

# Composites Techniques for the RV Builder

The dos and don'ts  
Sun N Fun April 7 2022

Michael Bergen  
Custom Technologies LLC  
443.597.3720  
dmbergen@customtechllc.com  
www.customtechllc.com

Richard Kaczmarek  
Aviation Composites LLC  
937.243.7303  
aviationcomposites2018@gmail.com  
www.aviationcomposites.net

# Description

- Many builders are using antiquated body shop techniques to ready their composite airframes and pieces for paint resulting in unnecessary added weight and potential coating failure.
- Further, builder groups perpetuate the practice of flawed techniques claiming success.
- The dos and don'ts and helpful techniques of readying composite surface for paint application will be presented to provide a lightweight and lasting finish.

# Aerodynamic Fairing Putty

- No Bondo directly on epoxy substrate!
  - Suitable on polyurethane primer if needed
- No spot glaze putty (reddish layer)



# 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

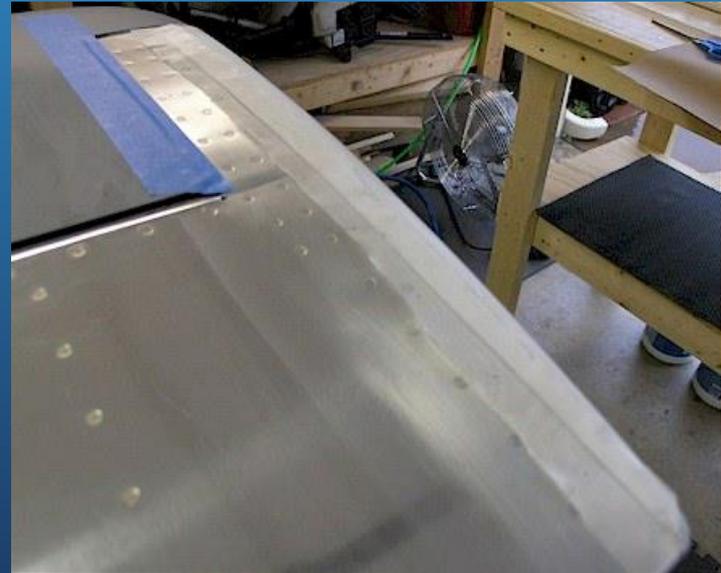
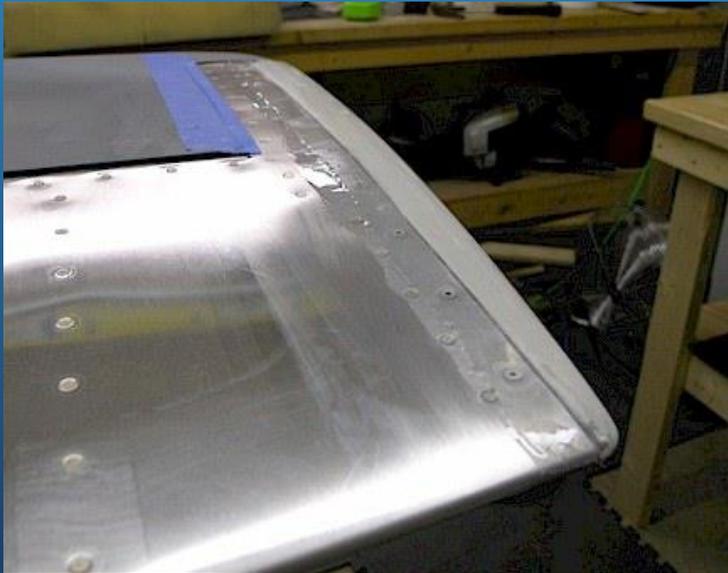
# SmittysRV.com Cont.

- What to use:
  - Recommend ProSet, MGS or PTM&W epoxy
    - Higher temperature tolerance (heat distortion temp or  $T_g$ )
    - These epoxies have  $T_g$  around 180F
  - +95% isopropyl alcohol (medical and laboratory regulated)



