Piper J3 Cub und PA18

Building Instructions

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Our Piper J3 Cub kit has been in continuous production since 1976. This kit being the first anywhere in the world designed expressly for (at that time) large petrol engines, and having a fully sprung undercarriage. It gives me pleasure to be able to say that many modellers have had their first experience with large models and petrol engines due to this kit of ours. I designed the Cub way back in ’76 for the Quadra, at this time the Quadra being the only Petrol engine generally available for model aircraft. If you have ever had anything to do with a Quadra you will know smooth running was not one of it’s characteristics. So, due to what can be best described as the agricultural qualities of this motor, I designed the Cub to be light and flexible, but strong enough to withstand the Quadra’s vibration levels. The structure of the Cub was found to be more than adequate for the Quadra. It is tough, tough enough to take the Titan ZG 62, without any extra reinforcing, as many people have found over the last several years.

Fitting the Titan ZG 62 comes from the ever increasing need for more power for glider towing. So why the need for a new kit. First, the original master plan is worn out after eighteen long years. Second, is the fitting of very much larger engines, and recently, with the silent block Hydro-Mount-System, designed by my partner Gerhard Reinsch for the Titan ZG 45 and ZG 62 engines, required some minor redesigning around the firewall, and of course for the fitting of larger silencers. Another reason, the wing section, up to now our Cub has what allegedly is the section from the full-size Cub. My partner has been saying for some time a Clark Y section would do no harm to the Cub’s flying qualities, and he’s right.

Over the years many modellers have asked about such things for their Pipers as flaps, tow line fitting, Clipped wing versions, wheel spats and more scale details.

The wing has been completely redesigned, the leading edge is spindle moulded, the wing section is the classic Clark Y, all spars are spruce and boxed, wing tips reduced in cross section, trailing edge is spruce and plywood. The fuselage is slightly redesigned for the fitting of the double cabin door.

What are we going to use for adhesives.

I would like to say a few very important things about adhesives. Use PVA glue for all joints except where epoxy is specified. PVA adheres very strongly to wood, is light and slightly flexible and very cheap. The single disadvantage with PVA is that it does not sand off very well, this being due to its flexible nature. Instant glues such as Flash or ZAP are referred to as CA (Cyanoacrylate) in these instructions and can be used for tacking Balsa to Balsa. Where Epoxy is specified means the well known Araldite 2011 made by Ciba-Geigy, this is the oldest, and is still the best of the so called two component epoxy adhesives, and will glue just about everything in a model, it takes 20 hours at normal room temperature (20 degrees) to harden. All hardwood surfaces to be glued must first be sanded with a coarse grit (120-180) glass-paper to raise the extreme fibres, sanding across and not parallel to the grain. No need to deeply scratch the surfaces as is the practice in joinery shops.

Do not use 5 minute epoxy anywhere in your Piper Cub, one reason being, this type of epoxy sets too quickly, this quick setting time does not allow the epoxy to wet the extreme wood fibres enough to form a strong bond. Another, and very important reason, is that 5 minute epoxy looses its strength very quickly and gradually becomes soft. Do not use any of the powder and resin glue systems, as these are also quick drying, very brittle and usually very heavy. Balsa cement is alright for free flight models and gluing paper templates to wood, but very little else.

For the laminated parts, such as wing tips and tailplane edges, use only PVA after first soaking the balsa strips in water, do not remove excess water, the water is essential for thinning the PVA as well as making the wood more bendable. If the PVA is insufficiently thinned, you will not be able to sand over the laminated edges. You will find a tube of Balsa cement useful to fix the printed paper for the cutout templates and control horns, Balsa cement can also be used to join the balsa sheet cores for the tailplane but nothing else. To glue the windscreens into place, use our Hyloglue-FL adhesive as this does not leave a milky residue as is the case with most normal CA-adhesives.

Use Loctite or similar screw locking adhesive for all screws with plain nuts.

Fittings.

Nowhere in this kit are metal quick links called for, use only the ball joints with the 3 mm threaded pushrods supplied with this kit. Metal quick links are unreliable as they are inclined to break, this is due to the type of steel used, it is a stamping quality steel, this stamping quality means it is brittle, brittle steel cracks under stress caused by engine induced vibration as well as the unclipping and reclipping to adjust the length of the pushrods. Ball joints are not only very reliable, they are neater and look a lot more realistic than quick links. The plan shows the ball joints are fitted to the control surfaces between two Tufnol horns, this method results in almost no play developing throughout the life of the Piper and is very reliable. The aforementioned pushrods supplied in this kit are 2,6 mm diameter, we have these pushrods specially made for us from wheel spoke material, which is malleable steel and can withstand a great deal of vibration. Keep all pushrods absolutely straight, and as short as possible, you will see that all the servos are installed in our Piper to allow the pushrods to be straight and short. Also the servos are installed so the output arm is outside the covering, install the servos so the output arm spigot is pushing against the Coverite, it is then a matter of touching the Coverite with a hot soldering iron and the output arm spigot is through the Coverite, this burning of the hole in the Coverite has the advantage that the fibres are melted together preventing small tears appearing later. Do not use 2 mm screwed pushrods anywhere on this Piper for control surfaces.

A few things about soldering.

Certain parts of the Piper must be either soft or silver soldered. Follow the instructions exactly, that is to say soft solder where soft solder is specified and silver solder only when silver solder is called for. Parts that must be silver soldered cannot be welded as the piano wire will become exceedingly brittle due to the very high welding temperatures. Do not allow anyone to persuade you that Argon arc welding will work, it won’t.

It is very important that you use the correct type of silver solder, this is solder that has at least 40% silver content. Use solder that is free of Cadmium, Cadmium is very unhealthy, unfortunately high silver content solder is very expensive but has the very real advantage that it runs with a temperature of around 640-680 degrees Centigrade, at this temperature, the piano wire just begins to glow at what is called the first cherry red visible in daylight. On no account allow the wire to get hotter. Use a piece of scrap wire and heat this up with the Propane gas lamp, you will notice the colours change from initial heating to a light straw, followed by a dark blue and then the first cherry red. Heat the wire further and you will then have a bright red and with further heating becomes bright yellow. It may sound a bit involved, but silver soldering is very simple and easy, requiring a minimum of tools, these are a Propane gas torch, a couple of firebricks to lay the work piece on, a tin tray, some dry sharp sand, a wire brush and emery cloth. The tray is covered with sand, the bricks are laid in the sand, you then have a fireproof base upon which to work and at the same time conserve most of the costly heat. It is not necessary to go to the expense of a gas welding plant, a Propane gas torch is enough, the secret is not the high flame temperature but the low melting point solder.

Silver solder is usually sold as round wire, there are also square forms available, we should use round wire with a diameter of 1,5 mm. A flux paste is required for silver solder, there are mainly two types of flux, flux for temperatures up to 800 degrees, and fluxes above for 800 degrees. We need the first type.

Silver solder is obtainable coated with flux. I do not like this for two reasons, first is that you have no real control over the flux as it has the tendency to melt too far back from the tip, and second, does not indicate the temperature clearly, if that’s not enough it has a really penetrating stink. The white Borax based fluxes are ideal as they give a very good indication of the temperature. This temperature indication works so: first, as the flux starts to heat up the water boils off leaving a hard white crust, as the temperature rises the crust starts to melt and suddenly collapses giving a clear fluid, this melting of the crust is just below the melting temperature of the silver solder.

Soldering in any form first requires that the metal should be clean and free of any grease or oil, then must be cleaned up bright and shiny with a wire brush and emery cloth. Lay the work piece to be soldered onto the firebricks, coat the joint generously with the flux, then heat the end of the solder rod in the flame and dip the rod into the flux, this then coats the end of the rod with flux. The solder rod must always be flux coated and heated before making contact with the joint. A cold rod merely serves to pull the heat away from the joint. As soon as the temperature is high enough the silver solder rod will melt and flow around the joint. The flux residue can be removed with hot water and then with a wire brush. We have the correct type of silver solder which is free of Cadmium and with 48% silver content, order # 0980 and Borax based flux # 0985.

For soft soldering you need a large electric soldering iron of at least 100 watts, soft solder is an alloy of tin and lead, a high tin content is better for our purposes, so use the wire form that is supplied for electronic work, this high quality solder has almost invariably a resin flux core. The normal plumbers solder has a much lower tin content and is useless. There is solder wire available with a small silver content of about 4%, this is excellent but unfortunately not easily obtainable.

The paste forms of flux as well as the resin core flux are not suitable for soldering piano wire and the like, you can make a really good flux very easily. You must obtain a small quantity of hydrochloric acid, a small piece sheet Zinc as well as a ceramic dish such as on old saucer. Cut the zinc into small pieces. Place the saucer on the ground outside your house and pour about two spoonfuls of the acid into the saucer, carefully drop a couple of Zinc pieces into the acid and stand back. You will see that the acid immediately starts to react with the Zinc and starts to boil and spit, but very soon dies down as the Zinc is dissolved, now add a little more Zinc and the process starts again and is finished when the acid stops dissolving the zinc. Allow the so called killed acid to stand for a while until it is cool then pour off into a small screw top bottle.

Soft soldering, first off pour a very little of the flux into a small saucer or similar, next tin the soldering iron bit by first cleaning off with a file and wire brush, allow the iron to get really hot. Dip the tip of the copper bit into the flux and immediately apply the solder wire to the tip, the solder should then flow over the tip and be bright and shiny. Should the solder not flow the iron is not hot enough or not clean enough. When the soldering iron is satisfactorily tinned clean up the pieces to be soldered same as for silver soldering. Apply a very small amount of the flux onto the metal parts to be soldered, heat these parts with the soldering iron and when hot enough apply the solder to the joint and the solder should then flow. Wash off the flux residue with water.

DO NOT DO ANY KIND OF SOLDERING IN AN UNVENTILATED ROOM AND ON NO ACCOUNT INHALE ANY OF THE FUMES.

I have set out these instructions in what I consider to be a logical sequence, set yourself a building stage and read the relative instructions, make sure you understand what is intended, identify each part before cutting and gluing anything, remembering the joiners motto, think twice and cut once.

Fuselage.

Cut out from plan sheet 4 and 5 the fuselage side sheet 5. The two fuselage sides are built over this plan and not the fuselage drawing on plan sheet one. You will notice the fuselage sides when finished are slightly longer when placed over plan sheet 1, you will realize that this is to allow for the curvature behind former (13). OK, let's begin.

The spruce longerons are ready chamfered, be careful to identify these longerons correctly, that is to say do not confuse the longerons with the bottom wing spars which have the same sectional size and with chamfered ends. The wing spars are packed together in a larger bundle than the longerons, the spar pack contains the trapezoidal shaped top spars. The longerons are packed together with the 10x5 spruce tailplane spars.

First check the length of your elevator servo body and mark this measurement onto the plan so as to be able to position the plywood servo mountings (217) correctly. Cover fuselage side plan 5 with plastic film and first make the right hand fuselage side (door side) using pieces (1)-(7) plus (8) (9) and (71). Pin down and epoxy the top longeron (1) and (2) together over the plan, noting that these longerons are ready chamfered for joining, this to form the bend behind the cabin. Cut out the double step at the rear of the bottom longerons using a file, pin the two pieces that form this longeron down over the plan using epoxy to join them.

Hammer in the pins, cut off the pins close to the wood, then hammer the rest of the pins flush to the surface, this is to allow the second side to be built over the first, this should ensure you finish with two identical sides. Don't worry, you will be able to prize the sides loose from the building board later.

