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ROCKFORD FLY-IN Another Fly-In is over and anyone who attended will tell you that it was a tremendous experience, especially for T-18 builders. Many of us had a lot of fun assembling the outer wing panels and the main center wing spar for the EAA Headquarters T-18. Paul Poberezny has extended a hearty thanks to everyone who helped on this project. Paul is very anxious to see this T-18 get completed because it is going to be used as an EAA Headquarters executive aircraft in which Paul will travel around to the various fly-ins throughout the country. On Saturday, Gov. Kerner of Ill. stopped in to view our progress. He said he has been watching it's progress during the last three years and hopes that by next year he will get a ride. All of the major components have been completed with the exception of the center wing which is about ready for assembly. Bill Chomo, who donates a lot of time to the EAA museum, has been working on the T-18 during the past few weeks in addition to his own T-18 project. We hope Bill will be able to find someone to help him because building one T-18 at a time is a big enough project.

T-18 Forum On Tuesday, August 2, at 11:00 a.m., a T-18 Forum was held in the main meeting tent at the Fly-In. John Thorp gave a brief history of the T-18 and then answered questions from the audience. Here are a few of these questions and answers.

1. What is the story on tolerances for the various parts in the plans?
ANSWER: The only tolerances called out are those required for proper assembly. None of the tolerances given are for strength reasons. The dimensions which are carried out to four places are not an indication that you are expected to work to four place accuracy.

2. We have heard about some slop appearing in the horizontal tail pivot points. What is the story?
ANSWER: Slop in the horizontal tail pivot point is not a problem for flutter reasons. However, there is no slop permitted in the tab linkage. Any slop in the tab linkage could cause flutter. The loading on the horizontal tail bearings is very low so no wear should occur due to bearing loading. Bill Warwick's T-18 now has 470 hours on it. It does have some slop in the horizontal tail but it does not appear to be increasing and has never caused any problem.

3. Center of gravity limits have not been called out in the T-18 plans. What should they be?
ANSWER: The theoretical neutral stability point is at 34% MAC. The N299V aircraft has demonstrated a neutral stability point at 31% with 94 pounds in the baggage compartment. This forward shift in the neutral stability point is apparently due to the high friction in the horizontal tail bearings. The lower this friction, the more aft will be the neutral stability point. It would be better to use anti-friction bearings in this horizontal tail pivot but it would be advisable to enlarge the fitting slightly if they were used. The forward c.g. limit is 15% MAC.

4. What horse power limits would you suggest for the T-18?
ANSWER: 125 hp is the minimum permissible and I would not recommend anything larger than a 180 hp Lycoming engine. Any one of the 4 cylinder engines over 125 hp would be satisfactory.

5. When are more drawings coming out?
ANSWER: I have now published 171 drawings. It was not originally planned that this many drawings would be published but the added expenditure has been made possible by the larger than expected volume of sales. 442 sets of plans have been sold. I am presently swamped with work connected with making a

living and I do not know how soon additional drawings will be completed.

6. Could the T-18 be made into a single place design?
ANSWER: The T-18 design would not be appropriate for a single place or for more than a two-place aircraft. Please leave it as a two-place. I hear about people who talk about simply lengthening the fuselage and changing it to a 4-place aircraft. This is not a safe thing to do and it would require a complete redesign. It is possible to go to as high as 1600 lbs gross weight but remember that the design calculations for the 6g aerobatic loading was based on a 1250 lb. limit. When you exceed this limit you do not have a fully aerobatic airplane.

7. What is the present estimate on performance?
ANSWER: Lee Hamyln says he gets about 150 to 155 true airspeed cruise on Ralph Thenhaus' airplane at 6.8 to 6.9 gal/hr fuel consumption. As you know, Lee won the AC Sparkplug rally at the Fly-In. I am also happy that Bob Kaergaard came in second.

8. What will flaps do?
ANSWER: They will reduce the landing speed only 5 mph but the biggest help will be to increase the glide slope by 8 to 10°. This will help the pilot judge his approach better.

9. What can a builder do if the FAA in his area doesn't like pop rivets?
ANSWER: Under the present regulations the FAA cannot legally prevent you from using pop rivets. If he gives you a hard time I suggest you go to his boss and his boss, etc. Editor's Note: I had a discussion with Bill Stout from the FAA in Washington regarding this subject and he confirmed that there is no specific requirements for homebuilt aircraft materials and the we can use virtually anything we want to. However, the local inspector may place whatever restrictions he sees fit on your aircraft until it has been proven out. The new proposed FAA regulations will hopefully clear up interpretations of items such as this.

