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Instruction Manual

Composite-ARF Pitts S12, 2.7m span

'TAVS Technology'

version: Preliminary

Instructions for Pitts S12 bi-plane

Thank you very much for purchasing our Composite-ARF Pitts S12 all composite aircraft, made with the revolutionary Total Area Vacuum Sandwich (TAVS) technology.

This kit is designed for 'expert' assembly and operation, and therefore we have assumed that the builder and operator of this aircraft has the necessary experience to do this safely and properly.

The Pitts S12 kit is 90% pre-fabricated at our factory, with the majority of the assembly already completed - only requiring engine/exhaust system, R/C components and ancillaries to be installed by the owner. These brief instructions detail the main points of the assembly, and show the solutions used by our factory staff for the linkages, R/C installation and motor etc., which are meant as a guide to assist you. Of course, if you have your own favourite and proven components, hardware, accessories and techniques then by all means please use them.

Before you get started building and setting-up your aircraft, please make sure you have read this instruction manual, and understood it. If you have any questions, please don't hesitate to contact your Rep, or C-ARF directly. Below are the contact details:

Email:	**feedback@composite-arf.com**
or	**techsupport@composite-arf.com**
Telephone:	**Phone your C-ARF Rep!!! He will be there for you.**
Website:	**http://www.composite-arf.com**

Liability Exclusion and Damages

You have acquired a kit, which can be assembled into a fully working R/C model when fitted out with suitable accessories, as described in the instruction manual with the kit.

However, as manufacturers, we at Composite-ARF are not in a position to influence the way you build and operate your model, and we have no control over the methods you use to install, operate and maintain the radio control system components. For this reason we are obliged to deny all liability for loss, damage or costs which are incurred due to the incompetent or incorrect application and operation of our products, or which are connected with such operation in any way. Unless otherwise prescribed by binding law, the obligation of the Composite-ARF company to pay compensation is excluded, regardless of the legal argument employed.

This applies to personal injury, death, damage to buildings, loss of turnover and business, interruption of business or other direct and indirect consequent damages. In all circumstances our total liability is limited to the amount which you actually paid for this model.

BY OPERATING THIS MODEL YOU ASSUME FULL RESPONSIBILITY FOR YOUR ACTIONS.

It is important to understand that Composite-ARF Co., Ltd, is unable to monitor whether you follow the instructions contained in this instruction manual regarding the construction, operation and maintenance of the aircraft, nor whether you install and use the radio control system correctly. For this reason we at Composite-ARF are unable to guarantee, or provide, a contractual agreement with any individual or company that the model you have made will function correctly and safely. You, as operator of the model, must rely upon your own expertise and judgement in acquiring and operating this model.

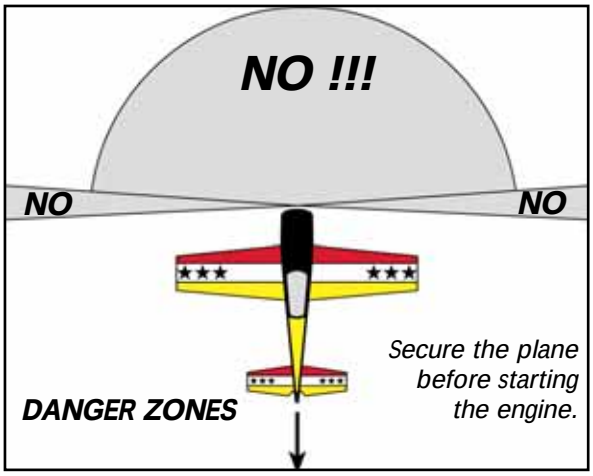
Attention !

This 'Giant Scale' aerobatic aircraft is a high-end product and can create an enormous risk for both pilot and spectators, if not handled with care, and used according to the instructions. Make sure that you operate your Pitts S12 according to the AMA rules, or those laws and regulations governing model flying in the country of use.

The engine, servos and control surfaces have to be attached properly. Please use only the recommended engines, servos, propellers, and accessories. Make sure that the 'Centre of Gravity' is located in the recommended place. Use the nose heavy end of the CG range for your first flights. A tail heavy plane, in a first flight, can be an enormous danger for you and all spectators. Fix any weights, and heavy items like batteries, very securely into the plane.

Make sure that the plane is secured properly when you start up the engine. Have a helper hold your plane from the tail end or from behind the wing tips before you start the engine. Make sure that all spectators are behind, or far in front, of the aircraft when running up the engine.

Make sure that you range check your R/C system thoroughly before the 1st flight. It is absolutely necessary to range check your complete R/C installation first WITHOUT the engine running. Leave the transmitter antenna retracted, and check the distance you can walk before 'fail-safe' occurs. Then start up the engine, run it at about half throttle and repeat this range check with the engine running. Make sure that there is no range reduction before 'fail-safe' occurs. Only then make the 1st flight. If the range with engine running is less then with the engine off, please contact the radio supplier/engine manufacturer and DON'T FLY at that time.



Check for vibrations through the whole throttle range. The engine should run smoothly with no unusual vibration. If you think that there are any excessive vibrations at any engine rpm's, DON'T FLY at this time and check your engine, spinner and propeller for proper balancing. The lightweight sandwich composite parts don't like too much vibration and they can suffer damage. The low mass of all the parts results in a low physical inertia, so that any excess vibrations can affect the servos and linkages.