Note that the right hand balsa side (door side) (4) is 6,5mm less in the width to accommodate the door opening longeron (71). Using PVA, glue into place the 6,5mm thick sides (8) (9) and (4) with the door longeron (71) between. Shape the ends of the two 6,5mm plywood servo mountings (228) to fit between the longerons. Do not fit the small plywood scabs (218) at lower edge until the sides are removed, but fit the two balsa triangles at the top. Glue the balsa end piece (6) between the longerons. Fit and glue all the balsa uprights and diagonals (7). The elevator servos are screwed to the inside of the mountings so that the servo body is inside the covering with the servo arm outside. Should your servos differ to a great extent to those drawn in section FF you must later glue packing out strips to the mountings (217). The days when you required more power from servos meant you had only slow acting types are fortunately long gone. Do not use slow acting servos for elevator, rudder and ailerons. It is incorrect as it can possibly be, the oft mentioned theory, that large models react slower than smaller types to wind gusts, therefore slow acting servos are sufficient. Turbulence is the same for any size of model, precious time is wasted until you the pilot, have reacted to a sudden gust, plus the minimum of half a second it takes for the slow servo, UNDER LOAD, to reach full travel is going to make landing in windy condition extremely risky.

The second fuselage side next. Hammer flush any protruding pins and cover first side with plastic film, this second side does not have a door opening, so use parts (3) and (4) but the rest is the same as for the first side. Build this second side over the first. When both sides have overnight to harden remove from the building board by carefully prizing the sides away from the cut down pins, clean up the two fuselage sides with sandpaper. You must now agree it is a satisfying experience holding the two sides in your hands that you have carefully made over the last days. OK, don't run off to some mind rotting film on the television, there's plenty more to do. Next, epoxy the 0,8mm ply fuselage doublers (10) to the inside of the fuselage sides don't forget we need a LEFT and a RIGHT HAND side!!! While you are about it, shape the four reinforcing scabs (218), that are on the inside of the elevator Servo carriers, and epoxy these into place. Smear the epoxy very thinly and evenly over the wood. Should you be making the J3 Cub then it is advisable for you to bend to a curve the forward fuselage sides while gluing the 0,8mm doublers into place. This is easily done by laying an 18-20mm thick wood strip under the front edge of the fuselage (under the firewall position) then using G cramps to press the fuselage down onto the building board about 180mm behind the firewall. This ready made curvature in the sides will reduce the tension when gluing the sides onto the firewall. It will be clear this curvature in the sides is only necessary for the J3 Cub. The sides of the PA-18 being parallel right to the firewall.

Glue together over the plan sheet 2 the formers (11) to (19), glue balsa sheet parts (187) to (12) and (182) to (14). Use epoxy for (11) (12) and PVA for (13) to (19). After removing the formers from the board, using a drill and round file, make the holes in former (18) to take the nylon rudder control wires fairleads (67).

Cut out the fuselage doublers (10) to conform with the shape of balsa sides (3) (4) and (8). Clean up the two sides with fine grit paper. You now have to decide about where you will fit the silencer, if you intend using the space between the firewall and former (22) to fit either our Hydro Mount System silencer, or to fit our inverted silencer #3877 for the ZG 38, you have to cut a strip off the bottom of this former (22) so that the floor is left open between firewall and former (22) to exit the cooling air. The front floor piece (36) is shortened in width and chamfered, (37) is left out, (38) must be shortened by some 13mm to fit between the fuselage sides. The half round section (173) must be glued accurately to the front of former (22). Refer to section BB and section along side as well as the drawing of the nose of the PA-18 on plan number 6 so you can have a clear idea what is meant. This cooling air exit slot built into the fuselage floor is very effective, and has the advantage of not being visible from the side.

If you decide to fit our Hydro Mounting System, you must cut out the firewall (21) as per the drawing supplied with the HMS. Drill the four holes for the M6 blind nuts and epoxy these to the rear face of (21). The Hydro Mounting cannot be fitted to the J3 Cub due to the smaller firewall.

Should you intend taking the intake air out of the fuselage, then you must saw out a 18mm diameter hole in the former (22), to reduce weight you could cut out the middle of this former and to prevent hot air being forced into the fuselage cover this opening with soft 3mm Balsa. Balsa has excellent insulating properties, no need for any Aluminium faced sticky tape or the like, just plain Balsa.

Sand away the whiskers and trim off the overhanging 0,8mm doublers (10). Lay right hand fuselage side over the plan number 5 and mark accurately as possible the four former positions (11) (12) (21) (22). Place the left hand fuselage side over the right accurately, inside to inside, temporarily fix together and transfer the former positions with a square and a pencil onto the left fuselage side. The firewall on the PA-18 is 14mm in front of the J3 firewall position, this is to allow for the fitting of the HMS silencers #4640 #6640. Depending on the size of motor you will be using, mark the right hand fuselage side only for the angle of side thrust, for the firewall (21), For the ZG 22 it is 1,5 degrees, ZG38 2,0 degrees and the ZG 45 / ZG 62 2,5 degrees, see plan sheet 3. The downthrust is zero in relation to the fuselage centre line for the four motors. The motors do have down thrust in spite of this geometric zero setting, and how does this happen you reasonably enquire.

This downthrust comes about due to the tailplane setting having positive incidence in order to increase the in-flight stability. The tailplanes positive incidence is 1,5 degrees and this raises the rear of the fuselage during flight. Raising the rear of the fuselage has a similar effect to the T tailplane in that it keeps the tailplane out of the disturbed airflow from the wing, thereby increasing the tailplanes effectiveness.

As we are talking here about basic aerodynamics, and to remove any possible doubts you may have about the rigging angles of this Piper, you will notice the underside of the wing is set at 1/2 degree positive incidence. This geometric difference of incidences does not mean you have an in-flight negative angle of incidence. The Piper's wing section, as previously mentioned, is the Clark Y. From the aerodynamic standpoint the flat underside of this profile does not count when establishing the angle of incidence, but what does count is the angle of incidence at which the wing section produces no lift. With the Clark Y section, this zero lift angle is reached when the flat underside is at minus 4 degrees. This all simply means there is an in-flight positive difference of 3 degrees with our Piper.

Your Piper Cub will fly perfectly with the angle of incidence for wings and tailplane as shown on our plan, so no need to reach for the 'phone, to ask about what might appear to you as being something wrong. Of course should our rigging angles not be to your taste, we are unable to prevent you from changing them. And if you do, I would very much appreciate you not telling your friends your clunker is built from our kit.

Enough with the aerodramiticus, securely pin the completed right hand fuselage to the building board. For the PA-18 version: Epoxy the three formers (11) (12) (22) onto the right side, make absolutely sure they are accurately placed and square to fuselage side. For the J3 Cub version: Epoxy the two formers only (11) (12) to the right fuselage side, leave overnight to cure. Do not remove right side from the board.

Check the accuracy of the formers position on the right hand fuselage side, then lay the left side onto the formers, place left hand fuselage side over the right and check around the two fuselage sides with a square for absolute accuracy of alignment. I use the word absolute as you will not have much joy with a Banana.

Epoxy the left side to the three formers in the case of the PA18, and for the J3 Cub, the two formers (11) (12). Check once more around the two fuselage sides with the square to see if left side is accurately aligned and leave overnight.

Next degrease the two ready formed steel tie bands((230) then cover the plan view of the fuselage with plastic sheet and epoxy these two tie bands between the three plywood pieces (41) two 12mm wide and one 17mm wide, accurately over the plan. You will of course ensure that the two holes are in line.

You now say you have a little spare time waiting for the epoxy to thoroughly harden, don't start picking the glue off your fingers preparitory to sneaking away in the direction of the nearest hostelry, no, start putting the tailplane together, it's cheaper and you're going to need this. The instructions for the tail start on page 15.

Remove the fuselage from the board along with the finished unit (41) and (230) and clean away any excess epoxy as you will notice later that you can see into the cockpit very clearly. Note that the steel bands (230) project on the top side a little this means you have to cut two small slots into the fuselage sides and into the U/C mountings (114). Epoxy the floor pieces (39) (40) (41) and the unit (41) and (230) the U/C mountings (113) (114) on and into the fuselage and leave overnight to harden. Plenty of time left over this evening to get on with the tailplane.

Fit the firewall (21) between the fuselage sides, it will be necessary to chamfer both sides a little to allow for side thrust angle. For the J3 Cub the fuselage sides must be pulled together with G-clamps over strips of wood to epoxy the formers (21) (22) to fuselage sides. Note that you must shape a little the triangular spruce glue fillets (171) to fit between firewall and sides to allow for sidethrust angle. With epoxy firmly set hard, sand off the excess fuselage sides that project forward of the firewall, this is the hatched portion on plan sheet 5.

Tape together the fuselage tail end and fit the six balsa formers (14) to (19) between the fuselage sides, holding in place with pins. As you place each successive former between the fuselage check each time to see that the fuselage is straight. Using CA, glue all seven formers to the sides. Remove the pins and run a bead of PVA down each side of the formers where they make contact with fuselage uprights. Fit the triangular Balsa piece (20) between the top longerons, then glue into place and at the same time glue fuselage ends together, checking of course to ensure there is no twist in the fuselage and leave overnight for the PVA to thoroughly harden.

The two tailplane seats (82) determines the angle of incidence of the tailplane, lay one part over the plan and check it for accuracy of outline, are the two pieces exactly the same? When you have satisfied yourself about the accuracy of the seats these can be glued to the top of the longerons along with the two seat parts (83).

Drill the 3mm hole in the tailwheel mounting (23) and epoxy this to the bottom longerons taking care not to fill the slot with epoxy that has to take the brass strap (117) and noting that the 8mm groove to take the tailplane brace wires strap (116) is outside. Take care also to wipe out excess epoxy so as to ease fitting and gluing the spruce gusset (170) later.

Glue together the C/S jig from (163) (164) and glue the 3x3mm balsa strip (31) along the top side of root ribs (300) with a gap of 3mm from top edge of the root ribs. How far the strips (31) come along the root ribs depends on whether you intend fitting a hatch in the cabin roof. A hatch makes for ease of screwing in the four nylon wing securing bolts, I can easily imagine you will curse each time you are on the flying field, putting your Piper together through the cabin doors. For those purists (masochists?) who will kneel and bend about, of course there was no such hatch in the roof, but then our name... Practical Scale. The hatch is drawn on plan sheet 2 under the formers, the construction of which comes later.

Glue together with CA the four pieces of Balsa (163) and (164) which forms the C/S jig, noting that this jig is a temporary one and is broken out after the root ribs (300) are epoxied to the formers. Using CA, glue the two 6,5mm root ribs to the jig over the plan sheet number 4, take care to be as accurate as possible and leave to harden.

Lay the fuselage exactly over the plan and mark accurately the position of the root ribs (300) onto formers (11) (12). This marking determines the angle of incidence so use a finely pointed pencil, not a felt tipped pen. Fit the two root ribs (300) now well glued to the C/S jig over the formers (11) (12) and just clamp these into place using the markings on the two formers to accurately align the root ribs.

Check to see that the root ribs (300) are accurately positioned and when you are satisfied cut four 6,5x6,5mm balsa spacer strips to go between the root ribs under sides and the top longerons. The purpose of these spacers is to allow you to remove the root ribs before finally fixing. You must take extreme care with the fitting of these root ribs as the accuracy of the wing fitting relies solely on the correct placement of the root ribs. Any inaccuracy with fitting the root ribs is going to have an adverse affect with flying your Piper.

So check carefully for alignment by sighting across undersides, and that the ribs are parallel and square to the fuselage sides. When you are sure everything is as it should be slide the root ribs off the two formers (11) and (12) apply Epoxy to the two formers and slide root ribs (300) over the formers (11) and (12) using the four uprights to assist in correct placement of the two root ribs. When the Epoxy has had overnight to harden you can cut out the C/S jig (163) and (164) and the four uprights as these have done their work and are no longer needed.

