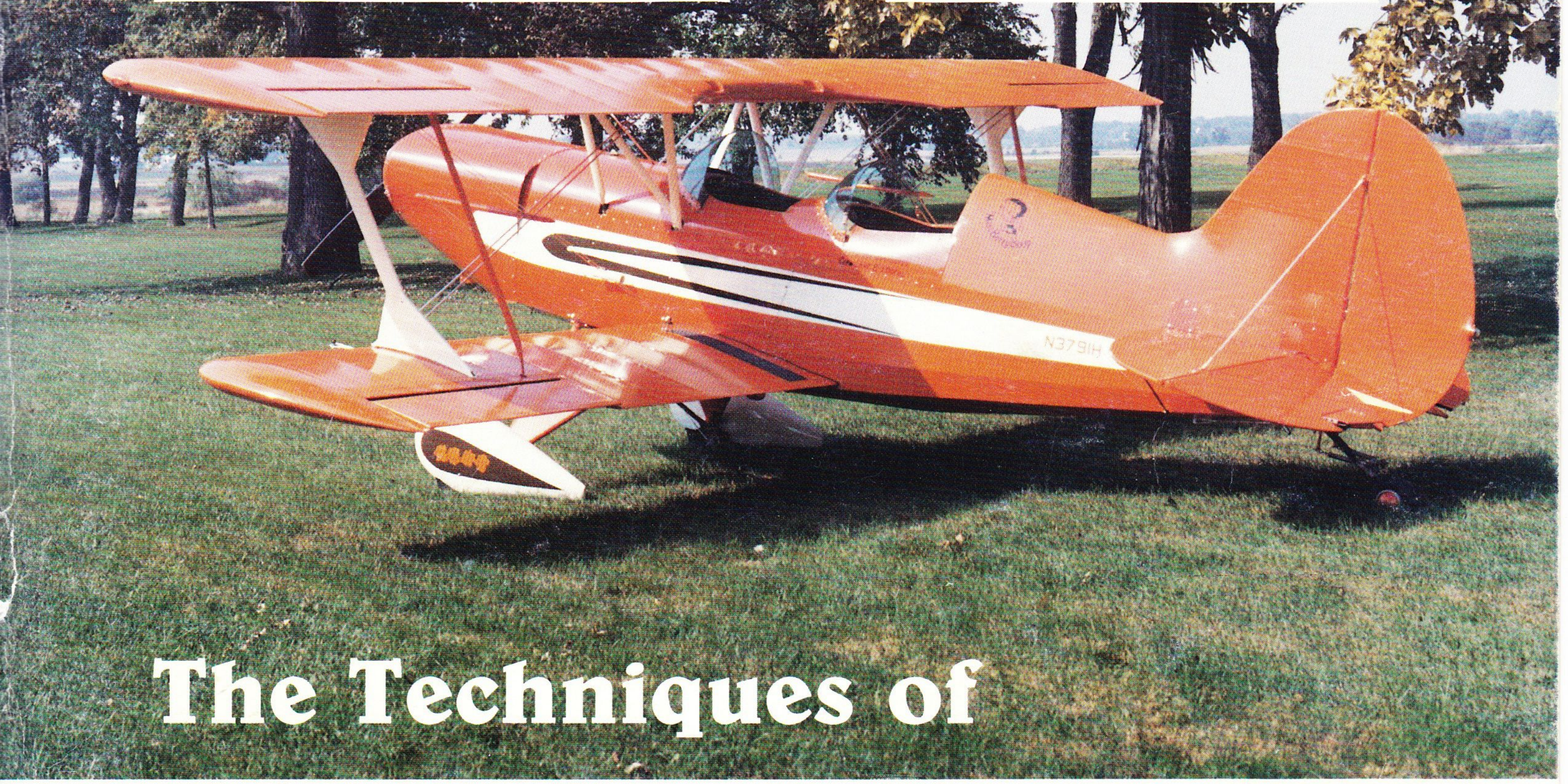
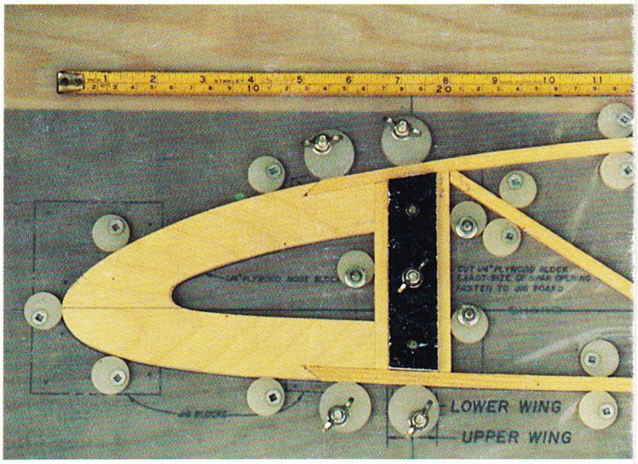
TUBE/WOOD/FABRIC AIRCRAFT



The Techniques of

Aircraft Building



KENT MISEGADES

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* *Compiled and prepared by S. H. 'Wes' Schmid*

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Cover — Acro II built by Bud Gores, Burlington, WI. Inserts show other partially built Acros, including unique wing rib jig devised by D. Geoff Anderson, Brownsburg, Quebec, Canada.

Below — Paul Poberezny working on Acro Sport wing panel.

Few men stand alone in their endeavors and the accomplishments. The design of the EAA Acro Sport was no different. To those men and women who made it all possible — my deepest gratitude.

Paul H. Poberezny

Acro Sport II built by David L. Blanton, Valley Center, KS is powered with a 150 hp Lycoming O-320. First flight was made December 10, 1983.

Paul Poberezny on an early test flight.

HOW TO BUILD THE acro sport

By Paul H. Poberezny
President EAA Air Museum Foundation

introduction

Looking for the ultimate in a home or school workshop project? Then perhaps building your own sporty little airplane might appeal to you. Impossible? Not at all.

Ever since the days of the Wright Brothers and Glenn Curtiss men have been fashioning good, serviceable airplanes in basements, garages and similar informal factories.

In the last ten years, more and more aviation enthusiasts and schools have been building their own — partly for the thrill of accomplishment and partly to provide themselves with an aircraft suitable for educational as well as recreational flying since aircraft factories now turn out high priced executive machines.

For the industrial arts program, the light airplane, its construction, its many and varied attributes, can aid tremendously in the finding of oneself. Unlike the bread board, foot stool and such other projects, the building of an airplane offers variation of skills and above all appreciation of craftsmanship, a rapidly diminishing art in this fast growing world of today.

For the school it is not the purpose entirely to prepare young men or women for positions in aviation industry. But the many skills such as woodworking, welding, sheet metal, engine work, hydraulics, drafting and especially the team work of working together can help one find his or her place in our working society — whether it be in the trades or aviation itself.

For the individual aviation enthusiast working at home — whether in his basement, garage or attic — the self-education aspect of constructing a lightplane can only make our country richer — and his talents an asset.

Basically it is easy enough, for the materials used are light, handy and readily formed and there is a wealth of mechanical literature available in how-to-do aircraft work. Yet, the job is still a challenge. For workmanship must be excellent and all dimensions accurate. Mainly, it is a matter of being patient and methodical rather than of unusual manual dexterity.

Early 1972 saw more than 4,000 homebuilt airplanes flying and some 10,000 under various stages of construction. Safety of the amateur built aircraft is well recognized for insurance can be obtained on most amateur built aircraft for the same rates offered to factory built aircraft.

This little biplane can be powered with popular light aircraft engines ranging from 85 to 180 horsepower class. With less power than that, takeoff climb as well as performance will be unsatisfactory. If the upper horsepower limit is exceeded, engine weight may unbalance this design and speed may over stress the structure.

Each amateur airplane building project costs a different sum and takes a different length of time — depending on the individual, his ability in finding material at favorable prices, and, of course, his working pace. Today, we have many suppliers of materials for the construction of light aircraft. EAA's house organ, SPORT AVIATION, lists the most reliable concerns.

If you work diligently nights and weekends, it could be flying inside of a year. If you take time out for a typical round of family and social activities, the project may take two to three years, but when it is all done the plane will prove to be the high point of your life and you will feel satisfaction is very much worth the effort.

For the high school project or Civil Air Patrol group, the completion of an airplane, one that students have constructed themselves, has been the highlight of their early lives. Having been privileged to test fly several aircraft constructed by high school students as part of their industrial arts education, I have always been thrilled by the enthusiasm of young men who, from tubing, wood and aluminum, have created something that suddenly came alive.

The educational plans given here have been thoughtfully worked out with emphasis on the growing interest and developing talents of our citizens through aircraft construction. A great amount of credit must be given to our EAA Air Museum Foundation and maintenance staff under the supervision of W. "Bill" Chomo in the successful completion of the prototype EAA Acro Sport and to Bill Blake for his excellent drawings. Yours truly has put a number of enjoyable hours in the air in this machine and was privileged to make the very first test flight.

I have found the prototype to be a pleasant airplane with flight characteristics suitable for the average licensed private pilot. Its roomy cockpit will provide comfort for the well over 200 pound and 6 footer pilot. Its wide landing gear provides ease on landing and ground handling. Its almost 20 foot wingspan provides more than adequate wing area and stall characteristics have proven excellent. A book could be written about building this airplane — the second best thing we can do is refer the prospective builder to literature which will supplement this article.

The Experimental Aircraft Association's publication list contains many manuals on wood working, metal, welding, hand tools, aircraft covering, engines, etc. For example, the Civil Aeronautics Manual 18 which explains approved methods of making structural detail such as splices in tubing and wood, stitching fabric to the framework, safety nuts and bolts, etc..

When working on the steel tubing of the fuselage and tail group, the manual on EAA Aircraft Welding will be invaluable. These are but a few of the manuals that the EAA Air Museum Foundation has made available.

The EAA member's monthly magazine, SPORT AVIATION, keeps the amateur aircraft builders posted on all phases of their educational endeavors and regularly features informative and technical articles.

It is essential that only aircraft grade materials be used in this plane. Non-aeronautical materials may resemble aircraft quality products superficially but there are great and important differences. Chrome-molybdenum steel tubing — known as 4130 among airmen — after a society of automotive engineers SAE specification number, is stronger than common mechanical steel tubing and is formulated to weld readily. It is manufactured to much higher standards in regard to uniformity of wall thickness, its absence of scratches and surface defects and straightness.

Nickel steel aircraft bolts, identified by AN* like mark forged on the heads, are much stronger than common bolts. They are machined more accurately and are individually inspected.

Aircraft spruce is cut from selected trees to meet high standards of grain uniformity and absence of defects and is kiln dried to lower moisture content in a way to increase its cell strength making it more dimensionally stable and to insure reliable gluing.