# 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!?



# Proper Aluminum Prep

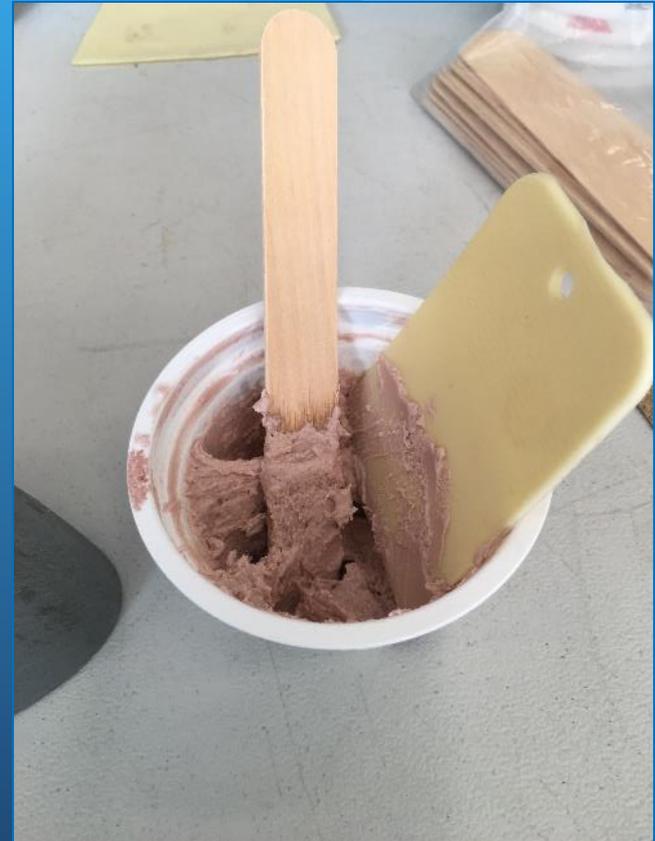
- Etch with Phosphoric Acid (KleanStrip concrete & metal prep at Home Depot)
  - Dilute 10:1 water for aluminum surfaces
  - 4 minutes with Scotch pad
- Rinse well with fresh water and dry quickly
  - Use paper towels not cloth rags (bond breaker)
- Apply 3M AC-130 (Sky Geek has it in stock)
- Let air dry in accordance with instructions
  - Go to lunch or dinner
- Apply resin and fiberglass using common practices

# Dry Micro Mix

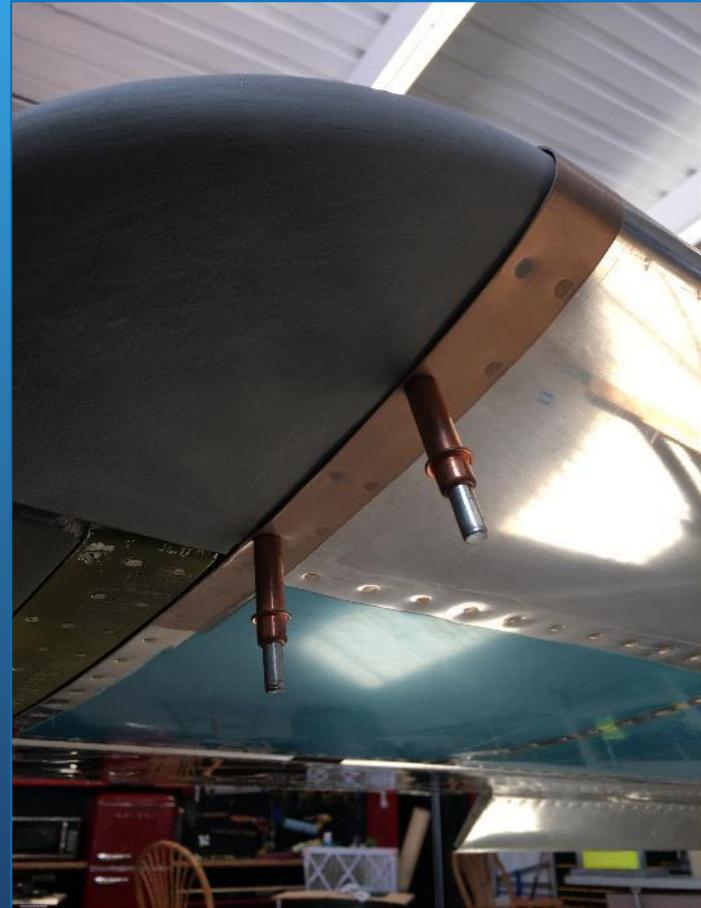
- Need materials:
  - Epoxy resin Glass microspheres
  - Mixing cups
  - Tongue depressor(s)
- Mix small quantity of epoxy resin (mix thoroughly for  $\geq 2$  min)
- Add micro-balloon a little at a time with tongue depressor and keep stirring
- Continue adding balloons until peanut butter consistency

