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HAPPY HOLIDAYS!! Well, better late than never, anyway. Here's hoping everyone had a good one, and that Santa brought you that new avionics panel or engine you asked for. As for me, I asked for a bunch of spare time so I could get N75PL flying again. We'll see if I get my wish in the coming year.

Meanwhile, let's continue with correspondence. You guys really come up with a bunch of good ideas, and I'll do my best to pass them along so everyone can consider them.

Continuing as I have been over the past few issues, **DAVE PANTON** is next in line. It seems that I am not the only one who has had vapor lock problems with a PL. Dave has a different engine (Lycoming O-290) and carburetor (actually, an Ellison EFS-3 throttle body injector) than does my N75PL, but the vapor lock problems are similar. The common ground between the two is (obviously!) the fuel is getting sufficiently warm at some point in the system to change state from liquid to vapor (or to put it simply, "boil"), whereupon liquid flow to the carburetor/throttle body is reduced at least to some extent, if not stopped altogether. That's the simple part. The reasons for this occurrence can be multiple and complex. But rather than rambling on about this, I'll just let Dave P. tell the story, essentially as submitted for the Recreational Aircraft Association of Canada:

Auto fuel in Aircraft

Early last year I switched to regular auto fuel from 100LL in my Pazmany PL-2 homebuilt, hoping for some of the benefits claimed. This aircraft has two fuel tanks and the system is setup to draw fuel from either but not both tanks via a cockpit mounted three-way valve . There is a firewall mounted gascolator and an electric boost pump in series to the mechanical pump on the engine.

The system is ideal for initial trials and I was able to do the initial test flying feeding auto fuel from one tank or 100LL from the other. I did quite a number and variety of tests including climbs to high altitudes, raising engine temperatures as high as I could get them and so on. I was initially satisfied with the results and began flying with auto fuel in both tanks.

In cold weather it seemed to run just fine but when the weather turned warm I had my first bad experience after closing the cowl flap and warming the oil into the green range. I was at 4500 feet about 25 miles from the airport and experienced almost total engine failure, erratic running and very little control via mixture, throttle, carb heat. I opened the cowl flap to flood the engine with cold air, turned on the boost pump and was able to return to the field safely. The engine then ran erratically on taxi and died in front of my hangar.

The Lycoming O-290-D2B engine is equipped with an Ellison EFS-3 throttle body injector, changed from a Marvel Schebler MA3 carburetor two or three years prior. I assumed the problem was vapour forming in the fuel and contacted Ellison. They suggested this was correct and do not recommend auto fuel for this reason. Further, they noted if I wished to continue using it, I might try venting vapours via a return line to the fuel tank. This can be done by fitting an upright tee at the throttle body injector inlet and bleeding fuel and vapours off through an orifice (size to be carefully determined). As this was an extensive R&D project and the aircraft has its only fuel tanks on the wing tips, I chose to try cooling the fuel system instead.

I visited Bob Leavens and obtained firesleeve to cover the 601 hoses forward of the firewall. Also, I fitted 1" SCAT tubing to feed cool air to the electric boost pump, gascolator, mechanical pump and carb fuel inlet area. Cautious test flights with the cowl flap open and boost pump on seemed to prove this system satisfactory. I even did climbs to 9500 feet to try to simulate the problem again without any sign of trouble.

Nevertheless I noted at times in flight, the engine seemed to run just a tad erratically, never enough to say anything was wrong but enough to keep one's attention. I could only relate it to situations where I had closed the cowl flap tight to raise the oil temperature into the green, had the engine fully leaned and the boost pump off. Usually turning on the boost pump, opening the cowl flap and richening the mixture seemed to help it run more smoothly. Upon landing on a warm day the taxi idle was erratic although it never actually quit as it did in the first instance.

The final incident occurred after a stop of about 4 hours and a takeoff on a warm day. At about 3000 feet on climb, the engine went briefly to idle power and recovered a second or two later. I continued the climb to 4500 feet and returned to homebase an hour away without further incident, boost pump on, mixture rich and cowl flap open. In this case the fuel had been freshly pumped the night before.

Finally I did a bit of science (about time!!) and sampled 100LL, fresh regular grade auto fuel and auto fuel from the aircraft tanks aged two weeks. I used a bucket of hottest home tap water, a little plastic bottle for fuel and a 0 to 10 psi pressure gage attached to same via a rubber hose. Dressed for trouble, I did the tests in my backyard well away from the house. I half filled the small bottle, placed it in the hot water bucket and agitated it, watching the pressure rise to maximum.