Make sure that your wing and stab spar tubes are not damaged. Check that the anti-rotation dowels for the wings are not loose. Check that the plastic wing retaining nuts are tight, as well as the M6 x 30mm that secure the top wings to the centre section, and the M3 bolts retaining the horizontal stabilisers onto the carbon tube are tight. Check that all 3 hinge tubes in the stabs are secured with clear tape, or equivalent, and cannot come out in flight.

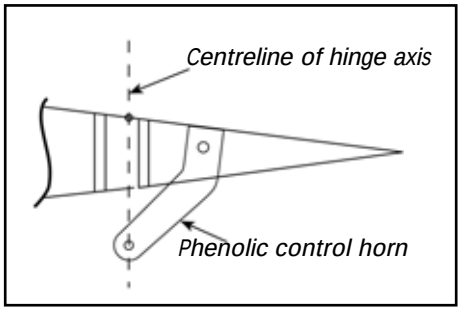
Please don't ignore our warnings, or those provided by other manufacturers. They refer to things and processes which, if ignored, could result in permanent damage or fatal injury.

Important/General Notes

Elastic Hinges:

The ailerons are hinged already for you - laminated in the mould and attached to the wing with a special nylon hinge-cloth, sandwiched between the outer skin and the foam. This nylon hinge is 100% safe and durable. You will never have to worry about breaking it, or wearing it out. There is no gap at all on the top wing surface, and there is a very narrow slot in the bottom surface, where the aileron slides under the main wing skin during down throw. This means that the hinge axis line is on the *top* surface of the wing, *not* in the centre. This is NOT a disadvantage, if you program in about 10% NEGATIVE aileron differential in your transmitter. This means that the 'down' throw needs to be about 10% more than the up throw. Why? Because the axis of the hinge is not at the centreline of the aileron, so it moves slightly in and out when operated, and the aileron gets a little "bigger" in surface area when moving up, and "smaller" when moving down.

The bottom slot needs some explanation, too. The cut line is exactly in the correct position so that the aileron slides under the wing skin smoothly. If the cut was a few mm forward or back, it would not work properly. So, make sure that the lip is not damaged, and that the aileron slides under this lip perfectly. It will NOT lock at any time, as long as the lip is not damaged. If damage occurs, you can cut off 2-3 mm, but you should NEVER need to cut off more than this.



Take Care:

Composite sandwich parts are extremely strong, but fragile at the same time. Always keep in mind that these contest airplanes are designed for minimum weight and maximum strength in flight. Please take care of it, especially during transport, to make sure that none of the critical parts and linkages are damaged. Always handle your airplane with great care, especially on the ground and during transport, so you will have many hours of pleasure with it.

To protect the finished paint on the outside of the model from scratches and dents during building, cover your work table with a piece of soft carpet, cloth or bubble-plastic. The best way to stop small spots of glue getting stuck to the outside painted surfaces is to give the whole model 2 good coats of clear car wax first, *but* of course you must be sure to remove this 100% properly before adding any paint, decals or trim. Alternatively you can cover the majority of the fuselage with the bubble-plastic used to pack your model for shipping, fixed with paper masking tape, which also protects it very well.

Flying Wires:

The flying loads on the wings are mostly taken by the flying wires, which must be assembled and soldered together by the customer. These joints are *extremely* important and must be made with silver solder - NOT normal 'soft' electrical solder. If the flying wires fail ... then so will your wings! If you are not confident of making good joints here, then please get help from someone that is good at this technique. See the section on Flying Wires for more details.

Adhesives

Not all types of glues are suited to working with composite parts. Here is a selection of what we normally use, and what we can truly recommend. Please don't use inferior quality glues - you will end up with an inferior quality plane, that is not so strong or safe.

1. CA-Glue 'Thin' and 'Thick' types. We recommend ZAP, as this is a very high quality.
2. 5 minute-epoxy (highest quality seems to be Z-Poxy)
3. 30 minute epoxy (stressed joints must be glued with 30 min and NOT 5 min epoxy).
4. Epoxy laminating resin (12 - 24 hr cure) with hardener.
5. Milled glass fibre, for adding to slow epoxy for strong joints.
6. Microballoons, for adding to slow epoxy for lightweight filling.

When sanding areas on the inside of the fuselage to prepare the surface for gluing something onto it, do NOT sand right through the layer of glasscloth on the inside foam sandwich! It is only necessary to rough up the surface, with 60/80 grit, and wipe off any dust with alcohol (or similar) before gluing to make a perfect joint. It is very important to prepare the inside of the fuselage properly, by roughing up and cleaning the surface, before gluing *any* parts to it.

Accessories

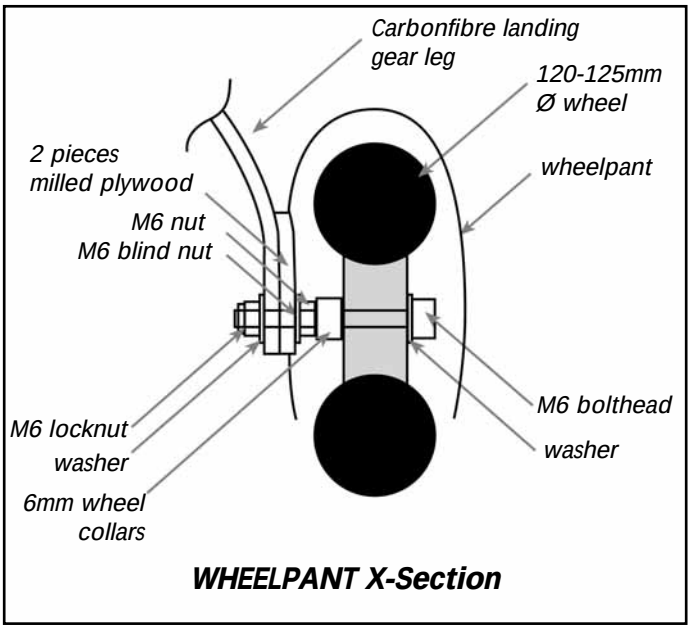
This is a list of the main things you may need to get your Composite-ARF Pitts S12 in the air. Some of them are mandatory, some of them can be chosen by you. What we list here are highly recommended parts, and have been thoroughly tested.

