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March 2, 1972

T-18 NEWSLETTER NO. 35

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TIPS FOR BEGINNERS - A neighbor is just getting a T-18 project started so now I have an opportunity to relive the learning experiences of a beginner. He bought a project with many of the parts already made, bu I think his experiences will give me some good ideas for how-to-do-it articles. For instance, today he called and asked if I would show him how to get started on an aileron. He had taken my suggestion and built a nice 4 x 12 table with chipboard nailed to a 2 x 4 frame. The first time I went to clamp a template to some skin material to keep everything nice and smooth for transferring (punching) holes, I discovered he had made the frame exactly the size of the table top with no overhang. Thus it was not possible to clamp to the edge of the table. So, Lesson One, allow the table top to extend out over the frame on all sides about two inches. This gives room for clamping during transferring and various forming operations. I find that 4 x 1 sheets of chipboard aren't always available so you can use one and one half 4 x 8 sheets. He had cut out an aileron skin after marking it with a pencil. It was cut slightly oversize with a pair of right handed sheet metal shears. The cut was made by completely closing the shear jaws making little lateral cracks each time. I found a small pair of straight scissors type shears hanging on the wall so I showed him how easily a nice straight cut can be made with them. So, Lesson Two, don't try to make straight cuts with right or left-handed aircraft type shears (double jointed type). Use the ordinary straight type "tin snips". He said the brand new Stanley Surform hand plane chattered. They always do this until worn down a little, even when pulled rather than pushed. However, I showed how it could be kept fro chattering by turning the plane to a slight angle. But with the rathe broad pencil mark, it was difficult to make a straight edge. So, I showed him how to mark a cutting line with a scribet, then cut to within about .010 and trim to the scribe line with the surform. Lesson Three, mark all lines, which will be cut, with a scriber. Neve scribe on a surface which will not be cut away, however. Someone might argue that it is not necessary to cut sheet metal edges anymore accurately than you can get with a pencil mark since the only critical dimension involved is to a rivet hole which is always .250" away from the edge. It is true that a .020" error on this dimension wouldn't matter that much, especially if you always made it on the high side. However, I find that it is always easier in the long run to work to accurate dimensions. The only precaution when using a scriber is to never scribe a line on metal which will not be cut away. If you haven't yet discovered it, when 1/8" rivets are used, the distance from the edge of the metal to the center of the rivet is never less than 1/4", or .250". To figure the edge distance for any size rivet, simply multiply the rivet diameter by 2. The most frequent problem with edge distance seems to occur at the corners of fuselage frames where they overlap the 3/4" angles. Frequently, the hole at the corner has come out too close to the edge and some builders have scrapped frames due to this problem. Scrapping is not necessary because a splice could be riveted to the frame corner, but most people don't like the idea of having a patch on their new airplane. There is an answer for this, i.e., if you use matched hole techniques and put the holes in the frames before bending, you can't have this problem. However, most of us start with the rivet pattern already in the skins which were made from templates. The frame hole patterns are then transferred after the frames are bent up and, although it shouldn't happen, the hole sometimes comes out too close to the

corner. Perhaps the skin pattern has a hole or two slightly off, so to be on the safe side, I would recommend checking everything out before you make your frames. Another possible variable is the shape of your frame joggle which could pull the corner in too far. To be on the safe side, you could leave 1/16" extra on the frame corner and then trim it off after the frames are bent and holes are transferred. When transferring hole patterns to the sides of the fuselage frames, always reference everything to WL 42. Unfortunately, this is where the upper edge of the 3/4" angle is located and a clearance hole is cut in the frame there. The nearest sharp corner on the frame edge is just above this point at WL 42.5, so use it as a reference for taking all vertical measurements. It was necessary to make a transfer strip to transfer the holes from the aileron spar to the aileron skin. I told him to be sure to lable the template with a felt pen showing which edge was forward, up, etc. The template was clamped to the skin and we were ready to punch with a Number 30 nibless Whitney punch Then I said to stop and check for proper orientation. Sure enough, th arrow labeled "forward" was pointing toward the trailing edge of the aileron. Lesson Four, before cutting, punching, or drilling anything, stop and recheck. Always assume you made some stupid mistake and try to find it. To keep from repeating the error during checking, measure from a different reference.

STROBE LIGHTS - John Shinn has arranged with a Daytona Beach company to supply strobe lights for T-18 Mutual Aid Society members for only $72.00 each, including shipping within the U.S. List price on these was $169.95. This is a "close-out" figure (there are 100 left) so get them while they last from: Willman Aviation, Daytona Beach Airport, Daytona Beach, Florida, 32015. This is the fixed base operator there and is a reputable company. There is a one year warranty. Don Carter is using one and says it works fine. It weighs 1.5 lbs., gives 50 flashes/minute and operates on 12 volts. Be sure to mention T-18 Mutual Aid Society.

LANDING GEAR MATERIALS - I've just ordered material from Machine Craft Troy Urbana Road, Troy, Ohio for several sets of main landing gears and decided you might like to have a material list for my gear modification shown in Newsletter #28.