I found fresh auto fuel pushed the needle to the pin in short order and judging from the rate of motion I expect it could easily have reached at least 15psi. The older auto fuel and 100LL were about the same, both under 10 psi. As a calibration, I tried air only in the bottle. It would go to about 4 psi. I finally learned fresh auto fuel seems to have substantially higher vapour pressure than aged auto fuel or 100LL. Admittedly my test was less than ideal but the results seem to correspond with my experiences in the air.

Since that time, I have been using 100LL and have not had further trouble. The Ellison people were correct in the first place. I am very happy with the Ellison's performance and have no intention to go back to the MA3 carburetor merely to use auto fuel. Admittedly this case may be a bit unusual but perhaps it will help you solve a problem for someone else.

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There you have it, straight from Dave P., who probably has about as many flying hours on a PL as anyone. I have a feeling that Dave's problem and my problem are not inherently the fault of the PL design, even though the common thread here is the aircraft type and the use of auto fuel. First of all, the PL fuel system is by definition an aircraft fuel system, and is intended to use aircraft fuel. While using auto fuel may have some benefits, auto fuel use may have some negative consequences also. (The negative consequences may cancel any positive economic benefits, if the engine quits!) I feel that in my case, there were multiple problems which were masking one another, to a certain extent. I believe I've solved the problems now (excessive heat under the cowling due to the heat muff, excessive fuel pressure to the carburetor with both pumps operating, and a carb. that needed work - and needed more work after the first shop handled it), but haven't had a chance to find out in the air yet.

As for Dave, I suspect a few differences between his airplane and mine which may account for his autofuel problems: First, C-GQUK has a somewhat larger engine (Lycoming O-290 as opposed to my O-235) and puts out a correspondingly larger amount of power. Since the byproduct of that power is heat, Dave has more heat to reject within the cowling. Not much, but some. If the situation is marginal, that may be enough to push it over the edge. Secondly (and this is a guess - I really don't know), it's possible that autofuel brewed for Canada has an even higher vapor pressure (and correspondingly lower boiling point at a given pressure) than does most U.S. autofuel, due to the generally lower temperatures found in Canada, even in the summer. (Yes, I'm aware that many parts of the U.S.A. are colder than many parts of Canada, winter and summer, but the distribution of different fuels to different areas is another question.) Finally, I have no idea how sensitive the Ellison throttle body injectors are to high vapor pressure. Are they more susceptible/less susceptible/or about equally susceptible to vapor lock problems as a Marvel-Schiebler carburetor? Anyone have any info on this?

One more point: I really admire your research efforts to compare vapor pressures of autofuel and aircraft fuel, Dave. Your methodology didn't provide absolute numbers (how does this compare with Reid Vapor Pressure values?), but the relative values seem to be valid. Your point RE: older auto fuel comparing closely with the pressures developed for 100LL avgas is interesting, too. This is another point in favor of refueling at the end of a flight, particularly if you don't fly often. The excessive vapor products will tend to evaporate from the tank vents over a period of time, particularly if the weather is warm. This probably won't work with your newer car, with the emissions control systems they have, but it will work for your airplane. We experienced this in a different way when I was involved with the EAA autogas tests several years ago. One of the FAA requirements was that a heated quantity of the fuel be tested in an airplane. The fuel we were testing was the highest Reid Vapor