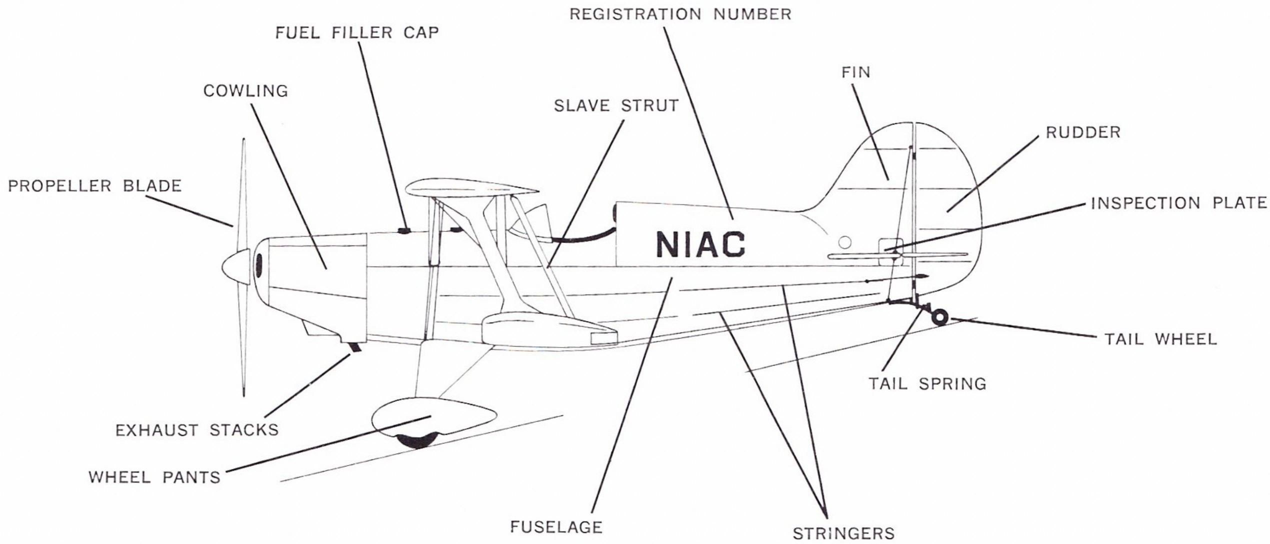
Cotton and linen aircraft fabric made of selected long fiber raw material specifically designed and woven to have high tear resistance to stretching under air pressure is carefully cleaned of oil and wax to insure that the plastic like liquid called "dope" will adhere. It is woven with controlled tension so that the dope will penetrate the weave enough but not so much as to cause excessive tightening which might distort the framework.

Other synthetic fabrics such as Ceconite® Fiberglas® and Stits Polyfiber® covering processes are also acceptable. These are but examples of aircraft materials from everyday goods. Now you understand why only aviation supplies are to be trusted.

When starting your project, it is essential that you obtain an amateur built aircraft log book, available from EAA Headquarters. It will provide for documents, history of inspections and materials used during your construction period. When buying items, save purchase receipts to prove to the FAA Inspector that aircraft grade material has been used, and when you have decided definitely to build a plane, get in touch with your area's FAA Maintenance Agent. Any airport will know where to direct you. Notify FAA of your plans because amateur built planes in recent years have had a fine safety record and the educational sport is doing much to stimulate public air mindedness. The FAA approves of the activity and the reason for notifying local agents is so that the FAA will know what is going on and offer such friendly advice as an agency may deem necessary.

You are going to have to deal with the FAA before the project is completed — several times. So it pays to get acquainted early.

Paul H. Poberezny — Designer of the EAA Acro Sport



nomenclature

AILERON: One of a pair of movable control surfaces attached to the trailing edge of each wing tip, the purpose of which is to control the airplane in roll by creating unequal or opposing lifting forces on the opposite sides of the airplane.

AIRFOIL: Any surface, such as an airplane wing, aileron, or rudder, designed to obtain reaction from the air through which it moves.

ANGLE OF ATTACK: The angle at which an airfoil meets the airflow. It may also be described as the angle between the chord line of a wing and the relative wind.

ANGLE OF INCIDENCE: The acute angle between the chord of an airfoil and the horizontal axis of an airplane.

ANGLE OF STABILIZER SETTING: The same as the angle of incidence as applied to a vertical or horizontal stabilizer.

ANGLE OF WING SETTING: The same as the angle of incidence.

ANTIDRAG WIRE: A wire running from an inboard point near the trailing edge of a wing to an outboard point near the leading edge, designed to resist forces acting on the wing in the direction of flight.

ANTILIFT WIRE: Same as a landing wire.

CABANE: An arrangement of struts such as those used to support a wing above the fuselage of an airplane.

CAMBER: The curvature of the mean line of an airfoil or airfoil section from leading edge to trailing edge.

CENTER OF THRUST: A line coincident with the center line of the propeller shaft, about which the thrust forces are balanced.

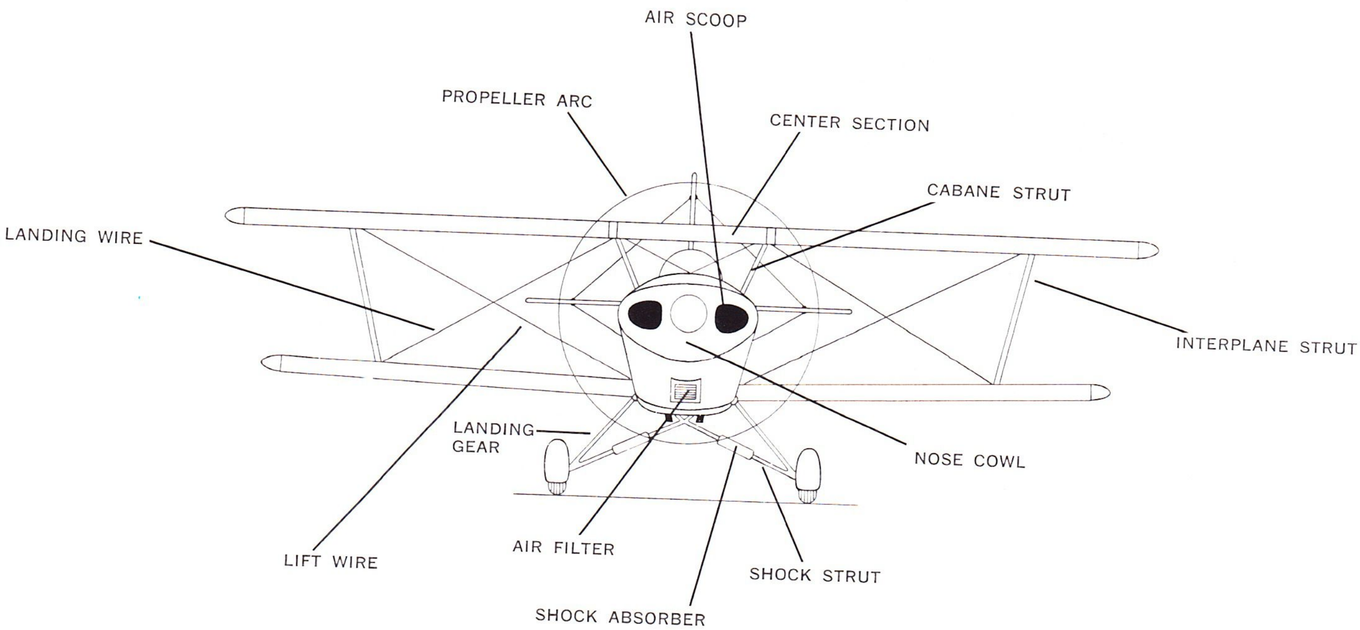
CENTER SECTION: The middle or central section of an airplane wing to which the outer wing panels are attached.

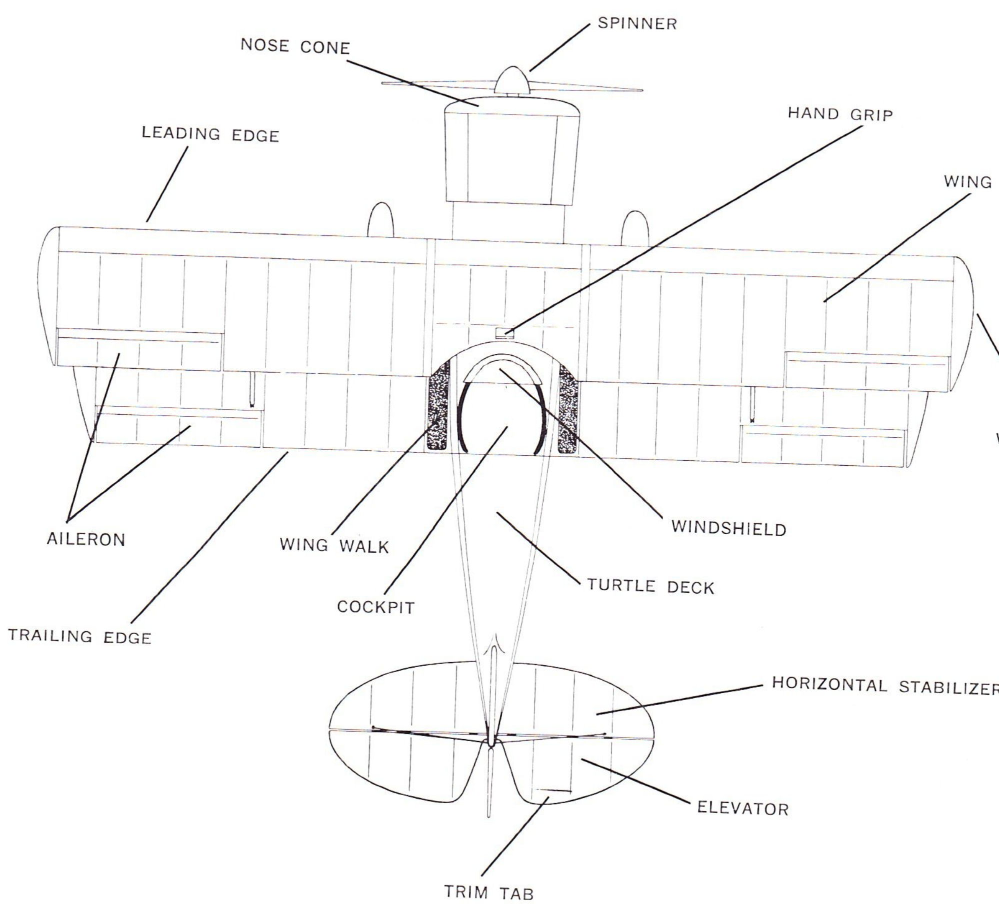
CHORD OF A WING: A straight line joining the ends of the mean line of a wing profile.

COCKPIT: An open space in the top of an airplane for accommodation of a pilot.

CONTROL CABLES: Cables connecting the control levers with the control surfaces.

CONTROL STICK: A vertical lever by means of which the pilot operates the longitudinal and lateral control surfaces of the airplane. The elevator is operated by a fore-and-aft movement of the stick, and the ailerons are moved by a sideways movement of the stick.