2 Inner legs each 1-1/4 x .313 x 58" 4130 tube
2 Outer legs each 1-1/2 x .120 x 32" 4130 tube
1 Cross member 1-1/4 x .083 x 28" 4130 tube
1 Piece 18 x 18 x .090 4130 plate
1 Piece 18 x 18 x .125 4130 plate
1 Piece 2.1 x 4.2 x .313 4130 plate
1 Piece 1/2 x .120 x 7 4130 tube
1 Piece 1-1/4 x .120 x 3" long 4130 tube

PLANS LISTING - Charles Lauderdale of 4829 Spencer, Torrance, Calif., has prepared two listings of T-18 plans. One is broken down by assembly and the other is numerical. Together they total 13 pages an look like a real time saver. He has donated the masters to a needy family who will sell copies. You may obtain a set by sending $.50 to: P.G.R., 644 Cornell Drive, Huntington Beach, Calif., 92647. He asks that you send a long return addressed envelope with 16 cents worth of stamps. If you don't have an envelope, just send the stamps and they can staple them like I do the Newsletter.

PROPELLER INSTALLATION - If you want to have a nice smooth-running propeller, it is necessary for the shaft extension to run very true. You cannot be sure of this unless you check run-out, after extension installation, with a dial indicator. This is very important and should be checked after every installation of the shaft extension. How much run-out is permissible? The Lycoming overhaul manual specifies that the crankshaft pilot (stub end projecting forward of flange) must run true within .003". It doesn't say whether this is plus or minus, or a total of .003. I assume it means total. So, if the pilot on the shaft extension runs true within .003 it should be satisfactory. The manual specifies a maximum run-out of 0.005" at the propeller flange face. It says that if the run-out, as measured on the flange face just outside the lugs, exceeds .018", the shaft should be rejected and that the flange can be straightened if runout is less than .018". John Thorp says that is is quite common for the propeller flange on O-290-G engines to be bent due to improper prying when the engine was removed from the generator. He straightens them by tapping with a lead mallet. He warns that it is possible to demagnetize the magnets in the magnetos by pounding on a crankshaft when installed in an engine. This has happened. The Lycoming manual recommends that if a flange has been straightened, the face should be re-ground and re-plated. To dial indicate your shaft, clamp a long bar to the push rod shroud tubes with two C clamps and then clamp the indicator to the bar. Another necessity for a smooth running propeller is perfect tracking. After installing a brand new M76 cut down to 72" long and re-pitched to 64", I had a very bad vibration even after making sure the prop extension ran true, balance was good, and the tip of the prop was tracked to within .010 inch. Upon checking tracking further up the blade, I found that it had considerable variation. I took it back to New England Propeller, Industrial Road, Windsor Locks, Connecticut, 06096. This is located at Bradley Field near Hartford. They confirmed that the front face wasn't right and worked on it. After this, I finally got a nice smooth running installation. And, unless my airspeed indicator suddenly went crazy, I've picked up some airspeed with the prop. At 2700 rpm, 2000 feet MSL and about 35°F, today I could indicate about 183 mph. With me alone, I could climb at over 1500 fpm. Also, I sure like the extra weight in the nose for it gives added longitudinal stability.

GOOD NEWS - The power company suit has been withdrawn. The big one is still pending but it is hard to imagine why it continues since John doesn't have any money and more will be spent on legal expenses than could ever be recovered even if they had a case against him. He is very appreciative for the donations which have been made to the legal fund. A total of $955 has been collected.

PROPELLER TEST FUND - Only $295. has been collected for this fund. Many people were reluctant to donate until they knew what was going on. Now that you know, why not help out. Everyone contributing will receive a full report on the results of the tests just as soon as they are concluded.

FUEL INJECTED ENGINES - Bob Dial, 5175 Wing Lake Rd., Bloomfield Hills Michigan, 48013 - First, let's talk about using the IO-320 EIA engine in the T-18. I'll list the advantages first:
1. Fuel feed is not sensitive to attitude, you can do light aerobatics without having the engine quit. Even without an inverted oil system,

it is safe to run the engine for about 90 seconds inverted. This may not seem like a lot but it will be sufficient for everything short of all-out competition aerobatics.

2. Inherent anti-icing. Because of the nature of the injected system there is nothing but pure air going through the injector pump. Therefore, there is no adiabatic expansion in a venturi such as with a carburetor and no ice formation. There is the possibility of ice accumulation at the air inlet for the filter but this is simply accommodated by the use of a calibrated, spring-loaded alternate air door which is automatically operated by the engine induction vacuum if the primary source becomes blocked by ice or for any other reason.

3. No requirement for an outside ram air box, thus a cleaner cowling. This is possible because the injector pump can have a large throat with an ideal air flow not compromised by the requirements for atomizing fuel, etc., that a carburetor has. This is not to say that high static air pressure at the throat of the injector pump is not desirable, it is, but the power loss by not having high static pressur is not as critical as with a carburetor.

