Sculpted Epoxy-Glass Install on Vans RV Windshield & Canopy

Richard Kaczmarek
Aviation Composites LLC
937.243.7303
aviationcomposites2018@gmail.com

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

Sun N Fun April 4th, 2019

THIS PROCESS TAKES TIME BUT IN THE END YOU GET A BETTER FITTING AND QUIETER CANOPY!

Plans Built Aluminum Skirts

Molded Composite Skirts

Outline

- Introduction
  - Recommended PPE (Safety glasses, Dust Mask Disposable Gloves)
  - Tools of the Trade
- Installation Planning
  - Resin Type
  - Cloth Type
  - Adhesives
  - Filler additives
- Area Preparation
  - Preclean
  - Abrading
  - Etching & bondline promoter

Outline Cont.

- Windshield & Canopy Installation
  - Selection of adhesive
  - Fitting
  - Edge preparation
  - Initial bonding
  - Clecos & clamping
  - Tapering the edges
  - Initial tabbing onto cowl boot
- Final Fairing Steps and Finishing
  - Common finishing preparation methods
  - Final topcoat

Installation Planning

- Resin Type
  - Epoxy!
    - Polyester or vinyl ester yields poor bonding results.
  - Several epoxy resin systems are readily available
- Cloth Type
  - Fiberglass: Style 7725 (AKA Rutan glass),
  - Carbon: (carbon cannot touch aluminum).
- Adhesives
  - Epoxy, 3M Panel Bond 08115, 3M DP460 adhesive
- Filler Additives
  - Glass microspheres

Area Preparation, Preclean

- Clean surface to be bonded by removing all oils and dirt
- Do not degrease with common degreaser
  - Could cause corrosion of aluminum in crevices
- Use Extreme Simple Green and ample water
  - Does not promote corrosion

Area Preparation, Abrading

- If replacing then remove old paint and composite.
  - Paint removal done with abrasives
    - 3M has a Rol-Loc bristle disc able to remove the paint without damage to aluminum substrate if handle correctly,
    - If grinding disc is used the risk is heat leading to local warping.
- If metal has powder coat or a light coat of zinc-chromate / phosphate then this is removed as well
  - This is a poor bond line promotor
  - Use 3M, or equivalent, Rol-Loc Scotch disk to keep the abrasion action cool
    - May use Rol-Loc abrasive disc if very careful to keep moving avoiding the build up of heat.

Area Preparation, Bondline

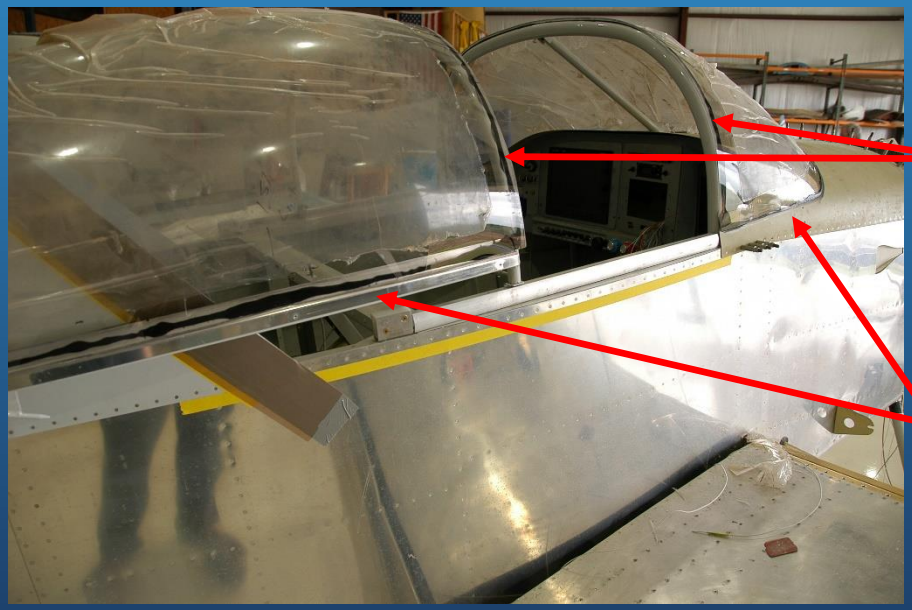
- Bonding to aluminum is critical
  - Many are successful with little preparation but highly recommend the bond line enhancement steps below.
  - Chemical treatment is best:
    - Phosphoric acid wash,
    - 3M AC-130 is a high-performance surface pre-treatment.
  - Selection of adhesive
    - Epoxy is the most tenacious and many come in a duplex cartridge that requires the appropriate ‘caulk’ gun.
    - Guns can cost up to $100 (3M has small plastic gun that is affordable for the minimal use)
    - GBI WEST System Six10 or G-Flex is readily available and only requires common caulk gun.

