



# Central States Association

*A Product of  
Creative Minds*

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## Jim Price Sets C-1a World Altitude Record

The World Altitude record is still in EZ hands. See page 23 for details of the nearly 7 mile high flight.

### Editorial: Resin System Considerations

**Terry Schubert (OH)** - Contact with competent builders has caused me concern about the resin systems we use. It seems all epoxies are adversely effected by high humidity before cure. Hexcel's 2427 is apparently more effected than others.

At the OKCGIG Jerry McAdams of Fort Worth, TX revealed an alarming event. He built his Long-EZ fuselage inside with Safe-t-Poxy. The outside was layed up using 2427. After cure he cut out for the landing brake and found the exterior skin delaminating between plies. With little effort the skin simply came apart. He replaced the skin with Safe-t-Poxy structure.

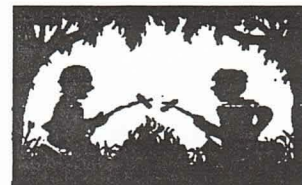
His winter time lay up was done in a shop heated with an unvented kerosene space heater. Such heaters produce considerable moisture as a by product of combustion. The high humidity probably effected the uncured first ply thus inhibiting a good

bond to the second ply.

Jeff Russell of Aero-Cad, has tested many epoxy systems before determining a system that will work in his North Carolina location. He will not use 2427 after the delamination of a Berkut firewall from a fuselage under construction. He said it looked like the tapes were laid up on wax paper.

You, as manufacturer, must ensure your layups reach full strength. Jerry and Jeff discovered their inferior layups. Imagine the result if those layups were on a center section spar and it was not replaced. The spar would certainly fail and cause death!

You must test your resin to be sure it develops good strength under your shop conditions. Remember Mojave is a very dry place and cured resin properties at RAF might be very different from a very warm humid area. **PLEASE TEST YOUR RESIN UNDER YOUR SHOP CONDITIONS!!** See page 9 for further discussion.



### OSH Hot Dog Roast

**Gene Zabler (WI)** - Please join Central States and the Wisconsin Bunch for a hot dog roast at OSH on Friday, August 2. We start the fires at 4 PM. Volunteers are needed. We are hoping to be in the same spot in the campground as last year. The campsite is located just west of the campground bicycle parking lot on the south side of the campground entrance to the Air Show.

Be sure to check the Homebuilder's Building (located on the field) for exact location and any changes. Hot dogs and lemonade will be served at a nominal charge. The Hot Dog Roast is a good opportunity for everyone to get together for good conversation and information on building and flying the greatest airplanes in the world.

See you at the OSH Hot Dog Roast!



## Another Resin System?

In the April issue Chris Mitchell reported Hexcell (maker of Safe-t-Poxy type & Epolite 2427) resins had sold the resins to Fiber-Resin Corp.

The latest CP reports the new owner has discontinued the resin, leaving many builders with a resin compatibility problem as other RAF approved resins have also been discontinued.

You may remember, in CP 77, that Scaled Composites stopped using the Safe-t-Poxy product when it was found to contain a very low percentage of MDA (a known carcinogen) and styrenes (highly allergenic).

Scaled Composites now uses a Gougeon Brothers Inc. (517-684-7286) resin system that is free of MDA. This resin is called PRO-SET. I requested a technical information package and found it was designed for fabrication of fiberglass, aramid, graphite, and hybrid composites using wet-layup, vacuum bag and resin infusion laminating methods.

PRO-SET Laminating Epoxies consist of four resins of different viscosity and three hardeners with different cure rates. Resins and hardener combine to create ten different epoxy mixtures, each with unique handling and cured physical properties. You need to select the proper resin-hardener combination. Some combinations require post curing if final stage cure is to ever be reached. A call to Mike Melvil at RAF found they use the slow cure material and post cure it. Mike has constructed an entire airplane with it and has constructed his Long-EZ aux fuel tanks with it. He is very happy with the product!

PRO-SET mini pumps provide accurate dispensing of PRO-SET epoxy. One full stroke of the resin pump and one full stroke of the hardener pump provide a proper ratio.