4. Fuel economy. This is one of the really outstanding characteristics of an injected engine. At 75% power I burn from 8.5 to 9.5 gallons per hour. An O-320 carburetor engined T-18 that flies cross-country with me regularly burns about 10.5 to 11.5 gallons per hour. This has been proven with several other T-18's and I consistently burn less fuel. Usually after a three hour flight I will have about 6 gallons more fuel left than the other T-18's. This is significant when you are flying cross-country and figure your reserves fairly close.

5. Smoother running and cleaner burning. The injected engine uses fuel more efficiently and it is noticeable at cruise and the engine has much less carbon buildup and less deposits in the oil; also, plug life is better.

Now for the disadvantages:

1. Installation. Because the injector pump is mounted on the back of the oil pan, the engine requires a special engine mount. Earl Ody bought the mount from a commercial airplane that uses this engine and cut the ring gear off and used it to build up an engine mount. This is probably the way to go but these mounts are difficult to come by and they are very expensive. I built mine up from scratch and it is a lot of work. Also the induction pipes are located lower on the oil pan and this complicates the cowling and the exhaust system installation.

2. Fuel system. This engine requires an engine driven fuel pump and an electrically driven boost pump. You cannot start the engine without the electrically driven pump and the engine will not run if both pumps fail in flight. You must have at least one pump operating at all times. This simply means that the fuel system installation requires more care in the design and installation than with a carburetor since it is more critical.

3. Cost. This engine is generally used on more expensive airplanes than the O-320 so the cost for the engine and for repairs is considerably higher. Although it may appear to be nearly the same engine from external appearances, this is far from the truth. It has two impulse mags, different pistons, different induction system, different case, different cam, different starter, different ring gear, type, two dynafocal mounts, different valves, etc. Very few parts are interchangeable and since this is a late model engine, parts are expensive and sometimes hard to come by.

4. Hard starting. Like all injected engines, the IO-320 requires a certain technique in starting and it can very easily be flooded and end up not starting. Also they have a characteristic rough idle and they should be idled about 1000 rpm. This is not practical since the T-18 will almost be flying at these rpm's.
5. Critical aljustment of the injector pump including a calibrated bench flow. If it gets out of whack, the overhaul price is around $400. It is not an item the average homebuilder is equipped to work on -- it can be costly.

I am happy with my engine. It is stronger, smoother, more powerful and more reliable than the carburetor engine. But I would not recommend it for anyone else and if I had it to do over I would go with the carburetor engine. The disadvantages listed do not warrant the effort required to overcome them as compared to the advantages. If anyone is contemplating this installation, I would be happy to help in any way I can but if the initial choice is between the injected engine and the carburetor engine I would say choose the carburetor model unless all-out performance is the objective."

PROPELLER TESTS - Bob Dial - "Now, about the prop situation. I just talked to John and told him that I have arranged for Dave Biermann at Hartzell propeller to instrument my airplane and run complete flight tests to determine the best prop extension combination. These tests are quite complex and require considerable time and engineering. As of now, the situation is this -- Hartzell has my EMM 76 prop, Parker Miller's DM74 prop, my original 1071 extension, John's new 1072 extension and a new barrel type extension designed by Sensenich. I am negotiating to get the tests run using both props, (DM74 and EMM 76) and all three extensions using my airplane and also using Parker Miller's airplane, if possible, since he has a very stock airplane using the O-320 carburetor engine and John's engine mount. This would give the most representative results and cover a great many of the airplanes now flying or under construction. Hartzell assures me that the test results would also cover the GPU's and O-290 series. We are going to end up with specific model props cut to exact lengths and using certain extensions and prop bolts. The test results will only be valid if these parameters are strictly adhered to. It looks like we may end up with a length of 68 inches on the DM74 and 71 inches on the EMM76. To change the performance for specific airplanes you will only be able to adjust the pitch, not the length. Let me caution you that these are only guesses at this point and the tests may show something entirely different. We are shooting for an S/N curve below 5000 psi in the first mode second order vibration regime which is the most dangerous one since it breaks props about 15-20 inches from the tip. We are also trying to get the second mode, sixth order vibration down since this is the mode that causes the prop to break 3-6 inches from the tip. This is much more common but not nearly as dangerous since the loss of 3-6 inches is not normally enough to cause the engine to come out of the airframe and the engine can be run at reduced power to get on the ground. The test equipment to be installe in the airplane weighs about three hundred pounds and is quite bulky. It consists of a 36V power supply, amplifiers, brush recorders, transducers, slip rings, sensors, and other equipment.

May I give a few observations about props? An incipient prop failure, (due to vibration fatigue), cannot be detected by any inspection method prior to flight. Stone nicks, gouges, etc., are obvious causes for not flying but a prop can be in perfect visual

condition and still fail.

The vibration modes which will fail a prop cannot be felt in flight.

Injected engines place less stress on props than carburetor engines.

