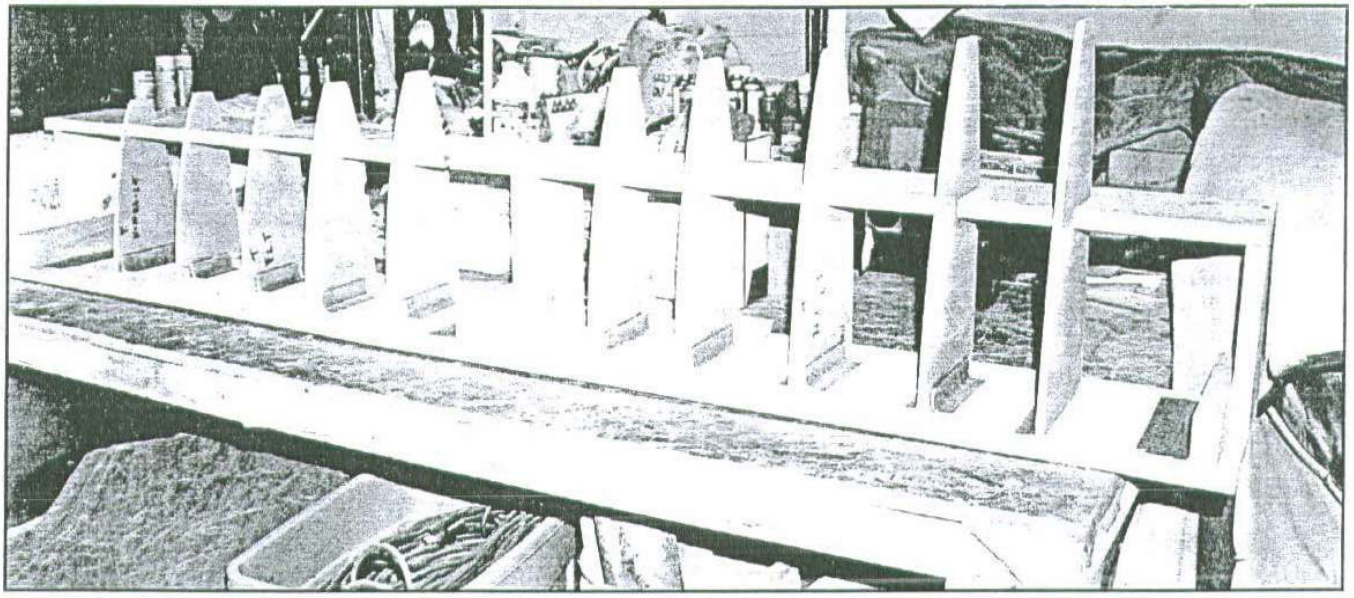
BUILDERS & FLYERS
GP-4
NEWSLETTER

THE OFFICIAL VOICE OF GP-4 BUILDERS ALL OVER THE WORLD

Volume 30 First issue of 2000



Larry Sheets of Bloomington, ILL making great progress!

Just one of the guys checkin in....

I started my GP-4 in January, 1998. Believe it or not-in my basement (the wife wasn't real thrilled). But, I'm making good progress. At this time, I have the fuselage ready for skin, the stabilizer, rudder, elevators and one side of the fin are skinned. I plan on putting another antenna inside the fin so left one side open.

I talked to Jackie Yoder about his process in making the fuel tanks in the wing rather than in the fuselage. I decided to do mine a little differently so I could eliminate the center fuel tank. I'm sending along some pictures of my fuel tanks to make understanding the process a little easier. The process I used was:

Make two tank molds out of wood with the wood ribs inside the molds. Make the back plates right on the front of the main spar to ensure a good fit. After the molds were completed I covered them with vinyl-esther-epoxy.

The tanks are 9 feet 6 inches long leaving about 4 inches between the tank and wing tip for wiring and plumbing. There are nine baffles in each tank and each one holds thirty gallons of fuel-so I should be able to cover a lot of territory without having to sit down and refuel.