An other resin option has entered the market. Former Hexcell product manager and Cozy Mark IV builder,

Gordon Bowen, (801) 394-5537, decided not to let Safe-t-Poxy technology die. He has introduced E-Z Poxy, 9315 resin and 9317 hardener, a near exact replacement for Safe-t-Poxy.

It seems that the early 2427 system had stability problems and reacted to moisture and CO<sub>2</sub> in the atmosphere. It developed a "cottage cheese" consistency. The product has since been modified to be more tolerant but seems to still have stability problems in very humid areas. I have had a batch of styrene and MDA free 2427 in my garage ratio pump for a year now and there has been no "cottage cheese" change in its consistency. I have kept a small light bulb burning in the epoxy cabinet to keep humidity down.

**High moisture causes decrease in physical properties of all epoxies!** Mike reports Scaled Composites uses desiccant in the epoxy pumps at their Mojave location. If they do that in dry Mojave imagine the humidity problems in Gulf coast states.

The E-Z Poxy has been introduced to offer an alternative for those wanting a product with a 20 year history of performance. It seems **less effected** by high humidity than the 2427.

I contacted Gordon and he stated the E-Z Poxy is much more stable than the 2427. He further directed me to contact Jeff Russell of AeroCad (910) 961-2238 to learn of the problems he had with the 2427 in a humid North Carolina environment. His article follows in this issue.

The latest Canard Pusher reports, "RAF can not comment on whether you should use E-Z Poxy, which more than likely contains MDA. It is up to you to ascertain how much MDA is contained in E-Z Poxy."

If you decide to use E-Z Poxy, RAF recommends the EZ-10 and EZ-84 combination. This system is available from Spruce (GA or CA) or Diversified Materials of San Diego.

A call to Mike Brown at Wicks (June 13) found that 2427 is in stock and will continue to be available as long as the manufacturer supplies it. At this time they are uncertain if they will market the E-Z Poxy. PTM&W and the old RAE systems are also in stock. Mike indicated 2427 and PTM&W were not resins of his choice. He feels PRO-SET and E-Z Poxy properties are far superior.

## Amine Blush in Resin

*Jeff Russell - AeroCad (NC)* - We have used the following resins and have found very different results in our testing: Hexcel RAE 2426 resin and 2176, 2177 hardener, Hexcel EPO-LITE 2410 resin and 2183, 2184, 2187 hardeners, Hexcel EPO-LITE 2318 resin and 2316 hardener, Hexcel 2427 resin and hardener, PTM&W 3660 resin and PR2032 hardeners (fast and slow) 5 different types, CLEARSTREAM EPOXY, WEST SYSTEMS 105-5 resin and 205, 206 hardeners for finishing, ALPHA - POXY for finishing, and RYCHOR EPOXY for finishing.

The climate conditions in which you work will most effect the way an amine base resin will work for you. The only non amine base resin system we have used is Hexcel's EPO-LITE 2183, 2184 and 2187 hardeners. The bad thing is these hardeners contain MDA and styrene. These Styrene-Monomer based systems dissipate water as they cure so that amine blush or other water related problems go away.

Amine blush is caused by high humidity and by the amine group in the resins and hardeners accepting CO<sub>2</sub> and H<sub>2</sub>O. This is noticed as a white film around the lids of a laminate or by a thin film that gums up your sand paper. People often think their resins are not curing and that they have been supplied faulty materials. The real culprit is amine blush caused by high humidity and high temperature.

As temperature increases, the air can hold much more moisture and CO<sub>2</sub>.



Higher temperature also increases the number of reactive sites available and sets up the perfect condition for amine blush to occur. With all this technical goop set aside, most builders only want to know how to prevent amine blush or how to cure the problem that they now have on their laminate. The following are remedies for amine blush:

1. Use peel ply. Amine blush forms most generally on the outer most portion of the lay-up. By using peel ply the amine blush is removed when the peel ply is removed, leaving a laminate free of amine blush and ready for secondary bonding.

2. Use a high quality resin, or a fast hardener. The length of time that resin is uncured is the length of time of exposure for the formation of amine blush. Reduce this time and you will reduce the amount of amine blush.