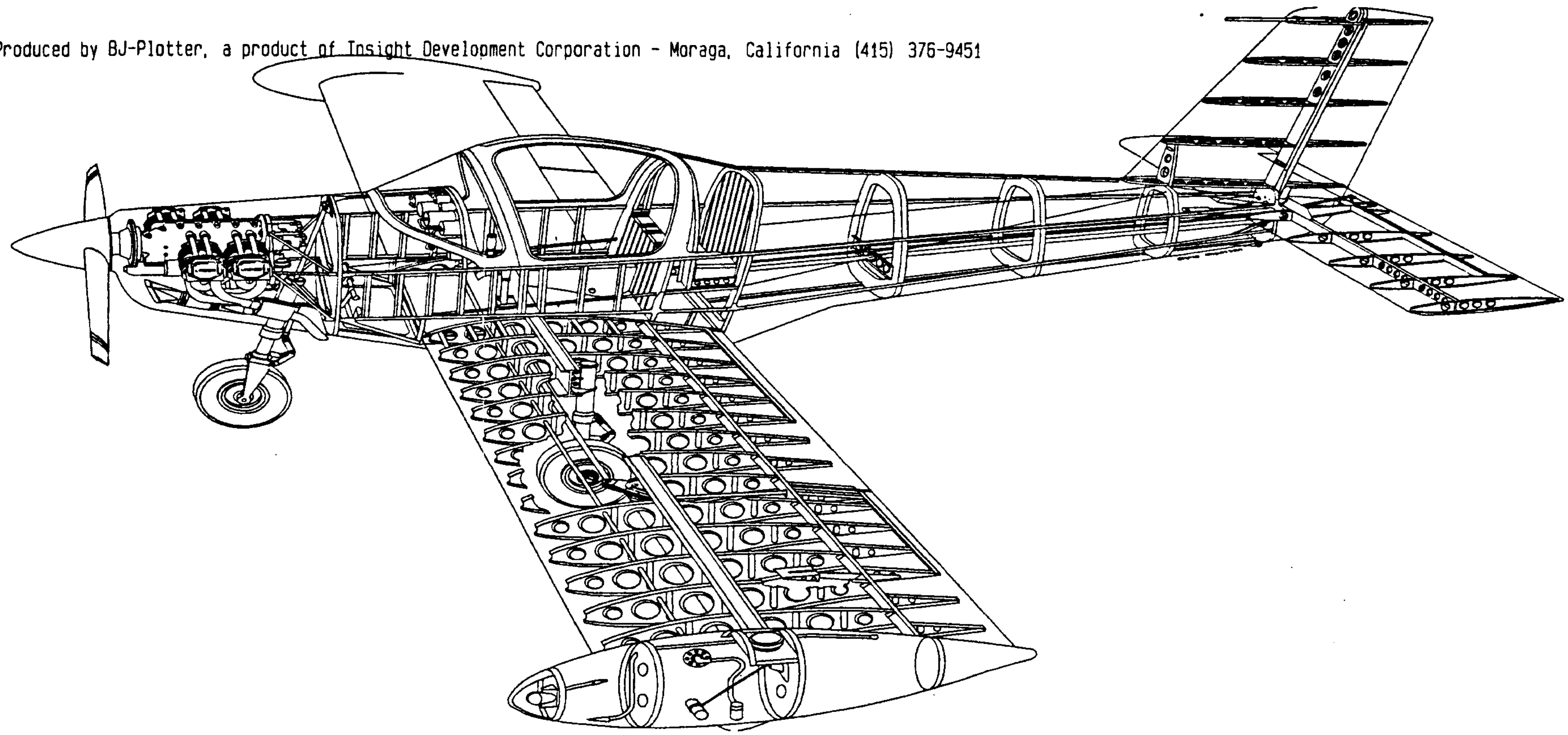
Pressure (RVP) fuel that had ever been brewed up by the Amoco research people in Naperville, Illinois. When we heated it (and that scared the hell out of everyone concerned!), you could literally see the stuff boiling if you looked in the drum. The bottom line to all this was that the airplane ran better on this stuff than on the unheated sample, since by the time it got into the airplane the most volatile elements had been boiled off - thus reducing the RVP! Logical when you think about it, but the Feds wanted us to test that way anyway. Moral of the story: If high RVP fuel is causing vapor lock problems, you can either (1) let it sit around for a while to evaporate off some of the higher volatility elements, and/or (2) warm it up. Gasoline is like water, in that the warmer you get it, the faster it evaporates.

Other considerations with autofuel and avgas: The reason I started using autofuel was not to save money (obviously, as little as N75PL has flown lately), but rather to avoid the lead contamination problems of 100LL avgas. While this fuel is supposedly "low lead," that's only true in comparison with the old standard 100 octane avgas. 100LL still has approximately four times the lead content of 80 octane avgas - no wonder it fouls your valves and plugs!! With autogas, you eliminate all this lead buildup problem.