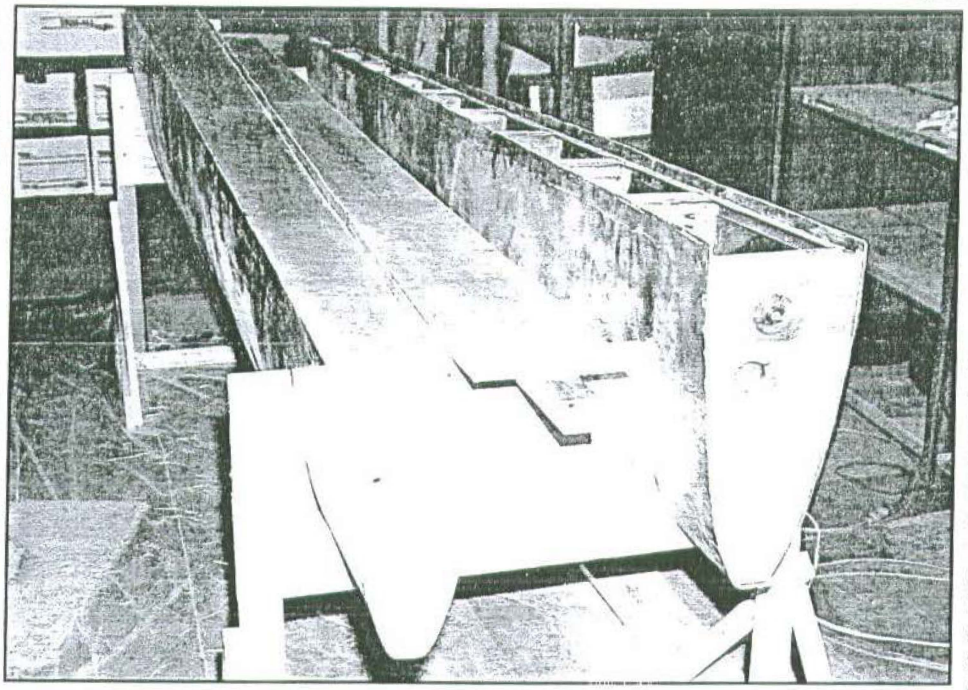
It took me about three weeks to fiberglass the tanks (that doesn't include the week to make the wood molds). I thought the extra time was worth it because these tanks:

1. Hold more fuel
2. Keep the fuel away from the wood, eliminating any contamination of fuel to the wood.
3. Easier to repair if a leak develops

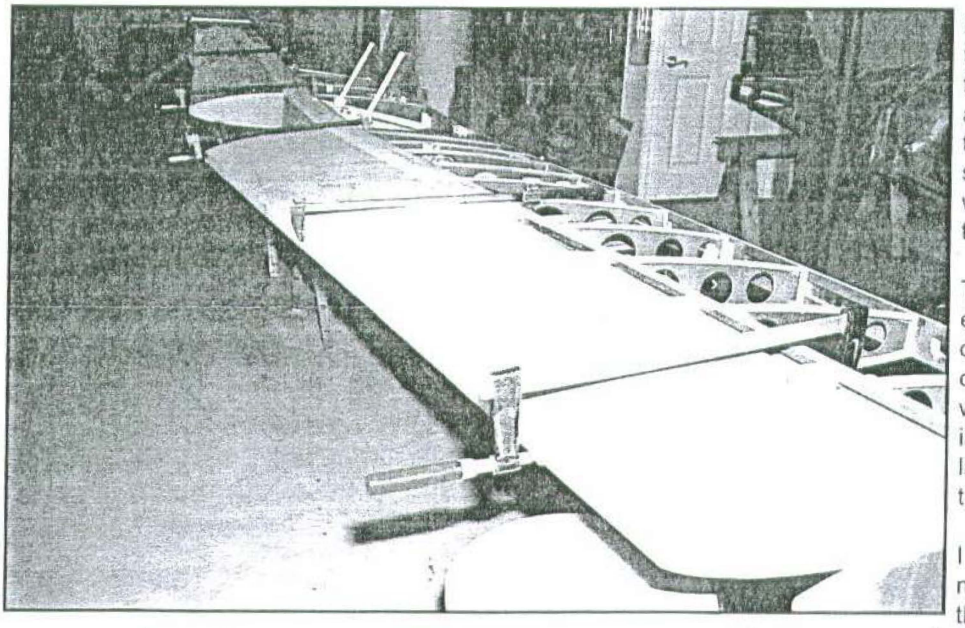
4. Increase the "G's" load (not that it doesn't have enough already)

Tank Process:

To make the baffles, I bought a 4 X 4 sheet of fiberglass from a friend who is building a Seawind. The fiberglass sheet is sandwiched over foam, making it 1/4 inch thick. This glass is the same that Seawind uses for their fuel tanks. Next, I made a jig so I could turn the molds while putting glass over them.