# Dry Micro Mix Cont.

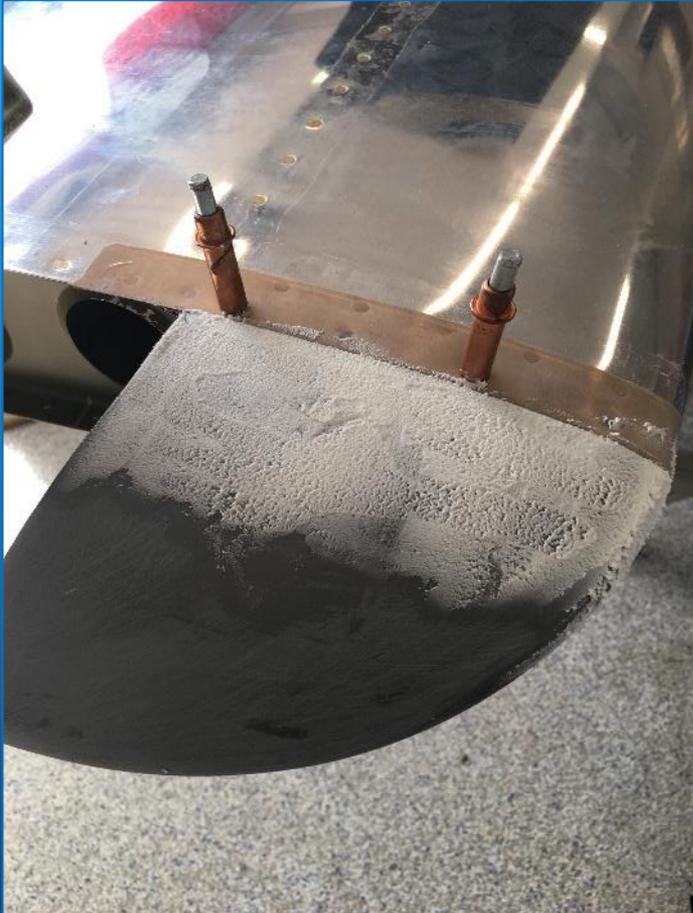
- Mix check consistency:
  - Make peaks of micro by pulling up with tongue depressor
  - Tip of peak should stand up and not curl over
  - When getting close to this consistency add very little balloons at a time as it changes over quickly
  - Don't want to have dry mix and have to add more epoxy



# Epoxy Putty Approach



# Epoxy Putty Approach



# Multiple Steps Required

- 2<sup>nd</sup> 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°
  - Don't hesitate to expose voids
  - Pick off the 'skin' over hidden void (could blister later)

# Sanding on Seam $\pm 45^\circ$



Sand to the edge using a proper sanding pad.