AIR SCOOP
PROPELLER ARC
CENTER SECTION
CABANE STRUT
LANDING WIRE
INTERPLANE STRUT
LANDING GEAR
NOSE COWL
LIFT WIRE
AIR FILTER
SHOCK STRUT
SHOCK ABSORBER


SPINNER
NOSE CONE
HAND GRIP
LEADING EDGE
WING RIB
WING TIP
AILERON
WING WALK
WINDSHIELD
TURTLE DECK
COCKPIT
TRAILING EDGE
HORIZONTAL STABILIZER
ELEVATOR
TRIM TAB

CONTROL SURFACE: A movable airfoil or surface, such as an aileron, elevator, or rudder, used to control the attitude or motion of an airplane and guide it through the air.

COWLING: A removable cover or housing placed over or around an aircraft component or section, especially an engine.

DIHEDRAL ANGLE: The acute angle between a line perpendicular to the plane of symmetry and the projection of the wing axis of the airplane.

DRAG STRUT: Any strut used to resist drag or anti-drag forces.

DRAG WIRE: A wire in wing structures, running from a forward inboard point to an aft outboard point to resist drag forces.

ELEVATOR: A movable auxiliary airfoil or control surface designed to impress a pitching moment on the airplane, that is, to cause rotation about the lateral axis.

FAIRING: A piece, part, or structure, having a smooth streamlined contour, used to cover a nonstreamlined object or to smooth a junction.

FIN: The vertical stabilizer.

FIREWALL: A fireproof or fire-resistant wall or bulkhead separating an engine from the rest of the aircraft structure to prevent the spreading of a fire from the engine compartment.

FUSELAGE: The main or central structure of an aircraft, elongated and appropriately streamlined, which carries the pilot and to which the wings are attached.

GAP: The distance between the chords of two superimposed airfoils.

HORIZONTAL STABILIZER: A stabilizer mounted horizontally on an airplane affording horizontal stability and to which the elevators are attached.

HORN: A short lever fastened to a control surface to which an operating cable or rod is attached.

INSPECTION DOOR: A small door used especially for inspection of the interior of an airplane.

INTERPLANE STRUT: A strut between two wings or other surfaces.

LANDING GEAR: The understructure which supports the weight of the airplane.

LANDING WIRES: Wires which brace the wings against the forces which are opposite to the normal direction of lift. These wires attach to the upper wing above the fuselage and to the lower wing near the outboard end.

LEADING EDGE: The foremost or front edge of an airfoil or a propeller blade.

LIFT WIRES: Wires which brace the wings against the forces of lift. They are also called flying wires.

LONGERON: A principal longitudinal (fore and aft) member of the framing of an airplane fuselage, continuous across a number of points of support.

PROPELLER BLADE: That portion of a propeller which cuts the air.

PROPELLER HUB: The part of the propeller that comes into contact with the shaft.

RUDDER: A hinged or movable auxiliary airfoil used to impress a yawing moment on the aircraft.

RUDDER PEDAL: Either one of a pair of cockpit pedals for operating a rudder or other directional control device.

SHOCK ABSORBER: A device built into the landing gear to reduce shock during landing or takeoff.

SPAN: The maximum distance, measured parallel to the lateral axis, from tip to tip of any airfoil.

SPAR: A principal spanwise structural member of a wing or other airfoil.

SPINNER: A fairing of approximately paraboloidal shape, fitted coaxially with the propeller hub and spinning with the propeller.

STABILIZER: A fixed or adjustable airfoil or vane that provides stability for an aircraft.

STAGGER: The amount of advance of one wing of a biplane ahead of the other.

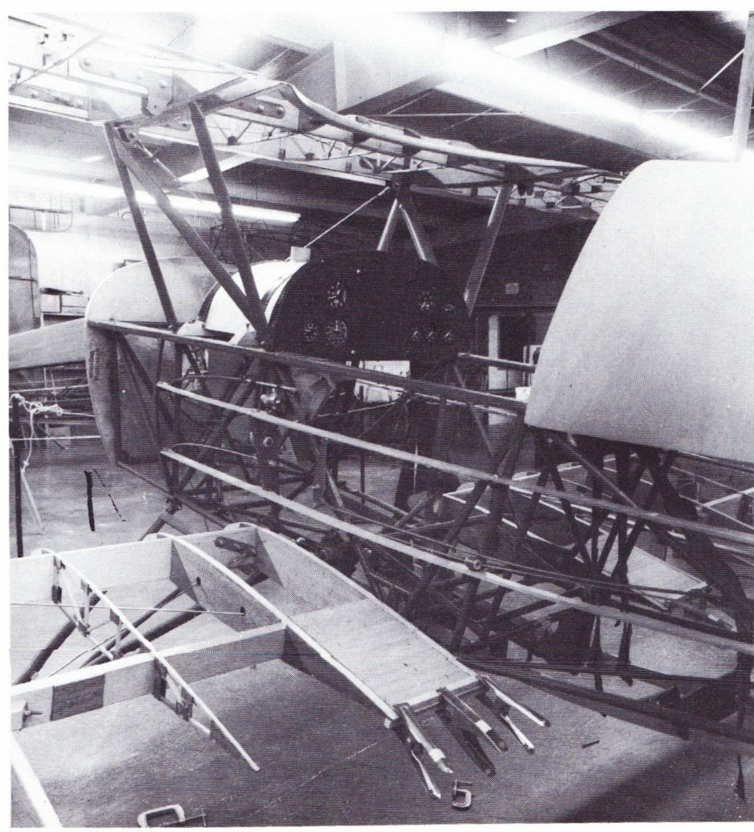
STRUTS: A supporting brace which bears compression loads, tension loads, or both, as in a fuselage between the longerons, in a landing gear to transmit the airplane loads, etc.

TAIL WHEEL: A wheel at the tail of an airplane to support the tail section on the ground. A tail wheel is usually steerable.

TRIM TAB: A tab attached to the trailing edge of an airfoil for the purpose of reducing the control force or trimming the airplane.

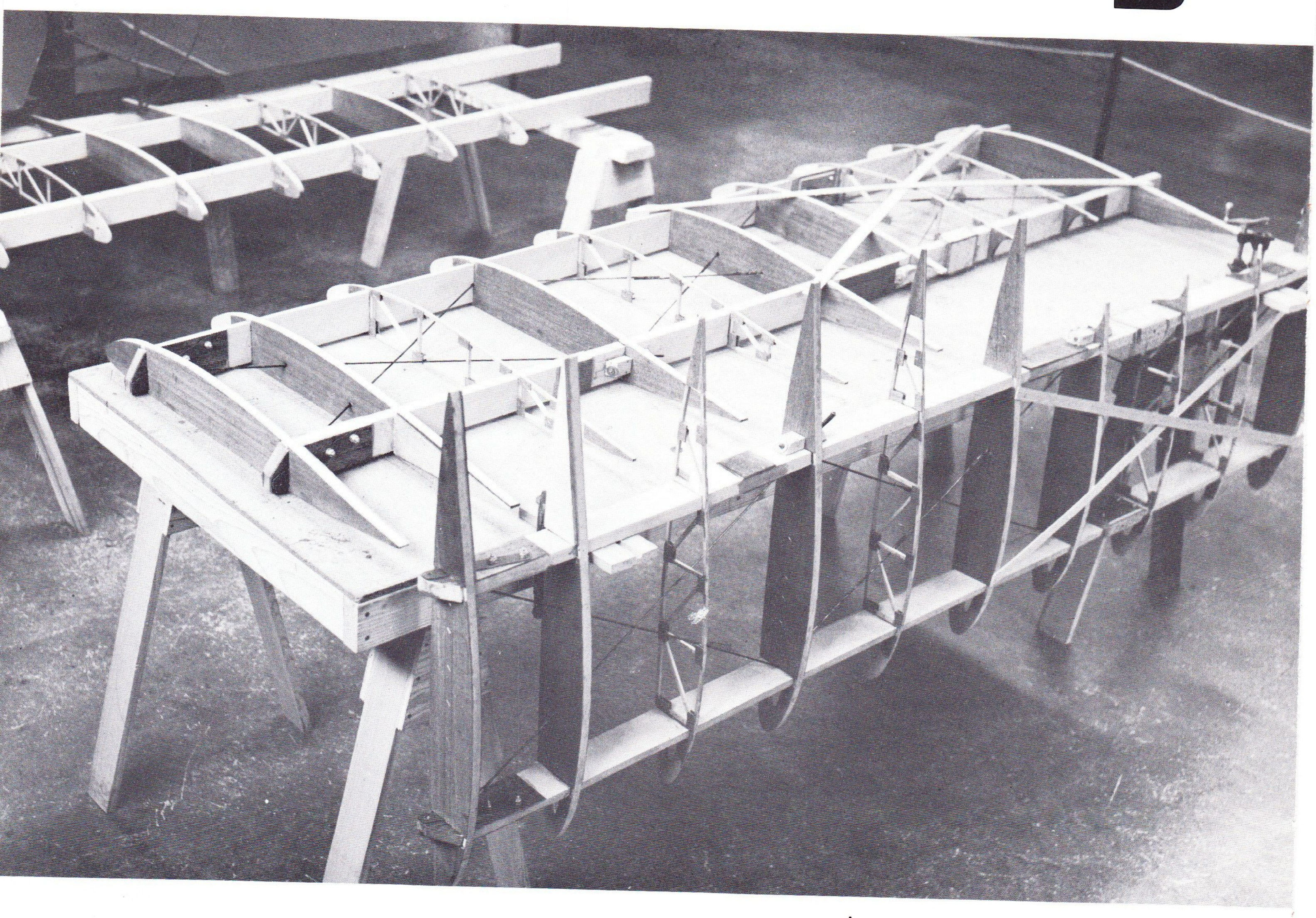
WING RIB: A chordwise member used to give the wing its shape and to transmit the load from the fabric or other covering to the spars.

WING TIP: The outermost extremity of a wing.



Note glue clamp holding wing walk plywood in position.

wings



Acro wing under construction.

It does not matter which component of a plane is built first. Many prefer to begin with the wings because a very modest investment in the materials will get you going. The drawings show how to make the wing rib jig which holds the several pieces in accurate relationship for the assembly. It is important that the outline of the rib section, called airfoil, be constructed accurately. The educational set of drawings available from EAA Air Museum Foundation include a full-sized detail rib and jig drawing and will insure accuracy and ease of working. Any deviation in the finished ribs over the plotted sections is quite apt to have a detrimental effect on performance and/or handling quality.

The airfoil selected for the EAA Acro Sport is the NACA M-6 which was developed in the wind tunnels and has had a long history of satisfactory performance in both amateur built and factory built aircraft.