However, a lot of autogas today contains various additives which were not in the picture at the time EAA and Peterson Aviation did their work for autogas STCs. The biggie is an oxidant called MTBE, which helps the fuel burn cleaner. From what EAA says, this stuff doesn't hurt anything, but there are a lot of other substances put into autofuel today that you have to watch out for. Alcohols are the prime culprit, be they ethanol (grain alcohol) or methanol (wood alcohol). These are also oxidants, and therefore desirable from an emissions standpoint. But they are also corrosive as hell to various goodies in your fuel system, particularly methanol. The tough part of all this is that it's difficult to tell if the fuel you're buying has any of this nasty stuff (or some other nasty stuff) in it. It's desirable from the fuel company's standpoint to dilute their gasoline with alcohol, as alcohol is cheaper than gasoline in bulk quantities. (Then why does it cost more for you, the retail consumer, to buy? I leave that as an exercise for the reader.) Since fuel produced with alcohol is cheaper and better for emissions, no wonder fuel companies like to dilute their gasoline that way. Check carefully if you use auto fuel in your airplane; read all about using alcohol in an airplane by reviewing magazine articles about the Rutan Racer, with its twin Nissan engines running on alcohol. Even with purging the fuel system after flying with alcohol, there were still corrosion problems in the fuel system. Sure puts out the power, though. Ask the people at the Indy 500. They rebuild their cars after each race, though, and I don't feel like doing that to N75PL after each flight.

Different subject: Some time ago Dave also sent along a beautiful CAD (Computer Assisted Design) drawing of a cutaway PL-2. See the next page:

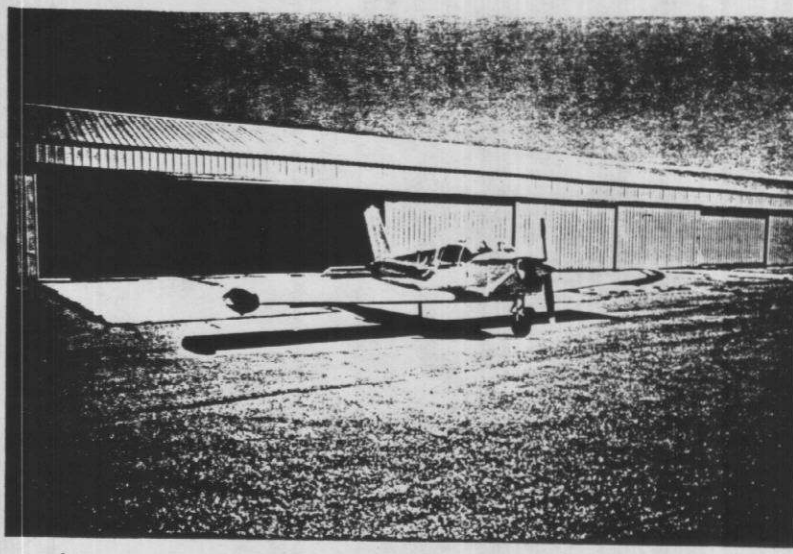
Produced by BJ-Plotter, a product of Insight Development Corporation - Moraga, California (415) 376-9451