Next job is a little different, its the tow line release, and you will find the drawing between the instrument panel and section EE. To start, bore a 3mm hole through the large, 8mm, brass tube (90), deburr and push the small brass tube (91) through the large tube (90) and silver solder these tubes neatly together using our silver solder #0980, not a difficult job. Next, bore through the large brass tube (90) to remove as much as you can from the small tube inside the large tube. Remove the rest of the small tube with a round file so that the inside of the large tube is perfectly smooth, a rather difficult job. It must now be possible to push the retaining pushrod (92) into the small brass tube (91) right through the large brass tube (90). The retaining pushrod must slide easily through the brass tube (91), round the nose of this retaining pin. Bore the 4mm hole in the towline release housing (89) as per the drawing as well as the 4mm hole in the top of former (12). Epoxy the tubing parts (90)(91) between the spruce parts (88)(89), then epoxy the complete release unit to the forward side of former (12). Use a steel straight edge to see that the brass tube (90) projects a little above the two root ribs (300) this to allow you to file the tube flush to the balsa sheeting (32).

Take four of the brass tubes (115) used for the wing location. Insert one of the steel pins (303) into a tube to within 3mm from the end, crimp slightly the end of the tube over the pin, crimp the tube just enough so that the steel pin cannot fall through. This crimping is to prevent the pin falling into the fuselage should the pin come loose in the tube later. The four crimped tubes must be degreased thoroughly with Acetone, roughened on the outside with coarse grit paper, then Epoxied into the root ribs.

Let us digress here for a moment, to possibly circumvent any argument about the reliability of these steel pins we are going to use for aligning the wings. These pins may seem to you at first glance a little fragile for such a task, but in fact these pins can take at least 150 times the weight of the Piper, so no need for concern. These pins are short as they are not intended to resist any bending moments, the struts are there for this purpose, so no need for any beefing up of these pins to relieve loading on the struts. You are very much mistaken if you think the struts are not quite strong enough and there is a need to Beef up these pins, to do so you are increasing the weight for no useful gain. However strong you make these pins they will not withstand much bending loads without the struts. For a strutted wing, regardless how it is laid out does not allow any significant bending forces at the wing roots.

The wing struts construction has been radically altered, instead of a vertical fixing screw at the fuselage end this screw is now horizontal. It means that it is practically impossible for you to overlook fitting the strut retaining screws, the struts will not stay in place without these screws being fitted and the wing will sag noticeably, of course you can forget to fit the safety nuts. To avoid forgetting these nuts make it a rule never to take the strut fixing screws into your right hand without having the nut in the left hand. Full-size pilots have a fairly long check list to go through before each take off, we only need a tiny strip of paper on the transmitter for our simple needs.

Should you be building the J3 Cub you must now shape and fit the two cabin corner blocks (169) between former (11) and the root ribs (300) glue these well into place as these serve to strengthen the join between the former and root ribs. These corner blocks are not fitted to the PA18, instead there is the two 3mm thick Balsa windscreen carriers (216).

To ensure a strong join between the root ribs and the two formers (11)(12) there are four spruce triangular glue fillets (229) to go between the root ribs and the formers. Use Epoxy for these fillets.

Glue the former heads (27)(28)(29)(30) to the respective formers, fit and glue the triangular cabin roof end (33) between root ribs and former (13), note that former (13) has two pieces of 5x10 balsa on both vertical sides. Glue the cabin roof planking into place, how far you plank the cabin roof depends on whether you intend fitting a removable hatch.

Next job is to fit the parts to hold the fuel tank in place. There is a drawing on plan sheet 1 over the fuselage side view showing tank fixings. Place the fuselage upside on the table. Glue the Balsa piece (177) onto the cabin roof end (33) and former (13). Bore the two 3,5mm holes in the plywood tank carrier (176) as per the drawing. Place the plywood screw strip (178) against (177); then holding firmly in place the tank carrier (176); mark through the two holes onto (177), remove these two parts (176) and (177) from the cabin and bore the two marked holes in (178) with a 2,2 mm spiral drill. Now make the top tank stay from the balsa pieces (179) and (181) and glue into place. Remove the tank screw cap and insert the tank neck into the into the plywood tank carrier (176), screw on the cap firmly, using the two 3,5x12,5mm self tappers fix the tank to the fuselage. It now remains to glue the tank seating to former (14)

Glue the four 6,5mm Balsa sheets (43) to the fuselage sides. Fit the small spruce triangular gusset (170) into place and mark the hole through (23) onto (170), remove the gusset and carefully bore out this hole enough to insert a round file then open up this hole to 5,5mm with the file, press the M3 blind nut (121) into the gusset having first smeared a little Epoxy under the blind nut, Epoxy the gusset between the longerons, then pull the blind nut fully down with a M3 screw, having first slightly oiled this screw to prevent the Epoxy gluing the screw into the blind nut, use one of the spring blades (134) to protect (23).

On plan sheet 1 above the fuselage side view is drawn the servo carrier for the rudder and the towline release servo. You will see that the carrier is shown in the plan and side view, the parts used are (45)(47)(59)(60)(61)(62)(63) and (183). This carrier is first built together outside of the fuselage, take note to measure and the mark the length of your servos for fitting and gluing the two plywood servo rails (45).

Epoxy the mounting block (59) for the rudder bar onto the ply scab (61) when the Epoxy is hard, then bore a 3mm hole through (59) and (61), preferably using a pillar drill. Cut out the rudder bar from the 1,5mm Novatex, referring to the drawing on sheet 1, cut down the nylon bellcrank (96) and screw this to the underside of the rudder bar with M2x12 cheese head screws. Press out the brass ball from a Ball joint (100) and screw this ball also to the rudder bar placing a washer between the ball and the rudder horn. Use Loctite to secure the nuts to the screws. Bolt the rudder bar unit to the carrier with the M3x40 socket screw (101) and three washers (102) and the safety nut (104) making sure the rudder runs freely on the nylon bearing. Drill a 5mm hole in the top Bowden cable fixing (63) and Epoxy this to the cabin roof end (33). Now glue the finished servo carrier into the fuselage.

Soft solder the tow line retaining pin (92) onto the Bowden cable using the brass tube (93), should you so wish you can use Epoxy instead of soft solder to join the release pin to the Bowden cable, providing you thoroughly degrease the Bowden cable. Remove about 20 mm of the black plastic covering from each end of the outer Bowden cable (94). Insert the inner Bowden cable into the outer then insert the ends of the Bowden cable into (63) and (60), but do not fix with Epoxy yet. Place the tow line servo onto the carrier and now check to see where the ball joint must be fixed on the servo output arm to give a positive release. Should the throw be too long you are wasting power. Fix the towline release servo with screws to the rails. Cut the Bowden cable inner to length. Degrease the servo end of the cable and Epoxy this into the Ball joint. Don’t worry it will not come out, especially when you have thoroughly degreased the cable, and you allow the Epoxy to squeeze out of the small holes in the Ball joint, thus firmly anchoring the cable in the Ball joint body. Allow the Epoxy to thoroughly harden in the Ball joint body before fixing the Bowden cable outer into the two fixings (60) and (63). Before Epoxying the Outer Bowden cable into the fuselage, set the servo to the release position, now check to see that the retaining pin (92) is fully withdrawn to allow a positive release. You will see that you can adjust the placing of the outer cable to get the release pin into the correct position. OK? Then Epoxy the Bowden cable into the fuselage and make a final check to ensure the release pin is correctly placed.

Now for the receiver / battery box lid. For this take the 10x5x700mm spruce strip (106). Note the two longer 10x5x760 spruce strips are for the tailplane spar, then the 1,5mm thick plywood lid (105). Cut to length the 10x5 spruce to form a frame on the lid, Epoxy the frame to lid. The four 12x12 Spruce screw blocks (174), these screw blocks must be first drilled out with a 5,5mm drill to take the brass bushes (345) later. The ends of these four blocks must be sanded to an angle, this angle can be determined by laying the blocks over the fuselage drawings. This angle is necessary as the lid frame must sit neatly onto these block without any space between. Refer to plan sheet 6. Should there be a space, the fixing screws, when tightened down, will shear off the blocks from the fuselage. Insert a M3x25 (104) socket screw into each of the four brass bushes (345), insert these screws into the plain end (unthreaded) and screw through the bushes until they almost come out of the threaded portion. The bushes have a plain end, this to allow the screw to be directed into the thread of the bush, removing the possibility of the screws jamming due to being cross threaded. Put a little Epoxy into the four blocks, then push the brass bushes with screws into the blocks slowly so that the Epoxy is squeezed past the bushes, stand these blocks up somewhere and leave overnight for the Epoxy to harden. Remove the screws (104) and file away excess Epoxy. Glue the four blocks accurately into the fuselage, accurately means that you are sure the hatch will sit fully on all four blocks. When glue is hard, take a M3 plain screw and cut off the head, fix the screw into the chuck of an electric hand drill and form a fairly sharp point onto the screw. Insert this screw almost right into one of the four bushes and press the hatch down onto this pointed screw.

Repeat this process for the remaining three bushes. Drill out the four marked holes with a 3mm drill and fix the lid to the fuselage with the four screws (104) and glue into place the balsa trap opening frame cross piece (44).

When you plan to take the intake air out of the fuselage and fit the Hydro Mounting System silencer behind the firewall you must make a tunnel out of 3mm Balsa to bridge the space between the firewall and the second plywood former. This is to prevent heated air from the silencer being taken in by the motor thereby reducing power output. This Balsa tunnel, having a fairly large cross section, plus the 18mm inlet hole in former (22), serves to further reduce the intake noise, apart from the noise reduction gained by sucking air out of the fuselage.

The throttle servo mounting (226). Cut out this mounting to fit your servo, mark and drill the four fixing screw holes, glue the two Balsa triangles to the underside of the mounting (226). You will see that this mounting is shown as far forward as possible on the plan, to keep the length of the Bowden cable to a minimum, so as to reduce the friction as much as possible. It is very important for a reliable tickover speed that the throttle cable be as friction free as possible, especially when using the Hydro Mounting System.

The fuselage floor is next, that is, parts (36),(37) and (38), these must be glued into place. But you have decided on fitting the silencer in the fuselage, in this case the floor piece (37) is left out, the piece (38) is raised at the front end, and must be reduced in width by 15mm so as to fit between the fuselage sides, this forms a very efficient hot air outlet that cannot be seen from the side. The piece (36) is chamfered on the rear and inside edge, refer to sheet 1 of the drawings, above the side view of the nose of the model and the drawing on sheet 6. The spindle moulded strip (173) is glued to the front bottom edge of former (22) to give a smooth airflow. This causes a strong suction giving more than adequate cooling, even under the most arduous towing conditions.

Sheet over with 3mm thick Balsa (42) the space between the firewall and former (22). Cut to length, fit and glue the 6,5x6,5 Balsa window frame (234) under the root ribs (300) and on the left hand side only of formers (11) and (12) (As door on the right side has its own frame). The sloping window bars (234) that are fitted between former (22) and the root ribs (300). Noting that there two of these bars (234) on the left side only to provide enough surface to fix the side windscreens. On the right hand side the door frame forms the second bar

Sand to profile the vertical grain sheeting (43) and (42), refer to section AA and plan sheet 6.

Glue together the pieces (34) and (35) that form the rear window frames. Cut out from the plan the template for the shape of the rear window frame, glue this with balsa cement to a piece scrap ply wood and shape to line, use this template with a ball point pen to mark out the opening. Then shape and fit and glue these frames to the fuselage.