Put release film on the forms (be sure to get all the wrinkles out), then one layer of glass mat to get a slick finish inside the tanks, or a rich resin. Next put two layers of six ounce cloth over the molds and overlapping at the leading edge. Let dry at least a day, then peel the skin off the molds, Be sure to put peel ply over the second layer, or you will have a lot of sanding before you can lay up anymore layers. I put in the two end caps emporarily and clamped them in place.



put two parallel fish lines or stringer lines from the back of the one cap to the other. Then took two 10 foot straight edges and clamped to both sides of the outside of the fuel tank and ran several clamps down the straight edge on both sides eliminating any bows. Next, fit all the rest of the baffles just touching the strings. First, glass both end baffles or end caps in place and let dry.

Then take one of the straight edges and lay on top- straight from end to end. (I made a jig to hold nine baffles end and straight and cut the 1 l/2 i angles and glass them to the back of baffles).Then install all the baffles a bring them up to touch the straight ec and glass in place.

Put five more layers of 6 ounce cloth the tanks, leavi two of the five sh of the leading ed to prevent build u Make several 1 1 inch fiberglas angles for the ba fles and sides insic the tank so you ca glass the back to i Use the back of th molds to make th back of the tan skin. The back is 3/ inch past the lengtl of the forward spa giving you 3/4 inc overlap on the fron of the spar making a channel. The back is five layers of six ounce cloth. Be sure to put peel ply on both sides of the back when laying up the glass. Then mix fiber and aero epoxy and glass the tanks to the front of the spar. Next glass the wood leading edge to the tank.

Then, two more layers of six ounce cloth over the whole tank, overlapping the wood skin by I or 2 inches. Next put the last finish cloth over the whole wing.

I am willing to sell the molds or to explain the process in more detail to anyone who is interested. Happy Building, And Flying.....

Lynn Sheets
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Bloomington, IL. 61704
Phone: (309) 662 0062

Thinning West System Epoxy

This article appeared in the Fall 1999 issue of Epoxyworks, *published by Gougeon Brothers, manufacturers of the West System epoxies. This topic has been kicked around for years in both the composite and wood/composite aircraft camps. It is peice of information we all can use - Spud*

A question frequently posed to our technical staff is "can I thin West System epoxy so it will flow or penetrate a better?" The answer to that question is "yes, but not without consequences." Many of the advantages of thinning epoxy are offset by disadvantages in other areas of epoxy performance.

Thinning epoxy means lowering its viscosity. Low viscosity epoxy flows better, is easier to roll or brush, saturates fiberglass fabric quickly, and penetrates more deeply and more easily into porous surfaces like partially rotted wood. There are two methods of temporarily thinning epoxy. One is to heat the mixture and the other is to add solvent to the mix. The goal of both methods is to reduce the epoxy's viscosity. This article explains what happens to West System epoxy when it is thinned either by heating the components or adding solvent to the mixture.

Through knowledge gained from our comprehensive test programs and from 30 years of practical experience, we have learned that epoxy formulation is a balancing act. When one characteristic is altered-e.g.. changing handling attributes by adding a volatile solvent—other characteristics like moisture resistance and strength are also changed. Our chemists formulate a well balanced, versatile epoxy that provides excellent structural strength and moisture resistance. If you elect to modify it, you become an epoxy formulator and need to understand the effects of your changes.

Armed with the information in this article, you can decide if thinning epoxy is worth the tradeoff in performance.

Is thinning necessary?

There is a perception that epoxy needs to penetrate deeply into wood to be effective. Sometimes this is true, but most of the time it is not. Some common misconceptions are that deep penetration of epoxy 1) makes rotted wood as strong as new, 2) in' creases adhesion, and 3) makes wood more waterproof The following is a brief discussion of these points.