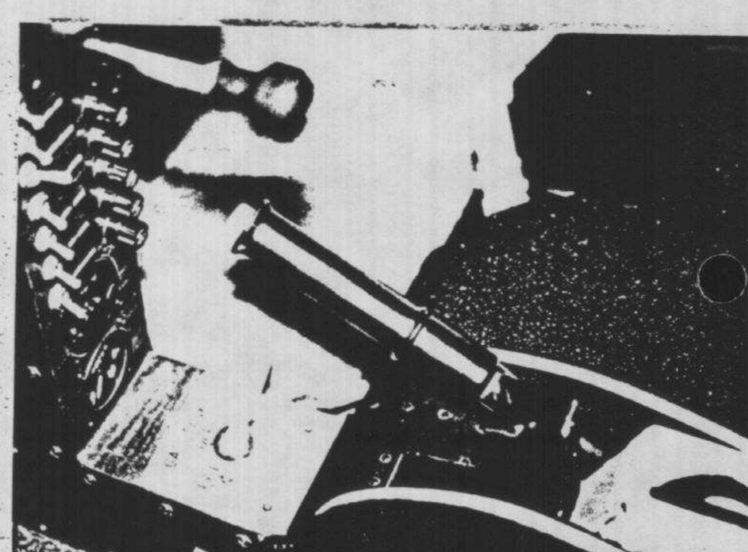


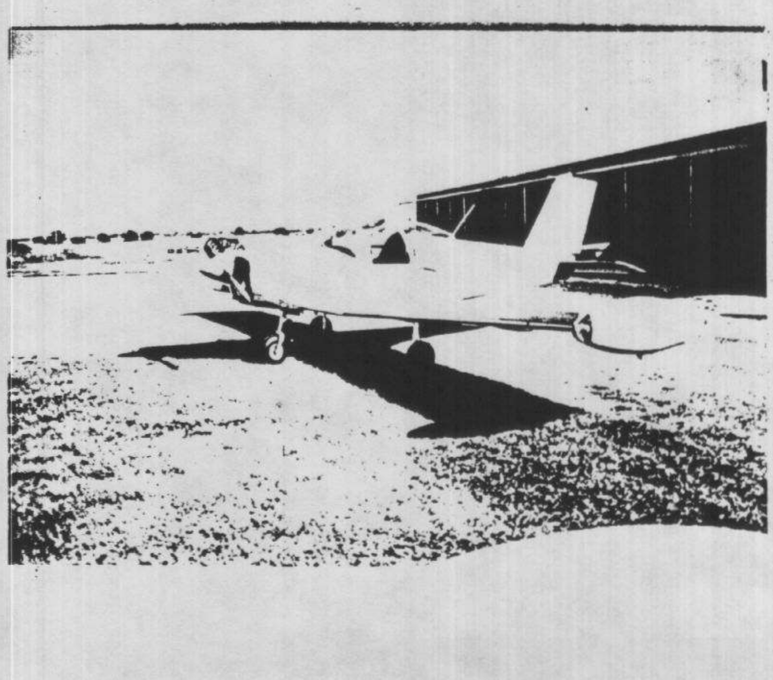
AutoCAD drawing by Chris Knowlton; courtesy of Autodesk, Inc.

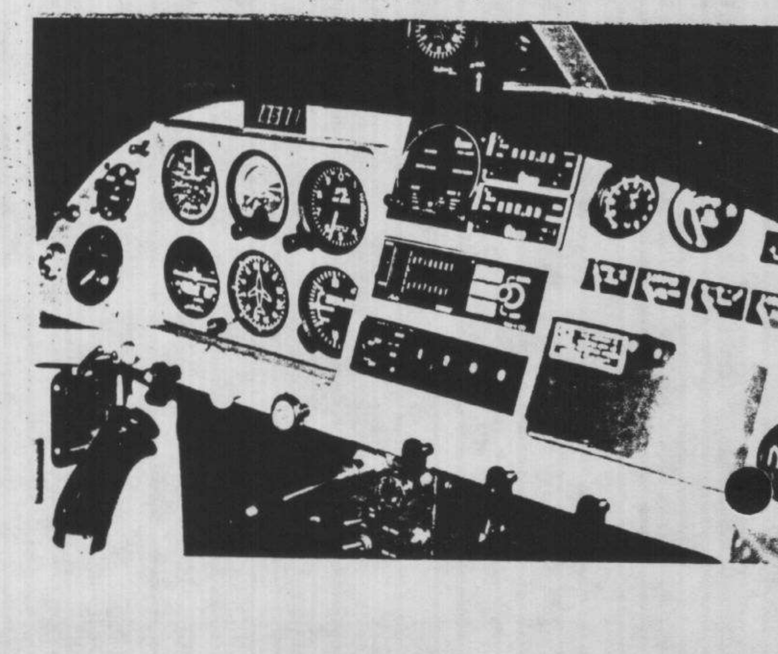
I went ahead and left the advertising on the sheet, just in case any of you guys are interested in how it was done. CAD drawings are like airplanes, though - a beautiful end result is primarily the product of the person doing the work (Chris Knowlton, in this case), rather than the equipment they're working with. Yes, I know it's a bit elongated, but that's a function of minor incompatibilities between the CAD program and printer. Actually, I think the PL-2 looks pretty slick when it's stretched a bit like this. What do you think, Paz? Can you redesign it like this? Might be kind of tough to overcome the problems of the ovoid tires and engine cylinders, though.

Way back when, **PAZ** forwarded some color photos from **BILL RAKSANYI** of Bill's PL-1. See below:

