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## **P-51**

So here we are one year on from the 2012 RCM&E Special and another war bird to whet your appetite. This year we didn't have the usual online vote for your favourite to be designed as we have gathered quite a list of runners up which I'm now 'dipping' into and picking out a few of my personal favourites.

For this years subject, we decided to do the P-51B Mustang.

Now this subject should be well received by our Americans friends but also from the vast numbers who had previously voted for the P51 and in particular, the razor back B version. Needless to say I'm sure it will be well received.

Now as part of the design process I decided to ask a few question on the RCM&E 'Modelflying' forum as to what you would like to see incorporated into the design. As usual you didn't disappoint!

So here are the top 5 'wants' you ask for;

1. Jig tabs on the rear of the wing ribs so the wings can be constructed true and without twist.
2. Working scale flaps.
3. Design to incorporate a retractable tail wheel.
4. Electric powered but suitable for IC conversion.
5. Option to build the later 'bubble canopy' 'D' version.

The trouble is with asking questions is the amount of 'wants' you get, so you really have to sort them into the practical and the not so practical. So the above list was really the ones which I thought were achievable in the time scale. Now the last one, did give me a lot more work than I thought, as I had to build another airframe to check the parts were OK. One of the pleasing things with this design is I only had to modify three fuselage formers to turn the 'B' version into the 'D' version. In the CNC pack you will have the opportunity to make either versions, but at this point in time I haven't got round to making the bubble canopy mould yet, but hold tight....it will be on its way.

Talking of mouldings, the Vac set for the B version is now available along with the CNC pack and additional wood to finish the model.

In the scheme of things, to design the P-51 B wasn't too difficult. Once you have designed one single engine fighter the recipe is generally the same. As last years RCM&E Special plans was IC powered, I decided that for this year we would go electric powered. 4-Max have once again put forward a power train set up which having been tried and tested, can assure you it works an absolute treat.

One thing that did catch me out on this design was achieving the balance point. Bearing in mind I install a retractable tail wheel, I thought the batteries would need to be positioned through the fire wall and be accessed via the cowl. However, when the model was finished it soon became apparent the batteries needed to be moved back quite some way and that a new battery access hatch would have to be made in the top of the

fuselage. Although creating a hatch seemed a bit of a pain at the time, the alternative of removing the cowl in order to access the batteries, wouldn't of really work well.

The main retracts unit and oleo legs were sourced from Hobbyking the retracting tail wheel is nothing more than a retractable steerable nose leg from Eflight,(smallest size they do).

For those who don't want to source their own main retracts and oleo legs, Tony Nijhuis Designs Ltd can provide a set of these to suit.

So let's get on with the build.

## **WINGS**

The wings are a traditional 'built up' construction and are made over the plan.

Cut and pin the main lower wing spar (centre spar) on to the plan. Now fit all of the wing ribs remembering to angle W1 to take account of the wing dihedral. Note that the wing ribs have jig tabs fitted to help you build a twist free wing. As with most of my designs, the wings do not have washout.

Now fit the W3A and W5A doublers into position and fit the undercarriage bears UC1.

Now trim and fit top main spar and the top rear spar/trailing edge where the flap sits. Fit the inner leading edge and the trailing edge where the aileron sits. Now sand the top leading edge, spars and trailing edges flush with the ribs, so the wing sheeting sits flush on the ribs. Begin to sheet the top of the wing with 2.5mm medium/grade sheet balsa. Note that the sheeting where the flap extends, overhangs the spar/trailing edge by 4mm or so as shown on the plan.

When done, remove the wing panel from the building board and fit the remaining spars to the underside and trim off the jig tabs.

Now construct the other wing panel to the same point but add the wing braces B1 & B2 (using epoxy).

The aileron and flap servo mounting bearers should now be recessed into wing ribs W3 & W4 and W8 & W9. At this point install the aileron extension leads or 'draw' strings for this to be done later. Now apply the shear webbing between the main spars as shown on the plan.

Now install the retracts. The retract mounts have been spaced and sized to accept a standard electric retract unit which are available through Tony Nijhuis Designs but an Eflight 120 size electric unit should also fit.

Note that between 6mm & 9mm of packing will be required to bring the retract unit flush with the profile of W5.

Now sand the bottom leading edges, spars and trailing edges flush with the ribs ready for skinning the bottom of the wings.

The wings should now be joined making sure the wing braces are secured with 30min epoxy.

Now fit the infill pieces between W1 & W2 at the rear to reinforce where F8 fits on to.

Now make up the flap hinge support blocks (3No.) per wing, and glue these to the inside top skin and spars as shown on the plan.