1) Rotted wood impregnated with epoxy does not make the damaged wood as good as new. Deep penetration of epoxy into rotted wood will make the wood hard but it will not restore its original strength. This is not important if the rotted material is non load bearing. A rotted door threshold does not need to be strong, just hard. How' ever, when the wood fiber is damaged, wood loses its ability to carry loads and unless the fiber is replaced, it will not regain its full strength. A rotted deck beam or sailboat mast needs more than epoxy consolidation to return the wood to its original load carrying capacity.

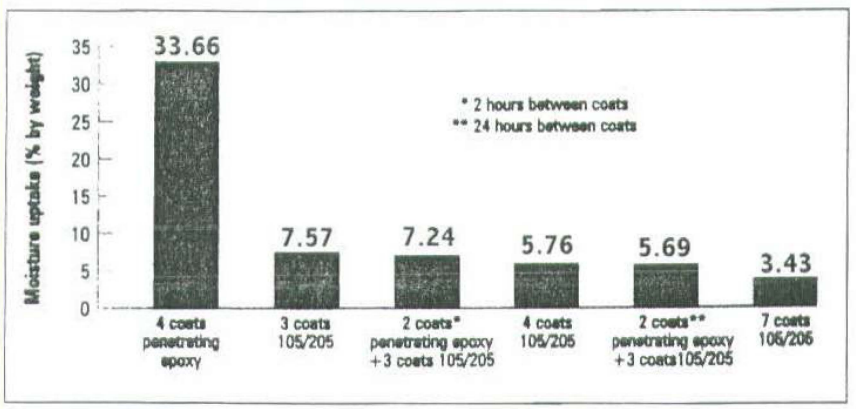


Figure 1. MEE of various combinations of thinned and unthinned epoxy at six weeks exposure to 100% humidity.

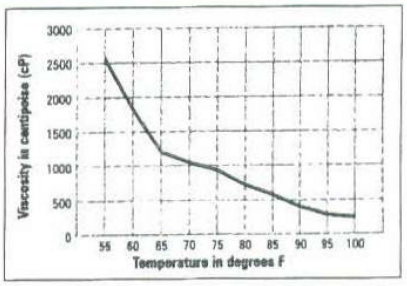


Figure 2. Viscosity of 105 resin vs temperature. Resin viscosity is reduced as the temperature is raised.

2) Adhesion in all but the highest density wood is not enhanced by deep penetration of the glue into the wood. Research performed at the Forest Products Laboratory showed that adhesion to birch was in' creased slightly by using thinned epoxy. In lower density wood species like Sitka spruce or Douglas fir, the weak link is the cross grain strength of the wood. It does not matter if the epoxy penetrates 1/4" into the wood or 0.005". The strength of the wood, the amount of surface area and the adhesive ability of the glue determine the strength of a glue joint. Most types of wood glue do not penetrate deeply, yet, if used properly, they can exceed the grain strength. Epoxy is no exception.

3) Water resistance of a piece of wood is not enhanced by deep penetration. Wrapping wood in plastic makes a pretty good waterproof seal without any penetration at all. Likewise, an epoxy coating on the surface is more water-resistant than a thinned epoxy coating that has penetrated deeply into the wood because, in most instances, the epoxy thinned with solvent is porous.

The USDA Forest Products Laboratory developed the Moisture Exclusion Effectiveness (MEE) test. It is a measure of how much moisture is absorbed by wood when it is continuously exposed to 100% humidity. Higher numbers mean the wood has absorbed more moisture while lower numbers indicate less moisture is absorbed. You can see that epoxy with solvent added is not nearly as moisture resistant as un- epoxy (Figure 1). However, if you need an epoxy coated surface that is less of a vapor barrier, thinning West System epoxy with solvent is a valid way to achieve this.

Thinning epoxy with heat

Heating the resin/hardener components and then mixing them together results in a thinned epoxy mixture that, when cured, retains all the characteristics of epoxy cure at room temperature. The viscosity of epoxy is very sensitive to changes in tempera' sure, and warming the components (resin and hardener) and/or the substrate substantially lowers its viscosity (Figure 2).

With wood, the best method of thinning epoxy with heat is to warm the wood and have the resin and hardener at room temperature. Mix the components and apply the mixture to the warm wood surface. Remove the heat source just before the epoxy is applied. When the epoxy mixture comes in contact with the warm wood, it gets warm and its viscosity becomes lower. As the temperature of the wood falls, the thin epoxy is drawn in deeply before it begins to gel. By heating the substrate instead of the components, you get the best of both worlds-low viscosity epoxy on the work surface and longer working time in the mixing pot.

