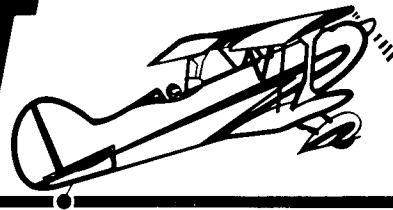


ACRO SPORT Newsletter

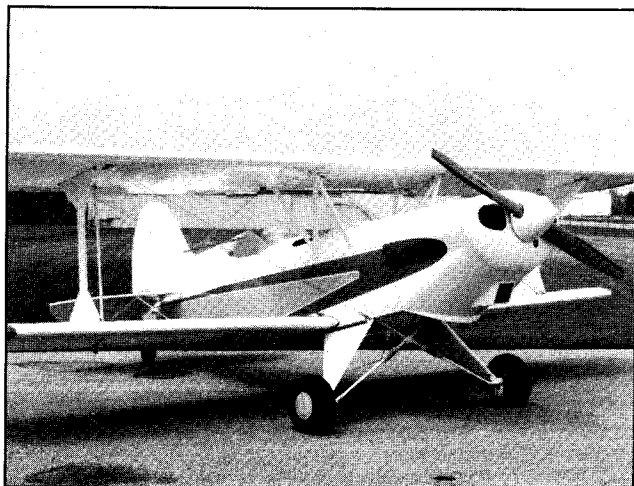


Editor Ben Owen

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FRANK JOHNSON'S ACRO SPORT II



Congratulations are in order to Frank Johnson of Fort Wayne, Indiana for completion of this beautiful Acro Sport II. Some of the changes incorporated are the Smith Miniplane type of shock gear.

Frank reports:

Well Ben, six and one-half years and 3000 plus hours later, my Acro Two made it in the air. April 18th was the big day and S/N 741 flew as good as I had expected. A little back-ground first.

If anyone ever had a "calling" for aviation, it was me. My father received his license in 1940 in CPT program but even up to the age of 21, I had no interest in anything but golf and even worked on a golf course. One day mowing countless blades of grass, I spotted a crop duster off in the distance spraying a field. I was mesmerized watching him do his routine. The next day I had an introductory flight and in June of 1976 had my private license. That year also took me to A & P school. In 1978 I had my first job working on turbine powered aircraft and two more jobs later, I ended up in Fort Wayne working on Lear jets in 1980. Since then, I got my commercial license and now fly professionally in a Merlin 4C.

Now for the homebuilts. In 1962, my dad started on a Mechanix Illustrated "Baby Ace". At eight years old, I watched him build ribs and tried to convince my friends they were not

snowshoes. He took me to Rockford the next year where we went to our first EAA convention. It was great. Well, in 1983, the little Ace was not in the air yet. It was too long. My dad and I trucked it to Fort Wayne where I spent the next two years finishing it. Its maiden voyage was in June of '85. In '83, I was serious about my own homebuilt and the Acro Two was everything I wanted. I started building ribs in the winter of '83 when I could not work on the Ace. By the summer of '85, the 5 wing panels were done short of leading edge and cover. I wanted to gas weld the steel work but even an A & P's skills at this are somewhat limited so I took a night class to sharpen up. I found a partially tacked up fuselage from a disgruntled builder and hauled it home. I basically had to start over with it because after doing a lot of doublechecking measurements, it was too far off for me. In a couple of weeks, the basic fuselage was welded up. Some of the heavier components were tig welded by fellow builders, landing gear, engine mount, cabane ends and lower wing fittings. I found a mid-time Lycoming O320-E2D of 150 horsepower. The prop is a Sensenich W74/54EM. I used the Ceconite 76—process with butyrate dope finish. It is green and yellow on white. It has a gravity feed fuel system with electric boost pump mounted below the front floorboard. Empty weight is 960 pounds with the EWCG 5 inches forward of the lower wing leading edge. I am getting 113 mph at 2500 rpm. The prop is a little flat to get any more speed. I was lucky to get 100 hours in ten different tailwheel aircraft over the years before I flew the Acro, it helped tremendously. It flies great but is a bit more sensitive than other taildraggers I have flown. As of early July, I have 25 hours on it and have most of the bugs out of it. My first fly-in will be MERFI in Marion, Ohio. I hear there are a lot of Acros over that way.

Brief Editorial

EAA has aircraft registration cards available. You can call and request one or you can just send in the information on the aircraft you are building. We use these to refer others to builders of Acro Sport and other aircraft in the immediate vicinity. It has been very helpful to us.

The Acro Sport II has had four sets of corrections to four sets of plans. The first set had a green cover, the second set had a yellow cover, the third set had a pink cover and the fourth set also had a yellow cover and was printed in October of 1989. The corrections are needed for all. If you don't have corrections, please write to EAA Information Services.

