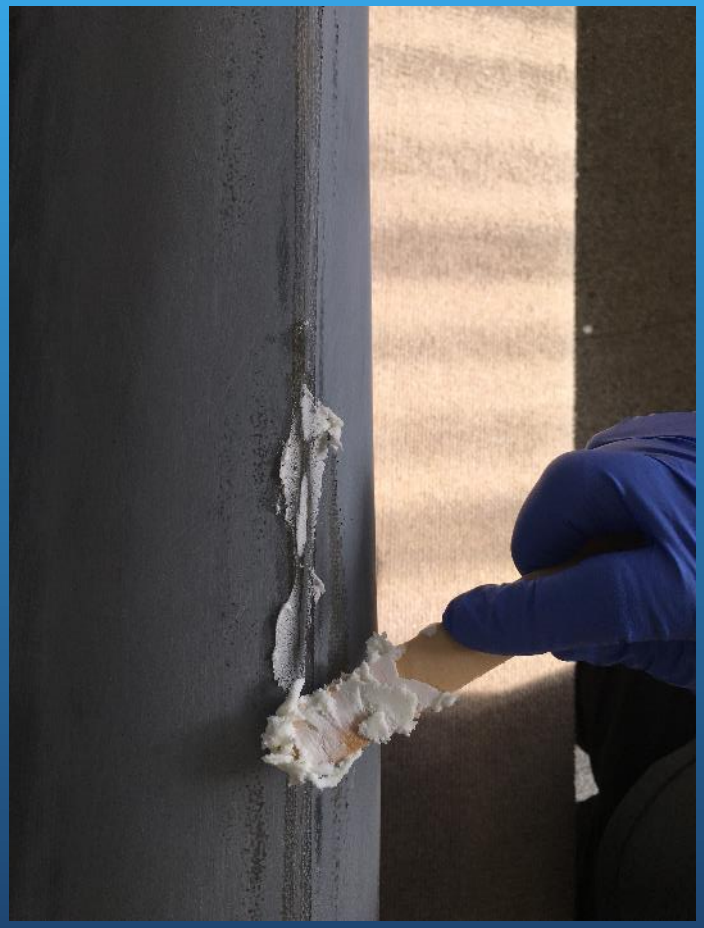
Picked voids have sharp edges and need to be dressed

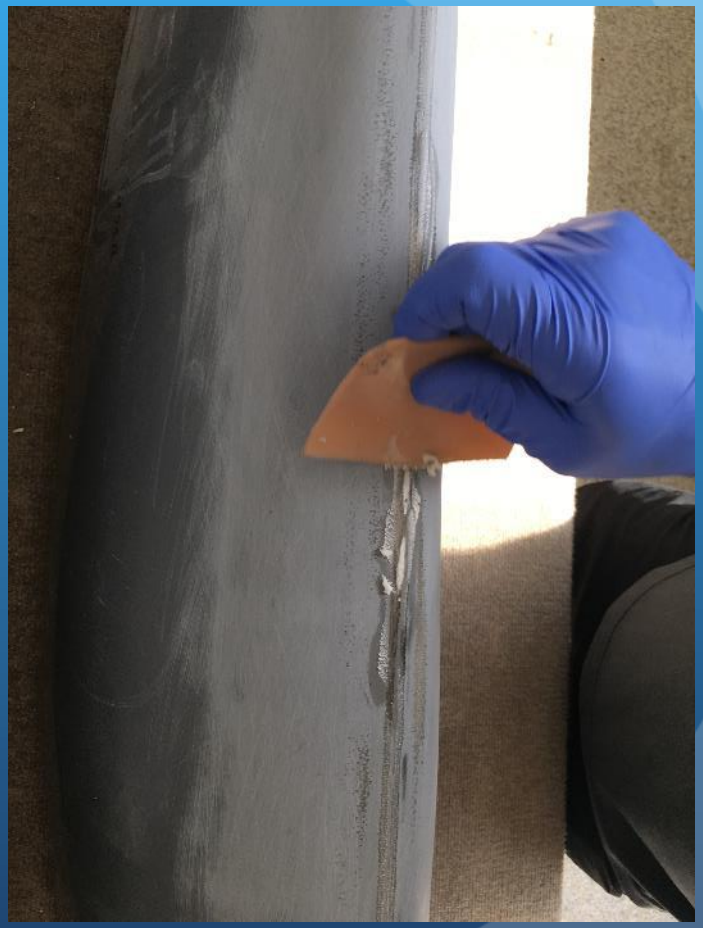
Bubble Busters Continued

Die Grinder
Or
Dremel Tool

GO EASY!!