The stringers (68)(64)(65)(66) now give the fuselage its shape. The top stringer is formed from two strips 3x6,5 so as to make the curved form at the front end easier. Chamfer the top stringer strips so these fit onto the cabin roof. Glues these two strips together on the fuselage. The shoulder stringers are also glued together on the fuselage but with a slight difference, this is, the inside strip is spruce. Cut the four reinforcing gussets (168) from 3mm Balsa and glue these between the stringers (64)(65) and former (13), note the grain direction. On each fuselage side there are two edgewise stringers made from 3x6,5 Balsa, the uppermost of these two runs from the end of the fuselage up to the front of former (13) where is feathered out against the longeron. On the full size machine you will perhaps notice that this stringer comes to an abrupt end at the front. But you can chose which you prefer. The lower stringer runs from the end of the fuselage up to the vertical grain sheeting. The bottom stringer is laid flat and runs from the end of the balsa fuselage sides (4) to the vertical grain sheeting (43). Of course this stringer is fitted up to and between the strut fixing straps. Note this stringer is sanded to a wedge form from immediately behind the vertical grain sheeting to the end, this stringer is there solely to give a clean edge to the Coverite. Without this wedge form stringer, the Coverite will stick in places to the fuselage side and look horrible when painted. Refer to section CC on plan sheet 1. On the right hand fuselage side 5x6,5mm Spruce stringer (172) is glued over the door longeron (71). The small step between (172) and (43) is filled out with a small piece of Balsa and then sanded to a flat wedge form.

A piece of 6,5x6,5mm Balsa strip is glued each side of the door opening running from (172) to (43) at the front, at the rear from (172) to (1). These two filling pieces must be sanded to wedge form. Glue to the inside faces of the door opening the two small strips of 0,8mm plywood (25), sand these to profile when the glue has hardened.

Now for the two doors, cut out the longeron (1) where this spans the door opening. First, the bottom door, glue together the frame from 6,5x6,5 Balsa plus the two vertical rails (221) from 3x6,5mm Balsa. The door frame is covered with the 0,4mm plywood (70), save the waste pieces of this plywood to strengthen the top door corners. Make the top door the same as the bottom door but cover this top door with the 1mm PVC windscreen material, use our FL instant glue or CA glue. Glue two small pieces of the 0,4 plywood to the inside top edge of the bottom door so these stick up over the edge a little, this serves to hold the bottom door shut with the upper door.

Cut the two 10mm long slots into the top door to take the two wire door catches, one method is to bore a hole in both ends of the intended slot and saw out the material between the holes with a fret saw, then clean up the slot with fine file. The catch bolts (209) are formed from the 2mm piano wire as per the drawing. Cut from the 2mm ID brass tube the six pieces of tube (210) 15mm long plus the two short pieces. Push one piece of 15mm long tubing onto each of the catch bolts, followed by a compression spring (211) and a short piece of the brass tube. Press this short piece of brass tubing against the springs until the spring is slightly compressed, a drop of CA on the short piece of tube to permanently fix this to the bolt (209). Slide one piece of the 15mm long tube onto a bolt, insert the bent up end of the bolt into the slot in the door and with Epoxy fix the two moveable pieces of tube to the door, take care to prevent Epoxy getting into the tubing. Fit the second bolt to the door, check to see that the bolts are correctly placed and leave to harden. Drill out two M2 nuts to fit over the two bolt ends and soft solder or Epoxy these two nuts to the wire. Mark the position of the four Nylon hinges on the two doors, let these hinges fully into the doors so that they are flush to the edges. Do not fix these hinges permanently to the doors yet. Temporarily fit the doors into the opening and operate the bolts a few times to mark the holes to take the two pieces of brass tubing (212). Bore out these holes with a 3mm spiral drill. Epoxy the two pieces of brass tubing into the holes.

Should you wish to form a trap door in the cockpit roof, this is made by first gluing together the Balsa parts (222), (223), (224), (225) and (231). Note that you will not find the numbered parts (223), (224) and (225) in the kit, but these you must cut out from the rest of the cabin roof sheeting (32). Shape the trap to conform with the shape of the root ribs (300) upper surface. Paint the glazing bars and ribs with a mid green paint before fixing the PVC windscreen material to the hatch. The roof window for the J3 Cub is a small strip and you can mask this window area off and paint the rest of the PVC. For the PA18, the roof window varies in size from aircraft to aircraft and unusually fully glazed over. When the hatch is glued together. Fix the PVC glazing to the hatch with either our FL or normal CA glue. Glue the PVC only to the frame, that is to say do not glue it to the middle ribs and glazing bars, as you will find this glue will impart a very untidy and ragged appearance. You can see these glazing bars on the full size machine and you will see that the Perspex is fixed with screws, the heads of these screws laying on the surface. The hatch is fixed using the same method you have just used for the doors, with the slight exception of the two beech wood dowels.

In case you have not made progress with the tailplane on the side, then you had better begin now.

Tailplane and Fin.

Both these components are identical in construction, the tailplane drawing is on plan sheet 3. The fin and rudder is on plan sheet 1. First job, cut out the slots for the hinges in the core sheets (50)(51) and (74)(78). Glue together the cores (48)(49) and (50); (51)(52); (72)(73) and (74); (76)(77)(78) and (79). Lay these cores over the plan to check for accuracy of outline. Mark the position of the spars and ribs with a ball point pen both sides. There are extended lines to assist in marking. Pin these cores firmly to the board. You can now glue to one side of the core the tailplane spar (53), the Balsa elevators leading edges (54), the elevator stiffeners (56), the tailplane centre section (55), the rudder leading edge (233), and the rudder horn reinforcing (81). The 6,5x5mm Spruce king post (87). A 20mm long piece of 5x6,5 spruce against the rudder king post to take the brace wire fittings this piece being cut from the King post. Cut and fit all the 5x5mm Balsa ribs, cut all the ribs to overhang the cores a little. Make sure you pin down securely each part glued to the surface of the cores to prevent the curling of the cores due to the action of the PVA. When these parts have had overnight to harden, remove all the pins and finish the undersides. When fitting the second fin king post, fit and glue a strip of 2mm Balsa between them. Pin down the second sides the same as for the first.

The tailplane edges must now be laminated together around the cores. This laminating of the edges means you are going to have to use quite a few small nails to hold the laminating strips in position until the glue has hardened. To avoid damaging your building board with the nails it is better you find a piece of chipboard big enough to take the tailplane parts and about 12mm thick or more.

Sand off the ribs so that they are square to the cores. Cover the chipboard with plastic film and fix the tailplane parts firmly to the board with pins hammered well in. Now take the 2x12mm Balsa strips and lay these in water (in the bath?) for a few minutes, it is sufficient to hold these strips under a running tap, which ever way, you must ensure these strips are really wet. Wetting these strips serves two purposes, the water thins the PVA making it sandable, the strips are easier to bend when wet. Remove the strips from the water, do not shake off excess water but lay a bead of PVA from end to end along one side of a strip, lay the second strip over the first, another bead of PVA right along the strip until you have four pieces together. Press the four strips together and wipe away the excess PVA and water with a tissue. Apply PVA to the edge of the first tailplane part to be laminated and fix the four strips around the edge using fairly close spaced wire nails. Space these nails so the Balsa does not have the chance to leave the edge of the cores. Before leaving overnight to harden press down any strip that might have moved out of place.

With all five tailplane parts finished with the laminating of the edges, cut the slots for the horns. Be careful, the slot for the elevator horns appears on the plan view as if it is a slot that is cut through the leading edge. Instead cut out these slots by boring first a hole at each of the slot and then cutting away the middle with a pointed knife. Use a pillar drill when possible to make the 2mm hole for the tailplane brace wires fixing.

To use only one servo for the elevators you will have to join the elevators together with the spruce elevator joiner (189). This means you will have to cut out part of the fuselage to allow space for this joiner, also you will see that you need to cut away a part (not all) of the longeron for this purpose.

The various horns have to be made from the 1,5mm Tufnol sheet. These horns can easily be cut out with a fret saw. Glue the printed sheet of the horns to the Tufnol with Balsa cement or similar, this can easily be cleaned off afterwards with Acetone. Insert the horns into the control surfaces to check for a neat fit, do not glue into place yet. Fit the tailwheel fork (123) to the rudder, this means first drilling a 3mm hole into the rudder and cutting a 3mm slot from this hole to the bottom end of the rudder. Temporarily fit the control surfaces to the fin and tail with the Nylon hinges, plane and sand the complete tailplane to the sections shown. The tailplane on the full-size Piper is made of round tube, you will note all sections concerning the tailplane show the mating parts and the laminated edges to have a half circle section to simulate tubing.

Take out of the tailwheel bag two 9mm washers (124) and drill a 1,5mm hole in each washer, soft solder these washers to the ends of the fork, file these washers to an oval shape and Epoxy the fork into the rudder. You will find this fork does not present a problem when you cover the rudder with Coverite.

Mark onto the centre section of the tail underside the position where the tail is glued to the fuselage, cover these strips with Selotape. This Selotaping is necessary, as to be able to cut away the Coverite later and at the same time have a Balsarite free strip so better to glue the tail onto the fuselage.

Before covering the complete tailplane, it is better to make paper patterns for the whole model, then lay these patterns out on the Coverite, this way you can position the patterns to avoid wasting the material and at the same time have enough odd ends to cover the tailplane. When laying out the paper patterns for the wings you must take care to note the weave direction, woven covering materials shrink a lot more in the length than they do in the width. So the wing patterns must be laid lengthwise on the roll of Coverite and not across the width, if you cut the wing covering across the width you will find the material sags between the ribs. Cover tailplane with the material cut lengthwise from the roll the same as for the wings. The covering material is cut for the fuselage from the width and that is to say cut strips from the width and then lay this lengthwise on the fuselage as the fuselage stringers have the same effect as the ribs in the wings.

Cover the two elevators, tailplane and rudder with Coverite after having primed the wood with Balsarite. Do not cover the fin, this comes later when the fuselage is covered.

You can now Epoxy the one rudder horn (135) and the two or four elevator horns (220) into place after you have roughed the glue areas on the horns with coarse grit paper. It is essential to see that these horns are accurately placed especially so with the rudder horn, the two holes in the rudder horn must form a line that passes exactly through the hinge line. If the rudder horn is slanted to the centre line the you will not have an identical amount of throw each side. You can easily check placing of the rudder horn with a short piece of 1,5mm piano wire laid across the horn, this wire should cover both holes, with the wire having a small gap between it and the leading edge of the rudder. Refer to the drawing on sheet 1. It follows that the elevator horns, when using two servos, must also be accurately Epoxied in place or you will have a difference in throw between the two elevators at all positions.

In the case where you have a single servo for the elevator you must fix the one piece elevator unit, after covering, onto the tailplane. For safety Epoxy the hinges into the elevators and tailplane. With two elevator servos, the rudder and elevators are permanently fixed after final painting is carried out.

Fuselage cont.

Sand the fuselage side stringers to a feather end under the tailplane. You can now glue the tailplane to the fuselage, cut away from the tailplane under side the strips of Coverite where the tailplane fits onto the two seats (82) and remove the strips of Selotape. You now have a Balsa to Balsa glue joint that is not impaired by either the Coverite or the Balsarite. The tailplane must be accurately fitted and glued, in the plan and the end view, to the fuselage. To check the plan view of the model to see that the middle of the tailplane is on the centre line this can be done by measuring the length of the tailplane spar and marking the halfway point on this spar. Now check to see that the tailplane is square to the fuselage, by marking the distance from the tailplane point to the end of the centre section rib (300) on a strip of wood one side of the fuselage, then check this length on the second side.

Glue the fin onto the fuselage, ensure that the fin is vertical and exactly in line to the centre section. The fin is faired into the fuselage with the two balsa pieces (84) and (85). The two Balsa pieces (86) must be shaped and sanded to a slight trapezoidal shape see section FF, then glued to the top surface of the tailplane and former (19).

The plastic fairleads (67) for the rudder control wires can be fitted and Epoxied to the fuselage, fit these fairleads to keep the wires as straight as possible, for this purpose, file away a little Balsa on the diagonals (7).

The Undercarriage.