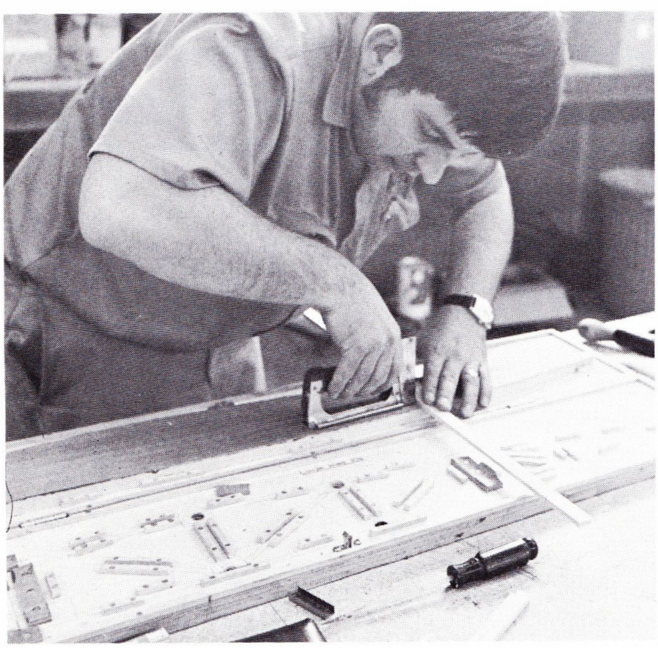
If it is decided to make a wing rib first, select a piece of ¾″ plywood at least 40 inches long and wide enough so that the full size wing rib drawing can be placed on it. Many builders trace the full size rib drawing on to the wood building jig thus eliminating the need of wax at glue joints to prevent sticking to the paper.

Glue blocks of wood or excess wing rib material strategically along the curve, uprights and diagonals to hold the many rib pieces into proper position. These can be glued and nailed to the rib jig. The ribs are made out of ¼″ square spruce. You may purchase rib stock from a supply house or saw it out yourself from spruce boards. The plywood nose block is laid into position first. The upper and lower wing rib caps placed into position and the vertical and diagonal cap strips are cut to size and fitted into the jig. To save time it would be advisable to prepare one set and use that as a master, determine the number of each of the pieces and mass cut them, placing each into individual containers, numbering them so that a production line method can be established.

The plywood used for gussets is 1/16″ mahogany 3-ply material of aircraft grade which may have a light colored inner-ply of some wood such as birch. Aircraft plywood is made with special care to avoid hidden checks, splits and knots in the inner-plys and to perform the finished sandings so that both outer plys are of equal thickness thus producing a reliable stable material.

You will note in the wing rib sketch how the vertical and diagonal members are butted together. This is so the center line and hinge lines of force will all meet at one common point and achieve maximum rib strength. Gussets may be attached with Urea resin glues such as Weldwood or with resorcinol glue such as Elmer's Waterproof Glue. These brands are widely distributed and have proven satisfactory for airplanes. Other glues could be used but not until their suitability has been established. Follow mixing instructions carefully to get correct thicknesses.

Wood parts must lie flush and true. If spruce strips have been sanded — scrape areas to reglue. With a sharp edge of a piece of glass remove all sandpaper dust. Lightly scarify the surface of hard mahogany plywood to add adhesion. The tiny nails used to attach gussets add almost nothing to the joint strength and serve mainly to hold



To insure uniformity, wing ribs are built in a jig. All jigs necessary for construction of the Acro Sport are shown in the plans.

gussets in place and to create pressure. The adhesion of aircraft glues depends on pressures, not stickiness. Poorly fitting joints are those with inadequate pressures and will be pitted with pockets of glue which will be brittle and unreliable.

The use of a magnetized upholsterer's tack hammer to pick up and drive the tiny nails is ideal. Do not use substitute fasteners which could rust as rust spots lead to rotting which will weaken the slim wood strips.

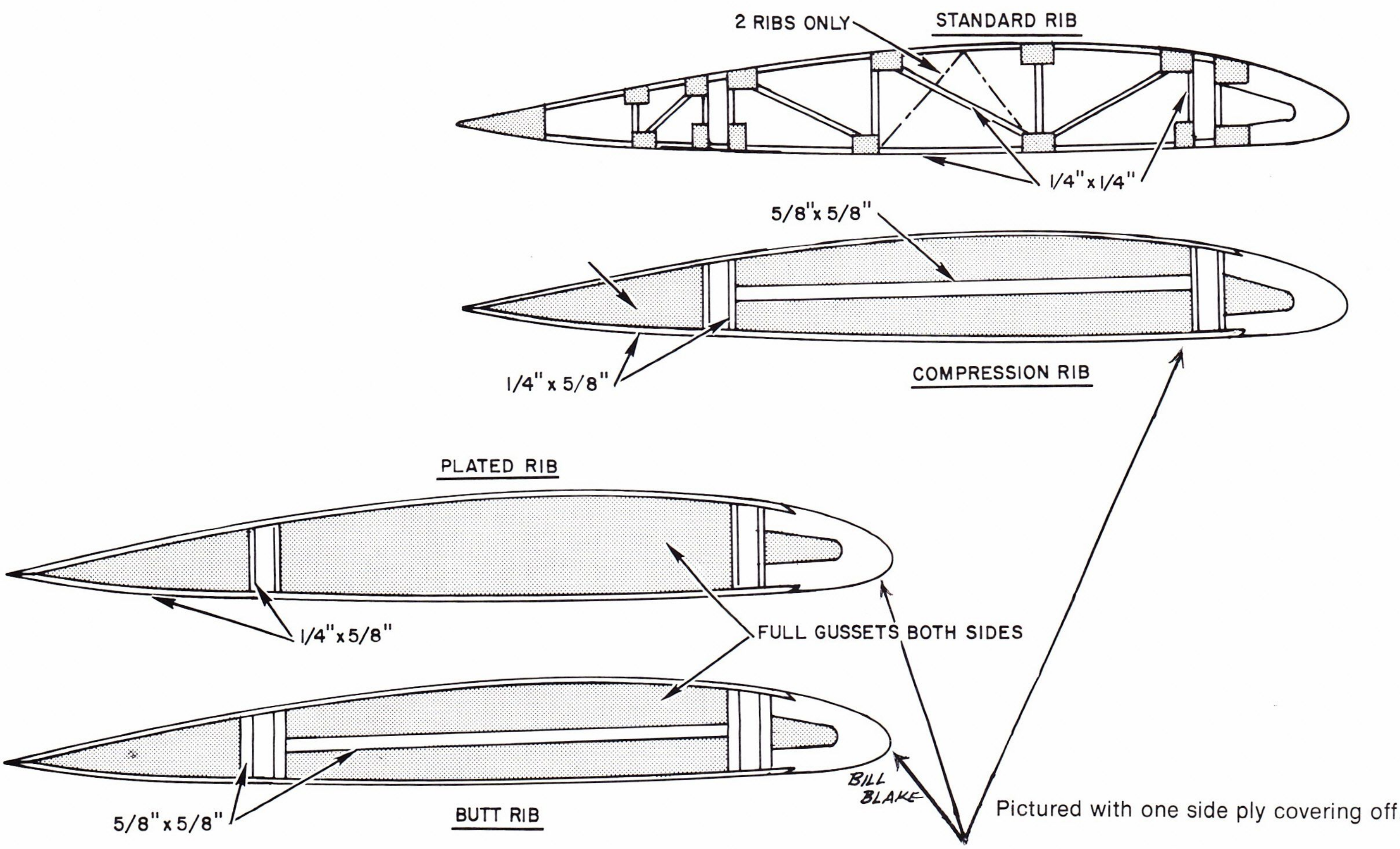
Apply all gussets to the upper side of the rib being careful not to split the cap strip when inserting the ½" aircraft quality nails. Remove the rib, turn it over and apply gussets to the other side. Go lightly on glue to avoid ooze droplets and so as to attain a craftsmanship quality.

Study the plans to see how many full ribs and how many aileron or shorter ribs to make and note also how the wing root ribs differ from others. When all wing ribs are finished, stack them together to see if all are alike. Cutting down on minor high spots on the cap strips of the stack pile with a sanding block is permissible provided, of course, that no cap strip is weakened. Many builders allow a little overhang of the wing rib gusset so that when the ribs are sanded the gusset is sanded down smoothly and fits flush with the upper and lower wing rib cap strip.

When preparing wing spars, great care in lay out and milling must be taken. Any firm supplying aircraft spruce will usually saw and mill the rough stock to any specified thickness and width. They know the right cutters and speeds to use to get a smooth finish. Many builders supply drawings and dimensions when ordering their spar stock. Then the material arrives ready for finishing touches. Remember, the wing spars are some of the most critical load carrying members in an airplane. It is recommended that FAA certified Aircraft Grade Sitka Spruce be used. It is interesting to note that when a wing spar is under bending loads or flight loads there is compression on one edge and tension on the other. The neutral axis of a spar is the line where there is neither compression or tension in the wood fibers and usually it is at the very middle or center of the spar.

The birch plywood doublers that are glued on the spars keep bolts from pulling out along the grain of the spruce at the attach metal fittings — in such areas as where the outer wing struts attach and the metal wing fittings attach to the fuselage or the center section. These doublers or torsion plates must be firmly glued to the spar and can be secured either by nails or by clamps until the glue is dry. Carpenters clamps are more than adequate and any surplus glue should be wiped off with a cloth before it dries.

All bolt holes in spars must be as true and



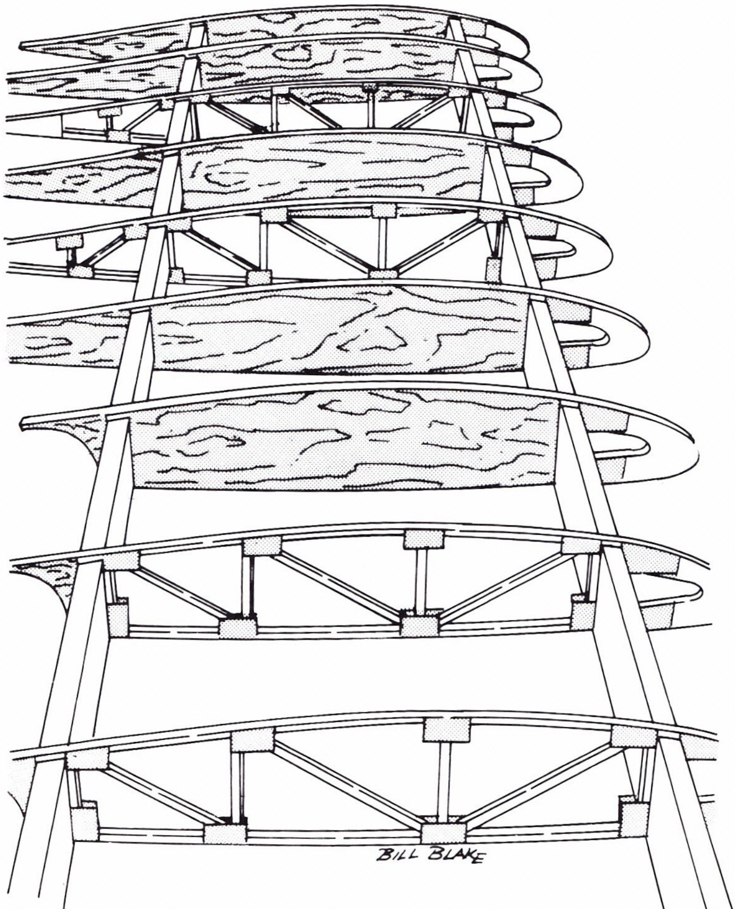
The different ribs used in the Acro Sport wings.

accurate as possible. One might consider practicing on scrap wood first. Do drilling on a drill press to attain accuracy. Don't use a hand drill. Spar holes and fitting holes must meet as perfectly as possible otherwise some bolts will do more work than others and crush or tear the wood. Rest the spar on a block of scrap wood and drill through into the scrap to avoid splintering the spar material when the drill breaks through. Run the drill at a high speed, make sure it is always sharp and feed it slowly to avoid tearing the wood fibers. Twist drills ground to a sharper point than is normal for boring metal make cleaner holes in wood. Boring patterns can be made from metal scrap stock and used to get accurate alignment in spacing in both spars and the steel wing fittings.