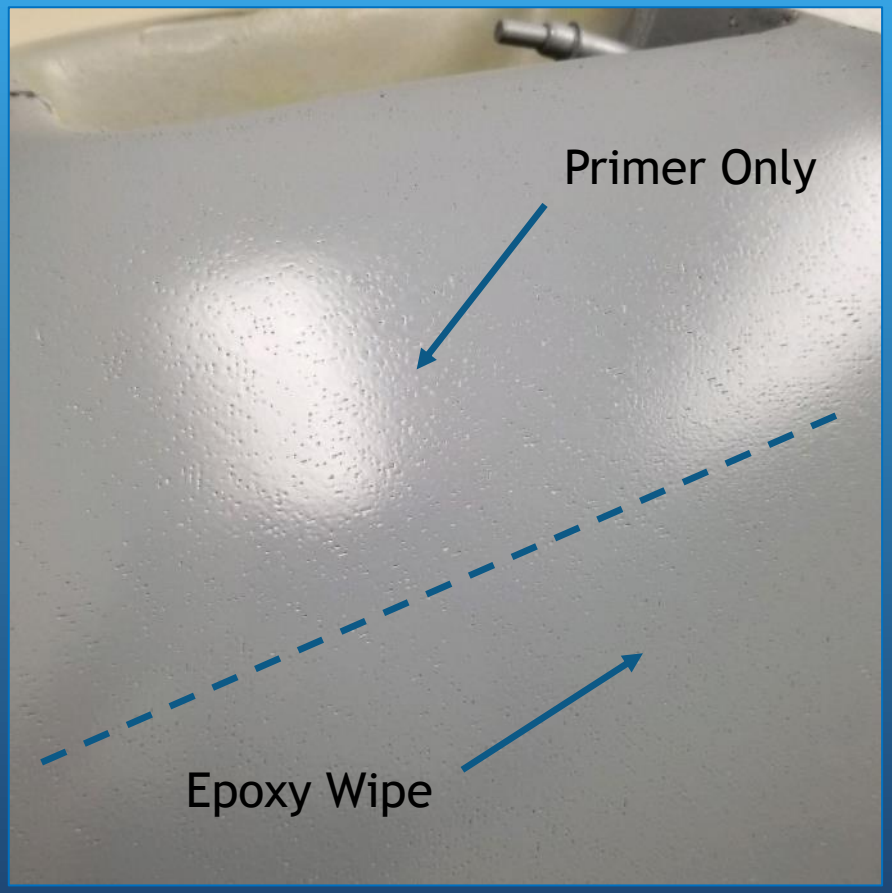
Filling Seam Voids with Micro Putty





2nd Coat Wipe of Micro

Pinhole Busters



- Common to have pinholes in composite parts
- Need to fill pinholes prior to painting as primer alone will not fill them (even high build primers)
- Use ‘epoxy wipe’ to fill pinholes
- Use Loehle Wonder-Fil to fill pinholes

Epoxy Wipe

- Sand and clean the surface (be careful using compressed air that may contain water and oil)
- Wipe with 98% isopropyl on paper towel and then dry with clean paper towel
- Mix and wipe neat epoxy with rubber edge squeegee
- !!DO NOT THIN WITH ALCOHOL!!
- Let cure and sand
- Check for any remaining pinholes
- Repeat as needed
- HINT: only as much as needed