Windshield & Canopy Installation

- Selection of adhesive
  - Epoxy
    - 3M Corporation DP460
    - 3M Panel Bond 08115
    - GBI ProSet ADV 176/276
  - Urethane adhesive
    - 3M Auto Glass Urethane Windshield Adhesive 08693
    - Sikaflex 295 UV
    - Most any urethane adhesive available
  - Acrylic – like Plexus, sets too fast stick with the above choices

Windshield & Canopy Installation Cont

- Fitting
  - Windshield is trimmed to correct fit where it touches aluminum but near net where it is bonded to tube frame,
  - Canopy is trimmed to fit along bottom edge but near net at tubing front and back.



Windshield Installation

- Initial bonding of windshield
  - Abrade the contact area of the aluminum
  - 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 fit and predrill for clecos
  - Apply adhesive to aluminum and steel frame (two pairs of hands here)
    - Apply just enough for a squeeze that results in a ¾ inch wide bond line

Windshield Installation Cont

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

Windshield Installation Cont

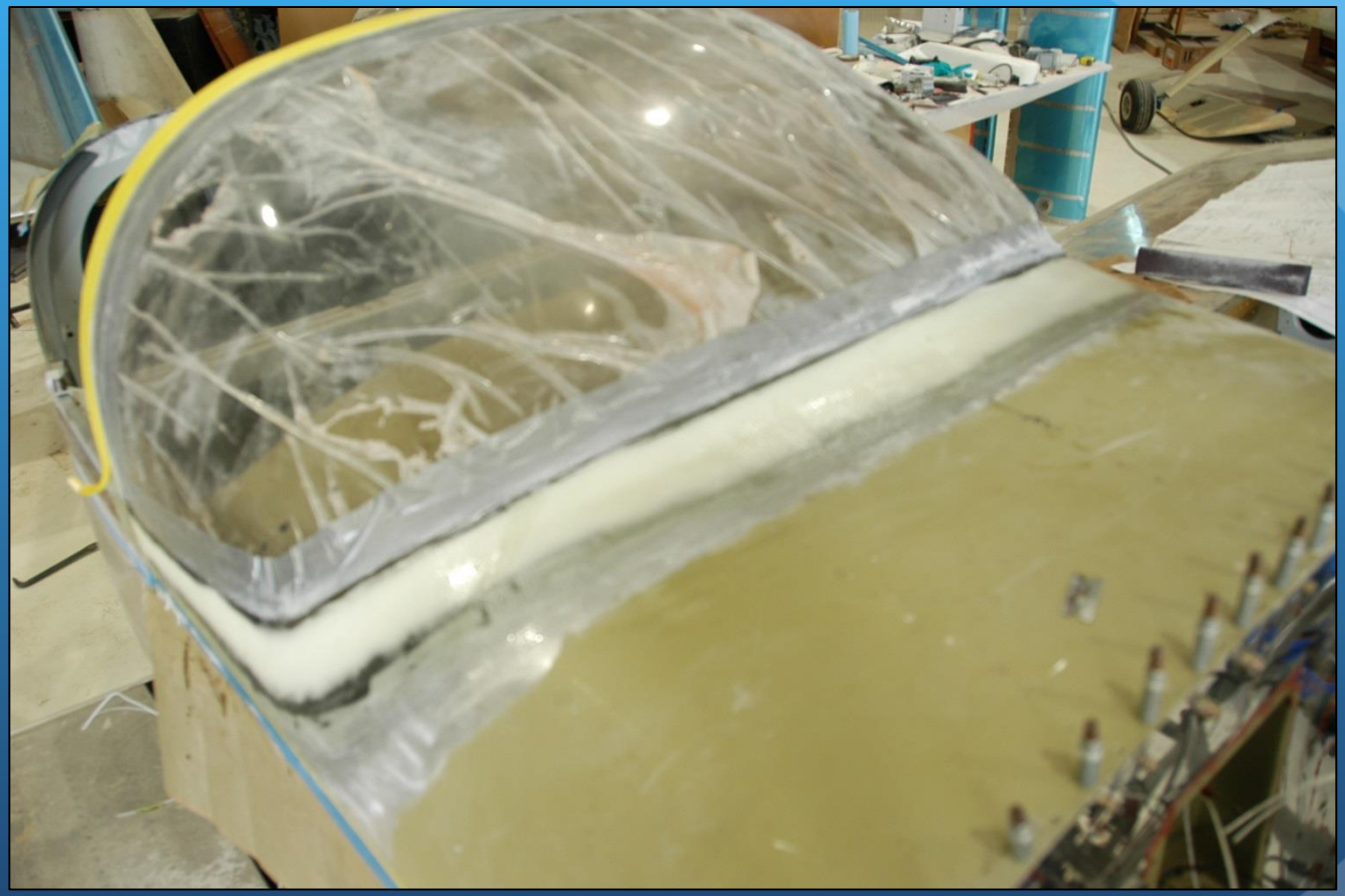
Grind taper on edge and apply epoxy

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 mare 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.

Canopy Installation

- Canopy may be bowed out at the bottom
  - Wrap canopy with ratchet straps and pull in bottom edges about one inch narrower than the frame width
  - Place in sun or set in a warm place for a few hours to preset canopy to prevent bowing load on frame