1. Power servos (16). We recommend JR 8511/8611 for the ailerons and elevators. Four JR8411's are quite sufficient for the Rudder set-up. (equivalents: Futaba 9351/9152)
2. Throttle servo. Any standard servo will do (eg: JR/Graupner 4041)
3. Aluminium Spinner 125 mm dia (5"), eg: Tru-Turn.
4. Main wheels 125mm (5"). Dubro wheels are recommended.
5. Tailwheel assembly. C-ARF can supply this as an option.
6. Engine DA-150, or equivalent.
7. Exhaust manifolds and tuned pipes. C-ARF can supply these for DA-150 as an option.
8. Powerbus system for servos. C-ARF can supply the Powerbox range as an option.
9. Tailwheel assembly of your choice. C-ARF can supply this as an option.
10. Receiver batteries and switches. Quality extension cables and connectors etc.
11. Fuel tank (1000+ ml) with gasoline stopper for gas/methanol motor. We use Dubro.
12. Cable ties in various lengths.
13. Propeller, to suit motor choice.

Did you read the hints and warnings above and the instructions carefully?
Did you understand everything in this manual completely?
Then, and only then, let's start assembling your Composite-ARF Pitts S12
If not, please read again before you continue.

Building Instructions

Landing Gear



WHEELPANT X-Section

The landing gear main legs have been installed for checking in the factory, and only need to be bolted into place for completing the wheelpants and wheels. Bolt them on from the bottom of the fuselage, using four M6 x 30mm bolts into the installed blind nuts. (see photo P1)

Fit the wheelpants to the legs. Glue the 'U' shaped milled plywood piece into the recess in the wheelpants with 30 min. epoxy, and the other 2 inside the wheelpants in the same position (see photos P2 and 3). Drill 6mm Ø right thru' the carbon leg (the dimple in the leg shows the position) and both sides of the wheelpant. Open up the hole in the outside surface of the wheel pant to 9mm Ø (to clear the head of the M6 bolt). Open up the hole in the inner surface of the wheelpant/plywood parts to 7.5mmØ for the blind nut, and glue into place with a drop of CA with the spikes into the plywood 'U' shaped part.

The wheel axles are M6 x 70mm hardened steel bolts. The head of the bolt goes on the *outside* of the wheel, inside the wheel pant. The order of the items on the bolt is: Bolthead, washer, wheel hub, washer, 6mm wheel collar(s), M6 nut, M6 blind nut, (plywood), carbon landing gear leg, and finally another washer and the lock nut. You may need to adjust the thickness of the wheel collar, or add a couple of extra washers to get the wheel exactly centred in the wheel pant, depending on the wheels you choose. A drop of Loctite on the M6 lock-nut is good insurance.

To keep the wheelpants at the correct angle, so that they clear the ground at the back, and flush against the milled plywood part that is glued to the carbon leg, glue a small square (approx. 15mm x 15mm) of scrap 3mm plywood inside the wheel pant 25mm above the axle hole and glue an M3 blind nut into it. Then secure the carbon leg to the wheel pant with an M3 bolt through the leg. Do *not* use a bolt larger than M3, as the larger diameter hole could weaken the leg.

If you wish to stiffen the main landing gear from twisting moments you can add either 3mm plywood, or better a 3mm aluminium, plate across both carbon legs inside the fuselage on the *underside* of the carbon legs. We recommend that you do this especially if you fly from rough fields. The size of this plate should be 50mm wide x 250mm long. Drill the holes for the M6 bolts to match the holes in the carbon legs. You may need to enlarge the slots in the fuselage a little to get the stiffening plate in.

C-ARF also have an optional tailwheel assembly for the Pitts, see more details on our website.

Remember - keep it lightweight at the tail end!

Cockpit Frame and Canopy

The moulded fibreglass canopy frame has already been trimmed and installed at the factory, with the retaining system completed, and you only need to trim and glue in the clear canopy.

Fitting clear canopies is always a little bit tricky, but this is the method we use:
Sand the inside edges of the fibreglass canopy frame carefully with rough sandpaper, to ensure a perfect fit of the canopy inside. Lay the clear canopy on top of the frame, and mark the rough shape with a felt pen or wax crayon. Cut the outer border of the clear canopy with sharp scissors, about 12mm (1/2") too big all around. When the canopy fits inside the frame roughly, mark the final cut line on the clear plastic. Then cut it to exact shape with a 6 - 8 mm overlap all around.

Make several hand-holds with paper masking tape (see photo P5) to make holding and positioning the canopy easy. Push the canopy up tightly inside the back of the frame and fix the bottom 2 back corners with one small drop of slow CA each (ZAP-O or Plasti-ZAP recommended). **Note:** Do NOT use any CA accelerator/kicker - you will immediately 'fog' the clear canopy!