High compression engines place higher stresses on prop than low compression engines.

The elastic stress failure on 2025 forged aluminum props is at about 10 million cycles. This is about 2100 RPM x 2 x 350 flight hours. The moment of truth on a new prop would then be about 300-500 hours.

The most critical parameters are, engine, prop extension, and propeller. The engine mount, compression ratio, airframe, aerodynami exhaust system, cowling, etc., all have some bearing on the stresses on the prop but the big items are the ones mentioned.

All prop extensions, no matter how well designed or built, increase the stresses on the prop and the engine.

Prop extensions decrease the natural frequency of the crankshaft and the natural frequency of the prop. (That's what all the tests are about -- how much?)

Clipping the prop increases the natural frequency of the prop.

Prop bolts are critical since, although they are under relatively low tension loads, and are not under any torque loads, the engine oil heats the crankshaft which in turn heats the prop extension and the prop hub. Over a few hour flight this heating is appreciable. If you don't think so, feel your prop hub after flight. Due to the large mass of the extension and the prop hub, there is considerable expansio of the metal. If the prop has been torqued on the high side of limits this expansion can easily exceed the bolt torque limits. (Refer to appropriate FAA & technical reports for further information.) The answer is, use high strength bolts made of 4137 steel or carpenter 416 stainless heat treated to 35-40 Rockwell, straightened, stress relieved, magnuflured, cadmium plated, baked five hours at 300 degrees for hydrogen embrittlement. Use high strength nuts. Change prop bolts periodically."

OIL AND YOUR ENGINE - From Avco Lycoming "Flyer" - "There are two basic types of oil used in general aviation aircraft piston engines: (1) Straight mineral; (2) Ashless dispersant (AD). Most of these engines use straight mineral oil for "break-in" purposes with a new remanufactured, or overhauled engine; then the operators tend to switc over to AD after "break-in" has been accomplished, (exceptions are our TIO-541 series and TIGO-541 power plants which require only AD oil). Those engines using straight mineral oil beyond the normal breakin period, and later switched to AD, must watch their oil screens after each flight until clots of sludge no longer appear. Lycoming does not approve any additives to the oil. The modern FAA approved lubricants do not require additional additives.

Clean Engine Oil is essential to long engine life, and the full-flow oil filter is an added improvement over older methods of filtration. Generally, service experience has shown that the use of external oil filters can increase the time between oil changes provide filter elements are replaced at each oil change. However, operation in dusty areas, cold climates, and where infrequent flights with long idle periods are encountered, will require proportionately more frequent oil changes despite use of the oil filter. The oil filter element should be replaced after each fifty hours of engine operation, and it should be cut open in order to examine the material trapped in

the filter for evidence of internal engine damage. In new or recentl overhauled engines, some small particles of metallic shavings might be found, but these are not dangerous.

The oil filter is more important to the high compression or higher power engine. Some of the aircraft manufacturers have had good success in the small, lower compression, four cylinder engines without using a full-flow filter. Generally speaking, these engines are also able to achieve their expected overhaul life, as long as oil was consistently changed, and operation and maintenance were accomplished in accordance with the airframe and engine manufacturers recommendations.

Pilots and mechanics should know what weight, type, and brand of oil is being used in the engine being serviced. At each oil change, this specific information should be recorded in the engine logbook. Except as a temporary measure in an emergency, different oils should not be mixed. Indiscriminate mixing of oil has created a high oil consumption problem, or clogged oil control rings and oil screens.

Oil Consumption is a very important trend to monitor in an engin The operator and maintenance people should know the general history of oil consumption during the life of the engine. It is typical of an engine during seating of new piston rings that oil consumption may be erratic or high; but after the rings are seated, generally within the first 25 to 50 hours, oil consumption should level off below the maximum limits established by the manufacturer. Later, during the life of the engine if there is a noticeable increase of oil consumpti within a 25 hour period, this could be a possible danger signal and calls for an investigation. The oil screens and filter should be carefully observed for signs of metal. Maintenance personnel should take a compression check of the cylinders, preferably using differential pressure equipment, and also look inside the cylinders with a boroscope or gooseneck light to detect any unusual conditions."

PROP TEST SITUATION - Just talked to Mrs. Dial by phone. She reports that Bob talked to Hartzell this week and they haven't been able to start the in-flight tests. He is to check back in several weeks. (Bob is a pilot for General Motors.) Received a letter from John Thorp today and he is within two weeks of flying his T-18 which is N-18JT. Shake tests on his A-76 prop cut down to 68" with 83" pitch show the first bending mode, second order is at 2800 rpm and second mode, sixth order at 2500 rpm. N-299V, Dr. Cottingham's, with a constant speed prop, is much better with first mode, second order at 3050 and second mode sixth order at 2190. You shouldn't operate at one of these modes. John is flying his T-18 with the 1072 extension and AN-8 bolts. He is not aware of a prop bolt failure problem due to hot propeller hubs. He says that any conclusions on props prior to the planned test program would be difficult to make and is anxious to see it completed. If you haven't sent in your contribution, pleas do so for we have a long way to go. EAA Chapter 361 from Tachilsawa, Japan sent in $25. How about yours?