Potential Problems

Thinning epoxy with heat can create problems, however. Warm epoxy cures much more quickly than you may be accustomed to. Have things organized before you mix the resin and hardener and move quickly. Use one of the slower hardeners-206, 207, or 209-to increase the working time.

How warm is warms? should be able to comfortably touch the substrate or the component containers when they are appropriately warmed-about 115°F maximum. Excessive heat will cause the epoxy to harden too fast, especially in thick applications. Very rapid cure will overheat the epoxy. If smoke rises from the curing epoxy, it is likely the epoxy is damaged and should be replaced.

Thinning epoxy with solvent

Adding solvent is a quick, simple method of thinning epoxy, but unlike using heat to thin it, the strength and moisture resistance of the cured epoxy are drastically affected. Below are some of tne effects adding solvent has on West System epoxy. While there are a large number of chemicals available to thin epoxy, we selected acetone, lacquer thinner and denatured alcohol for this discussion because they are commonly available and do a good job of reducing viscosity. Additionally, these solvents evaporate quickly and are less likely to be trapped in the cured epoxy-an important characteristic. For a variety of reasons, fast evaporating lacquer thinner appears to be more appropriate for thinning purposes than acetone or alcohol.

Adding a small amount of one of these solvents has a significant effect on the viscosity of the epoxy. For example, adding 5% lacquer thinner makes about a 60% reduction in viscosity (Figure 3).

Adding 5% lacquer thinner to epoxy

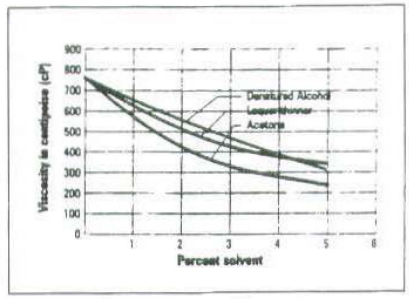


Figure 3. Viscosity of 105/206 epoxy vs percent of solvent added.

reduces the epoxy's compressive strength by 35%—a big hit in the mechanical properties of West System epoxy (Figure 4). The addition of more than 5% solvent results in an excessively flexible cured-material.

Thinning epoxy with solvent causes enough loss of strength that we (and most other reputable epoxy formulators) cannot recommend using it as a structural adhesive.

Adding a volatile solvent extends the pot life and cure time of epoxy and jeopardizes the reliability and predictability of cure. Additionally, with slow rate of cure, it takes longer before work can be sanded.

Adding volatile solvent may cause shrinkage of the cured epoxy. Applying thinned epoxy in large, confined areas (like consolidating a large pocket of rotted wood) is likely to trap some of the solvent. In thick applications, the epoxy cures very quickly and not all of the solvent has time to evaporate before the epoxy hardens. Over time, the solvent works its way out and as this happens, the cured epoxy shrinks and in many instances cracks.

Shrinkage also causes print-through. You may have a surface sanded smooth only to have the resin shrink. This shrinkage often reveals the texture of the substrate. Shrinkage can continue to be a problem until all the trapped solvent works its way out of the cured epoxy.

Adding solvents, especially acetone, alters the color of the cured epoxy. While the effects are not immediate, adding acetone to epoxy causes the color to change from slightly amber to very dark amber.

Adding solvent results in a temporary reduction in viscosity. Volatile solvents evaporate quickly as they are agitated during brushing or rolling, causing the viscosity to continually change as time passes.

Adding solvent to epoxy may damage the substrate. Many materials (Styrofoam for example) are not attacked by epoxy but may be attacked by the solvent used to thin the epoxy. Be certain to test the substrate with the solvent before using it to thin the epoxy. - *Brian Knight*

"Adding volatile solvent to West System epoxy has some adverse health and safety effects. West System epoxy components are nonflammable but the chance of fire or explosion goes up in proportion to the amount of solvent you add. Also, the vapors of many volatile solvents are hazardous to your health and proper ventilation is mandatory to prevent inhaling harmful quantities of them.

Adding volatile solvent to epoxy which is then applied as a coating may cause problems with various regulatory agencies. If your business is inspected for air quality, adding volatile solvents to West System epoxy may make your business noncompliant.