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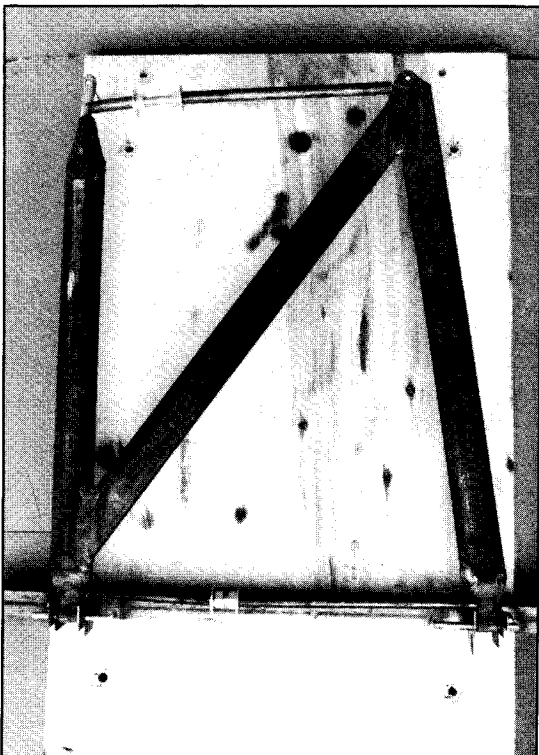
BUILDER'S REPORT — TOM WATSON

Tom Watson Fabricates His N Struts

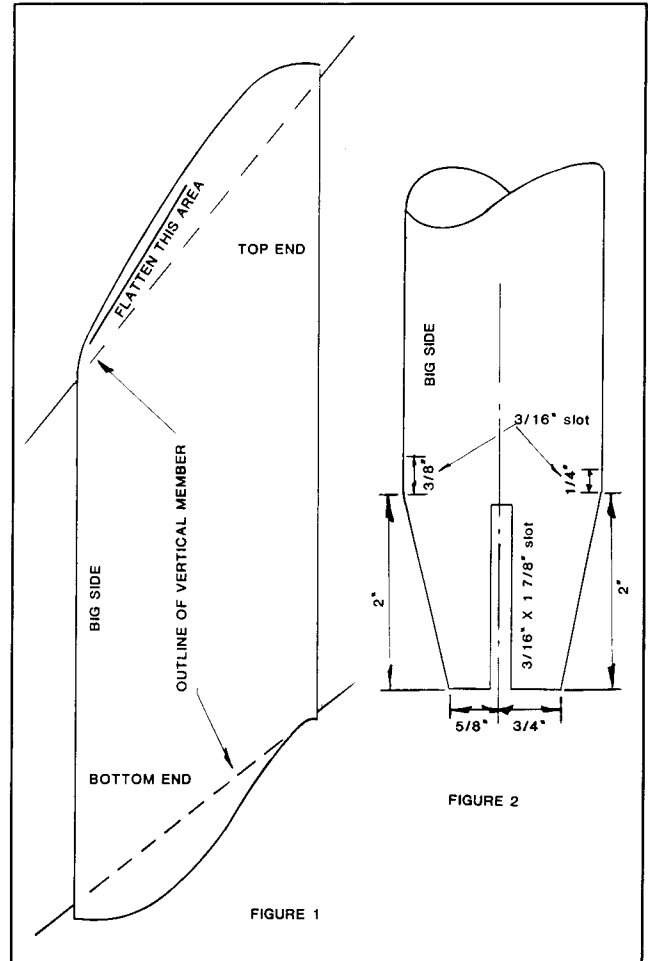
A jig was constructed to the exact dimensions of the center section wing attach fittings with a 3/8 inch drill rod used to line up the holes.



The upper ends of the vertical members were cut to shape, the barrels and inserts were put in place (without any tacking) and with the upper end bolt in place, the locations for the lower bolt holes were marked from the 5/16 inch bolts located per drawing dimensions.



The upper end inserts were clamped and welded along one side while still in the jig. The members can be removed from the jig for convenience in welding the other side. The upper ends were welded along the top of the insert and the finger straps were put on. He had cut the barrels to final width after welding the inserts and this required a lot of care when welding the finger straps. A better way would be to make two jigs, one with about 2 inches between the lugs and another with the exact final dimensions that would be used after the vertical members were finished. The barrels should be reamed out after welding to bolt dimensions, not to accomodate plated drill rod.