You have by now noticed that this Piper undercarriage is a little more complicated than the plain Dural, or simple piano wire types that maybe you have been used to. But our U/C is very strong indeed and light, the legs are sprung with multi strand rubber cotton covered cord, exactly matching the so called Bungee cord used on the full size aircraft. This rubber cord is far better than any spiral steel springs, the rubber cord has a very good shock dampening characteristic as well as being a lot lighter than any metal springing. This is the reason for Bungee cord being used on full size aircraft.

We have already silver soldered the critical parts of the U/C together, there remains the shock absorbers and their mountings for you to silver solder together. Do not allow the clubs metal working expert to persuade you into allowing him to weld your undercarriage parts together, despite all the talk about modern Argon arc welding and the like. Piano wire becomes exceedingly brittle due to welding temperatures. You will be aware of this brittleness after the first landing.

The U/C drawing is on plan sheet 4. The perspective drawing shows what at first may seem like a normal shock absorber but is only to limit the travel of the shock absorber leg. The flat strip hooks (144) are to carry the rubber cord. You will see that the cord is not shown on the drawing. The four M4 nuts to hold the ends of the shock absorber legs are drilled out with a 4mm drill, these nuts are soft soldered onto the ends of the wires. You attempt to cut a thread in these very hard wires will cause a sharp drop the petty cash tin. We have used nuts instead of washers for the main reason the solder area is much larger, also I think the nuts look better.

Start with four rubber cord hooks (144). Centre punch the four 4mm diameter holes and drill out these holes.

A word of caution about drilling sheet metal, whether you use a pillar drill or hand held electric drill, you must always use a pair of pliers or a small drill stand vice to hold the work piece. The drill goes through the first part without trouble but when the drill starts to break through the other side, the drill catches and turns the work piece with it, you can believe me that your reaction is just not fast enough to avoid very painful damage to your extremity trying to hold the metal.

Round the ends of the hooks with a file or belt sander and round off the sharp edges so these will not cut through the rubber shock cord. Deburr the holes with say a 8mm drill.

The top shock absorber legs (149), a hook (144) and a steel collet (151), silver solder these together noting the position of the hooks in relation to the bent up ends of the legs (149). When cooled these two legs (149)(144) and (151) must be silver soldered into the two deburred steel tubes (152). After these parts have cooled lay them in hot water for an hour or so then remove the flux residue with a wire brush. Bend the ends of the two hooks (144) slightly upwards.

The bottom shock absorber legs (148), a hook (144) and two steel collets (151). First silver solder the hooks to the legs, again noting the position of the hooks to the bent up ends of the legs. Place a collet onto the leg and push this against the hook, place a second collet onto the leg and silver solder this second collet to the leg, note that the first collet must remain free on the leg. Now insert one bottom leg into the finished top leg tube, push the moveable collet into the tube so that a millimetre projects from the tube. This projecting collet has no adverse affect on the working of the legs. Apply a little flux to this collet and silver solder this loose collet to the tube (152), taking care to prevent soldering the leg to this loose collet. Remove all flux residue. A 2mm hole can be drilled into the tubes so you can work in a little thick grease to provide lubrication and reduce noise. This hole can be sealed with adhesive band.

Next, the small pre-bent shock absorber fixing lug (143) must be silver soldered to the 3mm wire brace (150), then remove all flux residue as before. Insert a piece of 3mm plywood between the two halves of this lug and centre punch the two holes accurately and drill these out to 4mm. Hold this brace unit in the vice and file to the shape on the drawing.

Cut to length the 5x10mm spruce fuselage struts (147), file a half round groove into the ends of these struts so they fit tightly between the 5mm U/C. Degrease the legs with acetone and Epoxy these struts into place.

Lay the two preshaped U/C leg units on a flat surface with the four fixing plates flat on a level surfaces so they are sitting the same as would be if they were screwed to the fuselage and with the fuselage upside down. You should now be able to fit the completed wire brace (143)(150) into the two pieces of tube silver soldered to the two front U/C fixings. It may be you will have to deburr the wire ends and the brass tubing. Should the wire still not fit into the tubing run a 3mm drill right through the tube. The joint between the tube and the wire brace is fixed, the tube serves only to give sufficient glue surface for the Epoxy. Leave the U/C overnight for the Epoxy to harden. Before you go just bore out the four M4 nuts so as to be ready for the next day.

Fit the two shock absorber legs between the lug (143) on the wire brace and the lugs on the two legs, soft solder the M4 nuts to the ends of the shock absorber legs, last job is to cover the U/C with Coverite but first you must paint the wire legs with Balsarite, alternatively you can dissolve a little plastic hot pistol glue in Chloroform or TCE and paint this onto the legs.

Lay the fuselage onto the table upside down and place the U/C onto the fuselage as per the drawing, then mark one of the two 4mm holes in each fixing through onto the fuselage, remove the U/C and bore out these four holes with a 5,5mm drill. File the M4 blind nuts (112) to shape on the drawing. Apply a little Epoxy under the blind nuts and bolt the U/C to the fuselage, pulling down the blind nuts into the wood blocks (113) and (114). Drill through the remaining three holes with a 4mm drill just enough to mark the position of these holes, remove the U/C and bore through these marked holes with a 5,5mm drill. Fit the second four blind nuts into the fuselage with Epoxy and with the U/C in position pull these four blind nuts into the wood blocks as before. Fit the other four M4 screws and pull down all eight tightly and leave the U/C fixed to the fuselage overnight to allow the Epoxy to harden.

The springing on the U/C is, as previously mentioned, the multi core rubber cord. The cord is in the hardware bag, cut this in half and join ends together with a knot so you have two separate loops, put a single drop of CA onto each knot to secure it. This cord can be placed on the shock absorber legs in various ways and with different tension, you can increase or reduce the tension as you may think necessary. The cord is well protected against wear and from the exhaust gases with the covering. In spite of this the rubber bunch on the U/C, like the full-size aircraft, looks better with a leather pouch, the leather pouch material is not in the kit.

You will see on sheet 4 there is a drawing showing wheel spats. These spats are not part of the kit but we supply these as an extra. The spats are fixed to the axles with the aid of the 5mm screw collets (156). These collets are first silver soldered onto the brass straps (155). These straps and collets are glued with Epoxy onto the four spruce mountings (160). With a 5mm drill bore out the holes through the collets, brass straps and spruce mountings. Drill a 5mm hole through the inside wall of both spats. Epoxy the four collet units (155)(156)(160) into the spats after roughening the glue area on the inside of the spats. The wheels have aluminium plain collets pressed into the hubs, there are two pieces of brass tubing (157), Epoxy the brass tubes into the aluminium collets so the brass tube turns with the wheels on the axles and not on the aluminium collets. This method of fixing the spats has the advantage that the spats can turn on the axles in the event of a nose over and can easily cope with a fair amount of rough treatment.

Whether you fit spats or not, the brass tubing (157) must be Epoxied into the wheels, for wheels without spats, shorten the brass tubes to 30mm, you must also shorten the 5mm wire axles, the wheels are then held onto the axles with the two 5mm steel screwed collets and M3x6 socket screws, these screws must be fixed with Loctite.

Tailwheel.

First clean up with a file the brass tube (129) and Epoxy this into the aluminium hub of the wheel. Bend to the given shape on plan sheet 1 the three spring blades (134), the tank nipple (131) is shortened to 12mm long and is used as a bush for the 2mm wire wheel axle, this bush is held in the spring blades with the nut (134), this nut is secured with Loctite. Drill three 2mm holes in the tiller arm (125) and while you have the 2mm drill to hand open up the holes in three M2 nuts (120).

Soft solder one of these bored M2 nuts onto the shaft of the 2mm axle wire so this acts as a stop against the underside of the bush (131). Insert the axle into the bush then press a small piece of fine grit Wet and Dry paper onto the axle followed by the tiller arm and the bored out M2 nut, soft solder the tiller arm and the M2 nut onto the top of the axle wire, the sand paper will help to prevent the flux and solder running into the bush as well as providing a small gap between the tiller arm and the bush when it is torn out, the nut is to provide a larger solder area on the wire, the nut also adds a neat appearance.

Cut two small pieces of Wet or Dry paper, bore a 2mm hole in a piece of plywood, place one bored out 2mm nut onto the axle, lay a piece of the paper over the hole in the ply and press the axle through the paper, place the wheel onto the axle and press the second piece of paper onto the axle, followed by a second bored out nut and the soft solder these nuts to the axle, remove flux residue with tissue and tear out the two pieces of paper. The wheel should now turn freely on the axle. Apply a little thin oil to the bush (131) and the axle. To finish drill out the holes in the two brass straps (116)(117) and shape these with a file. The completed tailwheel unit is fixed to the fuselage after the fuselage is covered.

Wings.

Start with the laminated wing tips, using almost the same method as for the tailplane, the tips are formed from four soaked in water 2x20mm Balsa strips glued together with PVA. Have you noticed the large piece of chipboard laying in the kit and wondered if we were artfully getting rid of our waste, you now need this waste to form the wing tips. Cover the curved edge with a wide strip of Selotape and wrap this around the edge, find a piece of board a little larger than this chipboard template, cover the board with plastic film and nail the template to this board with a couple of small nails.

The spars are chamfered the same as the fuselage longerons. Epoxy the eight spars together. There are eight pieces chamfered on one end only and four pieces chamfered on both ends the latter must be cut in halves. The bottom spars are 6,5x6,5 square. The top spars are shaped (trapezoid) to fit rib contour.

The 2mm thick wing sheeting is cut diagonally on the ends and is joined together in a similar way to the spars. But not with Epoxy, you can glue the wing sheeting with Ca. The same goes for the spindle moulded leading edge and the sub leading edge.

Epoxy the two 0,8mm plywood ribs (334) to the two 6,5mm root ribs (333). Caution here, we need a left and a right set of root ribs with the 0,8mm plywood on the inside. Pin these ribs securely to a board. Epoxy the two 0,8 plywood doublers (347) to two main ribs (308) again making sure you have a left and a right hand pair and pin these also onto the board. Next day remove the ribs and clean up.

If your building board is big enough to take both wings, it is a nice thing to be able to build both wings at the same time from both sides of the board. Use the white CAD plotted plan of the wings to build the wings, should your board not be big enough, cut the CAD plan in half down the middle. Use the blue print wing plan solely for the numbers. Do not forget to cover the CAD plan with transparent plastic sheeting.

Trim the wing tip end of the bottom spar to fit against the wing tip refer to section GG. Make a small saw cut in the top side of the spar to allow you to pull the spar upwards to fit against the wing tip. This saw cut will be filled with Epoxy later and will not weaken the wing in any way. The top front spar (310) must also be trimmed to fit against the wing tip and the small saw cut this time is on the underside.

The front bottom spar (301) can now be fixed over the board. The spar must be placed accurately to fit against the wing tip, all the spars should have a little overhang at the root ribs. Cut ten small pieces from the 1mm thick white Styrene, this material is in two 300x30mm strips in the kit, lay these ten small pieces under the bottom spars between each rib, the purpose for these scabs of Styrene is to keep the spars inside the ribs contour. The two rear spars are prepared the same way as the front ones, refer to section HH. To fix the rear spars in position use two of the main ribs slotted onto the front spars as you will notice, that due to shrinkage on the plan paper width, the ribs do not exactly match the drawings. Shorten the pins and hammer these in flush to the spars topsides. Fix the trailing edge spine (305), this is the 0,8x18x460mm plywood, to the plan between the root rib and the aileron opening, Epoxy the spruce strip (304) onto the spine (305) and pin down to the board securely.

Glue with PVA the ten main ribs to the bottom spars, shortening the ribs in the aileron opening. The root ribs should be very slightly inclined inwards due to the dihedral angle of 1 degree. I have found it better to forget this inclining as the angle is so small it is very difficult to achieve accurately, with these ribs square to the board you will hardly, if at all, notice this slight difference when you come to fit the wings to the fuselage.