- Initial bonding of Canopy
  - Abrade the contact area of the aluminum, at lower edges, and steel tubing following the fitting of canopy frame
  - Cut back the inside protective film with scissors on acrylic
  - 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

Canopy Installation Steps

- Apply adhesive to aluminum and steel frame (two pairs of hands here)
  - Apply just enough for a squeeze that results in a ¾ inch wide bond line
- Clamp in place
- Reinstall canopy and frame. Cleco forward canopy to slide rollers
- Let dry overnight
- Tapering the edges of the windshield
  - Careful use small grinder after applying <u>at least</u> two layers of duct tape.
- Edge preparation of Acrylic
  - Mask off with duct tape and hand sand with 80 grit production paper
- Initial tabbing onto cowl boot
- Bond in place then fiberglass perimeters

Canopy Installation Cont.

- Set and clamp canopy on frame and mark trim line & remove.
- Cut back the inside protective plastic with scissors (no razor blades)
  - Preserve as much of the plastic as practical for protection during mounting process.

Canopy Installation Cont.

- Abrade surfaces of metal frame to remove coatings and provide anchor for bonding.
- Apply ample amount of adhesive.
  - Generous amounts of adhesive results in too much of squeeze out of material and difficult to clean up.
- Reapply spring clamps.

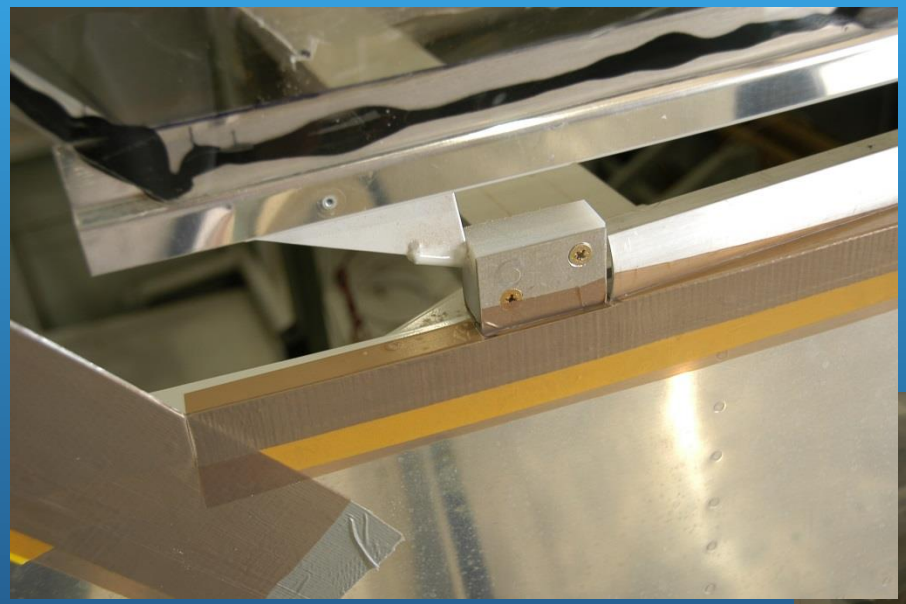
Canopy Installation Cont.