# RV-10 Wingtip Bubble Buster

Voids



Pick



# 'Popped Bubbles'

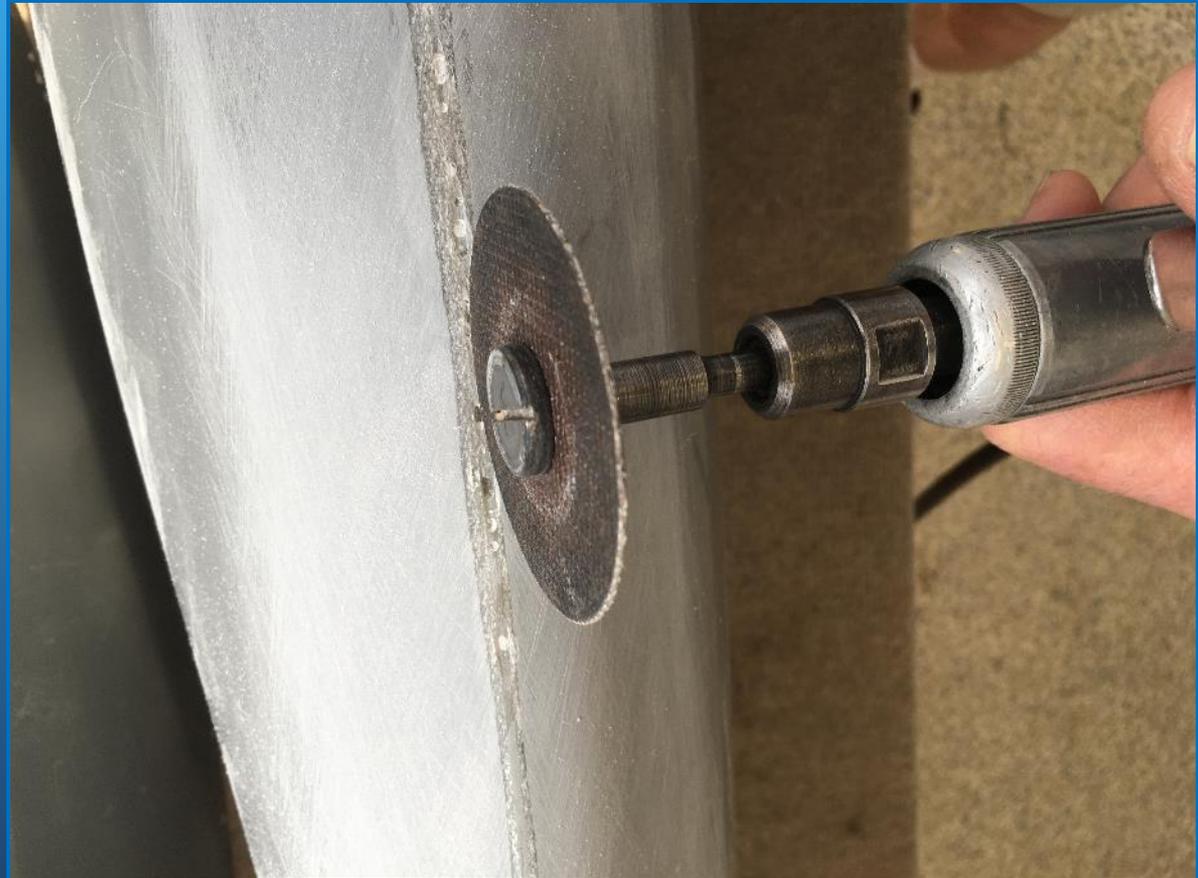


Picked voids have sharp