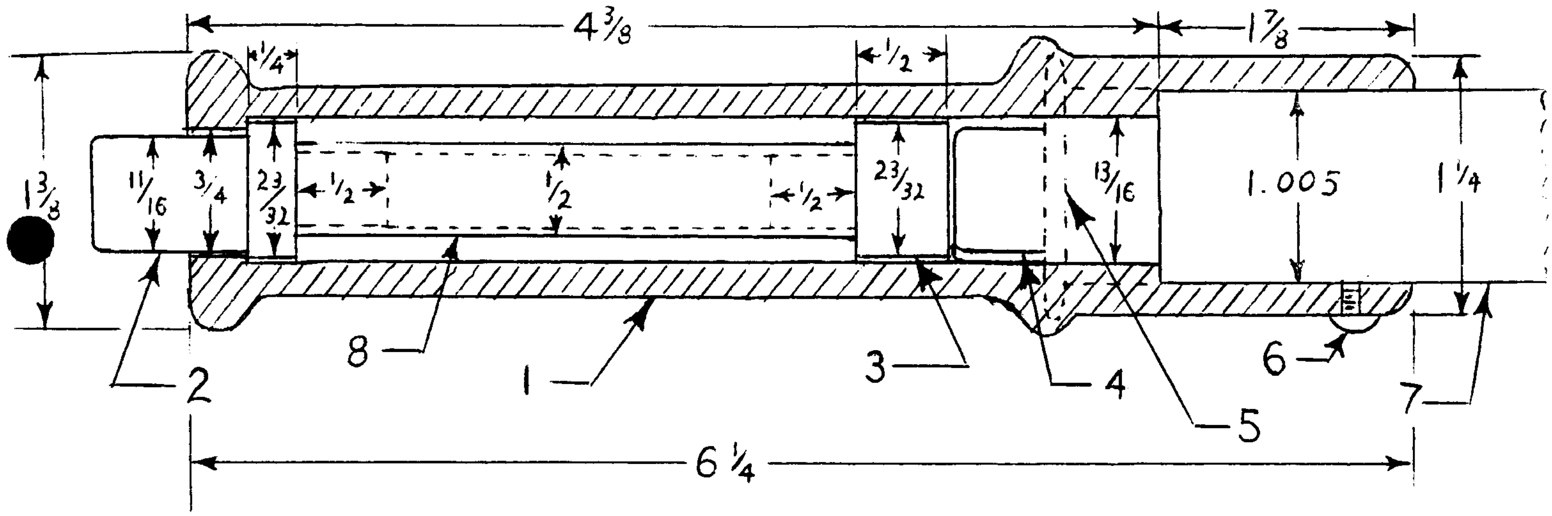








The above photos were taken shortly after Bill completed N45WR: in fact, the photo of the entire aircraft was taken at Gen-Air Park in Indiana on the day of the first flight. Nice panel, Bill! And by the way, there's a story (and sketch below) on the snazzy flap handle: This handle is not stock, but is a relatively simple and quick way to provide an extension for your present flap handle for more leverage. I made up the sketch below from Bill's overlay sketch on his plans, to save space. Basically, the end cap of the flap handle is removed and an aluminum tube extension is installed over the end of the handle. An extension pushrod is installed within the outer extension, and bears against the existing release button in the end of the old flap handle. The sketch below should make it clearer. I numbered the major components and included an explanation of each of those components below.



1: Bill R's new flap handle extension. The extension is machined from 2024-T3 aluminum rod.

2: New release button. Formed from Nylon rod. This button serves the same function as the old release button (4).

3: Release button extension end cap. Also formed from Nylon rod. This end cap bears against the old flap release button.

4: The original flap release button. You'll need to keep this part.

5: The original flap handle end cap and retainer for the original release button (4) and pushrod and spring inside the original handle. You can remove this and discard or keep for a souvenir if you want.

6: 10-32 machine screw to hold the extension to the original flap handle. Drill and tap the original flap handle for this screw, so it penetrates the wall of the flap handle. This will ensure that the handle extension will not slip off the end of the original flap handle.

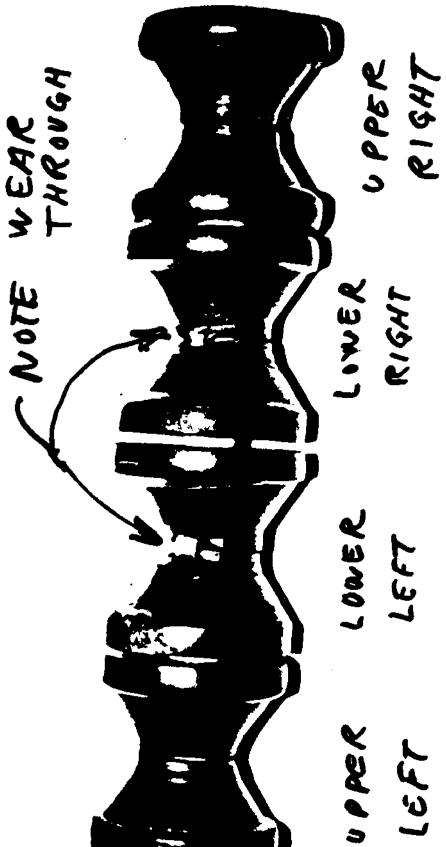
7: The original flap handle, of course!