- Reinstall canopy on the roller slides and cleco in place
  - Also attach to rear nylon slide
- Loosen clamps as necessary to adjust for any misfit or splay out of bottom caused by the Plexiglas
  - Clamps will not allow full closure of the canopy but as the tracks are parallel this is okay
- Let dry overnight
- Remove canopy and prepare edges for the finishing
  - Mask off area of Plexiglas to be sanded with <u>two layers</u> of duct tape
  - Carefully cut radiuses in corners for better look
  - Do a final sand and trim of edges.

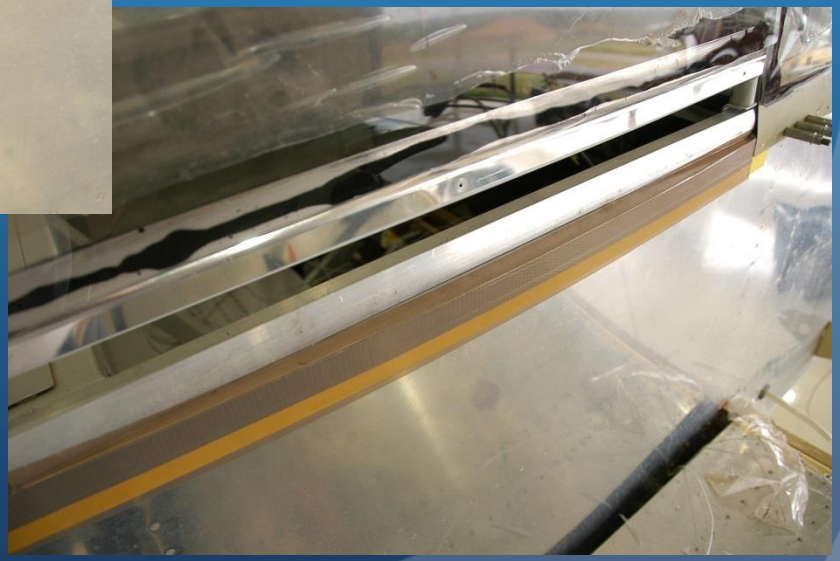
Canopy Installation Cont.

- Prepare the fuselage for the composite skirting:
  - Outline the areas of overlap on the fuselage with masking tape
  - Apply duct tape inside the masked areas.

Canopy Installation Cont.