Adding solvent to epoxy to enhance fiberglass wet-out will result in more "drain out" of the resin on a vertical surface. The fabric will wet-out quickly but it may become resin starved when too much epoxy runs out of the fabric.

Does thinning epoxy make sense? In some situations, thinning is appropriate. In others, it is not. We feel that in most circumstances using heat to thin epoxy is preferred to using solvents. As long as the epoxy does not overheat during cure, the full physical characteristics of the cured epoxy remain. Adding solvent is a quick, simple method of thinning epoxy, but the strength and moisture resistance of the

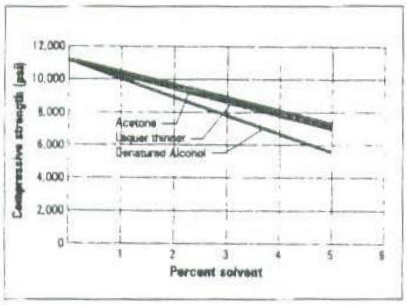


Figure 4. Compressive strength of 105/205 epoxy vs percent of solvent added.

cured epoxy are signiflcantly reduced.

We will continue to research this subject and publish our findings in *Epoxyworks*.

GEORGE'S CORNER

Fellow GP-4 builders:

The following article is not meant to criticize a fellow pilot or impugn his workmanship. I am only interested in extending our longevity!

A friend and local Glasair builder spent a number of years building his pride and joy. About seven hours into the flight test he had an engine failure in the traffic pattern. he was unable to communicate with slower traffic in front of him, which forced an extended pattern. He touched down in fairly rough ground just short of the runway. The aircraft broke in half just aft of the cabin and was totaled. The good news is that my friend walked away shaken but unhurt.

After much poking and prodding through the wreckage, they found the fuel selector valve failed to detent into the fullest tank during his pre-landing check. If you think about the possibility of some play between the valve handle and the valve itself, it's very possible to get it set somewhere between the tanks, with not enough flow to run the engine! The pointer could show the correct tank selection, but if you didn't feel it detent, due to play in the valve stem, you could stop the fuel flow.

The 4 way Weather head valve, shown on drawing #35, will detent into any of the four positions. It's imperative that no play is found between the valve stem and the flanged extension fitted to the spar.

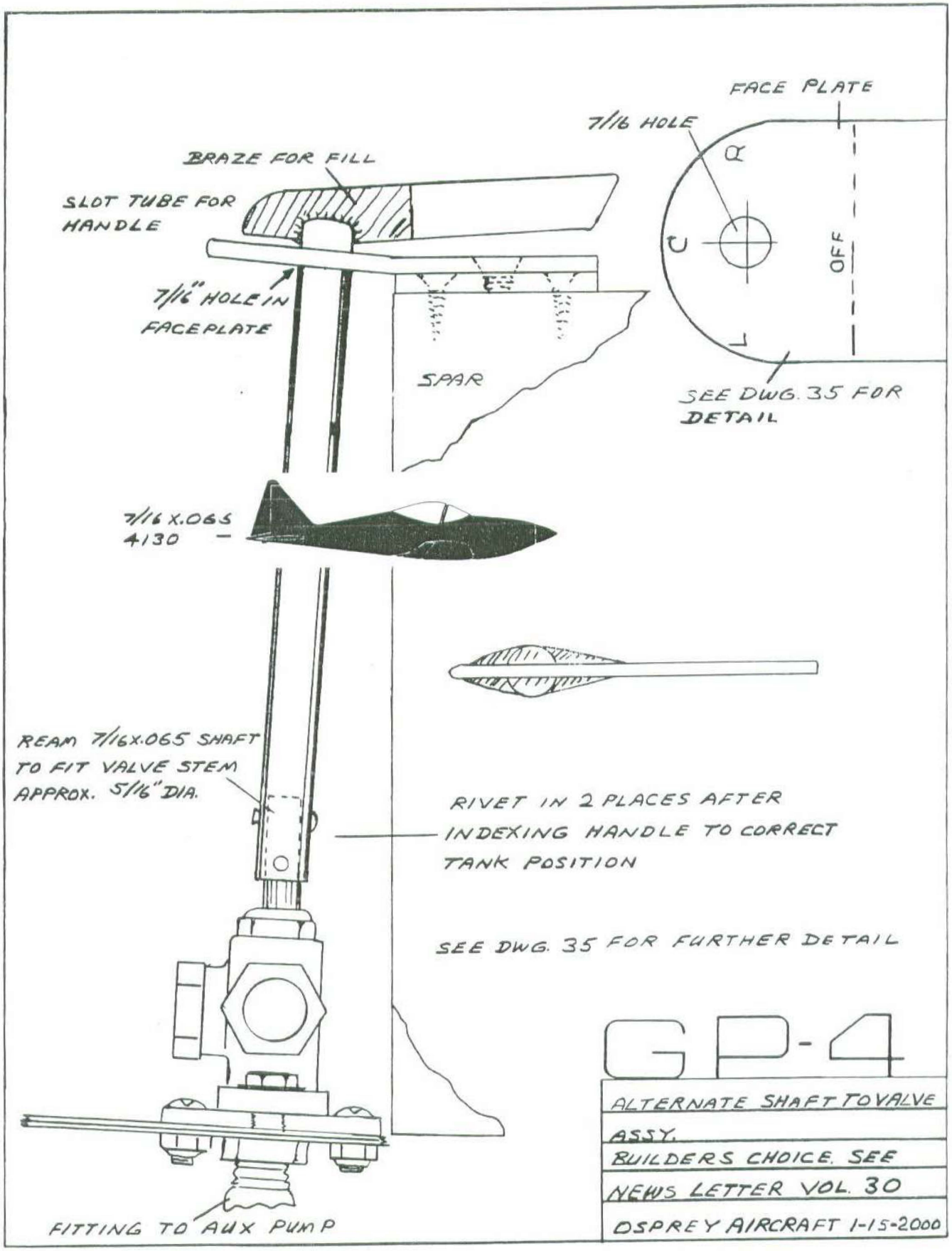
Over the years, I've sometimes found my valve is difficult to feel the detent. However, the stem-shaft connection is still tight, so I depend on the fuel valve, face plate for tank position.