Lee Hamyln reports that Ralph Thenhaus picked up 75 rpm with his new streamlined cowl and the prop extension. Apparently the prop extension gets the propeller out of the interference of the cowling and gives better efficiency.

QUESTIONS ASKED AT THE FLY-IN (L.D. Sunderland)

While I was working on the T-18 wings at the Fly-In I naturally was asked many questions about the project. The single item which seems to have more people scared is the forming of the wing ribs. People will apparently go to any extent immaginable to keep from trying to form a rib. They will notch them, crimp them, or pay extremely high prices for someone else to form them but they are afraid to tackle the very simple job of forming them as described in the building instructions. I think forming the wing ribs is one of the simplest tasks of the whole T-18 project. Just get the right tools and give it a try. But first be sure to read T-18 Newsletter No. 4 written by John Shinn on how to form ribs. Just be sure to get a good bucking bar, the right type of hard rubber mallet (available from Sears), and don't cut the nose of the rib to the exact size until after forming. If you cut the rib to the exact size at the nose you will surely run into trouble with a sharp kink at the bend line. I think it would be completely unnecessary to form your ribs out of 2024-O and then heat treat them.

Nearly everyone wanted to know how to make dimples in sheet stock. I strongly recommend that you follow the advice given in Newsletter #8 dated May 17, 1965 and make the simple dimpling tool shown there. If you do not have the facilities to make this tool you probably should not be building a T-18. Be sure to put a radius on the insert for the female die. Otherwise, the

flange on the male die will invariably pinch the metal and cause rings to show around the outside of the dimple. The Whitney Co. had a display at the Fly-In and they were pushing their combination dimpler and punch which will punch and dimple in the same operation. I strongly do not recommend this tool for two reasons. First it is impossible to punch and dimple with this tool without causing very bad cracks and tears around the edge of the hole. Furthermore, I can't imagine any holes in the T-18 which could be punched and dimpled at the same time using the type of matched-hole tooling which is described in the building instructions. The second reason why this tool is not good is because it does not produce a good quality dimple. The male die does not have a flange and therefore does not hold the metal down firm. The dimpler supplied for the Whitney punch by Sport Aero does have a flange around the male part and therefore produces a much better dimple. About the only place you will find the Whitney punch dimpler of value is for dimpling frames and wing ribs.

There were the usual questions regarding the use of pop rivets. Several reports have come in from certain FAA regions where the inspectors do not like pop rivets. If anyone finds this to be the case, ask the inspector to show you in writing what his authority is for disapproving of pop rivets. Since he has no legal authority for this you should have no problems but if he persists, get his objection in writing and send a copy to John Thorp.

Many people want to know about putting baffles or stiffners in the gas tank. John insists that baffles are not needed in the T-18 gas tank for damping of the gasoline. Furthermore, the baffles make the tank much more susceptible to fatigue due to vibration. His experience is that a tank with baffles cannot be made to pass a shake test.

SHEET AND ALUMINUM TUBING KITS - I have just received a new quotation from the distributor on aluminum kits. Prices have all increased due to the war. The prices for a quantity of 5 are: Partial kit - $240. Complete kit - $315. A further refund of about $15 will be made if over 8 orders are received.

If you want one of those kits send a certified check or money order to me made payable to Whitehead Metals Inc. It will be shipped direct to you. The complete kit includes everything you need in sheet and tubing. One complete and one partial kit will build two T-18's.

SPORT AERO Kent Hugus is retiring from the Navy August 31. He doesn't yet know where he will locate. He sends the enclosed notice.

CONVERSION OF THE LYCOMING O-290G FOR THE T-18 - By John Thorp (Based on a group discussion at the T-18 project during the 1966 EAA Fly-In, Rockford, Ill.; edited by J.N. Shinn)

Engine Background - The first engine of this Lycoming series was a 235 cu. in. model. I believe it had a 4-3/8 bore with a 3-7/8 stroke. The next step was to go to a 4-7/8 bore with the same stroke which gives 290 cu. in. They felt that the shaft was a little light so they beefed it up. Thus the standard O-290D shaft used in the O-290D and D2 is stronger than the O-235 shaft which they put back into the ground power engine, the O-290G. The next step was to bore it as much as they could which brought it up to 5-1/8" and thus the O-320. Except for provisions for a hydro-control propeller, there was no difference in the crankshaft between the standard O-290 shaft of the 125-135 hp engines and the shaft they used in the O-320 engine of 5-1/8" bore which was first rated at 150 and then later at 160 hp. Since it was bored out twice they couldn't make the bore any bigger, so as a next step they started increasing the stroke. They went 1/4" from 3-7/8" to 4-1/8" and this gave the 340 cubic inch engine. With the 5-1/8" bore in the 4-1/8" stroke, you have 340 cu. in. Now you can use the 340 cu. in. shaft with the 4-7/8"