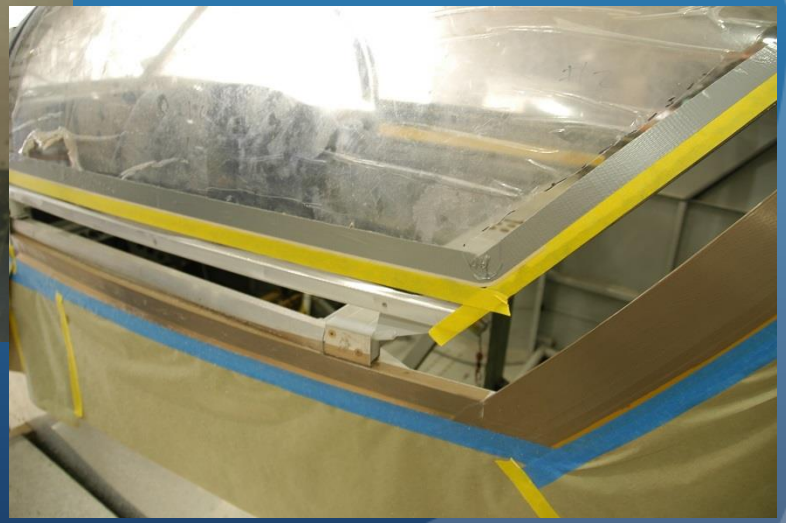
Teflon tape over duct tape



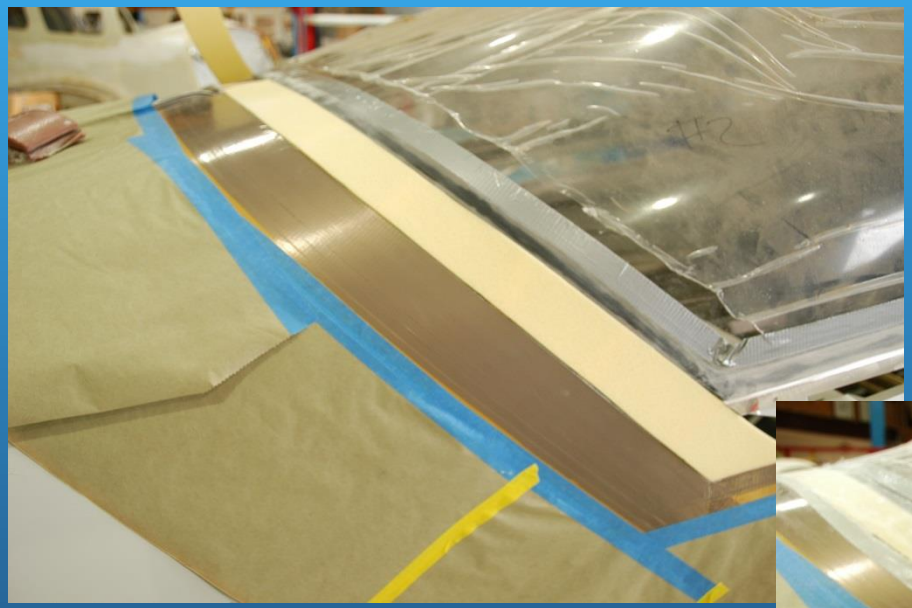
Duct tape as first layer
provides air gap when finished

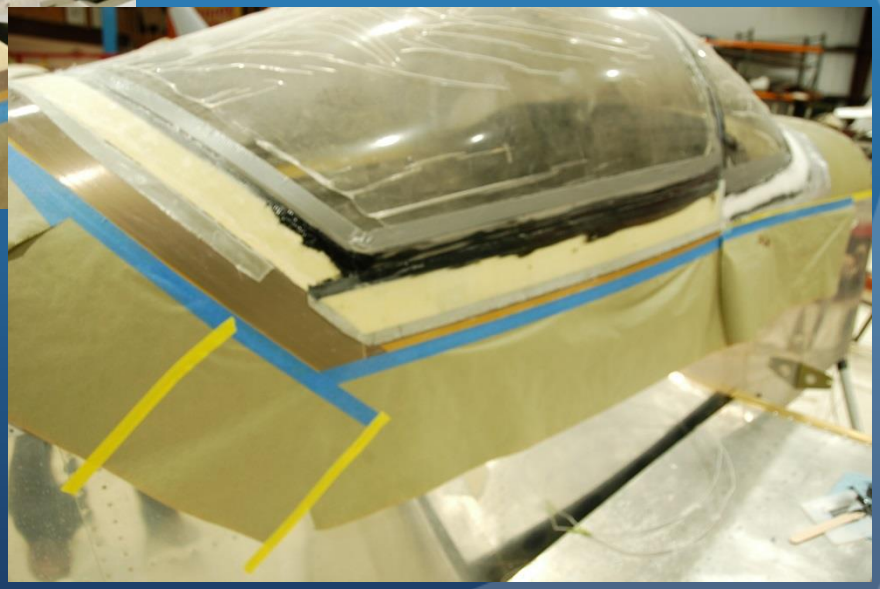
Canopy Installation Cont.

- Fit foam skirts and paper off area



Canopy Installation Cont.