For the aileron and flap servo carriers (341) you must cut eight pieces of 6,5x6,5 balsa (321) and these must be glued to the main ribs and to the top sides of the bottom spars, note that these must be glued to the ribs according to the height of your servos, this means that the servos must come against the covering material so that the servo output spigot comes through the covering with the servo just inside, refer to section II on plan sheet 2. Experience has shown us that it is not necessary to expend the time in making hatches, as the modern servos last longer than the models. Should you have bad luck with a servo, after a few seconds have elapsed you will not need a screw driver to remove a hatch.

The spar webbing is 2mm thick hard Balsa, the core pieces 6,5mm thick, you will find these webbing pieces are cut to length, but the width is shorter than the distance between the ribs, there is a simple reason for this and it is money, such wide balsa logs are very expensive and almost impossible to buy. So with these webbing pieces ready sawn to length has saved you quite a bit of work, and you having to glue these pieces together with CA end to end is not so bad. Use PVA to glue the spar cores (315) in place at the aileron opening. Do not use CA as this does not adhere well to spruce and other hardwoods.

Glue the top spars (310) and (311) into the ribs, check with a square the ends of the spars at the tips to ensure the top spars are the same length as the bottom spars. Point a piece of Balsa strip to clean away the excess PVA so that the webbing will fit neatly into the corners.

Make the two sub leading edges (312) from the three 3x16x910mm Balsa strips, glue these strips together with CA glue. Pin the sub leading edges to the ribs, check for accuracy and glue them with CA to the ribs.

Epoxy the 2mm plywood spar webbing onto the spars, these must be really well glued as they take all the loading of the wing struts. Glue the 8mm thick aileron root rib to the wing. Cut off flush to the rear of the spars the rib ends in the aileron bay. No need to save these as the riblets for the ailerons, the riblets, you will notice are in a small plastic bag, are ready made and cut to length.

Glue all the spar webbing (313)(314)(316) and (317) from the first to the last rib with the exception of the rear spar webbing between the root ribs (333)(334) and the first main ribs (308), this webbing on the rear of both spars at the wing roots must be left off temporarily as you have to first Epoxy the brass dowel tubes to the root ribs later, then you can finish the webbing. Glue the webbing pieces together with CA the same as for the spar core pieces (315) and then cut these to length, you do not need to be too accurate with fitting the webbing close to the ribs as this will not increase the strength of the wing. Balsa has no strength across the grain. The webbing serves only to hold the spars in place and to resist the shear loading forces on the spars this is the reason for the vertical grain.

Next day you can lift the wing from the board carefully, remove all the pins from the wing and the building surface, search for all the behead pins carefully, overlook this little chore and, I fear a sharp pain in a careless hand will immediately make you aware of your oversight!

Glue the two 6,5mm thick shaped spar web between the spar ends and hold the spar ends together with clamps, check that the spar ends are symmetrical.

Plane and sand the sub leading edge to conform with the ribs profile, keep this sub leading edge (312) parallel right to the end. Lay the wing over the plan and use a piece of the (312) to fit between the spar end and the sub leading edge, this piece of balsa must be formed slightly to a barrel shape.

Glue the 2mm thick bottom leading edge sheeting to the wing, laying the wing flat onto the board to ensure there is no risk of a twist being built in. You will have noticed that the plan shows this sheeting to lay only half way onto the spars, this making it easier for fitting the cap strips. The join between the wing sheeting must be placed as per the drawing that is to say on the inboard section for top and bottom sheeting. I prefer to use pinning strips, these need only to be balsa strips 6x6mm or so and placed over the sheet, with the pins driven through these strips into the spars and leading edge, spacing about 50mm apart. You will find it takes quite a bit of force to get the sheeting to sit onto the angled piece of shaped and angled leading edge.

Remove all pins and pin strips after the glue has had overnight to harden, then plane and sand the overhanging sheeting to bring this flush to the sub leading edge. Pin the spruce trailing edge piece onto the board cut off the pins and hammer these flush to the surface of the trailing edge. Apply Epoxy to the spruce and lay the wing panel over the trailing edge (304) and pin down securely avoid any movement of the wing as the ribs will not stand very much at the trailing edge. It is preferable to use Epoxy instead of PVA for the trailing edge as PVA can cause warping due to its water content.

Remove the pins next day and carefully lift the wing off the board. Fit and glue the strip of 2x5mm Balsa (335) along the aileron bay, should you be fitting flaps then this strip must be carried right to the root ribs. Cut fit and glue all the 2x5mm cap strips for the underside of the wing.

You must now nail the wing to the board to be able to fit and glue the top wing sheeting. With the top wing sheeting fitted you have now completed the D form torsion box, therefore to avoid building a twist into the wing requires that you firmly fix the wing to the board. Fit the 5x2mm strip (335) to the aileron bay as for the underside as well as the rib capping (335) to all the ribs. When the glue is hard remove the wing from the building board once more.

Sand away the overhang from the sheeting (322) until this is flush with the sub leading edge. Glue the spindle moulded leading edge (327), hold this in place with pins and then with masking tape pull the leading down onto the wing firmly, should your sanding be accurate you have a glue join you will hardly be able to see.

Place the laminated wing tip over the wing and mark the inside contour onto the leading edge and wing sheeting, sand away the wood outside this mark, sanding a little and then check by laying the wing tip against the wing, it is a somewhat tedious procedure, unfortunately the glass-paper is not invented that puts wood back. Behind rib (308) the wing tip must lay on the board so you must plane some wood away on the underside to achieve this. Glue the wing tip into place and ensure the wing tip fits onto the middle of the spars and sheeting.

Fit and then glue end rib (309) between the front and rear spars, glue the rib capping to the end rib (309), the 10mm wide rib capping (320) to the root ribs (333)(334) and the aileron root ribs.

Drill a 5,5mm hole in each bush block (338)(339), refer to the drawing, use a pillar drill if at all possible. Degrease thoroughly eight knurled screw bushes (345). One end of these bushes is plain, in this end screw a M3x20 socket head screw for all eight bushes. Should you not be acquainted with these bushes you have now discovered a real time saving device. With the plain half of the bush the screw is automatically fed into the thread correctly, this makes fixing the struts a matter of a few minutes. The length of the threaded part of the bush is a lot longer that the threaded portion of a normal nut, this means that when the screw is tightened down there is a lot more friction in the threads to hold the screw firmly, this has the great advantage that the screws do not need additional safety devices. So long as the screws are tightened down they will not come loose due to motor vibration. There is a ball joint head screw driver in the hardware bag for the M3 Allen cap screws, this screw driver is only for screwing in the screws lightly, for tightening down use the L shape Allen key as the head of the ball joint screw driver will break off. When you have found the maximum torque (approximately two broken off ball joints) a screwdriver will take, this torque loading will be enough to hold the screws firmly. Another thing to watch is when you leave the struts on the wings between flying, check that the strut fixing screws are tight before putting the wings onto the model. However, seal the ends of the bushes that goes into the blocks, this means a little hot candle wax on the screw ends where they stick out, it remains to insert Epoxy into the holes in the blocks and slowly press the bushes into the holes, wipe off the excess Epoxy and leave the blocks standing overnight.

Epoxy the 1,5mm thick rib onto (342) the balsa root rib (333). First fit the rib (342) on the wing root using the two brass dowel tubes (307), should there be a small difference between the outline of the wing and this root rib, do not sand this root rib to fit the wing contour, you must either sand down or fill out the wing to match the root rib. In other words you must not alter the shape of this 1,5mm ply root rib in any way.

As the root ribs (342) and (300) are shaped and bored in a jig together, the wing must now fit exactly onto the fuselage, leave nothing to trust, try it out. When the wing fits as it should, the two brass dowel tubes must be Epoxied to the wing, ‘almost forgotten, these tubes must be slightly crimped on the inside ends, you remember the reason was given earlier, it’s safety, in case the dowels come unglued for some reason, they stay in place, along with your wing. The dowels are Epoxied into the tubes after the wing is covered and painted. Glue into place the last pieces of webbing.

Use 80 grade paper to rough up the plywood webbing (318) (319) and the plywood rib doubler (347) to take the screwed bush blocks (338) and (339) and the glue surface of the four screwed bush blocks. Pin the wing down once more over the plastic film covered plan accurately, these blocks must be accurately placed. The safety of your model depends very much on the care you take with these four glue joints. For these joints it pays to take an example from the full-size aircraft industry. So mix enough Epoxy to glue all four blocks in one operation plus ending with a little over. So there is no doubt about what I mean, use only one mix and not two for gluing the four blocks. The left over Epoxy, use this to glue a piece of scrap plywood to a piece of spruce, you can then test this sample for strength. To allay any lingering doubt, the glue surface areas are quite big but what is the use of strong struts if the glue between the blocks is soft.

Ailerons.

Pin the trailing edge spruce strip (306) over the plan, cut down these pins and hammer in flush to the surface, pin the shaped leading edge (328) into place and then cut and glue all the bottom cap strips (335) as well as the 10mm wide cap strip on the aileron end rib between the LE and TE on the wing tip end, cut out the small half moon gusset (353) from 2mm scrap balsa and glue this down between the TE and rib capping. Epoxy the 0,8mm spine (305) onto the Trailing edge and rib capping followed by the top spruce trailing edge strip (306). Glue the aileron ribs (354)(355)(356) and (357) into place, noting the different thickness of these ribs, the top rib capping (335)(320) and that top half moon gusset (353) and finally the 0,8 thick plywood end facings (346). These latter pieces must be cut with scissors from the 165x55x0,8mm plywood, the same applies for the plywood facings on the aileron opening. Cut the four Tufnol horns and only temporarily fit these into the ailerons, these horns are better glued into place after the covering is on but before painting.

Flaps.

The full size J3 Cub was not fitted with flaps, these were fitted later to the PA18, if you have decided on a J3 Cub and you can deviate a little from your scale scruples, you will find it very worthwhile having flaps, especially when coming in on the finals. If your clubs finances are such it can only afford a short landing strip, with maybe a few trees that could be better elsewhere, and you have a ZG 45 or ZG 62 for a motor you will find the flaps are a real help, without flaps slide slipping will be the only answer to kill off enough speed for a short landing... Can you side slip a model?

The Pipers flaps let down to 60 degrees, are more of a landing aid than something to provide more lift, serve mainly to slow up and steepen the descent, allowing you to be able to judge the landing point easier and land inside the boundary.

So if you are convinced about flaps being useful in spite of the extra cost for two more servos, mark up with a square the rear face line of the flaps leading edge. Cut down accurately on this line parting the flaps from the wing and at the same time cut through the trailing edge against the root rib. Cut off the rib stubs from the wing and sand these flush to the webbing. Glue along the top backside edge of the rear spars the 5x2mm Balsa flap sealing strip (335). The flap presses lightly against this strip when held fully closed by the servo. The servo should of course be adjusted so that at extreme end of the throw the flap is fully neutral preventing excessive drain on the batteries. Build the flaps accurately so the gap between the wings and the flaps is fully closed with the flaps at neutral.

Glue the flaps leading edge (351) to the ribs, glue into place the inside end rib (331) and the cap strip onto (320), the Balsa horn block (348) and the hinge blocks (349), cut out the horns from the Tufnol sheet fit these horns into the flaps but glue these into place after covering but before painting.

Wings cont.