edges the need to be dressed

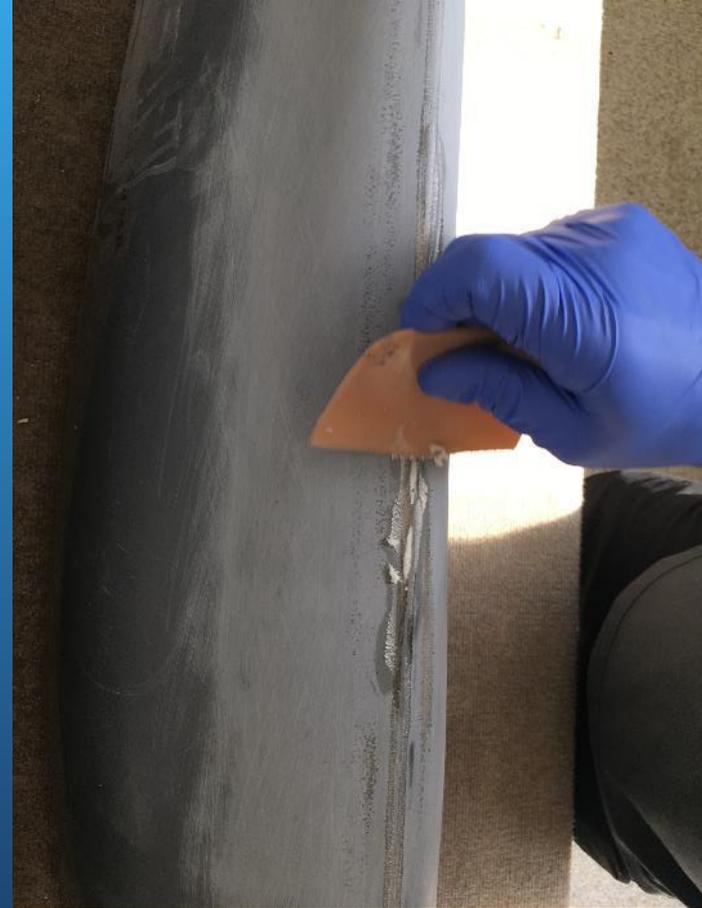
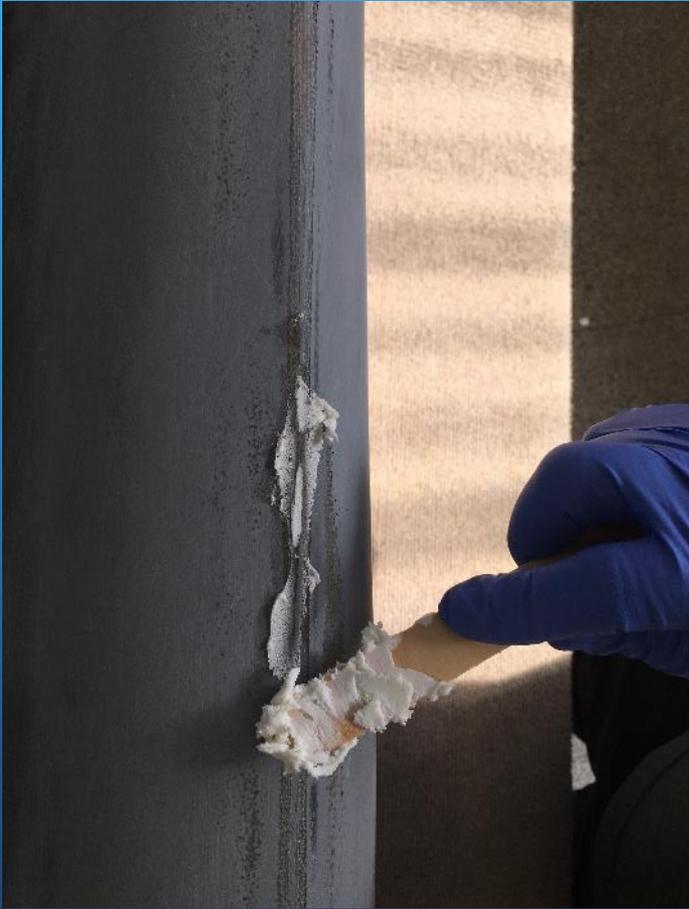
# Bubble Busters Continued