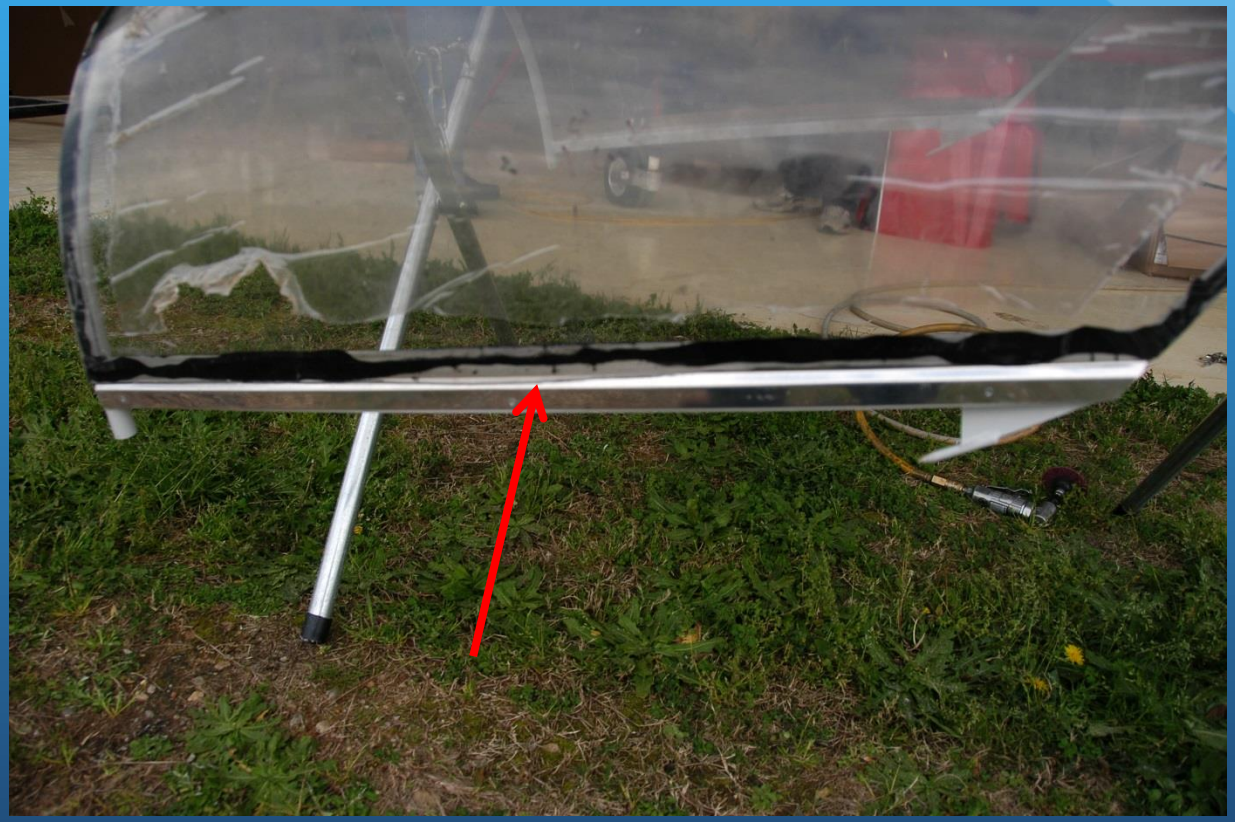


Selection of Resins

(Available from Aircraft Spruce and Wicks)

- Gougeon Brothers Inc. (GBI) ProSet Epoxy 125/135 resin
  - Hardeners: LAM-226 (med), LAM-229 (slow), LAM-237 (extra slow)
- Hexion MGS L285 resin
  - 285F (fast), 287S (slow) hardeners
- PTM&W Aeropoxy PR2032 resin
  - PH3660 (fast), PH3665 (slow) hardeners
- With all three of these resins room temperature curing results in good properties; curing at elevated temperatures, or post curing, will result in the highest achievable strength and Tg.
- GBI is the only manufacturer that claims that hardeners may blended to adjust cure times. MGS is clear that one cannot mix components of the 285 and 335 resins together. PTM&W is silent
- We do not recommend the use of the Endurance Technologies E-Z Poxy!
  - Contains carcinogenic constituents and unreactive diluents

Canopy Installation Cont.