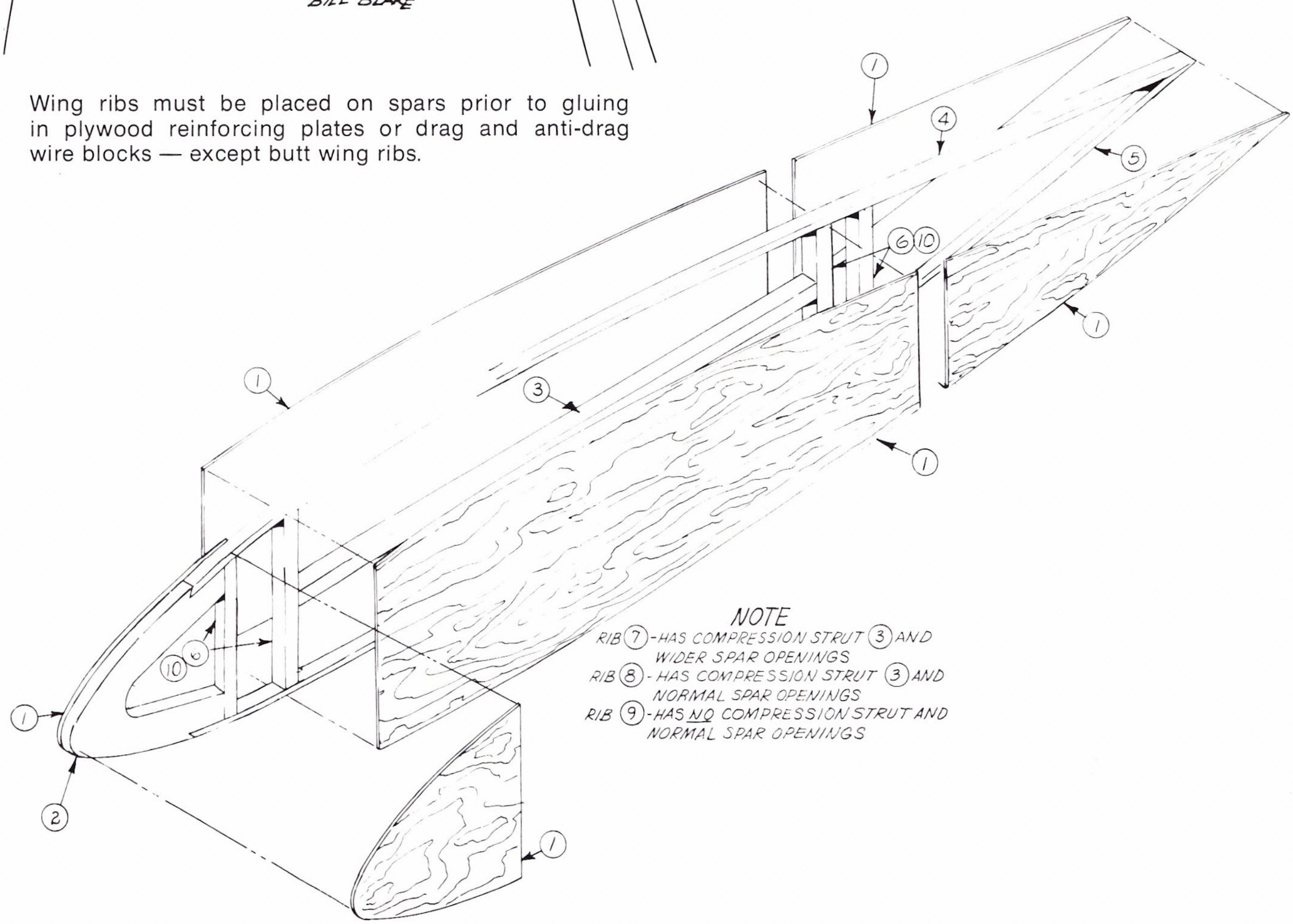
When boring right and left spars, take pain to get location and spacing of holes on each exactly alike so that when doing stalls the wing panels will be symmetrical and true, for if one wing panel was lower then the other, a greater lifting action would result causing the airplane to roll or turn.

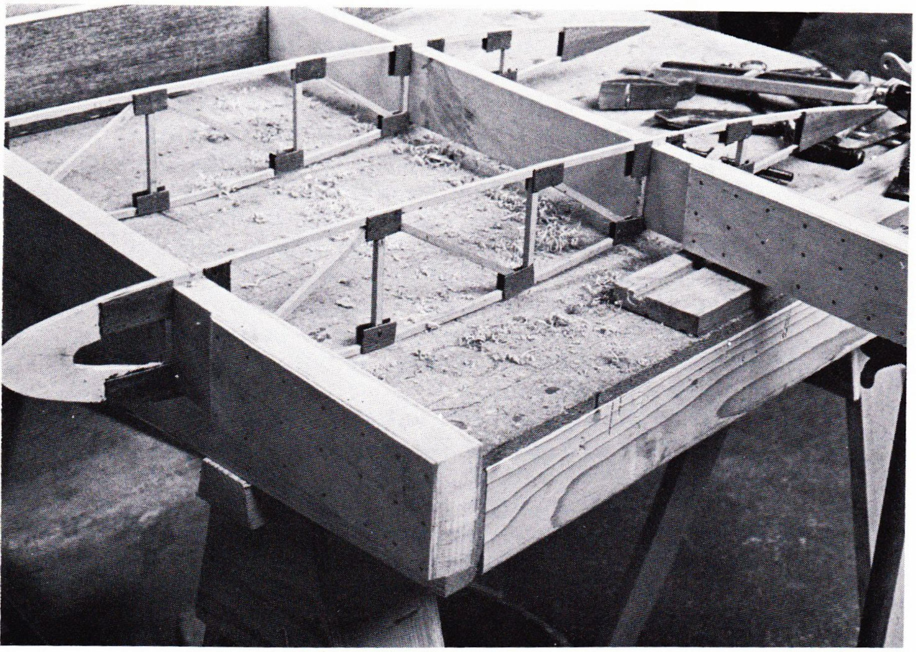
The system of "X" wires in each of the wing panels, as noted on the drawings, are called drag and anti-drag wires and handle the fore and aft airloads on the wing system.

The compression struts fastened to the ribs are out of wood and are placed in areas where the drag wires go through the wing spars. Later



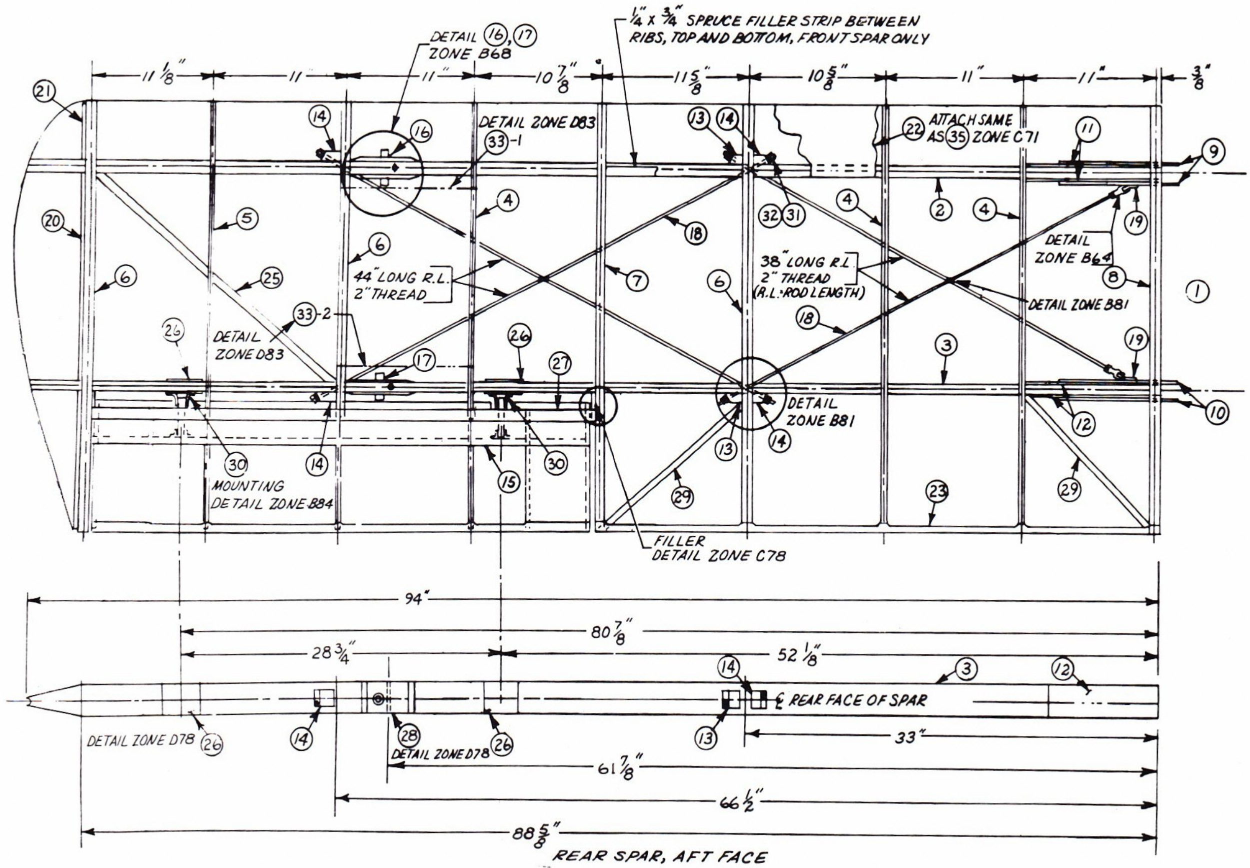
Wing ribs must be placed on spars prior to gluing in plywood reinforcing plates or drag and anti-drag wire blocks — except butt wing ribs.