To insure that the valve handle stays tight to the valve stem, you might consider riveting the handle shaft to the valve stem. This would require removing the face plate and shaft assembly from the fuselage. The riveted assembly may be a little easier to fabricate. Which ever way you decide to attach the shaft, just be sure you have a good, tight assembly. (See alternate valve assembly drawing herewith)
Some gas valves have small universal joints between the valve and the handle for misalignment. There is usually a little play in these small U joints, so they should be avoided to insure a positive rotation between valve and handle.

Jake and I have been experimenting with electronic ignition. We should have some numbers for you soon.

Regards to all,

George


FACE PLATE
7/16 HOLE
BRAZE FOR FILL
SLOT TUBE FOR HANDLE
7/16" HOLE IN FACEPLATE
SPAR
OFF
SEE DWG. 35 FOR DETAIL
7/16 X.065 4130
REAM 7/16X.065 SHAFT TO FIT VALVE STEM APPROX. 5/16" DIA.
RIVET IN 2 PLACES AFTER INDEXING HANDLE TO CORRECT TANK POSITION
SEE DWG. 35 FOR FURTHER DETAIL
FITTING TO AUX PUMP
GP-4
ALTERNATE SHAFT TO VALVE ASSY.
BUILDERS CHOICE. SEE NEWS LETTER VOL. 30
OSPREY AIRCRAFT 1-15-2000

The Classifieds

For Sale: GP-4 project: fuselage framing, vertical stabilizer framing, horizontal stab and elevators framing complete. Firewall installed. All fuselage internal hardware complete (D. Capps). All wood packages, two fastener kits. Project signed off by EAA Tech Advisor with compliments on construction quality. Fuselage signed off for closure. Stu Fitrell, sfitrell@lxpk.veridian.com or (301) 373-8087 or 25723 Vista Road, Hollywood, MD 20636. (27/28)

For Sale: GP-4 project - Most wood materials to complete. Most metal parts cut-to-fit and tack welded. New hartzel prop and spinner to George's spec's. Contact Tony Mikus in the evenings after 5:30 PM mountain time. (970) 963-9575 (27/28)

For Sale: New Hydraulic Gear Plans Upgrade. Convert your GP-4 manual landing gear system to hydraulic - electric system. Complete with emergency back up system. (Note: System must be installed prior to wing skinning!, no retro-fits) Complete print package for $150.00 Mail your checks to: George Pereira 3741 El Ricon Way, Sacramento, California 95864 phone (916) 483-3004 Fax (916)978-9813 E-mail GP-4@juno.com