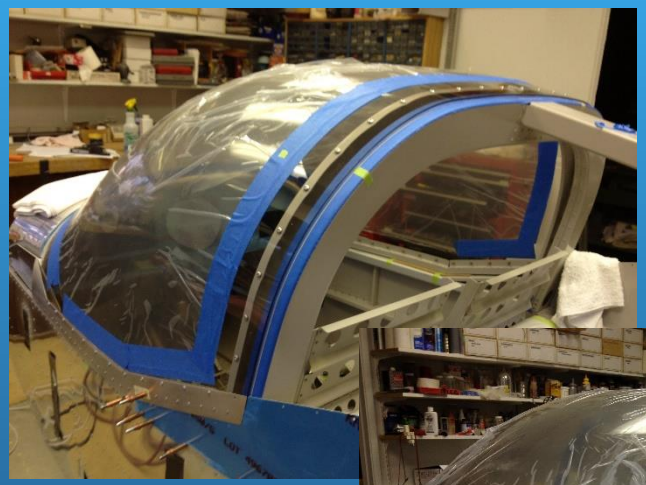
Take your time and apply adhesive carefully!

Chastain RV-12 Summary

- I would say this is relatively easy but time consuming!
- Applying layers of glass and then filling low spots with chopped fiber then the micro final fill and shaping
- Mix carbon black with resin because it will show on the inside and you will not want to paint the inside.
- The dress edge of the FG to the plexiglass is no more than a thickness of masking tape.
- Probably want some minor heat to accelerate the stages of cure.
- Use super good release agent/technique to release from fuselage.

Chastain RV-12 Canopy

RV-12 Masking Off Laminating Areas



RV-12 Canopy Lamination

Carbon black added to the epoxy resin to avoid painting the exposed inner surfaces

RV-12 Surface Finishing

Common automotive finishing techniques used

RV-12 Canopy Final Steps

Final Steps Finishing

- Common finishing preparation methods
  - Surface finishing can be accomplished with common automotive techniques
    - Sand area to 120 or 180 grit
    - Epoxy dry-micro
    - High build PPG epoxy primer
    - Sand and block to 400 or 600 grit profile
  - Apply final topcoat

Etcetera

Additional and Helpful Information

Recommended PPE

- ✓ Eye Protection – use a least ANSI approved glasses. The missing cut off wheel piece in the photo nicked the side of my nose and I have since purchased a face shield.
- ✓ Hearing Protection – a least 23 dB of attenuation. The 'band' style I prefer as it allows you to wear safety glasses comfortably.
- ✓ Skin Protection – gloves preferred as the ointments don't protect enough, especially when working with solvents.
- ✓ Respiratory Protection – recommend the 3M double elastic style or cartridge mask.
- ✓ Tyvek sleeves – I highly recommend these as they are great when laminating (no skin reaction) and sanding (no itch).

Tools of the Trade

- Basic Hand Sander, 1”-2” wide chip paint brushes and small plastic cups & mixing sticks
- Fabric Cutting Tools
  - Wheel cutters
    - These are excellent but need to use a good surface to cut on so that the blade lasts.
    - Use Masonite, plywood or urethane mat from sewing sources
- Rags (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 similar
- Gloves
  - Nitrile
    - These are great if one has a reaction to latex, however they are not resistant to ketone solvents (acetone or MEK)
  - Latex
    - Resistant to strong solvents but may cause skin reaction
    - Skin reaction solution is to wear nitrile under the latex gloves when cleaning up with acetone or MEK

Tools Cont.

- Scissors
  - These should be good industrial grade which will save time and hand fatigue
- Razor blades
  - If the preference is still to use a single edge blade then cut using a straight edge and keep the blade at a shallow angle
- Straight edge
  - Preference is an aluminum straight edge. May want to add a non-slip surface on the back.
  - May also use a drywall square as it is convenient to make quick square cuts using the edge of the table or bench
- Hip square
- Table Top for Cutting Surface
  - A large table with a Masonite top works well. Do not use particle board or under lament for the cutting surface as it eventually results in little wood chips in the fabric

No No's

- Rags (read bond breaker)
  - Cloth rags are not used no matter how often they are washed or washed with
  - Preferred are the Scott Blue Shop or the Multi-Ply, Reinforced Nylon Fiber Utility 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 adds due to the medical requirements. Try to get 92%.
- 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
- 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 local medical supply
- Resins: Aircraft Spruce or Composites One
- Vacuum bag supplies: Coast-Line International (coast-lineintl.com)

Questions?

- Join us at the Composites Workshop for a hands-on demonstration
  - Easy processing demonstration

- Emails:
  - dmbergen@customtechllc.com
  - aviationcomposites2018@gmail.com