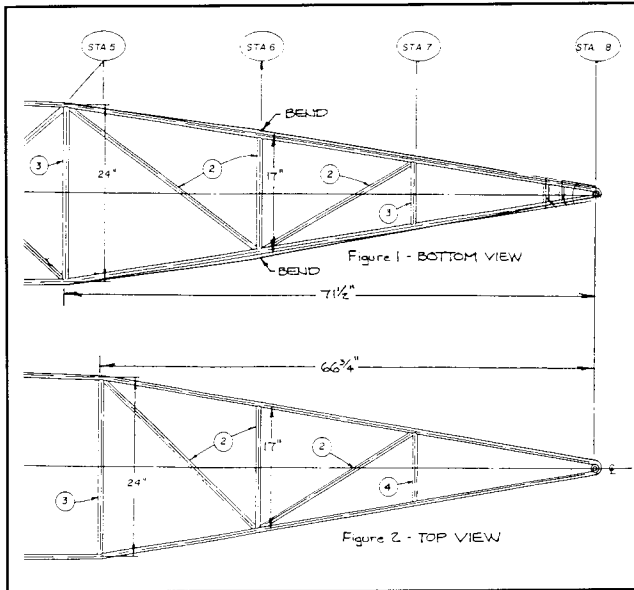
The ends of the diagonal member need to be notched in. The sides also have to be squeezed together in the area indicated to fit properly. Spreaders are needed when welding the diagonals in place to keep exact dimensions. The jig and bolts have to be moved to the other side of the plywood to weld the opposite side in place and with the spreaders.

The drawing sheet 12, detail A-3 gives a front adjustable strut fitting as a Piper number 14481-00. This is a part number for a 3/8 inch fitting. The part number for the fitting with a 5/16 inch hole is number 13770-00.

NOTE: We regret this issue was delayed.

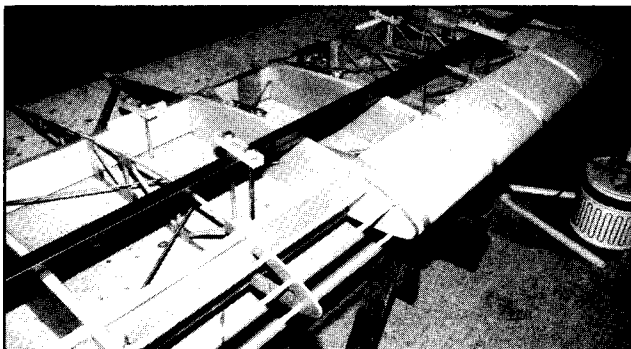
Fuselage Construction By Tom Watson

The fuselage drawing (sheet 2), reproduced as Figure 1 (bottom view) and Figure 2 (top view), shows the bottom longerons as being straight from station 5 to the tail post (station 8). This is geometrically impossible if station 6 is to be a square section since the top longeron is also straight but is bent at a different dimension from station 5 to the tailpost. Station 6 should be fitted square (crossed chains to the layout table is a good idea) and an additional bend should be put in the bottom longerons at that station. The correct outline of the bottom longerons and dimensions are shown on the figures.

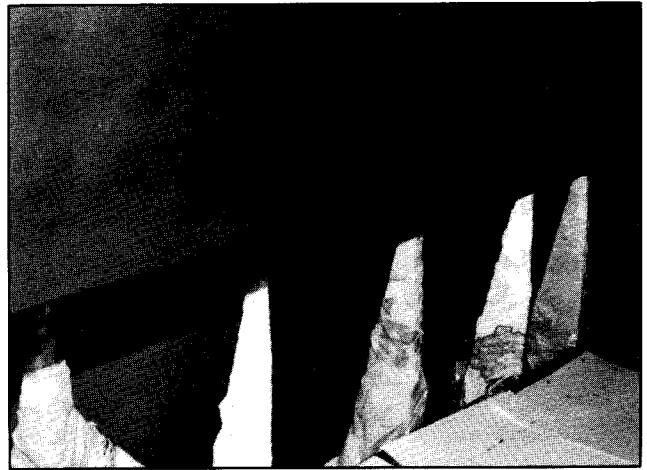


Tom Watson's Acro Sport II

Tom elected to cover the leading edge with 1/8 inch birch plywood. The wing has to be set up as square and level as possible prior to applying the plywood because nothing moves later. This, in effect, closes the leading edge with what is known as a "D-tube". He put 1/4 inch stringers placed in notches in the nose blocks as shown in the photo. The plywood was soaked both sides with hot water, wiping with a sponge off and on for about an hour. Then it was temporarily nailed along the top. The strap clamps, as shown, were used to draw the plywood tight to the rib nose blocks. He had seen technical tips on using intertube rubber and a tourniquet but this would not work with 1/8 inch plywood. The plywood was left to dry 2 to 3 days and just before application, the internal surface was coated with the thinnest coat of epoxy resin as he could manage (scraping with a block). The top edge was nailed with 2 inch center with 3/4 inch aircraft nails and strap clamps were used to draw the plywood into place.