Loehle Wonder-Fil

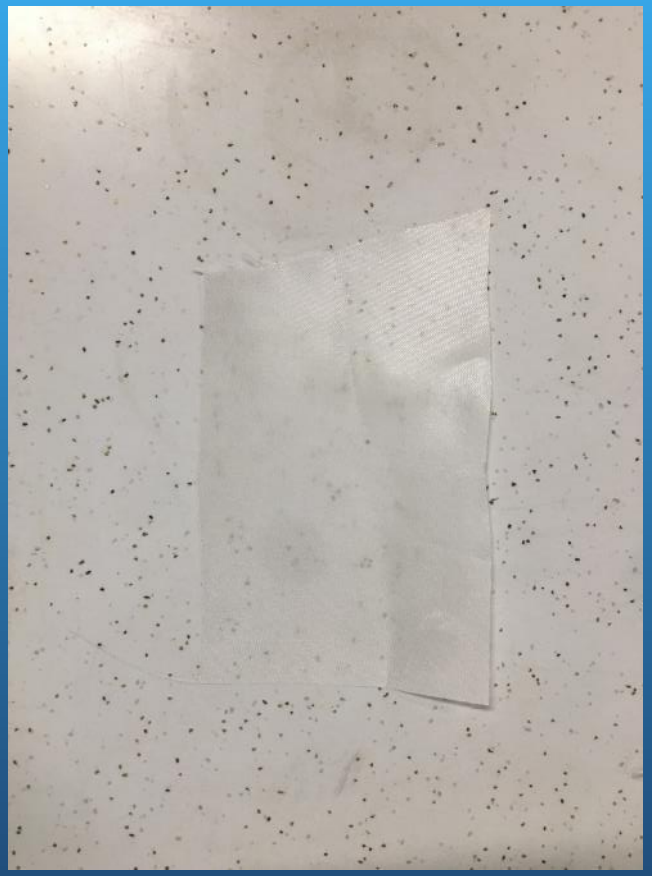
- Suitable for fiberglass, carbon fiber or sanding scratches on wood
- Quick wipe on
- Wait 15 minutes
- Wipe off
- Disappears with the next sprayed coating layer

Composite Wing & Stabilizer Tips

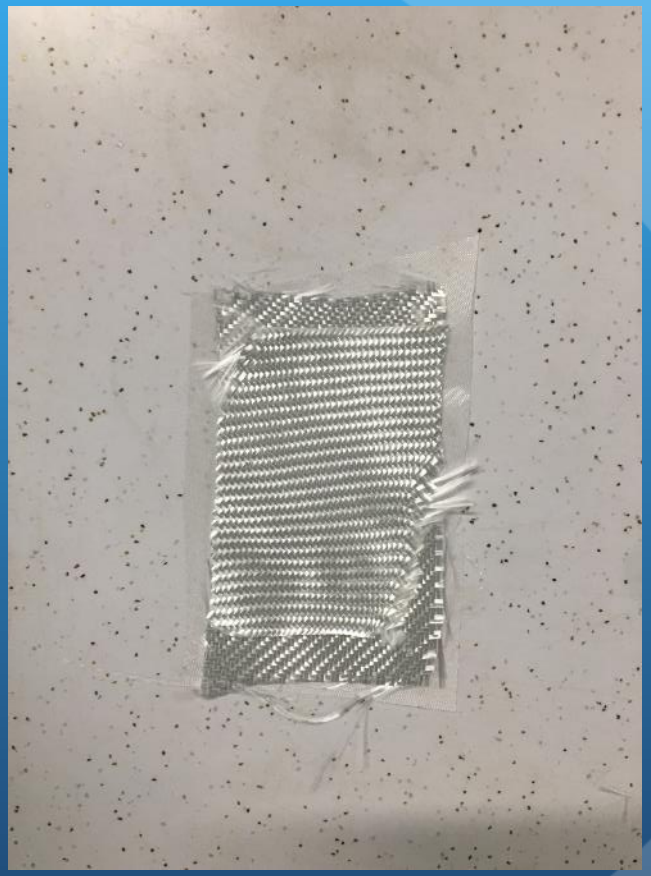
Fillet Fabrication

- Needed:
  - Mold released surface (glass or Formica)
  - Peel ply
  - 7725 glass fabric (Rutan fabric)
  - Resin
- Peel ply against flat released surface
- Three plies of cloth wetted out with resin
- Peel ply on top

Fillet Fabrication Cont.