For Sale: Pre-fabricated composite components for GP-4. Cowling , exhaust blisters, inlet ramps, tailcone . Complete four-piece package. Call or E-mail for current pricing. Shipment will be sent "Freight Collect" - Jake Jackson - Rio Linda, CA (916) 992-0608 E-mail jakejackson@jps.net

Back Issues: We have all of the GP-4 back issues (#1 thru #23) available for $3.00 each. Mail your checks to Bill Spornitz - 1112 East Layton Drive - Olathe, KS 6061-2936

Wanted: Looking for a GP-4 project that is "well under way" through "close to being finished". Will consider all projects. Contact me at (503) 646-5276 or by mail at Edward Mitchell, 13835 S.W. Devonshire, Beaverton, OR 97005

Wanted: An original video (not a copy!) that George Pereira made on the GP-4. I have a multi-copied video now, but is very poor. Will gladly pay a reasonable price. Contact: Spud Spornitz (913) 764-5118 or 1112 East Layton Drive, Olathe, Kansas 66061

For Sale: I have a T-18 canopy/winshield still in crate that I'll sell for $800.00. Rich Nadig Phone 423-396-2917

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E-mail ***GP-4@juno.com***

Subject: The Student Pilot, the First Month.

Week 1: **Monday:** Rain, **Tuesday:** Rain, **Wednesday:** No rain; no visibility either. **Thursday:** Take instructor to lunch. Discover I don't know enough to take instructor to lunch. **Friday:** FLY! Do first stall and second stall during same maneuver, cover instructor with lunch.

Week 2: **Monday:** Learned not to scrape frost off plexiglass with ice-scraper. Used big scratches on windshield as marker to set pitch. **Tuesday:** Instructor wants me to stop calling throttle, "THAT BIG KNOB THING." Also, hates it when I call instruments 'GADGETS'. **Wednesday:** Radios won't pick up radio stations, so I turn them off. Instructor seems to think I missed something during the introductory flight, **Thursday:** Learned 10 degree bank is not a steep turn. Did stall again today. Lost 2000 feet. Instructor said that was some kind of record. My first complement, **Friday:** Did steep turn. Instructor said I was not ready for inverted flight yet.

Week 3: **Monday:** Instructor called in sick. New instructor told me to stop calling her "BABE" Did steep turns. She said I have to have permission for inverted flight. **Tuesday:** Instructor back. He told me to stop calling him "BABE", too. He got mad when I pulled power back on takeoff because the engine was too loud. **Wednesday:** Instructor said after the first 20 hours, most students have established a learning curve. He said it seemed there was only a slight bend in mine. Ah-ha!...progress! **Thursday:** Did stalls. Clean recovery. Instructor said I did a good job. Also did turns around a point. Instructor warned me never to pick ex-fiancee's house as point again. **Friday:**Did pattern work. Instructor said that if downwind, base, and final formed a triangle, I would be perfect. More praise!

Week 4: **Monday:** First landing at controlled field. Did fine until I told the captain in the 747 ahead of us on taxiway to move his bird. Instructor says we'll have ground school all this week on radio procedures.**Tuesday:** Asked instructor if everyone in his family had turned gray at such an early age. He smiled. We did takeoff stalls. He says I did just fine but to wait until we reach altitude next time. C-150 will be out of shop in three days when the new nose-strut and tire arrive. Instructor says his back bothers him only a little. **Wednesday:** Flew through clouds. I thought those radio towers were a lot lower. I'm sure my instructor is going gray. **Thursday:** Left flaps down for entire flight. Instructor asked why. I told him I wanted the extra lift as a safety margin. More ground school. **Friday:** Asked instructor when I could solo. He laughed till he cried. What was so funny?

Remember: I don't write these words of wisdom,
I just pass them on down the line

Respectfully submitted by Chuck Kaplan, Walpole, MA

BUILDERS & FLYERS
GP4
NEWSLETTER

1112 EAST LAYTON DRIVE
OLATHE, KANSAS 66061

First Class Mail

NEWS FOR CRAFTSMEN OF FAST WOODEN AIRCRAFT!