Tape the front of the canopy to the frame temporarily. Mount the canopy frame to the fuselage (use all 4 bolts), and tape the back of the canopy frame tightly to the fuselage. Using the masking tape handles to pull the canopy outwards firmly against the frame, working from the back towards the front, glue the edges of the canopy in place in 2 more places each side, with just a single small drop of CA at each position, all the time checking that the edge of the canopy is tight up against the frame at the front.

Visually check from the front and back to make sure sure that the canopy is straight. Now that the canopy is fixed in position and cannot twist or warp anymore, you can carefully glue the rest of the canopy firmly in place. You can either complete the gluing from the outside, allowing the CA glue to wick into the joint between the frame and the clear plastic or, as we prefer, you can carefully remove the canopy frame from the fuselage, and use a 30 minute or 24hr epoxy and micro-balloon mixture for gluing all the edges to the frame on the inside surface. Even if you use the CA glue method, we recommend that you also glue the inside edges with the the epoxy mixture to be sure that the canopy cannot come off in flight.

Supplied with the canopy frame is a painted-to-match strip of fibreglass which can be glued on the clear canopy to form the central hoop.

Horizontal Stabs

The stabs are 99% finished at the factory, and the phenolic control surface horns are already glued in place for you. Hinging is with 4mm O.D brass tube, through the phenolic hinge posts installed at the factory. To prevent the hinge tubes coming out during flight you can solder a small washer to one end of each tube, and retain them with a small piece of clear tape.

Install the 2 carbon stab tubes (16mm Ø), with the shorter one at the front, and slide the stabs on. The tubes already have M3 blind-nuts glued into the at the factory for the four M3 x 12mm bolts that retain the stabs from the underside. Don't forget to put a bit of clear tape over the bolt heads for flight.

Servo choice:
The elevators can travel more than 45 degrees and must be controlled by a pair of hi-torque servos for each elevator, and we definitely recommend a pair of hi-torque digital servos like JR 8411,

or JR8511/8611 (or Futaba 9351/9152), as shown in the photos. In addition we strongly recommend that you use metal servo output arms, such as the 1.5" SWB 'Double-Loc' arms that are shown in the photos.

We provide cnc milled carbon/ply servo mounting plates in the kit, and the photos show the recommended position - however you can fit these plates further forward if you wish. Wherever you chose to fit them, it is important that you stiffen the fuselage at this position by laminating at least 4 carbon rovings (supplied) to the fuselage at the front ends of these plates, with 24hr laminating epoxy scuff up the fuselage to ensure good adhesion, and glue the servo plates in with slow epoxy and micro-balloon mix. We have also provided 2 triangular balsa/carbon reinforcing plates that are glued to each end of the servo plates as shown in the photos.

The elevator servos are installed in cnc milled phenolic plates, which are screwed to carbon/ply plates that are already installed in the fuselage. We have included 2 different types of phenolic plates - one pair fits the JR8411/8511/8611 servos, and the other for Futaba 9152 servos.

Note that the servos are bolted to the phenolic plate *without* using the rubber grommets supplied with the servos. Instead the grommets and brass eyelets are installed in the cutouts around the edges of the phenolic plate, and these are screwed to the ply/carbon plates using the 2.9Ø x 13mm sheetmetal screws provided in the kit.

The elevator pushrods are made from the 8mm Ø carbon tubes supplied, with short lengths of M3 threaded rod and 6mm wood dowel glued into each end. Photo P8 shows the construction technique. Make sure that you rough up the inside of the carbon tubes carefully, and glue the attachments in with thick CA. Believe us - they will never come out ! Note that the M3 all-thread should only project out of the carbon tubes about 22mm each end.

M3 aluminium clevises connect the pushrods to the servo arms, and M3 ball links are bolted between the pairs of elevator horns with M3 x 20mm bolts and locknuts. Use a little Loctite to be sure! When you have set up the throws and neutral points for both elevators, fit short lengths of brass tube over the M3 threaded rod, with M3 nuts, and use Loctite or CA to retain. This stiffens up the M3 all-thread and makes sure that nothing can move in flight.

Mark and cut holes for pushrod to exit the fuselage, and adjust to fit with 2mm clearance all around the pushrods at full throws. When satisfied, trim and glue on the 2 plastic moulded pushrod exit covers supplied. (Photo P11).

Note: Try to always leave the stab tube fixed in one stab, and never remove that one bolt, as it is difficult to find the right position for the stab tube again if it is removed from both stabs!

Finally add the CNC milled plywood supports for the pushrods inside the fuselage. (see photo P12)

Rudder

The rudder is hinged to the fin with a 4mm Ø tube which passes thru' the phenolic hinge posts that are already installed for you. Retain the tube in the same manner as the elevator tubes.
The phenolic rudder horns are already installed for you. Connection to the servos uses the large diameter cable, crimping tubes, M3 nuts and M3 connectors supplied.

Rudder servo set-up

The 4 servo rudder set-up is identical to our 3.3m Yak 55SP, and has been proven over several

years. Fit 4 hi-torque digital servos (JR8411 or 8511/8611 or Futaba 9351 recommended) into the cnc milled phenolic plate provided, as shown in photos P13 and 14. Mount the plate onto the carbon/plywood main board using the rubber grommets and 2.9mm Ø x 13mm screws provided in the same manner as the elevator servo set-up.

Assemble the pear-shaped phenolic servo output arms (provided) as shown, and glue to large diameter plastic servo output discs. Rough up the surfaces of the discs and the phenolic well to ensure good adhesion. Secure with at least two 2.2Ø x10mm screws through each, as shown.