3. Cap all resins as soon as possible. This reduces exposure to the elements that cause amine blush. (DO NOT USE EPOXY PUMPS) Humidity in fiberglass and core material will effect how a laminate will turn out too.

4. Work in a controlled environment if possible. It is often hard to have a temperature and humidity controlled shop, but we can do our lay-ups at times when the temperature and humidity is not extremely high as we frequently see it in North Carolina.

5. Amine blush can be washed off with a clean cloth and warm water once the initial cure has occurred.

6. Sanding will remove the amine blush and also gum up your sandpaper. **Amine blush must be removed before subsequent or secondary laminates or lay-ups are initiated. If the amine blush is not removed, the interlaminar sheer strength is only as strong as the amine blush.** I find that the easiest method is to purchase a high quality resin that is not susceptible to amine blush and use peel ply. By doing this, I get the best of both worlds. I get a resin that is easy to work with and that has

higher qualities in virtually every area. I reduce sanding work and lighten my laminate by using peel ply. With these issues in mind, we use only EPOLITE 2183, 2184, 2187 hardeners which eliminate amine blush.

We, at AeroCad, have had bad results testing Amine base hardeners. On a glass to glass bond (tape glassing cured bulkheads in place to other cured glass) the tape glass would peel off like it was bonded to wax paper. We also found fully cured laminates to have poor peel strength between plies. Vacuum bagging also produced the same reaction.

We deal with 80 to 90 percent humidity in our areas most of the time. We feel you should always test your resin systems to see if these types of problems come up. Most of our peel strength problems were seen in the winter time. The longer the cure rate the more moisture that seemed to creep into the laminate. We had material reps examine the problems we found in our testing and, surprisingly, no answers came from them.

Our fix is to just use Styrene-Monomer base hardners.

RAF is in the desert with almost no humidity so they will not have our high humidity problems. Use all resins as if you are a Guinea pig in your area. **TEST - TEST - TEST** until you know the resins will work for your needs in your area.

We also found that the  $T_g$  (glass transition temperature) was not what the resin manufacturer said it was. We took nose struts made of S-2 glass and sample resin from manufacturers and post cured it, slowly stepping up to 190°. We would then let it cool and re-heat it to 160° then 170° and so on until the resin became rubbery. Some samples would only reach 160° and others maybe 180°. Are resin manufacturers lying to us as end users? They told us to expect 10-20% lower  $T_g$  values because we were not in THEIR lab. If that is the answer you can expect from them, you had best TEST - TEST - TEST.

## VHF Antennas in Long-EZ/Cozy Aircraft

Tony Rothwell (Australia) - I am building a Cozy 3 and am at the stage where I was making the winglets. I did some calculations and figured I knew better than the original designer of the radio antennae. I thought that each half of the VHF communications dipole should be around 22.6" rather than the 20.3" specified. I made one winglet antenna to the book dimension and one to my dimension and covered both.

Wrong! Fortunately, in those days I worked for the Australian Civil Aviation Authority and knew the fellow who ran the measurement and calibration laboratory. I took the winglets to the lab and had them measured for "bandwidth" and resonant frequency.

The plans built, 20.3" antenna was tuned nicely to 124.038 Mhz and the reflection co-efficient was less than 0.4 from 114-135 Mhz and less than 0.3 from 117 to 130 Mhz. Clever me had produced an antenna tuned to 111.04 Mhz, way down near the bottom of the navigation band and with a reflection coefficient below 0.3 only from 108 to 116 Mhz. Truly woeful!

I had to carry out an operation and shorten each antenna leg to its correct figure then repair the holes. More work and a heavier airplane resulted. I wish I could say I had truly learned a lesson and not made any more changes but it wouldn't be true.

I just hope my IO-320 with an MT prop delivers results to justify the weight and the cost. With a little luck, I'll know within the year. Gee doesn't work interfere with building?

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### For Sale

Cozy III, \$16,000. All glass work done, primed and ready for engine, instruments and paint.

O-200 Vari-Eze for sale, \$15,900, low time, light weight electric starter, etc. Call Chuck (352-637-1184