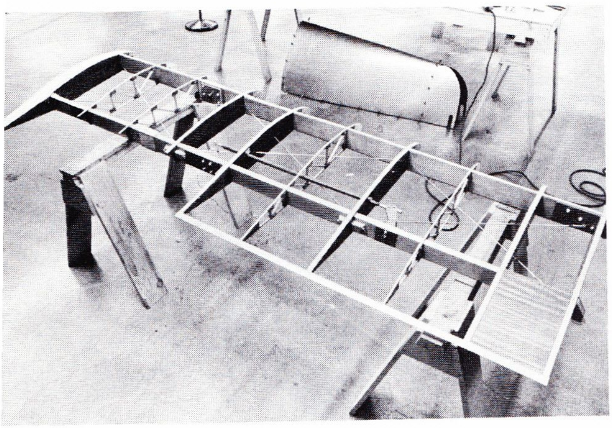


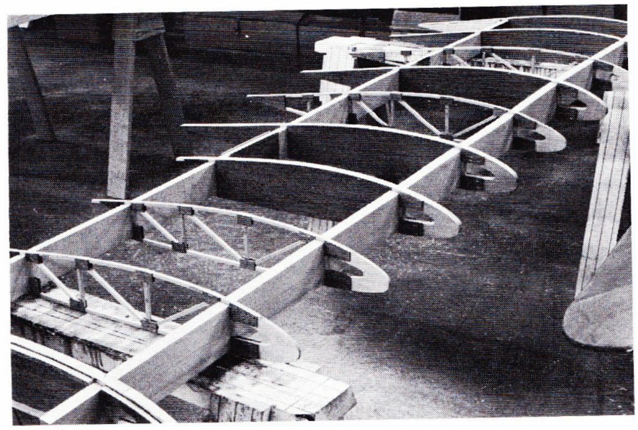
Acro wing under construction. Note plywood reinforcing plates glued and nailed into position. Wing ribs should be put on spar prior to gluing of plywood reinforcements on the spars.

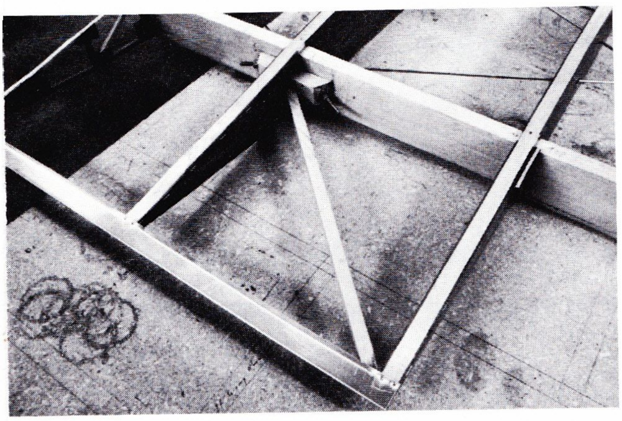
Positioning wing ribs on the wing spars. Rib positions are accurately measured and penciled on front and rear spars before sliding ribs into position.

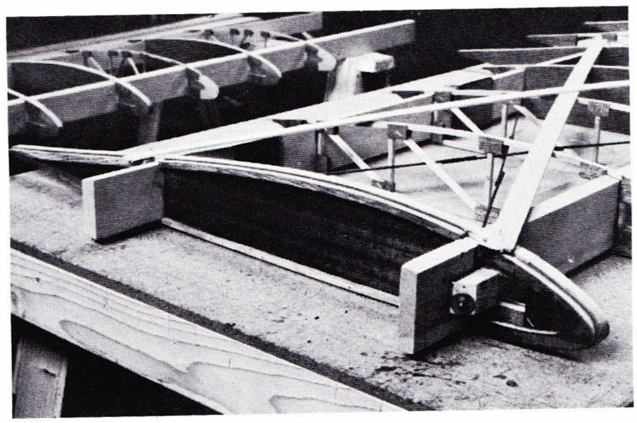


UPPER WING









Wing trailing edge attached top and bottom by ¼" aircraft nails.

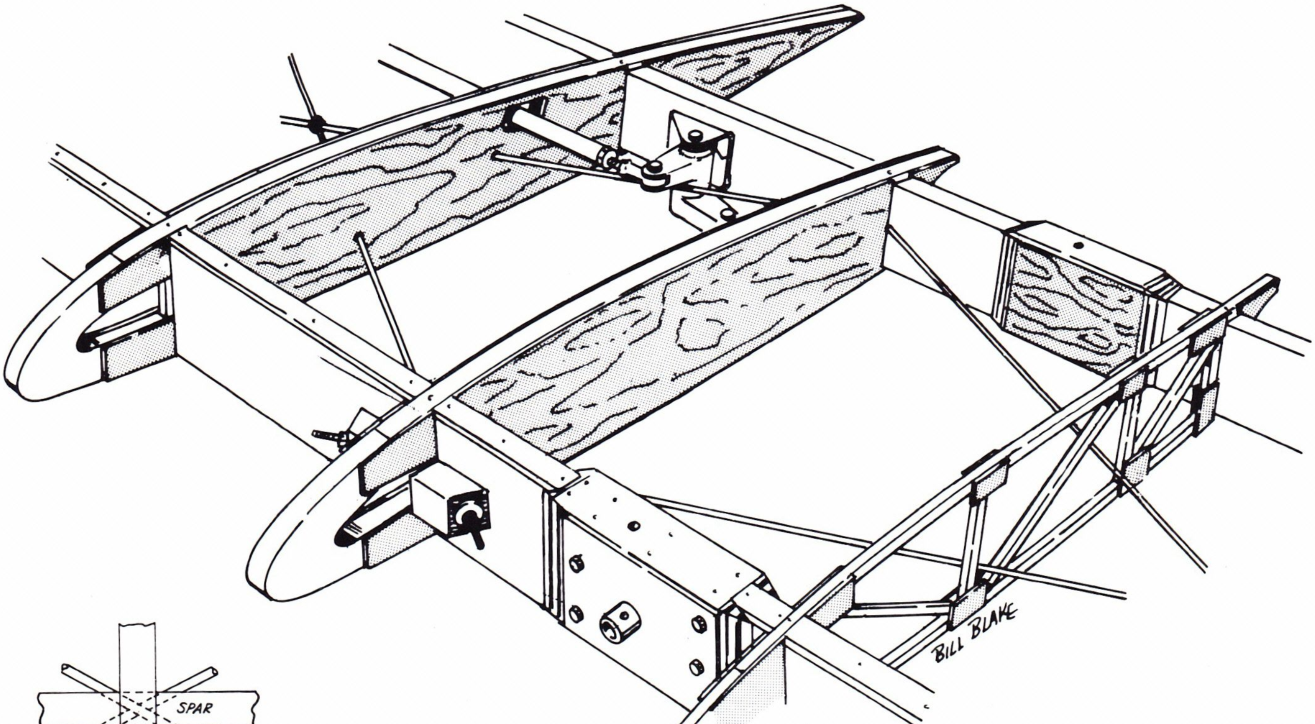
Wing tip prior to shaping spar ends and installing molded fiberglass tip. Strips across top of ribs are used to square wing by prior to installing drag wires.

these wires can be tightened and adjusted to square or trammel the wing so that perfect alignment of all fittings that attach to the fuselage or center section and wing struts are true. The trammel bar, which is made of two adjustable, pointed tools, is used to take accurate measurements between each bay of drag and anti-drag wires. Drag and anti-drag wires may be ordered to the proper length as well as streamlined flying wires from the Mac Whyte Company, 2906 14th Ave., Kenosha, Wisconsin. It is a firm specializing in aircraft wires and cable. The latter stretches when load is applied and will not serve to hold the wing structure in a rigid configuration against air loads.

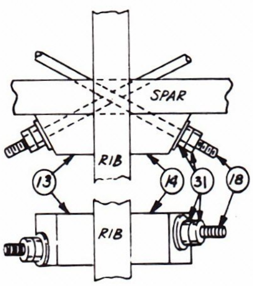
All wing fittings are made out of 4130 aircraft quality steel. To make fittings, spread machinist lay-out dye on the metal which makes scriber lines show up clearly. If you live near a commercial metal working shop, they may be able to cut fittings out with a Doall Band Saw or with a fast moving punch like a machine called a nibbler. Hack sawing and filing are slow but turn out very good work and the majority of homebuilders use this method.

In laying out fittings onto the flat stock sheet steel, be sure that accuracy is adhered to at all times. Transferring the dimensions from the drawings to the appropriate thickness of sheet metal requires considerable accuracy. Bending where required is usually accomplished cold. If you try heating a small area with a welding torch and hammering the metal over progressively, a lumpy bend results. Small bends are made by clamping metal between hard wood or metal blocks, one of which is edged to the radius shown on the plans. It is important to observe the bending radii specified for too sharp a bend causes surface cracks and too mild ones lead to inaccurate fitting dimensions.

Bolts that must be adapted to fittings should be able to be pushed lightly into the fitting holes. If they go in with any looseness, vibration will let them shatter and elongate the holes too rapidly. Go slow — the finest practice is to drill holes a trifle under sized, put mating fittings together and ream both at once to a perfect light-push fitting. File edges to a smooth finish before bending to avoid starting cracks. Don't let non-slip vise jaws mar fittings or metal. Use soft brass face plates on the jaws.

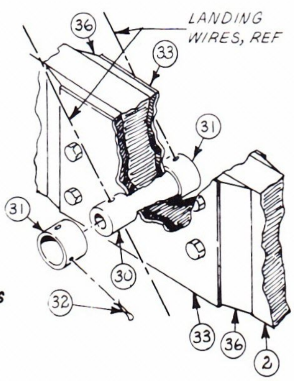


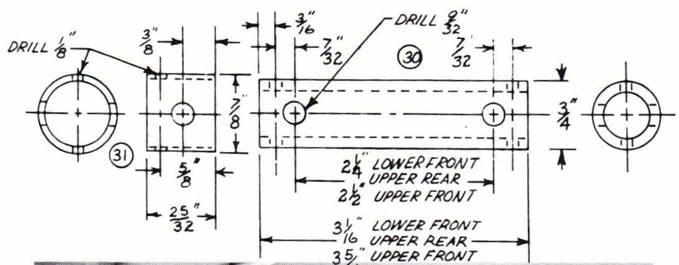
Lower wing of Acro Sport showing drag and anti drag wires and blocks, aileron push pull tubes, short compression rib, and I wing strut attach point.