MATERIAL LIST - Jack O'Keefe, Bronx, N.Y. writes that he received a material list from Monroe Maximer, 1010 Erie Street, Massillon, Ohio, 44646, and it is well worth the $3. He also says he buys his aluminum from STRAUS Aluminum, 800 Sneidiker Avenue, Brooklyn, N.Y., 11207 at reasonable prices.

FIRST FLIGHTS - This has been a very productive summer for the T-18 air force. There has now been a total of 81 T-18's which made their maiden flights. Here are the latest additions:

ORDER	PLANS NO.	N NO.	OWNER	FIRST FLIGHT
67	455	455DT	Don Taylor, Box 316, Hemet, Cal	24 May 71
68	589	5661	Bill Stattler,	1 May 71
69	583	---	Fred Davidson, Nashville, Tenn	5 June 71
70	347	110JH	Jack Hagle, Crystal Lake, Ill	31 April 71
71	614	614DP	Dewey Parks, Greenville, SC	9 June 71
72	492	262PE	Bill Eckel, Pasadena, Cal	18 June 71
73	430	3952	Earl Ody, Montebello, Cal	9 July 71
74	426	11101	Nick Seraphinoff, Warren, Mich	16 July 71
75	376	18TT	B.C. Roemer, Manitowish WaterWi	26 Aug. 71
76	427	---	Floran Sullivan, St Paul, Mimn	23 Sept. 71
77	---	1014Z	Bill Gillen	---
78	207	11EH	Bill Hart, Milford, Mich	---
79	652	VH-CMC	C.R. Canning, Colliggwood, Vict, Canada	
80	536	(Cont. IO-340A)	David Springman, Tomah, Wis	6 Aug. 71
81	684	71SC	Sandy Crist, Torrance, Cal	19 Feb. 72

Dave Springman's is the first Continental powered T-18.

DEBURRING - W. Warnack, 139 Bayshore Dr., Baytown, Texas - "I ran across an interesting approach to deburring. I have a small draftsmans electric eraser. By experimenting with different eraser rubber, I came up with one with just a little 'grit' in it. I can polish rivet holes very nicely by just touching the eraser in and around the hole. Very quick and easy once you locate the right eraser rubber. Have a question regarding the horizontal tail 509 mounting lug and spacer. Tolerances called out are very close and I doubt if I can ream out to 1/1000 accuracy. I understand that it is not intended anyway. My question is this: Is relative movement intended to occur between the 509 lug and the spacer, between the spacer and the 1/4" bolt, or both? Talked with Paul Stanley in Galveston. He expects to fly about Easter. Has all inspections completed except the final one before the test hop".
ANSWER: The fit between the 509 lug and the bushing is very important. This is the bearing for the horizontal tail. When the bolt is tightened, it clamps the spacer so it cannot turn, so all motion is between the steel spacer and the aluminum 509 lug. If you can't ream accurately, you can certainly tailor the spacer OD to make a nice close fit in 509. My horizontal tail shows no signs of slop at the pivots after 252 hours.