bore and you have 309 cu. in. The next step (and the reason why there were not more O-340's built), was that they said, "Well, let's see how big an engine we can make". As a matter of fact, Piper had an airplane that had to have it. The original Comanche was thought to have been capable of flying with the 150 hp engine and it didn't work out. Since they had bored it as big as they could make it, they then stroked it as far as they could stroke it which was another 1/4" to 4-3/8" stroke which is currently the biggest engine that they make in the 4 cylinder series. It's 5-1/8" bore and 4-3/8" stroke and this is the O-360 (180 hp).

Part Interchangeability: The bulk of all the parts in this whole series of engines that I talked about are interchangeable. Some of them strictly interchangeable without doing anything to them, others require a certain amount of modification. For example, you can put an O-360 crank in the GPU engine, O-360 cylinders on this engine, and O-360 pistons and rods, but you have to do a little bit of sculpturing in the case with a rotary file to get clearance for the rod bolts on the connecting rods. But this is exactly what Lycoming does. Everyone of the earlier O-360 engines had hand-sculptured cases. They were basically the same case but they had to remove a little material in order to get rod clearance. (They have a new series of engines now which they call the wide deck engine, that I am excluding from this discussion because none of the power section parts will fit on the GPU engines.) I'm talking about the O-360's used up to about a year and a half ago. But back then, you could mix up almost any combination of parts that you wanted. I put a set of inclined-valve cylinders off the O-435 (the engine that was used in the Navion and the Aerocommander), on a ground power engine and called it the O-290G-Whiz because it was 290 cu. in. but it was really a hot-rod engine. Now the only real problem with that was that the O-435 has hydraulic lifters where the ground power engine is set up for mechanical lifters and the rocker arms for the O-435 cylinders gave you no provisions for valve adjustments. So this problem was never completely satisfactorily solved. We did solve it by welding, etc. but we didn't feel that this was too good. I am sure that there is a way that you can actually match up the rocker arms and have an O-290G-Whiz if you want to; it would put out about 160 hp.

Crankshafts: There's a surplus crankshaft from the O-320 that's used in the Piper Twin Comanche. The shaft has lightning holes in it and because of propeller problems with a twin-engine plane it has been necessary to replace the shaft with one that has a heavier flange and no lightning holes. As a result there are shafts becoming available that are perfectly satisfactory for single engine airplanes that are much better than the standard O-235 shaft that's used in the ground power engine. This shaft is basically the shaft that is in the 150-160 Lycoming engines.

The best source I know is our engine repair stations that at the time of overhaul an AD note must be complied with so the shafts should be available through them. You can use the GPU piston, valves and all, but of course there isn't any point in using this heavier shaft if you are going to stay with the standard GPU parts. This shaft is externally the same dimensions as the 235 shaft so the compression ratio and displacement would be the same. The shaft that I talked about yesterday that does a lot of things at once is the shaft from the O-340. Now unfortunately there were not many O-340 Lycomings made. The shaft can be purchased new from Lycoming for around $500. This one shaft does a lot of things; it will increase the displacement from 290 cu. in. to 309 and will increase the compression ratio of the standard GPU pistons from 6.5 up to 8.1. As a result you will have an engine that's capable of putting out somewhere between 155-165 hp (depending on the rpm that you elect to run it) by only just changing the shaft. You have to use a minimum of 91 octane fuel. The shaft is structurally stronger even than the O-320 shaft and is quite adequate for any power that you can get from the engine even with

additional modifications such as the use of the big intake valves and seats, the big carburetor, and other hop-up items that can be incorporated in the engine.

Carburetors: It has been my experience that the MA-4 makes a very excellent carburetor for this engine. If you can find one from an L-5 (the O-435 190 hp Lycoming, 6-cylinder engine is used in the L-5) this carburetor may be used fairly successfully without any modifications or any work on it at all. It's just a little bit rich but all this means that you start your leaning a little bit early. If you want to go to the next step above that, take the carburetor to a Marvel-Schebler Repair Station and have it set up for a 150 Lycoming and this works perfectly on this engine. It's about as good an arrangement as you can get. If you tell them you want to use it on O-290G, they are obligated to send you packing; so don't intimate that you are going to use it on anything but an O-320 engine.