Cut the slots for the nylon hinges (332) for this X-Acto have a special hinge slotting tool, alternatively you can make a very effective slotting tool from a hacksaw blade, on plan sheet 4 is a drawing showing what I mean, grind the backside to a really sharp edge and to a fine point at the end. I find cutting the slots in the aileron first and then laying the aileron against the wing then with the hacksaw blade slotting tool cut through the aileron leading edge onto wing, go slowly to prevent ragging out the webbing, the slots for the flaps must be cut through the rear spars as the hinge line must be right at the bottom of the flaps, this means you have to cut a upwards slanting Vee slots into the spars and into the flap leading edges. Temporarily fit the ailerons and flaps into the wing using all the hinges, check around to see that the ailerons and flaps conform to the wing shape, a little sanding can be carried out in the event that there is a slight difference between these surfaces.

The whole wing must now be cleaned up with fine grit paper, for the leading edge you must take extreme care, the flying characteristics and stalling tendencies, are made or marred by what you do to the leading edges with sand paper. What I wish to say is that it is a waste of time and money to just sand around the leading edges any old how, better is to make a template from thick card using the drawings to mark out this template, continually use this template to check the nose shape right along the wing as you clean up with the sanding block. Sand carefully the top only of the spruce trailing edge to a flat triangle, refer to the section II plan sheet 2. The wing tips are rounded in section this is shown in the two sections GG and HH also on plan sheet 2.

The servo fixing rails (341) for the aileron and the flaps must be glued to the 6,5x6,5mm strips (321). The servos must be placed on the rails (341) so that the pushrods are parallel to the direction of flight.

Wing Struts.

The struts are built together over the plan sheet 4 and up to the steel fixing straps (194), these straps are fitted later. You will see that the spindle moulded half round struts (190) and (191) have the groove to take the steel straps cut into one half only, this means you have to be careful matching these struts together before applying the Epoxy. When you are sure the struts are correctly paired then you can Epoxy these together but leave the last 20 cm free at the top end, this being so that you can adjust and glue the straps correctly into the struts later.

With the Epoxy fully hardened, shape the root ends so they fit together accurately over the plan, Epoxy the strut ends together using the two plywood tongues (203). The brass tube (192) must be fitted exactly between the two steel strut fixing lugs (203). For the lucky people that have access to a small lathe this job can be done in the chuck very quickly and easily, for the ones without, most modellers have an electric drill and a file and these simple tools can be used instead, whichever method you use, the brass tube must be a tight fit between the lugs. The two brass tubes when finished must be degreased as well as the formed steel bands (198), when these steel bands do not fit exactly to the section on the drawings on sheet 4 then bend these until they do. Epoxy the brass tubes (192) into the steel bands, to harden and temper the Epoxy, place the parts in a cooking oven at approximately 100 degrees, it states on Ciba Araldite that the Epoxy can be tempered at 180 degrees with this temperature the Epoxy reaches its highest strength. So why 100 degrees, the problem is that most ovens have very inaccurate reostats so this lower temperature is a safe compromise.

The fuselage ends of the struts must be shaped to a flat taper with the ends being 5mm thick. Cut off the out side ends of the struts so these have a length about 10 mm longer than the plan, sand off the top edges of the four struts as is shown on the front view of the top ends. Bend to a small radius the four strut ends (194), by a small radius is meant that you must on no account bend these ends in the vice say, so that the bend is sharp or angular as this will weaken the steel, the bend must have a soft radius. Insert the four bent strut ends (194) into the struts, hold the steel band (230) (192) onto the struts with clamps.

For the next job you will have to clear off the building board and somehow arrive at a length to take the fuselage with both wings attached. The model is placed upside down on the board with the Balsa spacer (219), this spacer is 11mm thick and is placed 120mm from the wing leading edge, refer to plan sheet 6. This measurement of 11mm is to give the correct dihedral angle.

With the four now shortened Nylon wing fixing screws (340) and the four Nylon blind nuts (336) fix the wings to the fuselage. The model is now together upside down over the board, the tail is probably hanging over the edge, but now prop up the rear of the fuselage until the wing undersides are parallel to the board, with the wing tips laying on the board which of course is absolutely flat? The small angle of dihedral will be correct. But sight over the wings from the tailplane to check for symmetry. You need two straight strips of wood, so called winding strips, about a meter long, place one piece square to the wing length at the root rib, the second piece at the wing tip, the two must of course be parallel to each other, sight over these winding strips and you will immediately see if your wing has a twist. Should you have anything like a little twist, this can be corrected with the adjusting the lengths of the struts to suit. Should you so wish, you can of course introduce 1,5 degrees washout into the wings. If you are not sure how to arrive at 1,5 degrees, this is not difficult it means with the cord length of 415mm there will be a difference of 10mm from the board to the trailing edge at the root and the trailing edge at the wing tip. You will understand of course this means with the model standing the right way up on the wheels, the trailing at the wing tips will be 10mm higher than at the wing root.

Who needs washout? For example, he who does not intend flying inverted manoeuvres with his Piper. For what one can term normal flying the washout is an advantage, washout makes the stalling characteristics more predictable, washout does not allow the Piper to be flown slower than a Piper with a flat wing. The washout causes stalling first at the wing roots, this means the dropping of a wing tip is not so violent and can be better controlled. It follows of course, with the model inverted the washout has the opposite effect.

Stunting with the Piper, this is endless fun, it is really waste of a damn good model to use the Piper solely as a glider tug, or for just flying around rather aimlessly. You cannot tell me that the full size Piper is not capable of stunting. On many full-size flying meetings in America one can often see so called clown acts with the Piper J3 Cub, what these Pipers are capable of, you would not believe unless you saw this with your own eyes. Watching a slick modern aerobatic machine, such as the EA 300 perform, is to say the least extreme boredom when compared to the breath taking antics of a Piper in the hands of one of these Rodeo pilots. Noteworthy is, these Rodeo boys use the full span normal J3 or PA-18 Pipers. The clipped wing Pipers have a higher rate of roll, this advantage is bought at the expense of a considerable increase in the wing loading, this does not enhance the aerobatic performance one bit, the opposite is the case. A while back there appeared a series of articles in the American Sport Aerobatics magazine about the Clipped wing Cub, most Clipped Wing owners regretted this pruning of the wings.

But we are digressing a little, back to the job in hand. It is a question of nerves with the washout, when you perhaps wish to indulge only occasionally with Aerobatics it is definitely better to forget the washout.

With the wings now in position we can at last finish the struts. Use a M3x25 socket screw to fix the strut ends to the fuselage, you will now be able to see how much you must remove from the strut outer ends but take care with this shortening as you must only remove the barest minimum of wood, this is to say, the further the wood comes to the ends of the steel straps the stronger the struts are. Check to see that the brass tube (192) makes contact with the strut ends on the full width with the strut outer ends over the brass screw bushes (345), sand a little off the struts if required. With both ends of the struts fitting satisfactorily, degrease carefully the steel straps (194) and (198). Epoxy the four straps (194) into the strut ends, now you see the need not to glue the last 200mm of the struts together. You can easily part the ends of the struts and smear enough Epoxy into the grooves knowing that the Epoxy is covering the full length of the straps inside the struts, fix the ends together over the straps with several clamps and leave to harden. Epoxy the strut ends (198) to the struts, and hold in place with clamps.

Remove the struts from the model after the Epoxy has fully hardened, the holes must be drilled out for the eight M2x20 screws. When possible use a pillar drill, when drilling these holes keep the speed down and use very little pressure or there is the risk that the steel band will be pulled up off the struts. The steel band must not allowed to get hot. Screw together the M2x20 cheese head screw (201) screws and nuts, secure these nuts with Loctite.

The Jury struts (193) are formed from the 1,5mm wire, these serve to prevent the struts from bending under compression loads. To fix these Jury struts onto the main struts, first silver solder the short pieces of brass tube (200) onto the brass strips (199), clean off the flux residue.

Push two of these finished parts (199)(200) onto the 1,5mm piano wire (193) bend up both ends of this wire with 15cm between both uprights. Epoxy the brass straps (199) to the struts taking care to ensure the Epoxy does not get into the brass tubing, hold the brass straps in place with clamps until the Epoxy is hard. Make the four Jury strut ends from the brass discs (196) and the brass tubing (197), the tubing is silver soldered into the discs. First drill the holes for the brass tubing and when the tubing is silver soldered into the discs, drill out the four 3mm holes for the M3 socket screws. Clean off all flux residue, you can glue these ends onto the Jury struts with Epoxy, you can also soft solder the ends of the Jury struts into the brass tubing. Fix the struts to the fuselage and wings. For Epoxy cover the brass bushes with a strip of Selotape. For soft solder place a piece of fine grit paper between the brass discs and the bushes.

Should you find the wire Jury struts a little too thin and naked, you can Epoxy a strip of 6,5x3mm Balsa stripwood to these wires and then sand the balsa to an oval section.

The struts are now ready for painting, my method is the traditional dope method, you can use any of the modern primer filler coatings, I prefer the dope, it is lighter and cheaper. I thin the dope with about 50% thinners, brush this on and leave overnight to dry, next evening I sand over with 400 grit paper, brush on another coat of the thinned dope and again leave overnight to dry. For the last three coats you can add colour paste to the dope, After four coats the surface is filled and should be rather shiny: Dope certainly gives off a penetrating smell to say the least, but it is relatively cheap, lighter and is a lot less harmful for your health than the modern two component paint.

Motor Cowl.

The motor cowl is secured to the firewall with four spruce blocks (174) the four brass screwed bushes (345), M3x20 socket head screws (195). The motor cowl you will find only just fits onto the fuselage one side due to the side thrust. The position of the blocks is shown in the section AA on the first plan sheet 1 and on the plan sheet 6. The ends of the blocks must be shaped to fit the cowl. It must be possible to pull down the screws without deforming the cowl, deforming the cowl means that the screw holes will widen out, you fit washers under the screw heads. We use wax as a release agent when making the cowls, it best that you wash off the surface of the gelcoat with Acetone to remove the traces of wax, then sand the gel coat lightly with 600 grit paper.

Covering.

You have already had a little practice covering the tailplane with Coverite so no need to take up your time with more advice except to say, use Balsarite on the wood and paint the inside of the cabin and the silencer chamber with light green coloured dope. Dope is ideal for this job. I prefer to sand over the complete model with 400 grit paper, a coat of thinned clear dope brushed over all surfaces making contact with the Coverite, leave overnight to dry, next day sand lightly with 500 grit paper, another coat of dope and again lightly sand over with 500 grit paper, then a coat of unthinned Balsarite, do not sand the Balsarite, the iron will melt this smooth.

First cover the fin, the Coverite forms the fairing between the fuselage and fin, this covering of the fin may appear at first glance a little difficult, it is not really, cut a piece of Coverite with ample overhang with the lengthwise weave running vertically. Cut the edge to fit against the tailplane, iron this Coverite onto the fairing (86) with a fairly low temperature to prevent the material shrinking as it is fixed onto the wood. Iron the Coverite onto the first rib (80) with the minimum of creases, pull the Coverite around the leading edge and king post and iron firmly onto the wood. Cover the second side. To prevent warping of the structure shrink with the iron turned up to a higher temperature after both sides are covered. The iron must not come into contact with the bottom rib and the fairing. Cover the rudder.

Fix the elevator servos into the fuselage and tack the servo cables to the inside of the fuselage, if you wish you can fit a piece of plastic tube into the fuselage to take the receiver aerial. First cover both fuselage sides, cut the Coverite from across the width and not the length of the roll, this means you will have to have a vertical join in the Coverite, this join is best at the rear of the fuselage. You may think this is not important, or nonsense, so you cut the Coverite from the length of the roll, the danger with using the length of the roll for the sides is that you may not be able get the Coverite to shrink tight enough and will sag between the stringers. There is also the risk of wrinkles appearing after the model is standing in the sun. Iron the Coverite onto the sides and wrap this around the shoulder stringers and bottom longerons, this will prevent the Coverite lifting when you cover the top and bottom of the fuselage. Before covering the top and bottom fit the hinges (332) into the rudder along with the horn. Fix the control wires (136) onto the rudder bar with the sleeves. Make the exit holes in the Coverite both sides, this is best done by melting through with a hot needle. The servo output shafts are pushing against the Coverite, use a small electric soldering, one very light touch and the shaft is through, go carefully with the soldering iron as you run the risk of damaging the shaft as these are invariably thermoplastic.