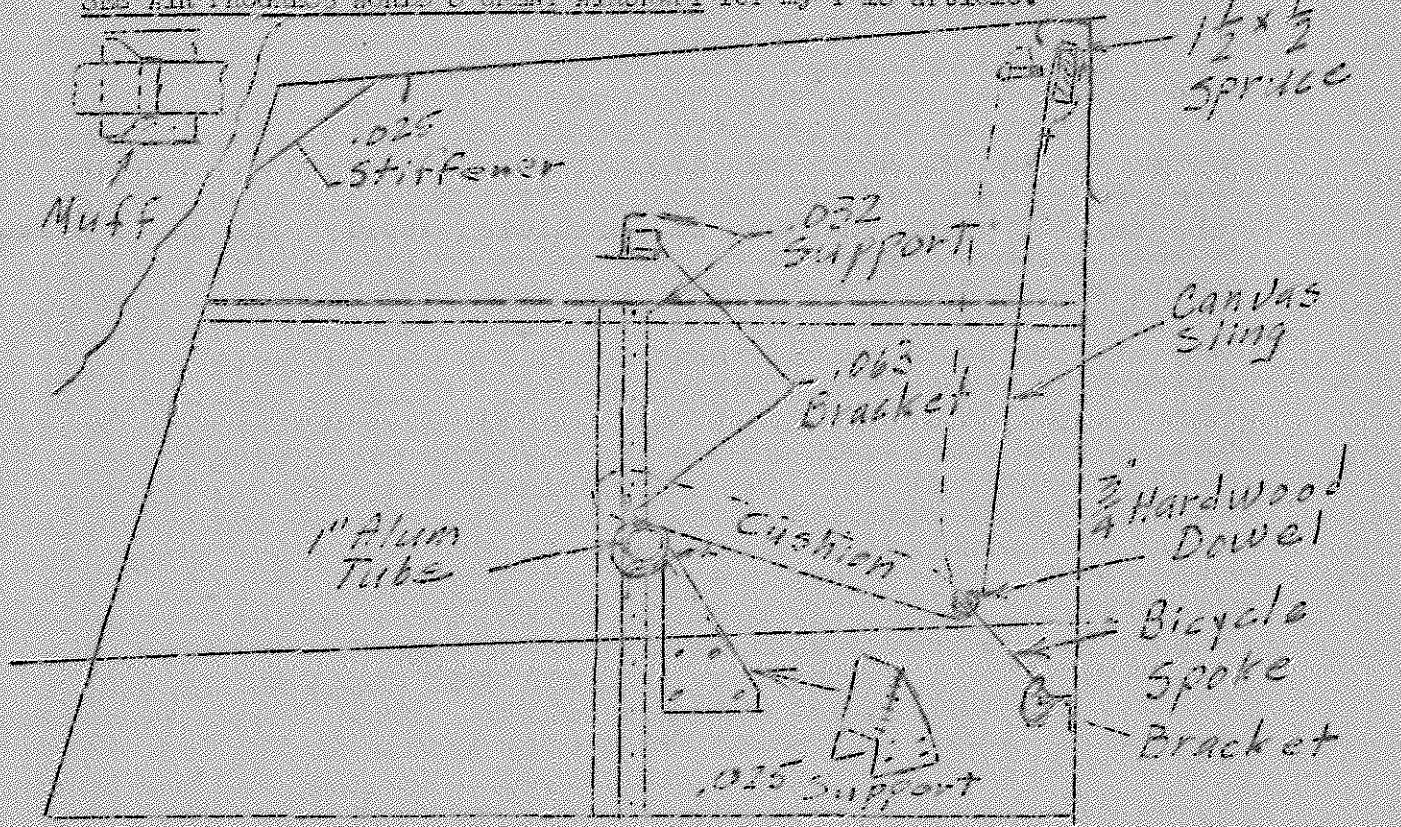
FLIGHT REPORT ON N-18TT - B.C. Roemer, Manitowish Waters, Wisconsin, 54545 -"I now have 25 hours on it and am still trouble-shooting the airspeed indicator. Only mechanical problems were the brakes -- not enough. We reworked them, getting more leverage on the pedals and they are satisfactory now. As for flying, there just isn't much around to top it. I've had my troubles with landings -- strictly pilot fault. I've never ground looped or even had any indication of one. Ground control is real good. It wheel lands real nice if you keep the tail high enough, but you sure use up runway. Doing the test flying with the forward tunnell off and main spar uncovered, I had a problem that might be worth repeating. We have a mike that

has a button on back that slips up into a fork which is located under panel center. I called into a grass field and tried to hang up the mike only had it backwards and couldn't get it to go in fork. You just don't look around under the panel while flying a T-18. It's got a mind of its own when not watched. Anyway, I got the mike stuck a bit and went on in to land -- gased and took off -- field is rough. After I used forward stick to get the tail up, I used back stick to lift off then forward stick to level off -- only I had no forward stick -- jammed. After cutting power and making an unimpressive landing (unless you were looking for thrills), I discovered the mike had fallen in the spar at the push-pull tube point. Needless to say, I hung it in correct and installed tunnel and cover plates, pronto. Can't use full flaps -- pressure and buffeting too high; restricted them to 30°. My son, Peter, flew off the wing of a Bonanza who had a very accurate airspeed indicator. It read 195 and he had no trouble to go ahead of him on the O-360. We have no gear flairings or wheel pants yet and a fixed pitch 68-81 which sure seems a good combination. We can't get over 2575 RPM so aren't getting full HP."

BENDING EXHAUST TUBING - L.D. Sunderland - "As you know, about the only part of the T-18 for which there has not been a good source of supply for raw materials has been the exhaust system. Finally, I have discovered how to make nice smooth bends in 1.75" stainless tubing. Someone will probably now say they knew how to do this all along, but if so, they sure kept it quiet. Here's how I went about it. First, it is necessary to have available a powered tubing bender. Since not everyone is fortunate enough to have one of these available you might throw up your hands at this point, but take heart, all is not lost. Almost any area large enough to have a muffler specialty shop has one available. The local Mac's Muffler Shop here in Endicott will make bends for one dollar a bend and will tailor your bends to any desired angle. (No mail orders.) I'm not aware of the different types of tubing benders which might be available but the one I used has an inner radius block with a semi-circular groove in it. Two hydraulically actuated die blocks, also containing semi-circular grooves, trap the tube at the bend point. As the bend progresses, these outer blocks wrap right around the inner block. When I tried a 90° bend in a piece of .035" wall stainless, it wrinkled very badly on the inner radius. After discussing the situation with several other builders, we decided to fill a section of tubing with sand and weld plugs in the ends to plug it. But this didn't work any better. Then, I made two aluminum plugs about 1.25" long which fit snugly inside the tubing. Then I drilled two 1/4" holes for bolts through each plug and the tubing. In one plug end I drilled and tapped a hole for a 3/8" bolt. The hole passed all the way through the plug. With a plug installed in one end of a 16" long section of tubing, I filled the tube with clean white dry sand purchased from the local Agway store. Then came the important part. I rested the tubing on the arbor of my grinder which acted as a nice vibrator. Within several minutes, the sand had settled down over one inch. Then I installed the plug in the other end, put in more sand through the 3/8" hole and then screwed in a long bolt which further compressed the sand. Off to the muffler shop with a little spare sand. Before putting the tubing in the bender, I removed the 3/8" bolt and looked in. Whatdayaknow, the sand had settled down more. After refilling, we made a perfect 90° bend with a 5" radius. So, order 20 feet of tubing and have fun.