Die Grinder  
Or  
Dremel Tool

GO EASY!!



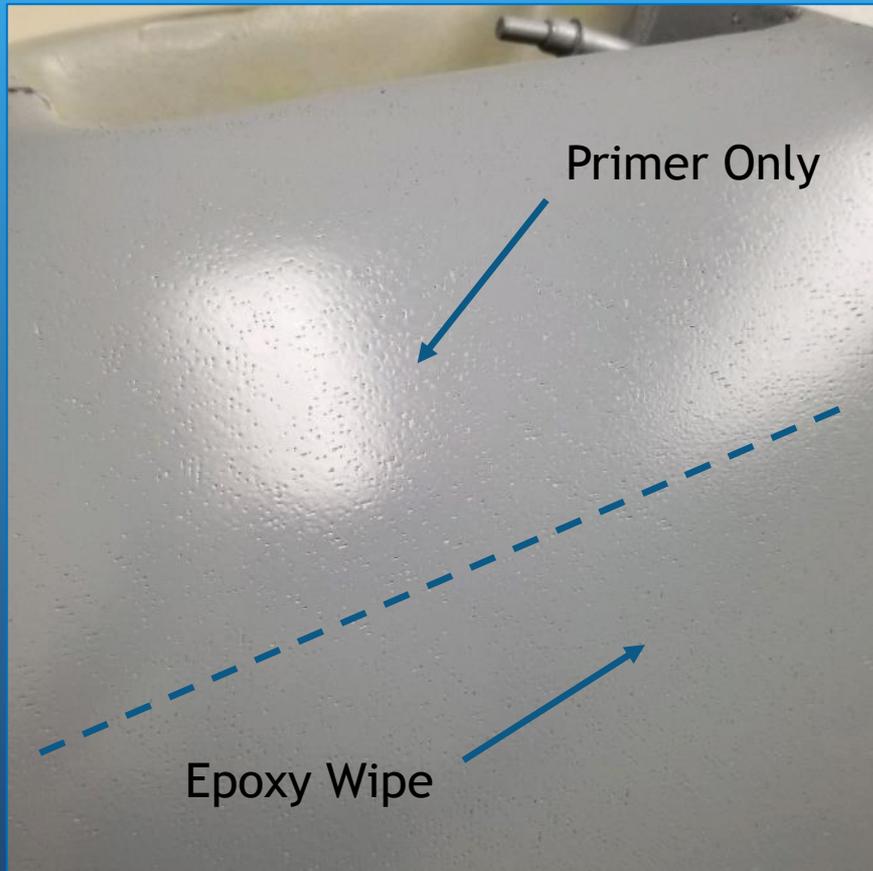
# Filling Seam Voids with Micro Putty



# 2<sup>nd</sup> 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

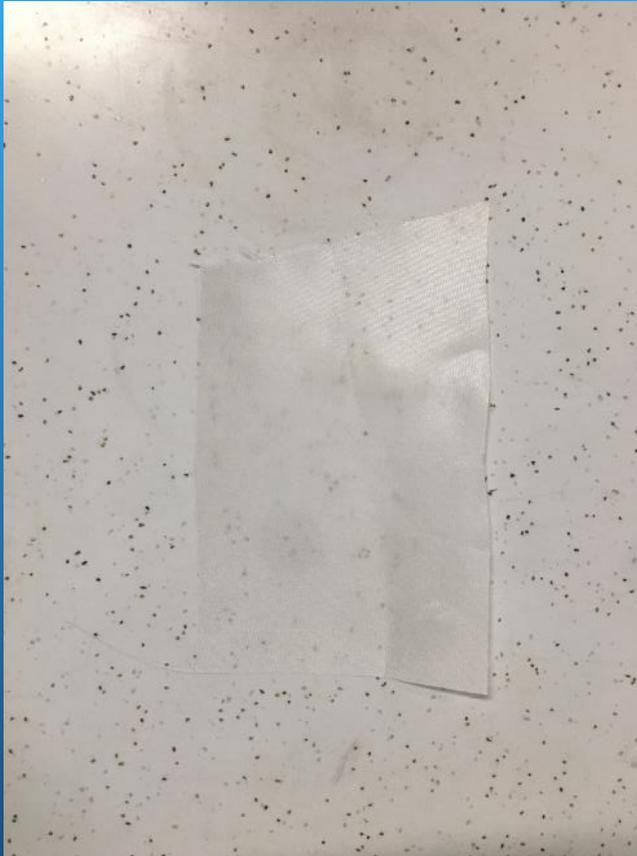
# Composite Wing & Stabilizer Tips



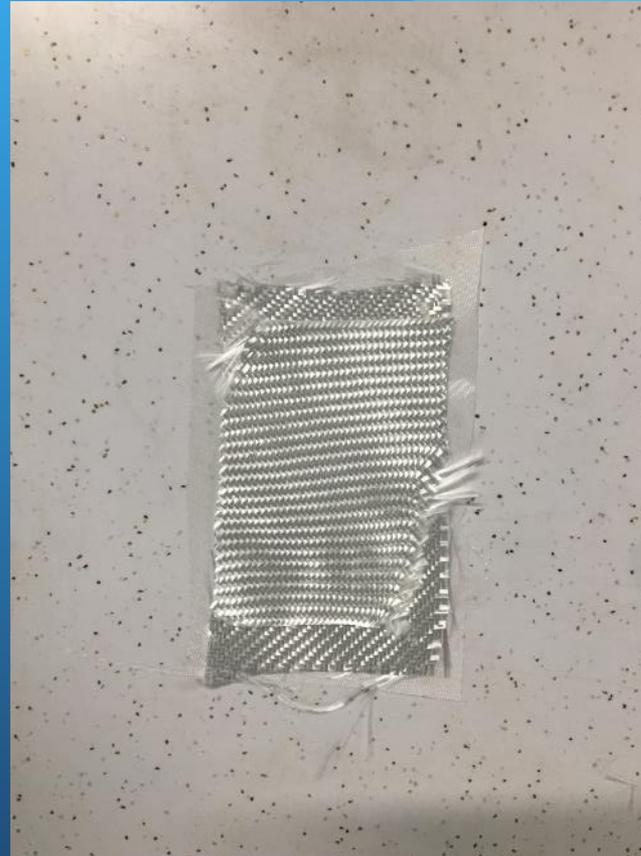
# Fillet Fabrication

- 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 part



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

# Windshield Installation

- Bonded vs Fastened Windshield
  - Van's Aircraft plans 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.
- **DO NOT FIBERGLASS OVER FASTENERS!!**
  - Fasteners will eventually show through