Valves: The exhaust valves that are stock in the GPU are superior, in my opinion, to the exhaust valves that you buy from Lycoming for the O-290D or D2 engine. The superiority is in what appears to be a higher heat-resistant steel and the provisions for the valve rotator caps. This valve is identical externally (except for the diameter of the stem) with the exhaust valves that are used in the later and more sophisticated Lycoming engines.

Piston Rings: An entirely satisfactory set of rings is the stock repair kit that is furnished with O-290G which uses a chrome top ring. The second compression ring and the oil ring are cast iron. These rings are good for somewhere between 500 to 600 hours before the oil consumption becomes excessive. The rings seat in easily; it makes an entirely satisfactory engine. If you want to have a 1000 hour to 1200 hour engine, then you should use all chrome rings and you can buy this as the stock ing set for the O-290D.

Fuel Injection: I have had no experience with fuel injection on these engines and I have no recommendations about it. I can say this: I wouldn't advise an amateur builder without considerable test facilities to try to adapt a fuel injection system from some other engine to the O-290G engine. I know that it becomes a laboratory job and it isn't something that the average homebuilder wants to become involved with. If it comes with the engine, then fine.

Magnetos: The S4LN-21 impulse coupling mag which is the only magneto furnished on the ground power engine is more readily available on the S4LN-20 which is normally used on the right-hand side of this engine as an O-290D2 and the O-320, etc. The T-18 mount was designed to use either two S4LN-21 with the impulse coupling and the adaptor plate, or if you do use the stock S4LN-20 you have to sculpture out some back clearance on the mount and then you have to add a reinforcement on the front. Practically, it's easier to get the -21 magnetos and practically there is some virtue in having two impulse coupling magnetos. In two experiences (not with this engine, but the little old 145 Lycoming in the Scooter) I have had the magneto of the impulse coupling go out and I was dead whereas if I had had two impulse coupling magnetos, I could have gotten the engine started and there was still enough magneto function so that it would have been safe to have flown home. As it was I was "dead on my feet," I had to have an overhaul on the spot. In one case I had to make a bus trip down to Los Angeles to get the magneto overhauled and another bus trip to get it back on the airplane. So practically, the thing to do is to use the T-18 mount setup just the way it is and use two of the -21 magnetos.

Oil Cooler: It isn't possible to use the O-290 engine in the summertime anyplace in the United States without an oil cooler. You can probably get away without it in the wintertime but you'll run over temperature in summertime

if you do. A very satisfactory oil cooler for this is the Corvair oil cooler which if you bought a lot of them you could get around for four or five dollars apiece. If you buy one across the counter from a Chevrolet service agency, it will cost you somewhere around $20. But $20 against $120 or $180 (for an aircraft cooler) is a cheap oil cooler and it is more effective than any other oil cooler that I know of. Or you can go to a junkyard too. The coolers are pressure-tested to pressure far in excess of anything that's needed for an airplane engine and I do have type certification of a Skyskooter with a Corvair oil cooler on it. The FAA took a hard look at the thing and first they said, "nothing doing" but I got Harrison to furnish me the testing, inspection, and qualification data for the cooler and then the FAA said, "well this is better than the aircraft coolers and we will have to buy it."

Mounting the Cooler: You make an adapter block into which you can thread pipe fittings to connect Aeroquip hose and use 2 O-rings in the grooves in the cooler and just one bolt to hold it together. Preferably, it should be mounted in a position right ahead of #2 cylinder (the front cylinder on the left-hand side). The oil take-off is from the oil gallery (front right) and to keep from robbing the engine of too much oil, it is necessary to put a restrictor in this hole. Use a steel AN fitting with a 1/8 NPT that will screw into the gallery which will go to 1/4" hose. Use 1/4" hose which is adequate for this partial flow setup. We braze up the hole in the 1/8 pipe end of the fitting and then drill it out 0.070 to 0.075.

Oil Filter: I am also recommending the use of the Corvair oil filter. It's a little A-C paper-type filter. Take the oil through the filter first so that you are filtering hot oil and then from the oil filter go to the oil cooler. The filter can be mounted on the right-hand side of the engine or underneath the engine depending on cowling space available. Use a standard Corvair part for this; it's the adapter that is used to put the oil filter on the turbo-supercharged versions of the Corvair engine. They have to have an adapter to move the cooler out sideways and this gives you the hardware which you can cut up and put the tapped pipe fittings in for your plumbing. It also gives you something to bolt the thing structurally to your baffles to hold it. These parts are extremely light; there's no problem in mounting them and they certainly do help the engine life. You go from the filter to the oil cooler and back to one of the tapped holes in the sump.