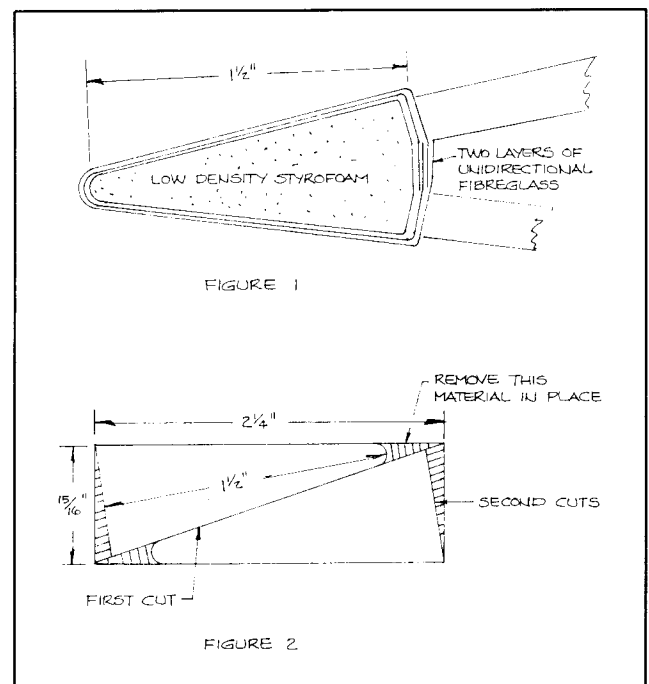
The trailing edges were built up of fiberglass and the foam blocks were glued in place between the ribs. The foam should be cut for a snug fit between ribs, not tight or it will bow. It can be glued in place with a couple of drops of epoxy glue. Do not let any of the glue squeeze past the foam as it is hard to bring to shape later. The styrofoam is best brought to final shape using another piece of foam as a sanding block. The rib area left to be uncovered has to be protected with tape and plastic. The foam in this photo is ready for the application of microballoon slurry (a sealer). Any indentations in the edge or at the ribs can be filled with a much stiffer microballoon mix.



The technique of marking the centerline and cloth outline on 2 - 4 mill polyethylene and wetting the cloth.

Photo 4 illustrates a cloth layer in place ready for layup. The foam underneath and close to the ribs requires extra resin. This is the most difficult area to fit and any fiberglass not bonding properly has to be removed and replaced with a stiff resin/microballon mix that can be reshaped and sanded to shape.

One of the advantages of the fiberglass is that any indentations in the trailing edge or the fiberglass surface can be filled with resin/microballon and finished to a perfect outline.



RIGGING THE ACRO SPORT II

Tips On Rigging The Acro Sport II

By Brett Clowes

Those of you who attended EAA Oshkosh '89 may have stopped by in the workshop area to watch and maybe assist with the assembly of the Acro II prototype, fresh from its rebuild. An attempt was made to rig the aircraft, which had very limited success. It proved impossible to obtain any consistency with the aircraft outside on the ground.

After the convention, the Acro was towed back to the Museum restoration shop. First, the aircraft was raised off its wheels. Blocks under the inboard ends of the axles and a sturdy sawhorse under the rear fuselage at the tailspring attach ensured a stable environment necessary to achieve the required accuracy.

Next, the airframe was blocked and shimmed until it was level laterally and longitudinally. It is important to do this as accurately as possible and check it frequently during the rigging operation. This proved a little difficult on the prototype as the only place the top longeron and a suitable crosstube were accessible and able to support a level, was in the front cockpit. This necessitated stepping on the lower wing to view the levels, not helpful!

There is a better solution, but it requires some early planning. That is the installation of a datum plate in the fuselage, preferably with a level mounted ridgedly to it.

One level only will do the job if you use the two dimensional type (centering a bubble within concentric circles). Otherwise, two conventional bubble levels will be needed. One mounted laterally, one longitudinally.

I would suggest this plate or level mount be installed as soon as the basic fuselage frame is tacked together. In this way, the builder will have a constant reference throughout the construction of the aircraft, enabling a high degree of accuracy to be easily maintained.

Admittedly, there are some pretty crooked airplanes flying happily about, but building goes a lot quicker and easier, if you build straight and get it right the first time. Not to mention the peace of mind a well built airplane generates.

The levels should be placed in the rear cockpit, and easily readable standing next to the cockpit with all the sheet metal in place. Think carefully about it, I'm sure builders can come up with some excellent installations.

A rig board needs to be constructed using the wing rib drawing. When the board sits on the wing either at the aileron area, on the wing walk or the upper wing bolt ribs, the top must be parallel to the chord line. Next, a good level must be mounted such as to not foul on the flying wires near the wing walk. It also has to be set to read level when the wings are at the correct 1-1/2 degrees incidence.

Ensure the level is securely attached and have it so until the job is complete.

Incidentally, some of you may recall me using a Craftsman pendulum protractor at the convention. This proved slightly erratic and difficult to avoid parallax error when reading. The use of a long level as described, made a high degree of accuracy simple to achieve and comparison of wing incidence across the aircraft to within a fraction of a degree.