Wings, start with the underside, cutting the Coverite from the length of the roll. Tack the Coverite first to the middle of the root rib turning this up the side, then onto the wing tip middle, tack a little more on the root rib, onto the wing tip until the Coverite is firmly fixed to the root and wing tip. Tack the Coverite to the middle of the leading edge and trailing edge, tack the covering step by step along the leading edge and trailing edge, you should end up with a wrinkle free covering and fairly tight before you start to shrink the completed wing.

Super Coverite needs only the minimal overlapping on the leading and trailing edge, the covering can overlap just on the outside edge of the trailing edge. On the leading edge the overlap is better placed on the underside to make this less noticeable. To trim the Coverite I find the best method is to lay the cutting edge of a knife blade onto the Coverite and pull the waste up and against the knife edge, this way you do not run the risk of cutting into the second layer. Should have the time to spare you can really make a nice finish by covering all the corners, edges and ribs with zick zack band, and while you are about it you can simulate the rib stitching with PVA. We have the correct size of zick zack rib taping, the order number is #2222, the rolls contain 16,5 meters.

Painting and Finish.

You are now at what I find a most satisfying point, on the way to a finished model. Painting, there is not a lot to say about this as you have surely developed your own methods and found out which materials you can best work with. One thing do not take your model down to the local Auto Body repair shop for spraying unless you can stay there and oversee the whole job. These Auto sprayers are a hard headed bunch usually and do not have the slightest idea what a light spray job is, should you turn your model over to these guys you will find that after they have built the paint surface up as they say, they then stick the whole model in their oven, you can guess the rest.

A modeller told us some time ago about his experience with the Auto Paint boys, he went to collect his model and when struggling to lift the super finish from the floor was told by the sprayer, who was apparently a modeller himself, that he had very good results with heavy models, our friend could hardly contain himself to ask whether they flew.

Installing the Tailwheel and Undercarriage.

After painting, screw the undercarriage to the model, this will help keep the pristine finish intact. Fit the tailwheel to the fuselage and connect the tiller arm to the rudder fork with the spiral springs (127) and the chain (126), the chain links you will find can be opened and closed again with pliers, the wheel must be in line with the rudder.

Windscreen.

Cut out a fairly thick paper template using the drawing on plan sheet 6, trim this template to fit, it maybe you have to make a second from the first, but get this template right before you start cutting the windscreen material. After this struggle you perhaps, not unreasonably, wonder why we do not make a vacuum formed windscreen, there is a problem with vacuum forming, it is that the plastic must be brought to quite a high temperature for forming. This heat causes the loss of a certain amount of the plasticiser, as well as causing tension in the material which means it becomes more brittle. The result is that the windscreen develops a milky appearance around some edges and small cracks soon appear.

Lay the template onto the windscreen material, with a very sharp and fine pointed knife make a very small cut into the surface of the plastic right around the template. You only have to bend the plastic sheet away from the cut and it will break through leaving a very clean edge.

The windscreen material is a high impact strength PVC, you will notice it is very stiff and therefore difficult to bend. Catch hold both ends of the front windscreen and bend to required shape, dip the rounded front into a bowl of boiling water, you will immediately notice the tension is gone and the shape is now formed, remove the windscreen from the hot water and let this cool in the air, alternatively dip the windscreen into cold water.

The windscreen goes around the root rib and up over the roof without a sharp bend. In the front view along side the windscreen template I have endeavoured to show how the PVC is bent around the cabin corners with a fairly large radius, you must note that these corners are different between the J3 and the PA-18 also the windscreen on the J3 is less inclined to that of the PA-18. The windscreen has a very large influence on the scale appearance, maybe you wish to have your model really scale, the answer is to find an original that you can look over, but a set of good photo's can also help.

Fix the windscreen to the diagonal struts with either our FL CA or the normal Ca. These glue joints must be reinforced and this is what the little bag of nails is for, you must drill a hole for each nail, apply a tiny drop of CA onto each nail and press this quickly into it's hole. To prevent any unsightly runs with the CA, I have found it is best to squirt a little CA onto a piece of glass and then dip the point of each nail into the glue. Fit the side windscreens using the same method. The windscreens have the frame painted on.

Tailplane Bracing

Drill both ends of the six die stamped brass tags (139) with a 2mm drill. Fix these tags to the tailplane and fin with the M2x20 cheese head screws (201) and the nuts(202), use Loctite to secure these nuts and the cut off the ends of the screws and file flat. Fit the Nichrome steel wire (138) between the tags and fix with the sleeves (137), there is no need for this bracing wire to be especially tight.

Servo Pushrods and Radio installation.

First the ailerons, drill out a ball joint (100) to 2,5mm, then screw into the ball joint the screwed rod (207), the rod is self threading in the Nylon. Fix the ball joint between the double horns on the aileron with an M2x12 cheese head screws, fix a second ball joint temporarily onto the servo output arm and using the radio set the servo at neutral, fix the aileron to neutral with a clothes peg or similar, you can now mark the length of the screwed rod for shortening. Cut a thread onto this plain end of the screwed rod with a 2,6mm die, if you do not have 2,6mm you can use a 3mm die, this 3mm thread, you will note is of course not so deep, to compensate you must drill out the ball joint with a 2,2mm drill. How does this come about? As you rightly say the supplied threaded end is 3mm, well the 3mm is due to the thread being rolled raising the material, screw the ball joint that you have opened out with a 2,2mm drill onto the threaded rod. You should now have the same throw as shown in the drawing, when possible arrive at the given throw without recourse to the servo travel adjuster on the transmitter, make any adjustment by altering the length of the servo arm. But you can arrange the differential in throw with the transmitter. The differential shown is approximate, you must finalize this after flying the model.

The flaps, as you see, are hooked up to the servo in the same way as for the ailerons. It an advantage to be able to mix the flaps with the elevator, program the elevators to give a little down trim when letting down the flaps.

The receiver with the two batteries is placed in the removable tray (184)(185) under the fuselage hatch (105), removing this tray gives access to the rudder and the tow release servo. Two receiver batteries, we never fly our models without a two battery system, this means two batteries, 6V each, two switches, two plugs, a diode in each of the positive leads. The various battery check systems with coloured diodes, you will soon know when the single battery is flat without lights to tell you.

CG position

The CG position on the drawing is from our prototype with a ZG 45 and our Hydro Mounting System fitted, the prototype required no lead anywhere. This model is very stable in flight, we can recommend this position of 120 mm rear of the leading edge for glider towing and flying around at weekends. For aerobatics we have found the CG better placed at 130-135 mm behind the leading edge. It is not wise to have the CG further back than 140mm. The maximum forward CG position is 105mm from the leading edge. Note that these CG positions were all taken with the tank half full. The most accurate way you can find the position of the CG is to cut a piece of say 8mm plywood just long enough to take the two root ribs (300) , this ply of course being high enough to keep the wing tips off the board. Lay the model upside down over this piece of plywood which is spanwise under the Piper, move the model to a position where it almost stays put, it will tip after a very short interval, finding the place where it stays put for the longest means you have found the CG exactly. To be sure about the model being horizontal, lay a spirit level across one wing, if your level is rather heavy place the middle of the level over the CG. Should this procedure not appeal to you and you wish to find the CG with an upright model then the nose MUST NOT be pointing slightly down as is often recommended. Our aim is to find the exact CG and not some point that we only know lays behind the CG. Use the spirit level.

First flight

Do not forget the safety check with the nut for the strut fixing bolt, do not tighten down the four nylon screw too much. These screws are in tension when the model is inverted, any over tightening of these screws is going to reduce their tensional strength. Four screws are used for safety, it is possible there is an air bubble or a similar fault in one screw.

Do not rush things, make a thorough check that everything works with the radio. You must make a range check with the motor at full throttle before the first flight.

Of course you are nervous, everybody is at this point, relax and for a moment just think about something entirely different. The Piper flies so well you can hardly go wrong. If you have been successful with other models you are going to get your Piper off the ground and back again easily.

In spite of the anxiety you have flown the Piper successfully, make a second flight and with enough altitude for safety try out the elevator throw. I set the throw so that with half throttle and full elevator the model makes a series of small loops without stalling. To find this point you must first have the throw so that the model stalls in the loops, gradually reduce the throw until the stalling tendency is almost removed.

With this set up and you are flying pretty low down, you make a small mistake, you can safely pull full up elevator. Also you do not have to avoid flying too near the stall for fear of a wing tip dropping.

For a safe landing there are two reliable methods. For the beginner the safest is to bring the model in over the landing strip to within say 10cm from the ground and let the elevator loose, allow the model to fly itself onto the wheels, the model will roll a bit with the wings at a very low angle of incidence, the resistance from the wheels will tend to keep the tail up and therefore the incidence down, without lift from the wings the Piper will stay on the ground as if glued there. Use only the rudder to steer. Shortly before speed drops off below minimum flying speed pull full elevator and this will prevent the Piper tipping onto the nose. When taxying always have full elevator as this saves damaging those expensive propellers.

For the expert there is only the perfect three pointer where the tailwheel is the first to make contact with the ground and the wheels second. Anything else is only a series of inelegant hops. When the wheels touch down first and with full up elevator applied the tail is forced down due to the inertia, as a result the Incidence of the wing is increased and at the same time the lift, causing the model to become airborne for a short time and so on.

You will find that the best three pointer can be made without the help of flaps but when you kill off excessive airspeed very low over the landing ground by keeping the nose well up. You will soon be aware that at slow speed and with the nose well up you will have difficulty in keeping the model straight with the rudder and getting her down where you want to. Side slipping is a very good and quick way to kill off excessive airspeed . You are nervous about trying this side slipping, then first a little harmless practice, try giving a little right rudder for three seconds, a little left rudder for three seconds and so on but at no time correcting with the ailerons. Be careful as you can very quickly reduce the airspeed, with the sharply reduced airspeed the Piper can also stall quite sharply. You must learn to be able to judge when to let off. The old and bold pilots words there’s no substitute for altitude......

As mentioned earlier, the Piper’s repertoire in aerobatics is no way confined to simple manoeuvres. Try a flick roll and you have to be very quick to react or your Piper will be half way into the next. For precise rolls you must have differential throw on the aileron servos, you must adjust this as necessary for optimum results but for aerobatics you need rather less differential, especially for the vertical (upwards!) roll. Sealing the aileron gap with Coverite dramatically increases the ailerons efficiency. The Piper then needs only two seconds for a full 360 roll. Our prototype weighed exactly 9 kilos with a ZG 45 and the Hydro Mounting System and propped with a (loud) 21x8" Menz, will fly vertically upwards rolling until the tank is empty from a 3-4m take off run. Our prototype model fitted with the three bladed 19x11" Seyer NT carbon fibre propeller is unbelievably fast and whispers and hisses around the sky, it is so quiet you can hear the airstream noise over the struts which is louder than the combination of motor and propeller. With the throttle at little above tickover the Piper flies around without losing height and you don’t believe it, well you now have a Piper so there is nothing stopping you giving it a try.

The lads in our club are fond of saying that what I do with our Piper is not comparable with the full-size, the full-size is just not able to fly so, it is rubbish of course, they are probably a little jealous and are considering whether to build a new set of wings or while they are at it a complete new Piper.

Apart from my introduction I have translated my partners German instruction exactly, with a few minor exceptions, for I have allowed a little license when drifting into the vernacular.

From him and me, we sincerely hope you have had a deal of pleasure from building this Piper than other, more perhaps, mundane pursuits. Happy landings folks.

Toni Clark and Gerhard Reinsch.