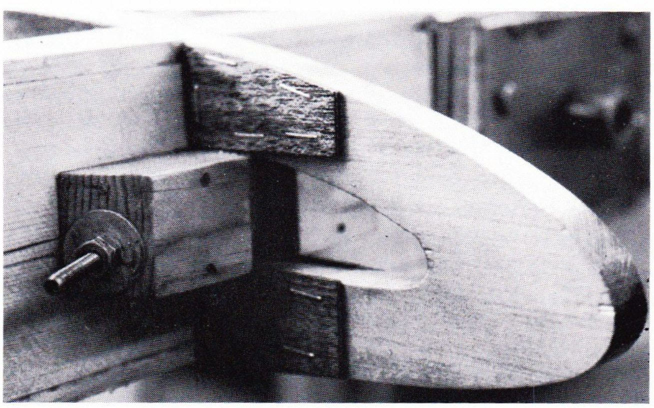


DETAIL, DRAG/ANTI-DRAG WIRE, PULL BLOCKS TYPICAL

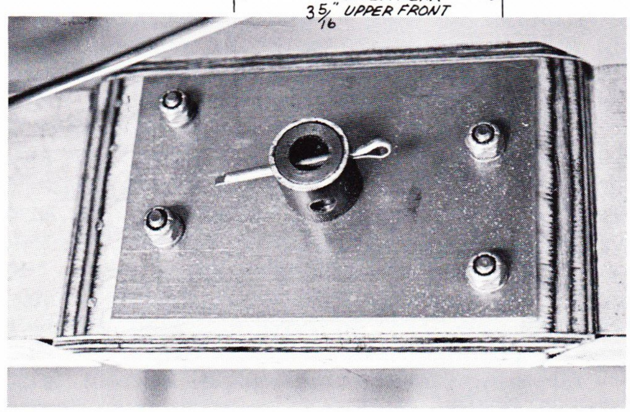
WRAP AROUND AND BETWEEN WITH SEVERAL TURNS OF RIB STITCH CORD



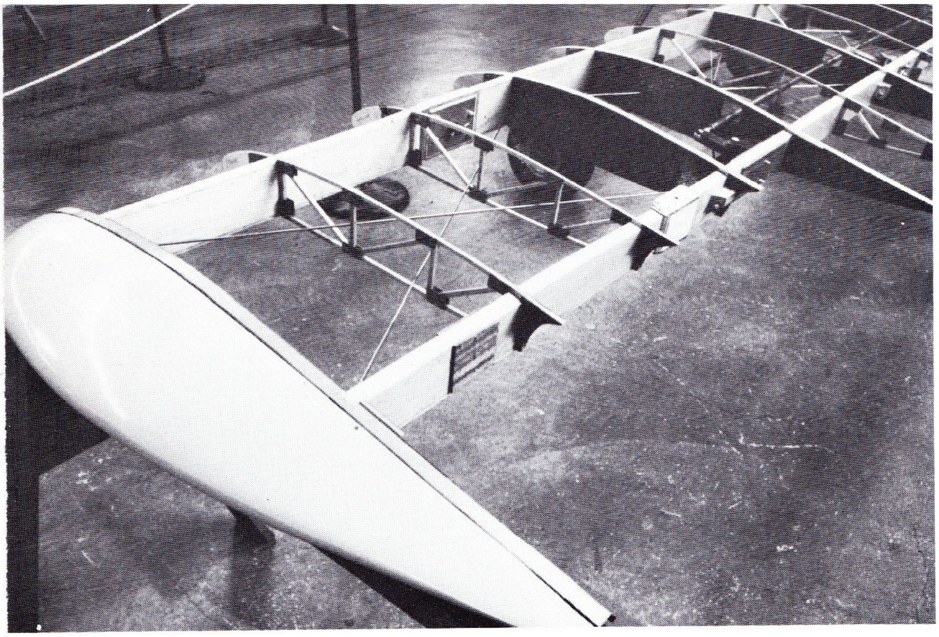




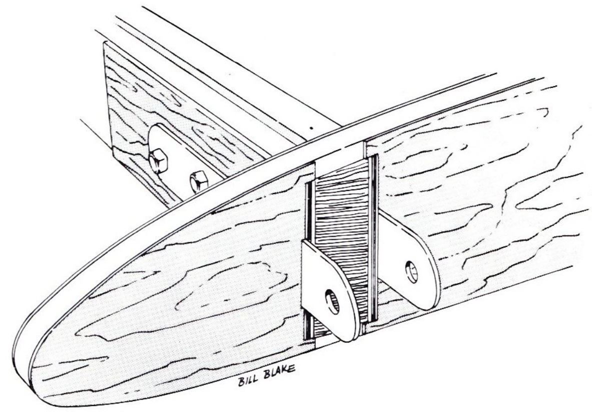
Wing anti-drag wire block, front of front spar. Hole for drag wires must be accurately drilled through block and spar.



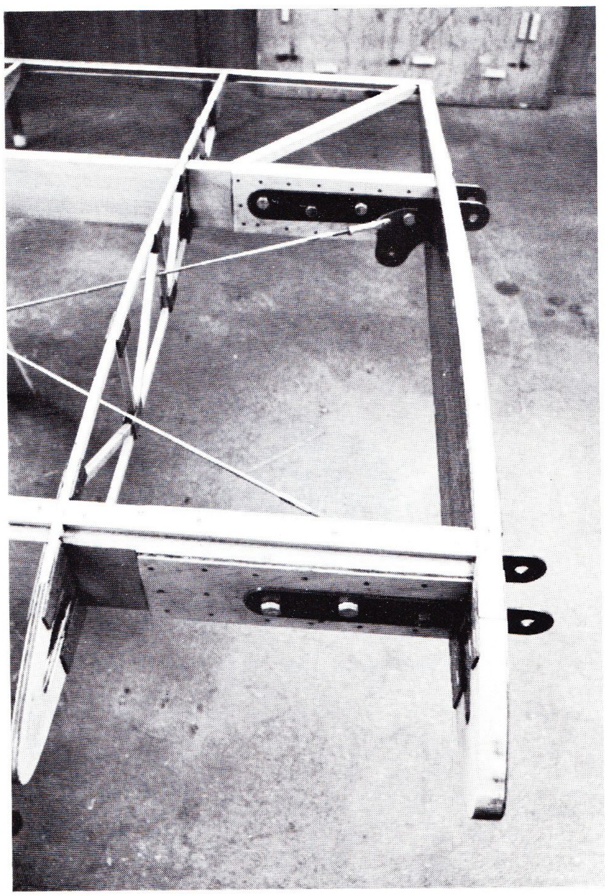
Wing spar outboard flying and landing wire fitting. This type of fitting of Pitts design will carry flying and landing wire loads.



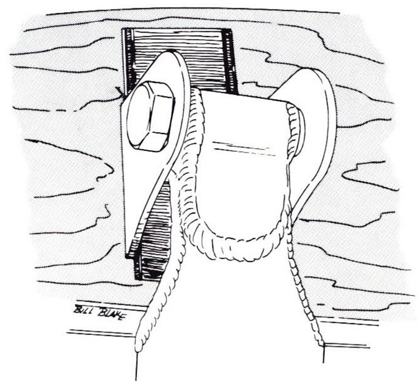
The fiber glass wing tip gives a smooth finish when the wing is covered. Aluminum trailing edge at aileron gap is next to be installed.



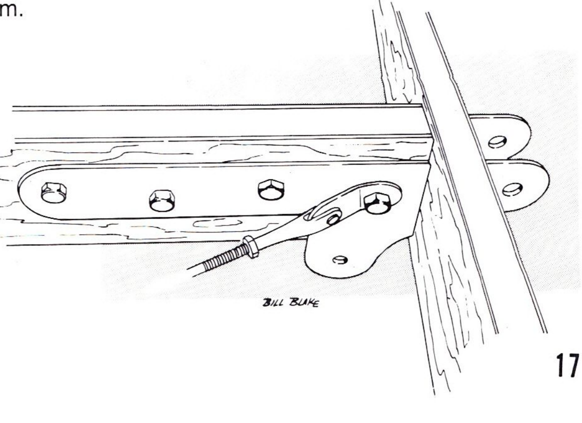
Upper front wing spaı fitting showing plywood reinforcing plates. Note plywood is notched out to permit fitting of metal wing fittings.



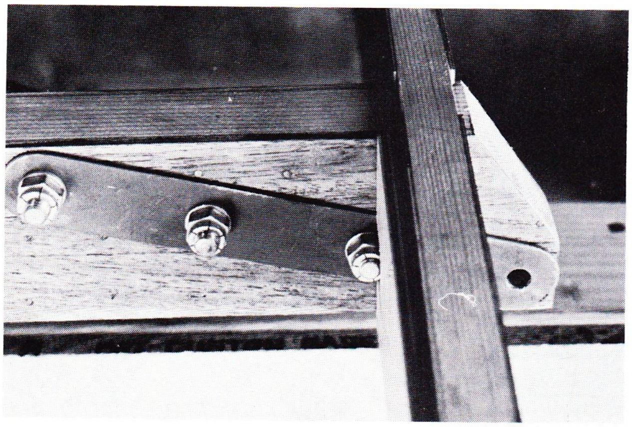
Right upper wing showing wing root fittings prior to covering leading edge with aluminum.



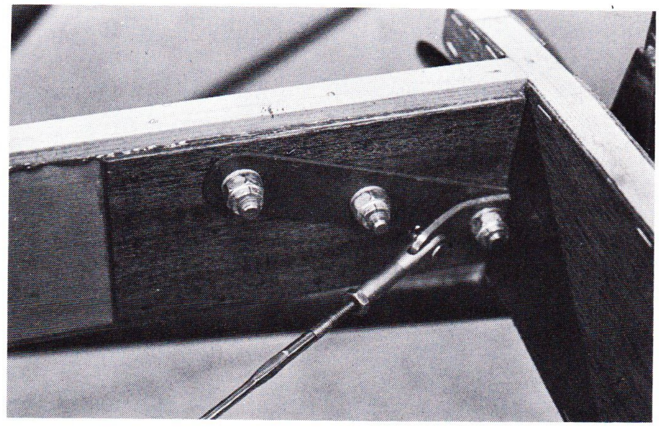
Upper right rear fitting showing drag wire attach method. Lower lug carries rear landing wire loads.



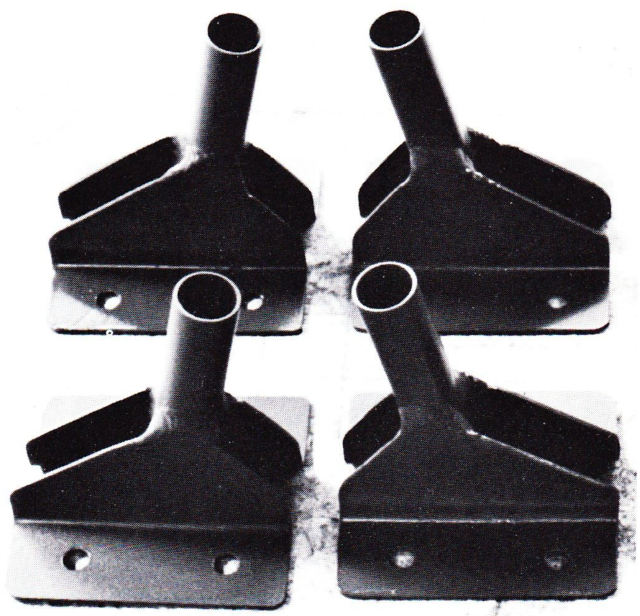
Lower wing to fuselage fitting. Do not over torque bolts as it can cause crushing of wood.



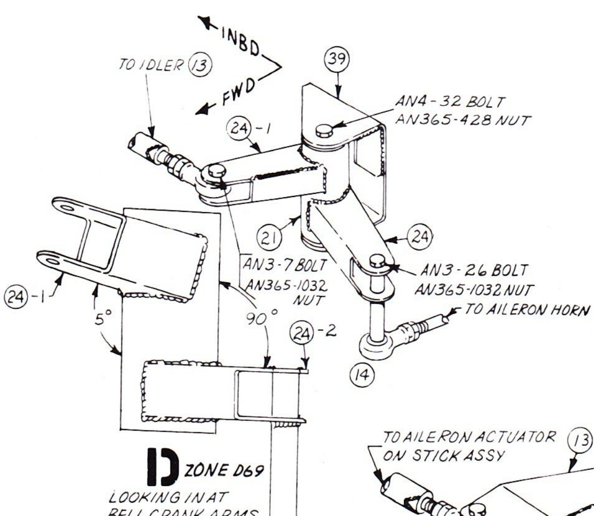
Upper wing root spar fitting and anti-drag wire. Note plywood re-inforcing plate glued on spar.