Set all servos and arms at neutral using your R/C, and connect the 2 pairs of servos together using the M3 ball links, clevises and locknuts provided. Adjust lengths of linkages carefully to make sure that the servos are not fighting each other at neutral and full throws. Note the washers used on top of the M3 securing bolts to ensure that the ball-links cannot come off. See photos 13 and 14.

Servos: The rudder is a huge surface on the Pitts - which definitely needs hi-torque power servos, and we highly recommend at least the digital JR/Graupner 8411's or Futaba 9351's for this important surface.

Make up the closed loop wires for the rudder from the hardware supplied, with a loop at the front that goes over the hooks on the output arms, and a quick-link with turnbuckle and locknut at the rudder end. For security pass the closed loop cable through the supplied 'crimping tubes' 3 times before squashing flat with large pliers. Note that the rudder cables should be 'crossed' over in the fuselage (see photo P12). This photo also shows the 3mm balsa plate (supplied) that must be glued across the back of the fuselage to keep the rudder cables separated from each other.

Make sure that the wires are tight, and check and adjust after the first few flights as the cables straighten out. Even a small amount of slop will prevent your Pitts from perfect tracking, and may allow flutter. Make sure that the cables cannot come out of the slots in the phenolic arms on the servos with a small scrap of balsa glued across the slots as shown in the photos.

Wings

The wings are 95% finished at the factory, and have already been installed on your fuselage to check alignment. They fit onto 30mm Ø aluminium alloy spar tubes. The bottom wings are secured to the fuselage with a pair M6 plastic knurled nuts onto the aluminium anti-rotation pins. The top wings have carbon anti-rotation pins that locate into the centre section, and are each secured with one M6 x 50mm bolt that goes thru' the slots in the underside of he wings into M6 blind nuts that are fitted into the centre section at the factory.

Servo choice: We highly recommend using 2 hi-torque digital servos of at least 10kg torque (eg: JR/Graupner 8411/8511/8611 or Futaba 9351) for each aileron as the surfaces are quite large.

The servo hatches are pre-cut in the wing, and supplied with matching servo covers and CNC milled plywood servo mounts for the JR8511/8611 servos. Rough sand the inside surface of the servo hatch covers and the milled plywood parts that make up the servo mounts to make sure you have a good gluing surface.

Assemble the servo mounts from the milled plywood parts for each servo, using thin CA and a 90° square (see photo P16). Fix the servos into the mounts with the 2.9Ø x13mm screws supplied in the kit, and place them on the hatch covers to check that the servo arms are in the cen-

tre of the slots milled in the hatch covers, and aligned with the aileron horns. Allow for the extra thickness of the C-ARF servo horns (supplied) that must be fixed onto the standard plastic servo arms in the same manner as the phenolic rudders servo output arms. You may need to make the slots in the servo hatch covers a little wider, by 1mm or so.

Tack glue the servo mounts to the hatch covers with CA, then remove the servos and reinforce the glue joints between the servo mount and the servo cover plate with slow (min. 30 minute) epoxy and milled fibre, with a nice glue fillet all around (see photo). These are important joints! Centre the servos using your R/C and fit the C-ARF phenolic servo arms to the plastic output discs using the same method as for the elevator servos. Secure with 2 2.2Ø x 10mm sheetmetal screws each. Fix each completed servo assembly and cover to the wing with 4 sheet-metal screws 2.9Ø x10mm provided.

Finally make up the linkages from the M3 x 70mm threaded rods supplied, with a steel M3 clevise at the servo ends, and M3 ball-link on the control surface ends, both secured with M3 nuts. The ball links are secured to the phenolic control surface horns with M3 x 20mm bolts and m3 locknuts. Don't forget to 'Loctite' the clevise and lock-nut on one end of each linkage, and fit short lengths of tube to prevent clevises from opening accidentally.

Cabane Struts

Bolt the stainless steel cabane struts into place on the fuselage with the M4 x 20 Allen bolts supplied into the blind nuts that are installed at the factory. The s/s mounting plates at each end must sit flush against the fuselage/wing surface, and you can bend them slightly to fit if necessary. Note that the 'U' shaped plates for mounting the flying wires should be to the back and the outside of the cabane struts. See photos P19 - P26.

Outer Struts

The outer wing struts are fully composite moulded parts with have aluminium inserts already installed for securing them to the top and bottom wings, which fit into the moulded-in 'pockets' in the top and bottom wings, and these have been installed and checked for alignment at the factory. Bolt into both wings with the M5 x 40mm allen bolts. Do not overtighten the bolts - rather use a drop of Loctite to make sure that they cannot come loose. See photos P21 and P26.

Flying Wires

The flying wires for the Pitts S12 take, perhaps, 75% of the flying loads. Therefore, the greatest care must be taken assembling and soldering the flying wires. If you modify the method or materials shown here, you do this at your own risk.

We have provided dual flying wires, so that if one breaks or fails you will still get your plane down safely. The joints must be silver-soldered (NOT normal soft-solder used for electronic joints) and if you are not good at doing this, then please get assistance from someone that is.

We used hard silver solder and flux with a very small gas blowtorch, but you could even use lo-temp silver solder, such as the excellent 'STAY-BRITE' brand available in the USA in most hardware stores. Just remember to clean off the joints very thoroughly after soldering with Acetone or equivalent to remove all traces of flux that would, otherwise, corrode the parts over time.