It isn't necessary to use a bypass on a partial flow system because of the oil congealing. In Canada you might need a bypass -- if you do, then there's a standard set of parts that you can buy to bolt on to the back of the case to give you a bypass valve. In the United States with the kind of weather we have here, there's no problem with a partial flow system. If the oil congeals the bypass system will shut itself off. With this system congealing doesn't interrupt any lubrication function; if it does congeal you just don't get any oil flow through the cooler and the oil will heat up and maybe it will start to flow and it will congeal again. It pretty well takes care of itself. You don't need an oil cooler under conditions where it is cool enough for congealing to occur. In my opinion these engines would never wear out with the kind of use an amateur builder would have a homebuilt airplane if it were not for dirt. In all the engines I have torn down and particularly the ground power engines, I'd say that 95 to 99% of the reasons for rejection of parts has been because something hard had gone through the engine. When the crankshafts are scoured and the bearings are ruined, it is due to dirt. The crankpins and the sludge pins are practically full. At this point dirt is recirculating and engines don't last very long after that. So compare the $4 or $5 you pay for a Corvair oil cooler agains the list price somewhere around $400 for a crankshaft.

Oil Breathers: The breather modification is quite simple on the ground power engine because there is a boss on the inside of the casting already there

that is just not machined. It's on the front left-hand corner of the case. I usually put a pilot drill through just by eyeball to see how close I am to th center of this boss. I then increase the bore just until I am on center and then drill it out for a 3/4 NTP but then just use a standard plumber's 3/4 pipe tap and a 3/4 aluminum AN elbow. You may lose a little oil out this front breather. It's not enough to be critical on oil consumption but it is enough to make the airplane dirty, so that on one installation that I worked on we ran the breather through an oil separator.

Propellers: The best propeller that I have seen is a 150 Tripacer Sensenich prop which is normally 74" diameter and 61" pitch. Tripacers are notorious for getting over on their backs so there is quite a supply of bent Tripacer props. You can usually have them straightened and there will be enough prop left so you can have the diameter reduced to a maximum of 67 inches. We've had good luck with a propeller that is 65 inches in diameter with 67 inches of pitch made from a Tripacer blank.

Lee Hamyln is now flying a T-18 propeller which is 67 inches in diameter; it came from a Tripacer blank. It is 68 inches pitch and it turns about 2900 rpm. I would prefer to have it down to 66 or 67 inches pitch and get another 100 rpm to get a little bit better takeoff and climb.

T-18 Draving Status: I'm not doing anything on the T-18 engineering at the moment. I have two or three more dravings to complete on the flap control system and after that I am going to take a look at a possible location for additional fuel. For the bigger engines, you need about another hour of fuel.

PROPELLERS - My prop has just arrived from Sensenich, Lancaster Airport, Lancaster, Pa., and it is a beauty. A cutdown prop costs $85 including bolts. A brand new factory reject costs $125. Both are good deals, so get your order in early. If they get a large number of orders it may take quite awhile to fill them. When ordering specify length, pitch and engine.

CANOPIES - Bob Gaede, 1702 Orlando Road, Baltimore, Md.,21234 produced his first canopies and is now beginning to fill back orders. He couldn't buy large enough plexiglass for a one-piece canopy, so it is split. He has both canopies and windshields. Write to him for prices.

TEMPLATES - Those of you who chooze to reproduce the prints and paste them to the plate stock to save layout time, don't forget to check every dimension very carefully. Several people have gotten into trouble with this procedure. Blue prints have a strange habit of changing dimensions. For this reason, I maintain that full-size rib layouts in homebuilt plans are totally useless except for rough checking your own layout.

FLEX SHAFTS - I have located a source for the flexible shaft material for the trim system. I just got rid of 25 sets at the fly-in and don't plan to reorder since Sport Aero will probably soon stock them. In the meantime, If you can't wait, I can get new stainless shafting for $3.00 per set. I still have a few pairs of the 7¼" wheel retainer bolts for $.75.

NEXT MONTH - Ron Zimmerman, who still makes prop extensions, will have an article on layout of a second degree curve. I've just completed the inspection and re-assembly of my GPU, so expect to have a blow by blow account of this job. PLEASE keep an orderly file on your back Newsletters and re-read them frequently. Quite a few people are still making the same old mistakes which we long ago learned how to avoid. I'm not trying to put out an issue every month anymore do don't be too surprised when there is some considerable time between issues. Now back to that wonderfully fragrant fiberglas mess! GET EM FLYING!!