Now, we can begin. First, the cabanes must be fitted with the center section and roll wires. Level the center section laterally. Now, adjust the cabanes to give the 1.5 degree incidence. The wires will have to be backed off before each adjustment. Check both left and right sides to ensure no twist creeps in.

You must get the center section accurately positioned before installing the wing panels, as it is near impossible to change the incidence after they are installed.

Now, gather a couple or three enthusiastic helpers. Entrapment methods are permissible. Take an upper wing panel and install it just with the bolts pushed through. The tension on the roll wires will have to be released.

The upper wing is supported at the tip while the corresponding lower wing is fitted and supported at its tip. The appropriate interplane strut is installed and the nuts spun on the bolts allowing the upper wing to be supported by the lower one.

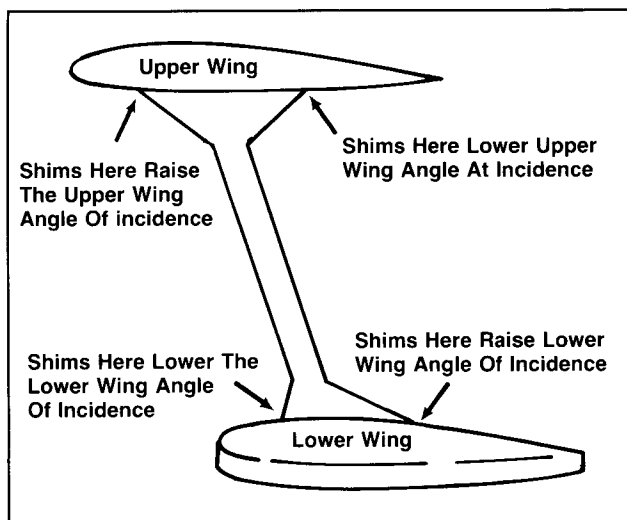
Install the landing wires and tighten until the upper wings are roughly level, remove the lower wings support. Repeat the whole process for the other side, and install all the flying wires but leave slack.

Adjust the landing wires until the upper wing panels are level. Check with long level and sight along the upper wings leading and trailing edges. Apply a little tension to the flying wires and check again.

The wing roots of both the upper and lower wings should be at the correct incidence determined by the center section and lower wing mounts respectively.

If the struts were correctly constructed, you can go on to the final tensioning of the wires as the wing tips will show the same angle as the wing roots. (The struts should be constructed with the wings installed and supported at the correct angles of incidence and dihedral). The rest of us can start shimming the struts as some twisting may be apparent.

I found the shimming of one wing had a negligible effect on the other. Penny washers can be used, although once the thickness required is established, aluminum shim blocks can be made and are neater.



Shims can be installed by releasing the tension on the flying wires a little supporting the upper wing and pushing out the appropriate bolt far enough to insert or remove the shim. Everything should be tightened back up and the incidence angles checked again.

This is a slow process but it is worth the effort. A biplane has enough drag problems without the wings all working in different directions.

Now, we can bring the wires up to full tension. It seems to be impossible to get a straight answer on correctly tensioning bracing wires, everyone has a slightly different idea on the subject. Fortunately, there are a number of experienced people hanging around EAA who helped me develop a "feel" for the job. It was also useful having a couple of other Acros sitting nearby for comparison.

To get pairs of wires to the same tension, to spread the load correctly, and in a limited way to compare tension across the airplane, I used a conventional wire tensiometer fitted with the smallest riser. It gave an uncalibrated scale reading. If using this method, care must be taken that the tensiometer will not damage the wires.

Incidentally, I used a couple of small crescent wrenches with their jaws wrapped in masking tape and cushioned with rags to adjust the wires.

It is important throughout the tensioning process to maintain the upper wings and center section level. Keep an eye on the outboard incidences too. It is possible to twist the wings with excessive tension on the forward flying wires. Remember, while the landing wires and rear flying wires are pulling against each other, the forward flying wires have nothing to work against apart from the rigidity of the wing panels themselves. Therefore, the tension carried by the forward wires should be less than the rear ones.

There is some good information in a past Acro Sport Newsletter on the Pitts methods of tensioning the flying wires.

The technique uses a piece of heavy rope and a spring balance to exert 50 pounds force at the midpoint of the wire. Deflection is measured.

Wire Location	Deflection At 50 Lbs. (Acro I)
Front Flying Wires	1 $\frac{3}{4}$ "
Rear Flying Wires	1 $\frac{3}{8}$ "
Landing Wires	1 $\frac{1}{4}$ "
Tail Wires Upper	1 $\frac{3}{4}$ "
Tail Wires Lower	1 $\frac{1}{4}$ "
Roll Wires	$\frac{3}{8}$ "

*Acro II will be similar with its slightly longer wires.

Once all is complete, double check the aircraft for levelness. Also, inspect that all the fork ends and nuts are in safely. Install the cotter pins in the clevis pins. Don't forget to finalize the wing mount and Cabane bolts. Now it really looks like an airplane.