Cut 8 pieces of the braided wire approx. to length and clean one end of each very well with Scotchbrite and acetone. Solder on an M3 threaded extender. Clean off all traces of flux with Acetone. Fit an M3 nut and an M3 aluminium clevise and attach pairs of wires to the inner connections on the top rear of the cabane struts and the aluminium plate in the fuselage by the landing gear, using m3 x 25mm bolts, locknuts and a little Loctite. Adjust the length of each wire at the outer end, and solder on another M3 extender and clevise in the same manner. Tension of all the wires the same, but do not overtighten or you could permanently deform the wings.

Make up the spreaders from the 8mm aluminium tube supplied, with a short piece of 6mm wood dowel glued into the ends, and then cut a slot to capture the pairs of flying wires. An M2 bolt and nut thru' the ends of the spreader tubes secures them.

Jason Shulman put our 2nd prototype Pitts (shown here) though it's paces at the C-ARF factory early in 2005.

Incidences

As a datum line for checking/setting all incidences you can use the fibreglass side rails of the cockpit opening, which are at 0 degrees.

The nominal incidence for both the top and bottom wings is 0° degrees, and this has been proven to be the best set-up after many flights with the 2 prototypes.

The stabiliser incidence is +1.5 degrees, and this is pre-set in the moulds.

The wings and stabs have been fitted to the fuselage at the factory to check these incidences. If you should find that the tips of the bottom wing have a little bit of positive incidence (0.25 - 0.5°) you will need to pack the front edges of the outer struts a little. Be careful when tensioning the Flying wires as this can also twist the wings a little and adjust the incidences.

The engine firewall is also set in the moulds, nominally at 0° up/downthrust, and 2° degrees right sidethrust.

If you want to have the most 'neutral' setting, you can reflex the ailerons on the lower wing 'UP' by about 6 - 8mm (1/4 - 3/8"). Since all the ailerons are independent from each other you can adjust this setting flight-by-flight to your personal preference.

Cowling

The lower cowling is secured to the fuselage with fourteen M3 x12mm bolts, washers and blind nuts, spaced evenly at about 100mm. The blind nuts are fitted inside the upper cowling, *reversed,* with the spikes pointing inwards. Rough up the inner surface of the upper cowling first, fit the blind nuts in place with a drop of CA, and when all are positioned correctly secure with some epoxy and microballoons mix.

You will need to make a 'U' shaped cutout in the back edge of the cowl for cooling, as shown in photo P1. We made it 160mm wide and 170mm front to back - and this has proved adequate even when flown in very high ambient temperatures.

We have also supplied 3 pieces of milled 3mm glassfibre/balsa in the kit to construct the engine baffle for the DA-150. This improves the cooling considerably and should not be omitted. Photos P31 and 32 should make the assembly clear. Paint flat black before gluing into place.

Motor and pipe installation

Both prototypes were flown with a DA-150 motor, using a pair of Greve tuned pipes, and this is quite adequate with a dry model weight of about 20 kg (44 Lbs).

The plywood firewall already has approx 2° degrees of right sidethrust /offset built into it, and 0° downthrust. Fine tuning of the sidethrust and upthrust is set by using an incidence meter and adding washers between the plywood firewall and the stand-offs in the usual manner.

If fitting the DA-150, draw a horizontal centerline on ply firewall, using the mould seams on the sides of the motor dome as guides. Draw a vertical centreline, and offset the engine mounting holes 40mm either side, and 45mm top and bottom. (the DA-150 has 90mm vertical and 80mm

horizontal mounting hole centres).

Hold engine in position to check that spinner will be in centre of cowling, before drilling the holes for M6 x 50 bolts, which go into M6 blind-nuts on the inside of the motor dome. You will need to pack the engine mount off the ply firewall by 15 - 20mm to give correct clearance from the spinner backplate, and we use packs of large diameter washers for this as it makes it easy to fine-tune the thrustline after check flights. The prototypes needed a very slight amount of upthrust - maybe as little as 0.2 - 0.4 degrees.

Don't forget to add a drop of Loctite on all the engine mounting bolts !

It is your choice what type of tuned-pipes to use, and the photos here show the lightweight Greve pipes and headers which are available from C-ARF as an option. Whatever exhaust/tuned pipe system you chose, you should keep in lightweight to assist with setting the correct Centre of Gravity position. We constructed a simple lightweight tunnel in the fuselage from foamboard, but you could also use balsa.

It is important to allow adequate cooling for the tuned pipe tunnel. The photos show the 4 holes that we used, all of about 50mm x 100mm long. Cut these with radiused corners to help prevent the composite skin from tearing.

Fuel Tank

4 balsa blocks 10 x 10 x 40mm are supplied for you to fix the position of the fuel tank, and these should be securely glued to the carbon/balsa main board, which is installed at the factory. Secure the tank with 3 or 4 cable ties thru' slots.

Make sure that you protect the fuel tubing where it passes thru' holes in the firewall etc, with rubber grommets or plastic spiral-wrap, for example. Also make sure that it is fixed securely to the underside of the top of the fuselage to make sure that it cannot come in contact with the hot exhaust.

Fit the correct stopper to the fuel tank for the fuel type used. (If using Dubro tank the gasoline stopper has a small 'O' moulded in the top of it). We use the excellent 'Tygon' brand of fuel tubing for all our models. It is totally gasoline and kerosene-proof, and does not go hard and crack with age. Secure the feed tube inside the tank to the clunk with a small cable tie. If the tube is even a little loose on the brass tubes though the stopper it will come off at just the wrong moment and your engine will quit. So solder some small rings onto both ends of the brass tubing (easily made from the soft wire of a paperclip wrapped around a small screwdriver) and secure with a fuel-line clamp or cable-tie. Don't miss this small detail - it could cost you your plane !