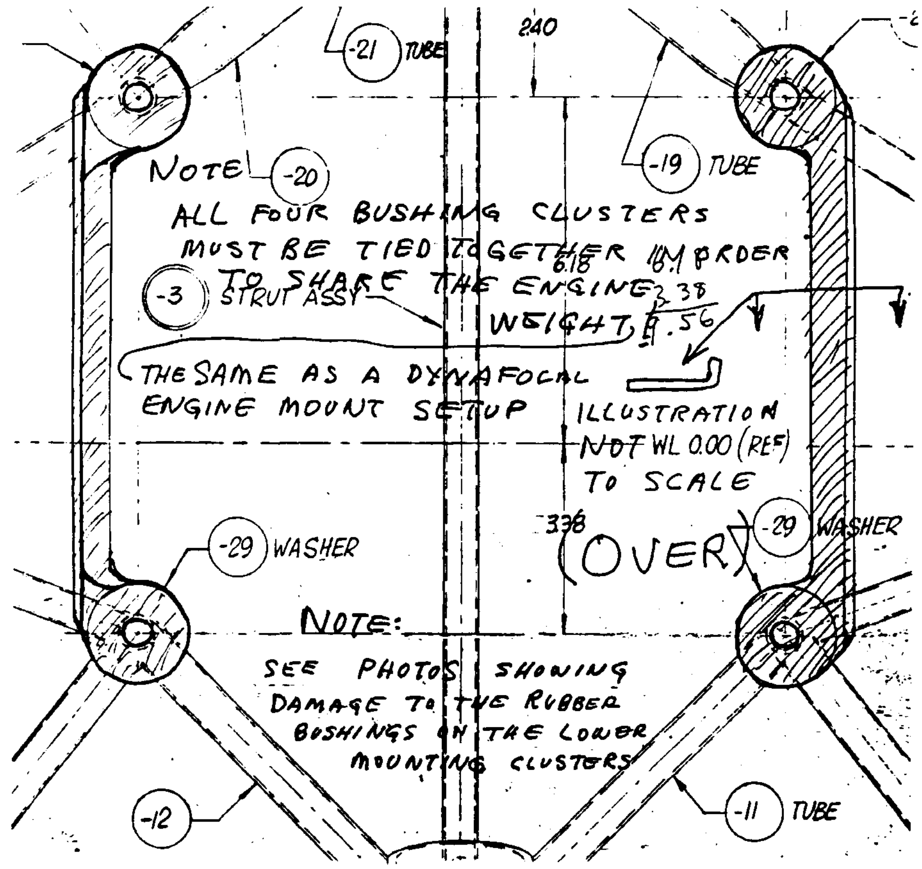
8: Flap handle extension pushrod tube. This is also aluminum, 1/2 inch outside diameter as you can see. Length is nominally 2-7/8 inches, but obviously you'll want to adjust this length to allow a tiny bit of play when the whole thing is assembled, in order not to be constantly bearing on the original flap handle release button.

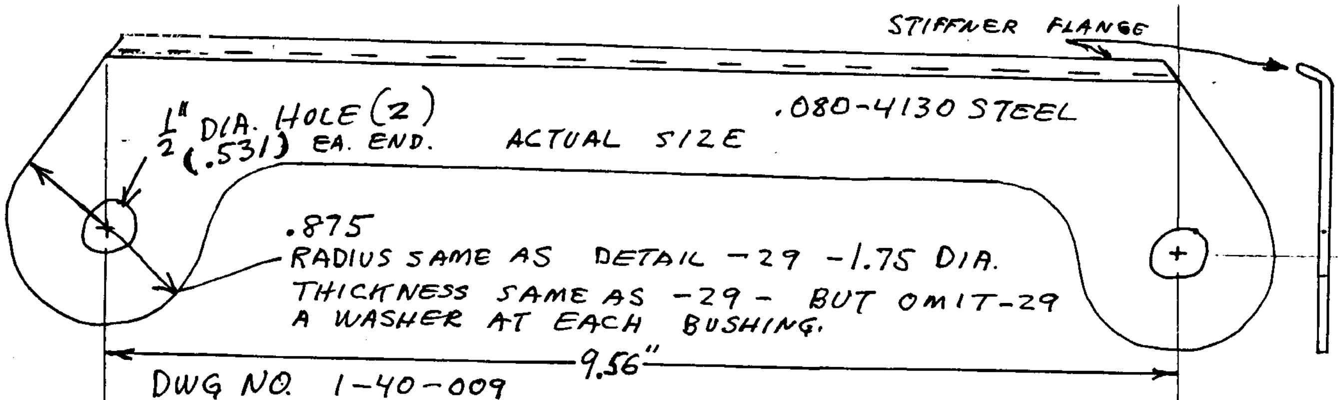
The sketch is (more or less) to full scale, and all of the dimensions on the sketch are in inches. The smaller the fraction, the tighter the tolerances. I would suggest something on the order of +/- .01 inch for the various inner diameters, with a first cut for the inside of the handle extension socket (the area that fits over the existing flap handle) of 1.000 inch, and working it out from there to precisely fit your particular flap handle. You'll want a tight fit here.