Setting Of Bolt Torque On The Acro Sport II Using a 76EM56 Engine

By Sensenich Propeller Company

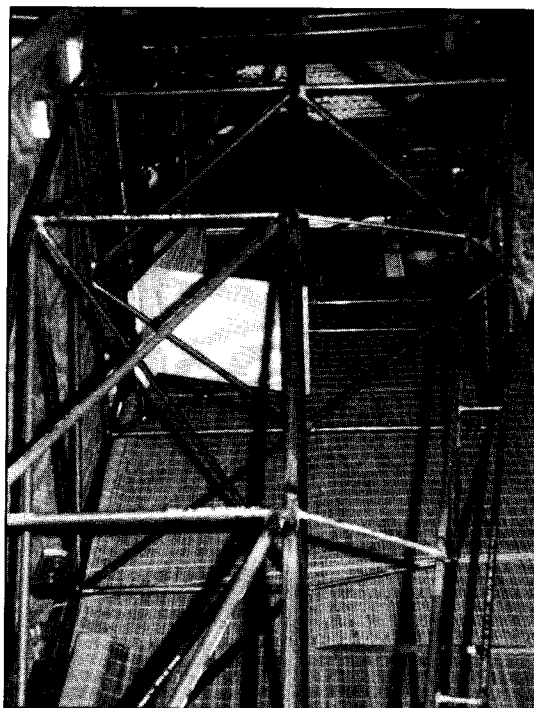
The correct bolt torque on the metal prop is 720 inch/pounds or if your torque wrench only reads in foot/pounds, it is approximately 62 to 65 foot/pounds.

AIRCRAFT PROGRESS

Progress on Lee Thomas' Corben Jr. Ace

The progress on Lee's Corben Jr. Ace as is shown, will be a full cabin! Lee resides at 29 Stevens Avenue, Rambleton Acres, New Castle, Delaware 19720.

The progress on Lee Thomas' Corben Jr. Ace.



Harold Forth's Acro Sport

Harold Forth started building his Acro Sport II on 4/3/82 and completed it on 1/3/90. It has an IO-320 Lycoming engine. The aircraft is finished nicely. The black fuselage with red and white trim as on the wheel pants, black landing gear and white wings with black and red trim.



ACRO II FLYERS REPORT:

Snap Rolling The Acro-Sport II By Don Baker

I finally got back to learning the snap roll in my Acro II. The good news is you can snap the ACRO with no changes to the wings or airframe, the bad news is that it takes some work to perfect it. After unsuccessful attempts last fall, I talked with various aerobatic pilots and read much material pertaining to snap rolls. Out of all this came a common line of reasoning: too deep a stall will kill the snap roll. That is exactly what the problem turned out to be. You cannot pull full up elevator, then kick rudder and get the ACRO II to snap roll. Instead, you will be left hanging upside down by your belts after only half a snap is complete wondering how anyone can screw up such a simple maneuver.

The theory is relatively simple. Part of the problem is that the ACRO has enough tail surface area to create an excessive angle of attack when high speed stalled with full stick. The rest of the problem, I believe, is due to the straight wing on the ACRO II. A snap roll is an autorotation maneuver. It is essentially a high speed spin. It is necessary to get one wing stalled and the other one still lifting to produce the desired autorotation. When an airplane is yawed, one wing will advance and one will recede long as the yaw persists. In a swept (aft) wing airplane, both wing halves (right/left) intersect the same amount of air during straight flight. But during yaw, the advancing wing will cut through the air with the relative wind more square to the leading edge than the receding wing. Since the yaw induced, advancing wing is exposed to more air, its wing loading decreases whereas the receding wing sees less air and its loading increases. If this airplane is near stall and then yawed with rudder, the receding wing is assured of stalling long before the advancing wing. This is a nice setup for a snap roll. Not only does the swept wing have the desired geometry for snap roll entry, but is also more or less insures that one side will remain stalled and the other unstalled throughout the maneuver provided yaw is maintained with rudder. A good line of demarcation (stalled vs. unstalled) is inherently provided at the sweep back junction of the wing. Too much elevator and I am sure that you could also mess up a snap roll in a swept wing airplane, however, it should be quite tolerant of elevator misapplication because of the sweep back effect.

For a straight winged airplane (ACRO II) the situation is different. When yawed, both halves of the wing see the same relative wind so both halves intersect the same amount of air, remain equally loaded, and tend to stall at the same time. Thus an inherent stall line of demarcation between halves of the wing does not exist as in the swept wing design. It is up to the pilot to put it and hold it where it belongs during the maneuver. This requires the pilot to feel the airplane throughout the snap roll and adjust the controls on the fly (pun intended).