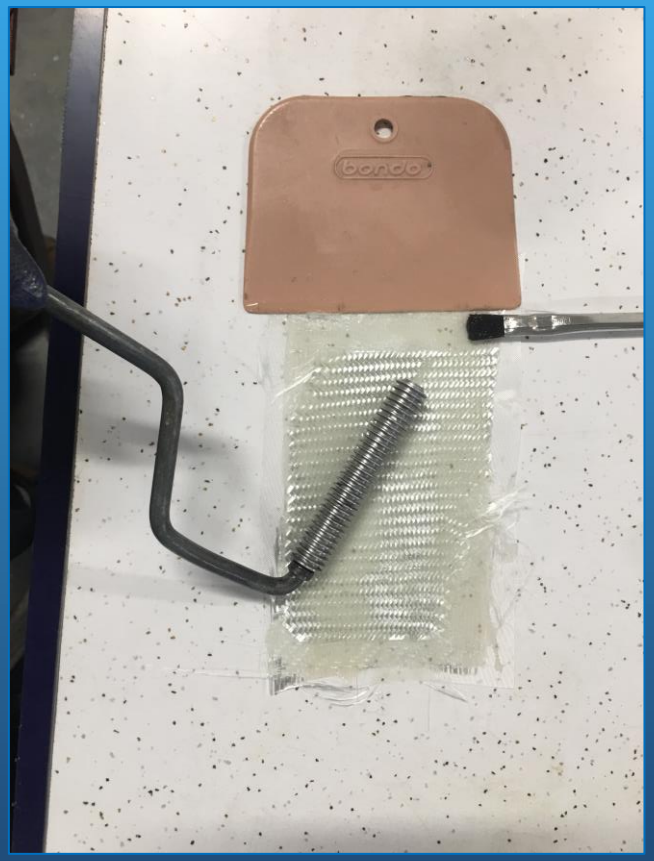


Peel Ply



7725 Fabric over peel ply

Fillet Fabrication Cont.



Wet out with epoxy resin and outer layer of peel ply. Consolidate with roller or spreader.

Fillet Fabrication Cont.

Teflon tape on for flange

3 Plies glass over tape

Fillet Fabrication Cont.

Flange fabricated

Flange trimmed & set on fillet

Fillet Fabrication Cont.

Bonded flange to fillet

Fillet inserted & glued in place with epoxy

No No's

- Rags (read bond breaker)
  - Cloth rags are not used no matter how often they are washed or washed with TSP
  - Preferred are the Scott Blue Shop towel or the household paper towel
- Fabric Handling – not handle with bare hands
- Shop heating – I do not recommend kerosene heat as it puts contaminants in the air and so on the surface of your work
- Diluents in resin – some have used alcohols to thin out epoxy resin – DON'T! Keep your resins at temperatures in the 80's or 90's. Use a heat box if you have to (wooden box with light bulb & thermostat).
- Open Fabric storage – keep your fabric in a bag to be free of dust and moisture: preserves sizing
- Open Resin storage – epoxies last a long time when stored cool & dry
- Solvent wiping / cleaning – many like to clean with acetone or MEK; these are potential bond breakers. I recommend isopropyl alcohol as it does not have any recycled additives due to the medical requirements. Try to get greater than 95%.
- Additives (fumed silica aka cabosil, micro-balloons, flox) – cabosil at less than 2% for thixing and balloons or flox as required. Cabosil has no strength. Additives are introduced after resin & hardener is thoroughly mixed

Source List

- Teflon Tape: CS Hyde Company, 1” wide Skived PTFE Part# 15-2A, 2” wide Skived PTFE Part# 15-2A (found it on Amazon recently)
- Airtech Flashbreaker Tape – Airtech (www.airtechonline.com) or Freeman Supply (www.**freemansupply**.com)
- Scissors: Kretzer Finny 74525 10.0” – Sewn Products Equipment Co., PO Box 357, Jefferson, GA 30549. www.sewnproducts.com, (706) 367-2755
- Wheel Cutters: Olfa Rotary Cutter sold at many fabric stores
- Fiberglass Rollers: E S Manufacturing, St Petersburg, FL (www.esmfg.com)
- Tongue Depressors: non-sterile – any online medical supply
- Resins: Aircraft Spruce or Composite Envisions
- Fabric, resins and vacuum bag supplies: Composite Envision (www.compositeenvisions.com)
- Loehle Coatings: https://loehlecoatings.com, ph: 850-482-4141