We use the normal 3-tube plumbing system, one from the clunk to feed the motor, one out of the bottom of the plane (vent/overflow - leave open) and one at the top for filling (close for flight).

Throttle servo

Included in the kit is a CNC milled plywood throttle servo mount, and you can fit this in any suitable position for your motor set-up. On the prototypes we fixed this inside the motor dome above the headers (see photo) which gives a nice short throttle linkage. However, we advise you *not* to mount it directly on the back of the firewall as engine vibra-

Throttle servo mount

tions can damage a servo quite quickly.

The ignition unit can be secured on top of the motor dome as shown in the photos. The ignition battery was fitted inside the motor dome on a foam pad, and retained using 3 cable-ties.

Fuel proofing
We highly recommend that you protect all the bare wood parts and edges inside the front of the plane with one thin coat of 24 hr laminating epoxy, or similar, brushed on. Be careful not to add excess weight here - it only needs about 25 - 30 grams (1 oz.) of epoxy to fuel proof all the wood in the whole area in the front of the plane.

Final check

Check that you have fixed all components securely. Keep in mind that everything inside the aircraft is loaded with the same G's as the wing and the wing spar during aerobatic manoeuvres. Check engine, cowling, wing and stab mounts carefully again.

- Are all extension leads, cables and fuel tubes securely fixed to the side of the fuselage ?
- Are all extension leads, cables and fuel tubes protected from rubbing against any carbon or fibreglass composite parts? Extension cables and tubes will be cut through in just one flight if they rub against the edges of carbon or glass, so please make sure that everything is protected with rubber grommets, plastic spiral-wrap, plastic tube or similar.
- Make sure that no fuel tubing or wires can come into contact the hot exhaust.
- Did you fit short Tygon or silicone tube pieces over all the steel clevises?
- Did you tighten the M3 locknuts against all the clevises?
- Are the swages crimped up nice and tight on the rudder cables?
- Have you put clear tape over the end of the hinge tubes and the stab bolts ?
- For added security add one small drop of loctite/thread locking compound on all engine mounting bolts, and those that hold the servo arms to the servos, especially important with digital types.

Then you can go on set up all the linkages, control throws and R/C system as described below.

Setting Up Your Aircraft

Centre of Gravity:
For the 1st flights set the Centre of Gravity at the front edge of the outer struts (70mm back from the leading edge of the bottom wing). This is the 'Pattern' C of G position. For serious 3D manoeuvres you can move the C of Gravity backwards to 15mm in front of the front strut securing bolt (approx. 85mm from the leading edge of the lower wing). Hold it with a helper at both wing tips in this position and make sure the plane balances horizontally, or slightly nose-down.

Don't forget to balance the plane laterally also, holding the spinner central bolt and a fingertip under the rudder, and if needed add a small weight to the light wing tip(s).

Engine Thrustline:
With a DA-150 and 32 x10 carbon propeller the Pitts requires 0° degrees, or just a very little UPthrust, maybe 0.5°. Right sidethrust was set at 2° and has proved to be very close to perfect on the prototypes. Of course, final settings can be fine-tuned to your liking after the first few flights, and will ultimately depend on your motor/propeller set up.

Control Throws:
Aileron and Rudder measurements are at the root/trailing edge position. Elevator measurements are at the widest chord position.

Elevator
All controls should be set with a dual rate switch. On high rate the elevator should really be at maximum, up to 50 degrees up and down (approx. 170mm/7”), but in this case with 50% exponential. Low rate should be approx. 90mm/3.5" both sides. This is the perfect throw for nice and crisp snaps. If you like you can add about 20% exponential to the low rate setting as well.

Rudder
Set the high rate to maximum throw (about 200mm/8”) both sides, and at low rate reduced to about 150mm/6”. Check your linkages and closed-loop cables and make sure that there is NO slop at all.

Ailerons
High rate aileron throw for both top and bottom wings is 60mm up and down. Use at least 30% exponential for high rate. For low rate you should decrease the throw to the *top* to 45mm, and the bottom to 50mm. Yes, this is a reversed differential due to the hinge line being in the top skin instead of on the centre line. You will have to finalise this differential figure during flight. At high rate, for 3D manoeuvres, this doesn’t effect the rolling too much, so you can maximize the throws to whatever is mechanically possible, even more up than down if you wish.

In General
Your Pitts S12 has very large control surfaces, which makes it very sensitive and reactive. It is always possible that these huge control surfaces can flutter at high speeds if the assembly, servo installation and linkages are not made perfectly. So please do yourself a favour, and make sure that you only use the best servos available, as we have recommended, and take the utmost care making your linkages. Check every linkage regularly for slop, and rather reduce the maximum throw than risking a high speed flutter due to sloppy servo gear or linkages.

We hope that you enjoyed the final assembly of your Pitts S12. Please let us know, if you think that any hardware is missing or inadequate. We have tried to make this airplane as complete as possible, and with good feedback from customers you will help us to continue making good things even better. We appreciate your comments very much.
Email: feedback@composite-arf.com

Thank you!
Your Composite-ARF Team

Appendix:

Packing List - Pitts S12 kit.