After well over 100 snap rolls (of varying quality), I think that I have found how to do them in the ACRO SPORT II. The airplane stalls far too deeply to allow full elevator for snaps. Snap rolls to the left are to be avoided because as we all know, left yawing causes propeller gyroscopic forces in the nose-up direction which will increase angle of attack, deepen the stall and worsen the problem. The line of demarcation (stalled vs. unstalled) can be affected by either rudder or elevator so control of both is important. Neither can be fully applied or kicked. Both must be applied quickly and steadily until rotation starts, then moved as necessary to complete the snap roll.

Here is what works for me. First acquire entry speed of slightly below. I use 85 mph indicated for an entry speed which is about 95 to 100 mph actual. I still have not found the source of error in my airspeed system, but that's another story. Next, advance throttle to well above cruise power, full power is OK. When the speed reaches entry speed, begin pulling elevator first followed almost immediately with right rudder. Move both together but keep the elevator slightly ahead of the rudder. Do not jerk either elevator or rudder or you will lose the feel. At about 20 to 30 degrees nose up attitude, the lift will break and the snap roll begins. Do not advance the rudder beyond this point, otherwise the snap will mush out, hold the rudder position. Also, do not pull the elevator further or the stall will worsen and the snap will mush out. Instead, "play" the elevator (forward) and you will feel the roll rate increase dramatically. The trick is to maximize the roll rate completely through the snap by elevator only. The elevator pressures will be surprisingly low for a maximum rate snap roll. As airspeed is lost during the roll, the elevator setting will need to change accordingly to keep right on the edge of the fastest roll rate, so you can't sleep on the controls. Aileron control is neutral throughout. If done properly, about 10 mph will be lost for a single turn snap and recovery will be smooth and easy. Recovery takes about 1/4 turn and requires opposite rudder pressure and neutralizing elevator. If done improperly, much airspeed will be lost, roll rate will be slow and erratic and recovery will be slow and mushy. This is one maneuver that you can tell by the feel whether or not it was correct.

Out of the 100 plus ones I have done in the last couple of weeks, none left me hanging inverted, half completed. The ACRO II will always do a complete snap roll, provided full elevator is not used. However, the best ones are the quick and smooth ones. The "bad" ones are mushy and recover slowly causing overshoot, but they are, by definition, a snap roll. Right now I can get a "good" snap roll about 50 to 60 percent of the time. With practice, this yield will improve further.

So far, I have concentrated on single turn snaps and cannot tell you much about multiple snaps. It seems to be relatively low stress maneuver on the airframe and pulls only 3 to 3.5 Gs. Higher entry speeds would increase the stress accordingly. You can pack a lot of snap roll practice into a short period of time. With a power setting near full power (IO-360), you can string 8 to 12 of them together without exceeding entry speed or losing (much) altitude. Both entry and recovery procedures can be practiced this way.

Happy flying, and happy snapping.

John White Reports Further on The Airplane He Bought From Dan Quibedeaux, N35DQ

Well, it is six months later and with 100 hours total time on our Acro Sport, we have gotten to know it a little bit better and have made some small changes and adjustments to 35DQ.

Basically, the airplane is great and we have not had to do anything major to the airframe or engine. The engine is a Lycoming IO-360-B4A (180HP) and was installed freshly overhauled. It has broken in good, oil consumption, compression and power very good. We have changed the inlet scoop and intake box to get the most ram air possible with good

results. The best item I would recommend to anybody with a Lycoming O-320 or O-360 is put a stainless crossover exhaust on it. The difference in price of a good stainless cross over verses a cheaply made system like the Wag-Aero unit is only about two hundred dollars or less. You will get a good horsepower boost (at least 10 percent; 15 to 18 HP) smoother running and with 20 inch tail pipes, a quieter cockpit sound. If you use the smoke system, you will appreciate the long tail pipes. Our Wag Aero tailpipes rotted off in less than fifty hours. If you go to cross over, there are some ready made types available, i.e. Wil Nubert at 518/273-2327. Both can build what you want for about \$550.00. If you have a long engine mount as for the IO-360, have the ball joint extend about 3 to 4 inches past the rear cylinder and you can use shorter tail pipes. The standard Wag Aero unit is too short for the long engine mount. The short pipes flop around and allow too much exhaust gases into the cockpit at slower speeds. We had 50 RPM maximum static increase and a 5 to 7 mph speed increase.



Another item that gave some trouble was the flop tube. I was experiencing fuel starvation inverted with 16 to 17 gallons left in the tank. The tank is made in a tear drop shape with the flop tube in the bottom. If you visualize the tank upside down, you will find that it is impossible to use the last 9 or 10 gallons of gas because the tank is wider at the top than the bottom. The flop tube cannot reach the last 9 to 10 gallons of fuel inverted.

The plans call for the flop tube weight to be made out of aluminum. I think the weight is not heavy enough plus the weight is about 4 inches long causing the hose to be shorter thus less flexible!