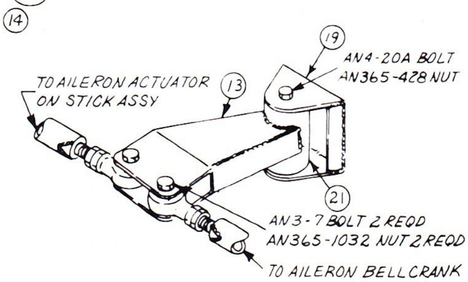


You will get to recognize these assorted aileron and bell crank fittings.

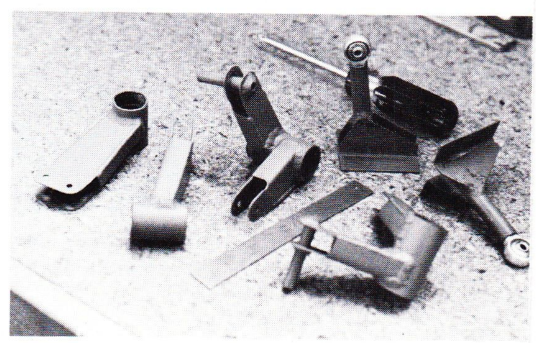


Rear wing spar to aileron fittings, less rod ends.





It would be well to tack weld fittings into place, prior to welding fit to spar and check clearance angles to wing anti-drag wires.

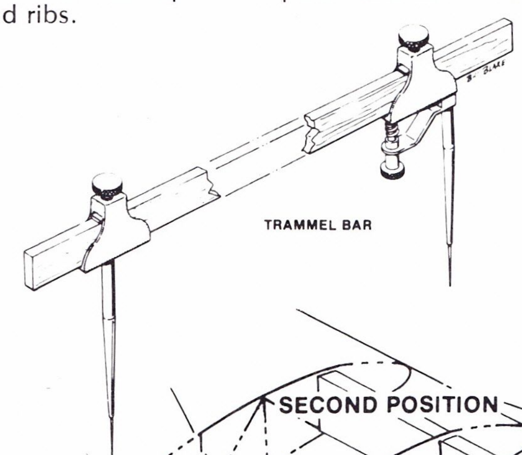


And there are more aileron fittings.

Take care not to run scriber lines across metal which will be part of a fitting. Don't chromium plate any fittings or struts because the usual processes suffuses steel with hydrogen ions and weakens it. When you do see chromed struts on aircraft, it is when special deionizing after the treatment has been used.

To begin assembling your wings, attach the wing strut fittings to the spars in accordance with the drawings. Great care should be given to slide the appropriate wing ribs into place prior to gluing the wing root or butt rib reinforcement plates to the spar. If these are installed the wing ribs between your "I" wing struts and the root fitting will not be able to slide onto the spars. Slide all ribs onto the spars after having pencil marked the spars with a tri-square to get the vertical ribs locating marks.

As can be seen from the plans, spar openings in ribs are made wide enough so ribs will slip over the spar doubler plates where needed. When ribs are in position suitable lengths of ¼" rib stock is cut to fit to fill up the space between the spars and ribs.

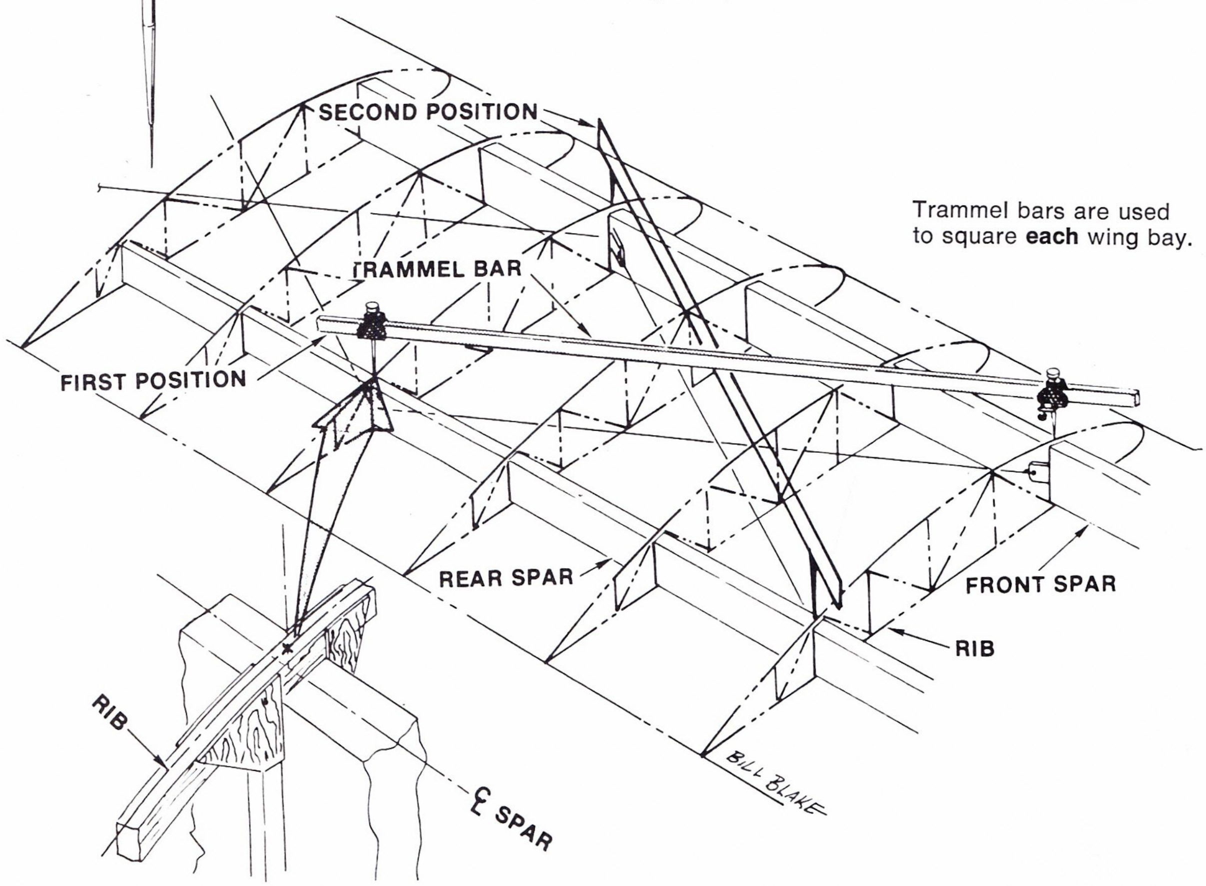


On the forward spar, the aluminum leading edge can be formed and fitted as wing construction progresses.

Upper and lower rib cap strips fit snuggly against the top and bottom of the spar surfaces and transmits air loads from the ribs to the spars, hence, the ribs need only be attached to the spars well enough to hold them into position. Glue each rib into place and two or three rust proof aircraft nails of ½" by 20 gauge through each rib vertical into the spar will do. Do not drive nails through the cap strips into the top or bottom of the surface of the spars for this will weaken the cap strips at a point of concentrated stresses. At a few places the wing rib vertical strips will have to be cut to make way for a wing and anti-drag wires.

With a basic wing supported to a level on horses, install all the fittings then put the drag and anti-drag wires in leaving them all slack and we are ready to square the wing. Great care must be used in drilling the holes at the proper angles through the wing spar and through the reinforcing block so that proper alignment of the drag wires is made.

On the top of the spars at every compression member, pencil a line to directly in the center of the wing rib. Then exactly in the center of the spar's top surface, make a clear dot by twirling a pencil on it. One can either purchase a set of trammel bars (see trammel illustration), or make one up out of a stiff rod, tube or stock with a fixed steel point (such as from a 5 & 10 Cent Store drafting compass head) at one end and a sliding lockable



Trammel bars are used to square **each** wing bay.

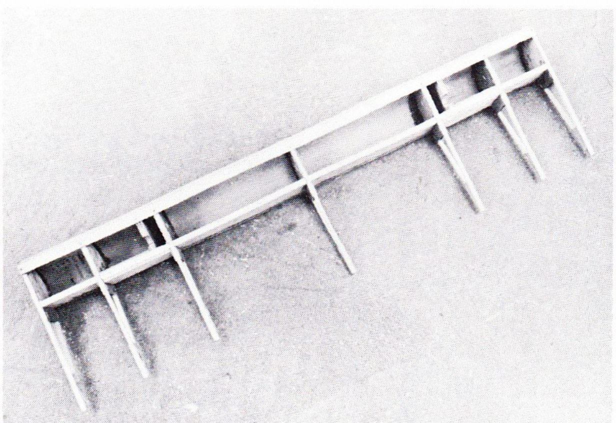
"Carrot top" Dorothy Aiksnoras applies 2 coats of clear spar varnish to all wooden parts.

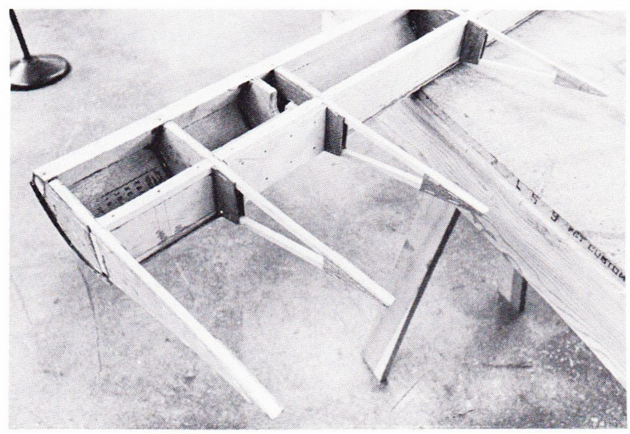
point near the other. The rod is a little longer than the longest wire.

Beginning at the inboard end of the wing panel, lay the trammel point on the inboard pencil dot of one spar and run the trammel over one wire diagonally to the other spar (the rear spar). Slide the point to meet with the dot there and then switch the trammel to the other wire to check the distance between the dots. Gradually tighten the wires all of the time working to get identical distance between the sets of dots. Then move out to the next set of wires. By the time the outboard set are straightened, the two wing spars will be straight and true and the ribs will be at a perfect right angle to the spar as seen from overhead.

When all wing woodwork and basic structure is completed, give the complete wing framing, spars and wing ribs two or more coats of clear spar varnish. The first coat should be somewhat thin to promote penetration. When done, the woodwork should appear filled and covered enough so that some glossiness is apparent. But don't build up a soft, rubbery coating which will dry, shrink and crack as it ages. Varnish can be applied to the metal parts except for those that might have to be adjusted and/or have cadmium plating such as drag wires or wing fittings. All metal fitting should be given a good coat of zinc chromate or Glid Plating, a popular rust preventative.

In making the aileron controls, do not alter any measurements or angles shown. The length





Acro Sport ailerons prior to trailing edge being installed. All wood internal parts should be varnished prior to covering.

Aileron leading edge prior to covering is held into position. Trailing edge material on main wing or aileron hinges have not been installed.