I think you could get by with about 8 bends. To make a mockup of your exhaust system, get some 1/4" rod, make four flanges from plate stock to fit onto the exhaust ports, bend and weld up a complete system right on the engine. To check for clearances, make up a bunch of 1.75" tubes from cardboard and slide over the rod. It is better to do this with the engine mounted right on the airplane. If you are using a Hamlyn type cowling, the tightest spots will be where the tubes curving down and inward from the attach points at the jugs pass the lower edge of the cowl cheeks. Few people are able to get more than a finger width of clearance there. That is all I have and it hasn't burnt a hole in the fiberglas. Don't forget to put in ball joints and slip joints. Slip joints are directly in front of the oil pan and a ball joint is placed in each of the two outlet tubes just aft of the "Y" joint. If you put a heat muff on the outlet tube aft of the ball joint, as I have, the stainless ends of the muff should be made countersunk as shown in the sketch below. This design prevents cracking. The outlet tube may need to be bent downward just aft of the muff to get clearance between the muff and the bottom cowling.

SEE AIR PROGRESS WORLD'S GREAT AIRCRAFT for my T-18 article.



BACK SEAT DETAILS L.D. Sutherland - Many people have shown interest in my back seat installation. Since it has worked out very well and is simple and light weight, I'll include a sketch. At least a half dozen T-18's have a back seat and I recommend it if you have very small children (under 100 pounds). The only problem is rearward cg. When my wife and I in front and my 50 pound boy in back I can't run the tank empty or pitch stability gets too low. I haven't tried it loading with my new 5 pound heavier MT prop, but it should be much better. The seat is a canvas sling type supported at the top with 1/2-32 bolts through a strip of wood and at the front with a 1" aluminum tube. The tube is supported on each end with .063 brackets riveted to .032 supports that are added between the 3/4"

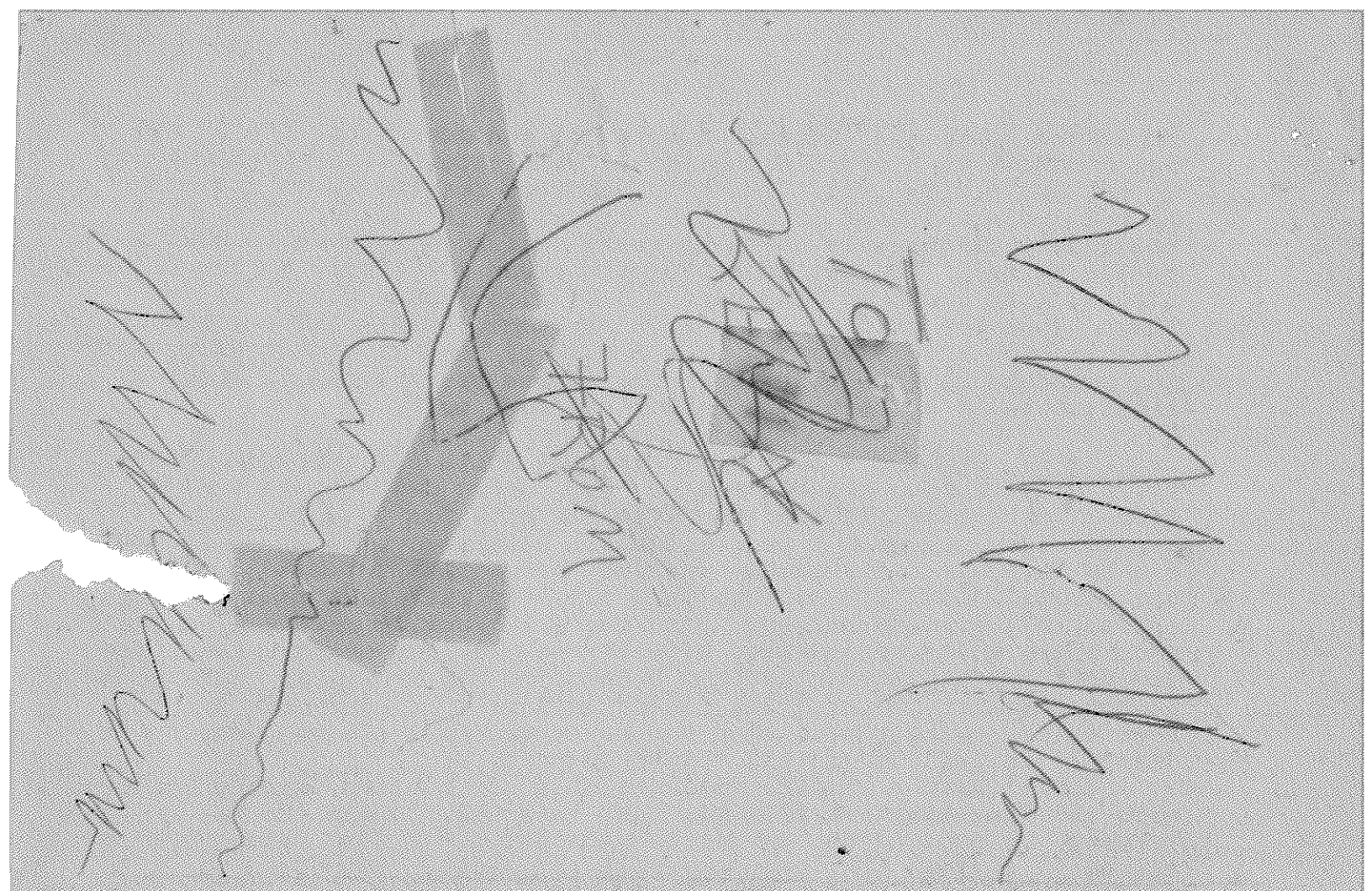
angle and the 1.125" angle. A notch is cut out of the top of one of the brackets to allow the tube to be slid to one side and lifted up at one end for removal. The quick removal feature is an absolute must to permit access to the aft part of the fuselage. Support for the center of the tube where it rests against a bracket is rivetted to the tunnel. The aft tunnel need not run completely to the floor. Mine is only about 4" deep with a 1/2" flange bent inward at the lower edges for stiffners. A 3/4" hardwood dowel holds the canvas down in back and is secured by a couple of bicycle spokes whose nuts are countersunk into the wood. The spokes are secured to brackets rivetted to 57 - which also anchor the seat belt.