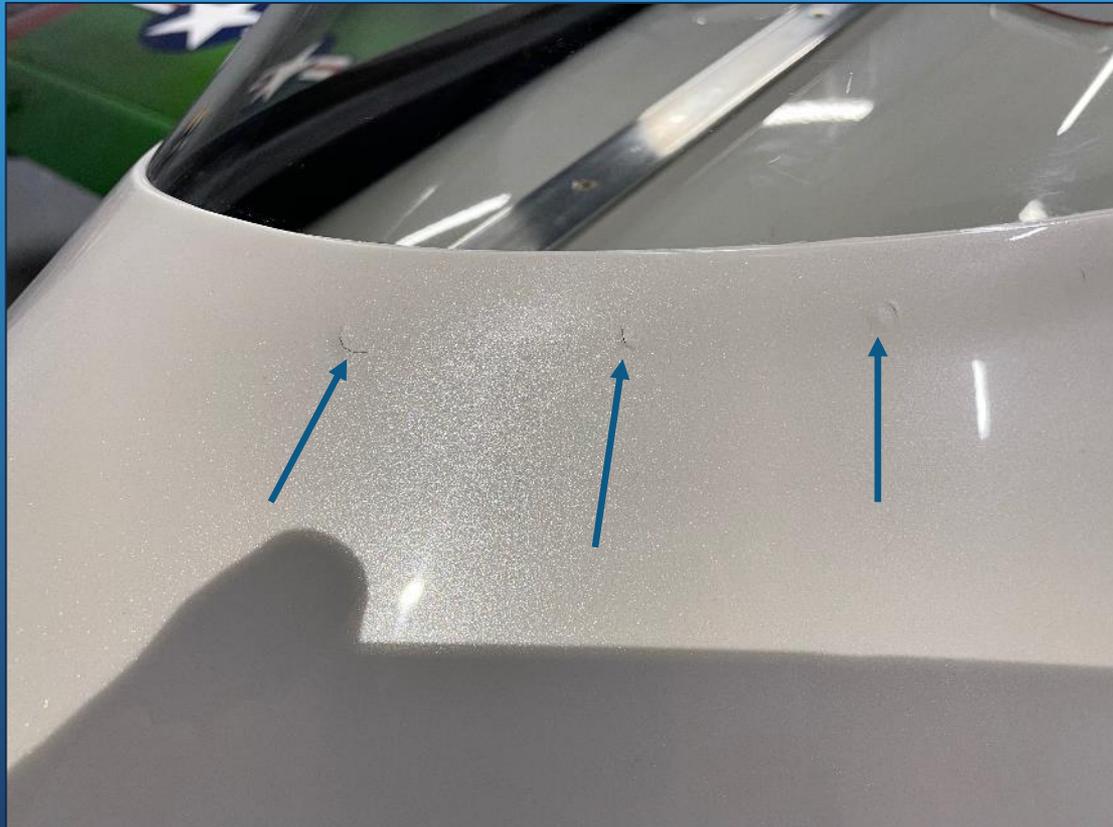
# Windshield Installation

- Mark Beard's Beautiful RV-8



# Windshield Installation Cont.

- Fasteners pushing through



# 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
  - 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
  - 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  $\frac{3}{4}$  inch wide bond line
  - Clecoe in place and let cure