To assemble all of the above, remove the original flap handle end cap (5), being careful not to let the spring eject the release button (4) into your instrument panel. Insert the 1/2 inch long end plugs of the extension release button (2) and extension end cap (3) into the aluminum extension pushrod tube (8), slip the assembly of (2), (3) and (8) into the new extension handle (1), and install on the end of the old flap handle (7). The result will be to give you approximately 30% greater leverage on those flaps when you lower them, or in other words to make it some 30% easier to lower them under any given conditions. Obviously, those of you who have not yet reached this point in construction, can accomplish the same thing by making your flap handle and the internal release pushrod longer in the first place. This fix is primarily intended for those of you (and me) who already have a completed flap handle assembly, and want to reduce the force required to lower those flaps - especially for the last notch when you're close to Vfe. (Why you need full flaps is another question, but that's your business.) By the way, the above (and below) were provided to me by Paz; however, they were originated by Bill R, as noted above. If you have any questions that aren't answered by the above, please contact Bill Raksanyi directly at 7510 McCook Avenue, Hammond, IN 46423, or give him a call at (219)844-3280. No collect calls please, and please remember to send a stamped, pre-addressed envelope along for a reply.

Another problem which some of you may have experienced, is uneven wear on your conical engine mount bushings. I believe this is going to be true of nearly any airplane using such bushings, but Bill R. has come up with a fix for our PL's. The photo shows the problem with worn through engine mount bushings on Bill R's N45WR, with the upper right sketch showing an overlay of Bill's fix on the PL engine mount drawings. The lower sketch is a detail of one tie. See the next page for photos and sketches:







THIS CHANGE WAS DONE BECAUSE THE ENTIRE ENGINE + PROP (O-320) WAS HANGING ON THE TWO LOWER BUSHINGS ONLY! THE TOP TWO MERELY WENT FOR A RIDE. THE HEAVY LYC. ENGINE + PROP WORE THROUGH THE TWO LOWER MOTOR MOUNT BUSHINGS AND RESTED ON THE BOLTS (METAL TO METAL) AND THE EXCESS VIBRATION CAUSED CONSIDERABLE DAMAGE TO MY INSTRUMENTS THAT HAD TO BE REBUILT FOR ($850.00) HORIZON — D.G. — ALTMETER — RATE OF CLIMB. THE UPPER BUSHINGS WERE PRACTICALLY NEW BECAUSE THE ENGINE MOUNT (UPPER SIDE) DID NOT. SHARE THE VERTCAL WEIGHT OF THE ENGINE + PROP. THIS CHANGE WAS MADE AND THERE IS A TREMENDOUS DIFFERENCE IN THE ENGINE VIBRATATION PERFORMANCE, PASSING THIS INFORMATON ALONG TO YOU, I WOULD RECOMMEND TO USE IT FOR THOSE PEOPLE WHO. USE THE HEAVIER LYC ENGINES! HOPE YOU APPRECIATE THIS INFORMATION.

Sincerely "Rocky" N45WR

Bill's comments on the sketches (reduced in size for printing; they're not to scale) are pretty much self explanatory, I believe. I can certainly believe Bill's statements concerning the vibration from the engine being in direct contact with the mounting bolts! I've had some excessive vibration myself, particularly at startup and cold idle, but I believe that to be mainly due to the (before rebuild) carburetor. Haven't had a chance to run it enough to check this out, though. This spring!

And that's it for issue no. 88 - out of room again. After tidying up a couple other projects (like income taxes and the current issue of the flight instructor revalidation course), I'll get into the next issue with a report on **D. J. SCHNEIDER's** PL, and a LOT of information from **DUANE SEYMOUR** and his progress, questions and tips on N25DS. Keep 'em flying, or working on 'em!

--Jack McCombs, PL Newsletter Editor