Main Items

Quantity	*Description*
1	Fuselage
1	Cowling (bottom half)
1	Canopy Frame (and fibreglass strip for hoop)
1	Top right wing (with 2 servo hatches)
1	Top left wing (with 2 servo hatches)
1	Top middle wing
1	Bottom right wing (with 2 servo hatches)
1	Bottom left wing (with 2 servo hatches)
1	Strut (right)
1	Strut (left)
1	Stab (right)
1	Stab (left)
1	Elevator (right)
1	Elevator (left)
1	Rudder
1	Landing gear carbon (pair)
1	Wheelpant left (Extra 3m size)
1	Wheelpant right (Extra 3m size)
1	Clear canopy
1	Wing Tube Aluminium 30mm Ø, 1060mm long (top wing)
1	Wing Tube Aluminium 30mm Ø, 920mm long (bottom wing)
2	Carbon tubes 8mm Ø (inside 6mm Ø) for pushrods
2	Brass tubes, 4mm Ø x 525mm long
1	Brass tube, 4mm Ø x 560mm long
1	Carbon tube 16mm Ø x 330mm (prepared in Assembly)
1	Carbon tube 16mm Ø x 300mm (prepared in Assembly)
1	Hardware pack
1	Instruction Manual (English)

Hardware bag

Fuselage pack

Quantity	*Description*
1	Engine baffle (for DA150) 3 parts balsa/glass
4	Fuel tank position blocks (10 x 10 x 40mm balsa)
1	Throttle servo mount (4 milled plywood parts)
4	U-shaped milled plywood parts for wheelpants
14	Allen bolt M3 x 12mm (engine cowling)
2	Allen bolt M3 x 20mm (wheelpant to landing leg)
12	Allen bolt M4 x 20mm (cabane struts and canopy)
4	Allen bolt M6 x 50mm (engine mounting)
4	Allen bolt M6 x30mm (Landing gear to fuselage)
2	Allen bolt M6 x 70mm (wheel axles)
4	T-nut M6 (engine mounting)
16	T-nut M3
6	Knurled nuts M6 plastic
2	Lock nut M6 (wheel axles)
6	Wheel collars 6mm
16	Washer M6
4	Washers M4
16	Washers M3
2	Tee-nut M6 (wheel axles)

Wing pack

Quantity	*Description*
2	Allen bolt M6 x 50mm (to secure top wings to centre section)
1	Flying wire (8 metres)
16	Clevise (aluminium) M3
6	Allen bolt M3 x 25mm
4	Allen bolt M3 x 12mm
10	Lock nut M3
16	Nut M3
16	Threaded Extender (steel) M3
2	Flying Wire spreader (aluminium tube 8mm Ø x 180mm)
1	Wood dowel 6mm x 100mm (for spreaders)
1	Cabane Strut (right) stainless steel
1	Cabane Strut (left) stainless steel
8	Servo mounts (milled plywood) for DS8511 servos
8	Phenolic servo arms
8	Clevises (steel) M3
16	Nut M3
8	Ball Link M3
8	All thread M3 x 70mm
8	Allen bolts M3 x 16
8	Lock nut M3
32	Sheetmetal screws 2.9 x 13mm
32	Sheetmetal screws 2.9 x 1mm
16	Sheetmetal screws 2.9 x 1mm
8	Allen bolt M5 x 40 (for outer strut mounting)

Rudder Linkage pack

Quantity	*Description*
20	Allen bolt M3 x 12
2	Allen bolt M3 x 16
6	Allen bolt M3 x 20
22	Lock Nut M3
6	Ball link M3
2	Threaded ends for pull-pull M3
10	Nut M3
1	Pull-Pull cable 3.2m
4	Crimping tubes for pull-pull cable (thick type, aluminium)
1	Rudder cable separator (milled balsa)
4	Clevises (steel) M3
1	Milled phenolic 4-servo-servo tray for (same as Yak 3.3m)
2	Large phenolic servo horns with arm (same as Yak 3.3m)
2	Large phenolic servo horns without arm (same as Yak 3.3m)
2	Small phenolic servo horns
2	All thread M3 x 45mm
2	All thread M3 x 120mm
12	Sheetmetal screw 2.9 x 13mm
8	Sheetmetal screw 2.2 x 10mm
16	Washer M3

Elevator Linkage pack

Quantity	*Description*
2	Allen bolt M3 x 20mm
2	Lock nut M3
2	Ball Link M3
4	Nut M3
4	All thread M3 x 60mm
4	Wood Dowel 6mm Ø x 50mm
1	Brass tube 4Ø x 50mm
2	Pushrod covers (plastic, painted)
2	Pushrod support plate (5mm balsa)

Elevator Servo Set-up pack

Quantity	*Description*
2	Phenolic milled 2-servo tray (JR)
2	Phenolic milled 2-servo tray (Futaba)
16	Allen bolt M3 x 16
22	Lock nut M3
16	Washers M3
12	Sheetmetal screw 2.9 x 13mm
2	Elevator trays (carbon/plywood 3mm)
4	Elevator tray supports (carbon/balsa 3mm)
1	Carbon roving 3m
6	Clevises (aluminium) M3
6	Nut M3
2	All thread M3 x 45mm
10	Allen bolt M3 x 12mm
4	Servo horn 2mm thick phenolic (long version)
2	Servo horn 2mm thick phenolic (short version)

Available Accessories:

Desert Aircraft DA-150 motor
Tuned-pipe system (Greve) for DA-150 motor
Manifolds/Headers (pair) for Greve tuned pipe and DA-150
Powerbox Competition and Power-Switches

Complete kit