# Windshield Installation Cont

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



# Windshield Installation Cont

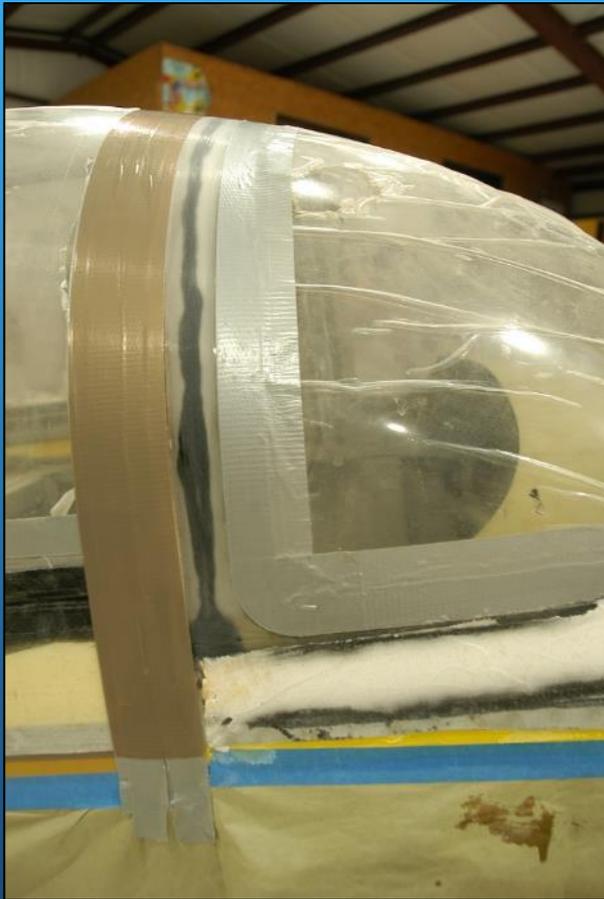
Grind taper on edge and apply epoxy



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

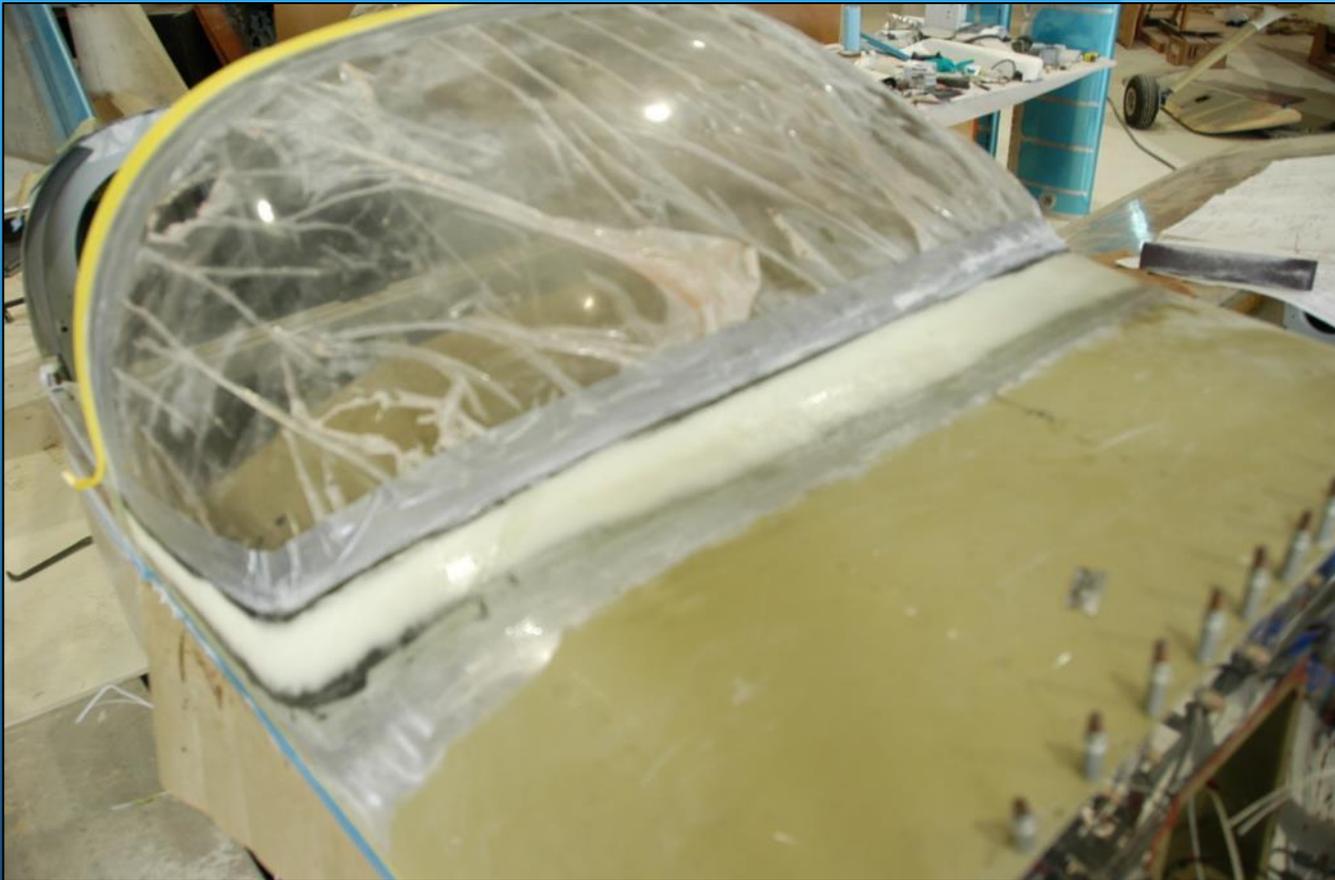


# Windshield Installation Cont



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  $\frac{3}{4}$  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.



# 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](http://www.airtechonline.com)) or Freeman Supply ([www.freemansupply.com](http://www.freemansupply.com))
- Scissors: Kretzer Finny 74525 10.0” - Sewn Products Equipment Co., PO Box 357, Jefferson, GA 30549. [www.sewnproducts.com](http://www.sewnproducts.com)
- Wheel Cutters: Olfa Rotary Cutter sold at many fabric stores
- Fiberglass Rollers: E S Manufacturing, St Petersburg, FL ([www.esmfg.com](http://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](http://www.compositeenvisions.com))
- Loehle Coatings: <https://loehlecoatings.com>, ph: 850-482-4141