I had B&F Supply make one that was 14 inches long with a short brass pick up. They have a good standard unit. It is much more flexible and heavy on the pick up end than the Wag Aero unit or the one per plans. Wag unit is only 12.5 inches long and p.u. is made of aluminum. Too stiff.

With the 14 inch unit, I have about 3/8 to 1/2 inch clearance from back of the tank to p.u. end. The hose is flexible and the p.u. is heavy. I can now burn down to about 9 gallons inverted before starvation occurs.

I think a header tank or a fuel tank with a built in header tank is a much better set up. Ultimate Aircraft used to have such a tank.

Installed a new tachometer calibrated at 2700 RPM and flight checked with a strobe type tach to verify actual RPM. 35DQ's tach read 200 RPM low.

35DQ has a Sensenich 76-56 metal prop installed. Some numbers you might be interested in:

Max. Static: 2350 at 2000 msl 75F

T.O. roll: 2500 at 2000 msl 75F

Climb at 90 mph: 2000 msl 75F

Max. wide open throttle: 2850 RPM with 210 lb. pilot and full fuel.

35DQ weighs 1050 lbs. empty. Has a Holmsely smoke and full electrical system.

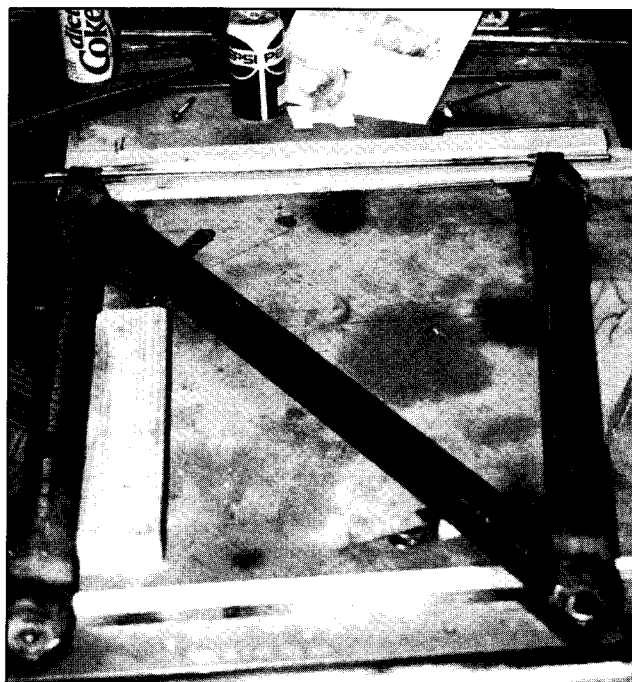
I think a 58 inch or possibly a 60 inch pitch prop would be better for the Acro and all around flying. At 2700 RPM, I'm only half throttle in level flight at about 130 IAS. Doing aerobatic, I leave it wide open and turn as high as 3200 RPM at 170 to 180 IAS. I don't like to but with a low pitch prop, it's the only way it will perform. If you look at the thrust curves of any propeller, you will find that thrust drops sharply at 2700 or more. The engine is producing horsepower but the prop is too inefficient at that RPM to convert it into thrust.

I intend to pitch my prop to 58 inches in the near future, I'll let you know how it works.

TECHNICAL TIPS

The Center Section Angle of Incidence

Neil Sidders had a little bit of difficulty in getting the center section struts at the proper angle of incidence. He used the front dimension of 27-3/32, but changed the rear dimension of 26.95 to 26.832. The main strut built flat on the table, with about a 5/16 inch spacer under the rear spar attach point at the bushing stock. He used a long rod for both bushings to keep them in line. He says it is essential to keep the front strut exactly vertical. For instance, if the height as shown is 27-3/32 inches, and the distance between fittings is 16-3/4, the distance from pin to pin on the diagonal works out at 31.85 inches, approximately 31-55/64 inches. However, this is not the true length of the diagonal, which due to offsets, etc., works out to less than this. You do want to maintain 1-1/2 degrees incidence, particularly if building it without the optional front cabane fitting fork assembly.



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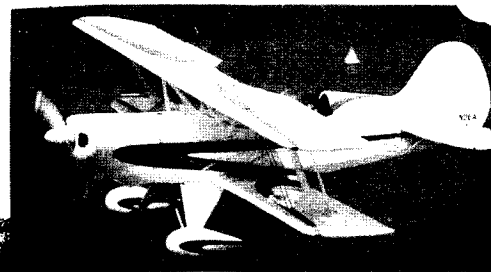
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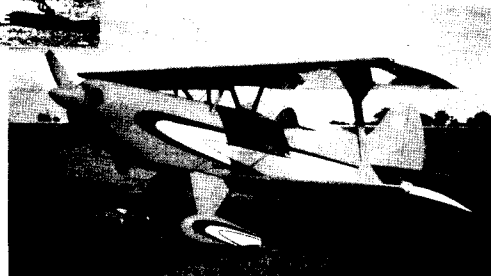
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