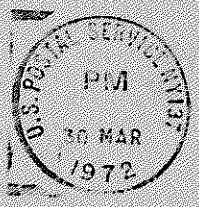
CORVAIR OIL COOLERS - John O. Cragin, 14 Smith St., Needham, Mass., 02192 - "I've been able to pick up some extra Corvair oil cooler system parts that I'd like to offer for sale for $4., $6. and $8. for the three types. I have a few oil filter support brackets that can be cut down for a neat installation. I plan to install mine on the firewall like you did but in a slightly different manner. I cut off all the surplus casting up to the inlet/outlet cavity with the four bolts holes around it. Pipe tap an aluminum angle bracket for in/out hoses and hard mount the bracket to the firewall. Make up a gasket and bolt the modified filter support to the bracket with four bolts. With this method the hoses are firewall supported directly instead of off the filter support.

I also have a limited collection of oil coolers, mostly the type with the fine aluminum filigree fins #6520632. A few are the 8 plate variety but none of the larger 12 plate type. I also have a few of the small 4 plate that can be paralleled easily with the 8 plate in a neat package equivalent to the 12 plate. John Thorp prefers the older #6520632 variety but has never run efficiency comparisons; nor have I. The fine fin type and the 8 plate are the same package size. These parts are all used and have been cleaned. I used liquid detergents (All, Wisk, etc.) and water and found them at least as good as gunk to clean them out. If further cleaning is desired be sure to rinse adequately to avoid oil foam problems later. I've pressure tested all the coolers to 100 PSI. Enclosed is a description of the coolers I have and paralleling details. I'll send these flyers to anyone interested that sends an addressed stamped envelope.

MANEUVERING SPEED - L.D. Sunderland - Don Carter finally got his T-19 approved for instrument flying. He needed to know the maneuvering speed for the T-19. John says it is 172 mph with 1500 lbs. gross weight. It is the speed where you can't exceed 6g. C_L max is 1.43.

WING ROOT FILLETS - Letter from Dewey Parks to Rudy Adler, 16716 Mearview Dr., Sangus, Calif., 91350 - "Thank you for your idea on the wing fillets, as well as for shipping them so promptly. The installation was as simple as you said and the fit was perfect. As far as appearance is concerned they are a great improvement, but the real advantage shows up in the stall. With either half or full flaps and the ship completely stalled it just "mushes down" at a high rate of decent with no tendency to hunt or tuck under. There is adequate stall warning (rudder shake) at about 5 mph above stalling speed. This is no me better than stall strips on the leading edge of the wing. I flew my T-19 to Oshkosh last week and was surprised to find no other T-19 with your wing fillets. Someone is missing a good thing. The T-19 is pure pleasure to me, exceeding by far, my expectations."





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