Begin to sheet the underside of the wing with 2.5mm medium sheet balsa. Be careful not to induce any 'twists' when enclosing the wing with the underside sheeting. It might be an idea to make a wing 'cradle' to support the wing during the sheeting process.

As you are sheeting mark with a pen the locations of the flap & aileron servos, plus where the retract mounts are positioned.

Now trim the top and bottom wing skins flush with the edges, remembering to leave an overhang at the flap edge.

Now fit the outer leading edge and shape this to the profile as shown on the plan.

Now cut out the wing tips from block balsa or sandwich sheets of balsa and glue the tips on to W12. Roughly shape the tips to shape then finally sand to a smooth flowing profile to match the wing.

Make up each individual aileron as shown on the plan by cutting to shape the bottom skin first. Now trim and fit the aileron leading edge which is made from 6mm sheet balsa. Now fit the aileron ribs and the aileron horn support block. Finally enclose with the top skin and trim to shape as shown on the plan.

The flaps are made in a similar way to the ailerons but before the top sheeting is applied, the flap leading edge should be rounded to a smooth radius as shown on the plan. The hinge support blocks should now be fitted and I would suggest at this point you dry fit the hinges and check the flaps move /rotate. When happy you have the flaps in the correct position, draw a line along the flap leading edge where the wing skin overhangs. This line is where the flap top sheeting should start back from. Refer to the rib profile on the plan for clarity.

Now move on to the fuselage construction.

## **FUSELAGE**

Each lower fuselage side comes in four pieces FS1, 2, 3 & 4 and each part is separately shown on the plan in dotted line, for you to trace around. In the CNC pack, these parts are cut for you. Note that the sides are not handed.

Glue the parts together to make a left and right hand panel and mark all the positions of the fuselage formers. Fit the wing seat doubler WS1 and now begin to apply 12mm and 18mm triangle to the edges as indicated on the plan. At the fuselage rear, the 12mm triangle will require saw cuts to assist in the bending to form the curvature and at the

rear, The triangle will need to be chamfered to allow the rear fuselage to be pulled together at the tail post.

Now glue into position fuselage formers F2, F3, F4 and F4a and the wing bolt support plate WP1 to one side only.

Now glue into position the other fuselage side, checking alignment as you proceed.

Make up the tail post from 12mm sheet balsa to the detail shown on the plan. Inset the tail post to one side only and glue into position. Now pull the rear of the fuselage together and glue the tail post to the other fuselage side. You may wish to use a building jig for this or clamp the fuselage to achieve true alignment. Now working back, slide into position formers F5, F6 & F7. You will need to wet the outer surface of FS4 and tape across the top FS4 at F7 while the glue sets.

Now fit F1 into position use PVA or epoxy.

Now add the 4.5mm sq fuselage longerons along the top.

Now sheet the top part of the fuselage three section from 3mm sheet balsa. The first section from F1 to F3; the second from F3 to F4 and the third section from F4 to F7.

Each section should be made up to form a single sheet cut approximately to size, but make sure it overhangs the top of the 4.5mm longerons.

To fit these sides, start by gluing the bottom edge to the 3mm flush with the inside face of the lower 4.5mm fuselage sides. This will leave a 1.5mm step on the outside fuselage side, which with a razor plane, the lower sides are blended into the 3mm top sheeting when the sheeting complete.

Note on the plan how the rear top fuselage side butts against F7. The bottom edge of the 3mm side 'kicks' out from F5 To F7 where it butts against FS2, (so the top fuselage side is flush with the outside of FS2 at F7)

Now curve the top fuselage side and glue these to the upper edges of the former and the sides of the longerons. You **WILL** need to wet the outside surface of the fuselage to aid bending. Be patient bending the wood and only apply gentle pressure. You will also need to clamp the top edges to the longerons to stop the sides from springing apart. Masking tape can prove very useful for this job.

If you have oversized the side sheets, the fuselage top edges should overhang the formers slightly so use a razor plane to bring the fuselage sides down flush with the tops of the formers and the longerons. When you're happy with this, apply the top front & rear decking using soft 9mm or 12mm sheet balsa as advised on the plan and razor plane/sand to shape.

For the electric powered version, make up the battery support plate and fit this into position, between F2 & F3. Now cut the battery access hatch to suit your choice of batteries in the top of the fuselage as detailed on the plan.

Now trim and fit the bottom front decking using laminates of 12mm sheet balsa and trim any overhang flush with F1 & F2. Only roughly shape at this stage as the wings and cowl will determine the correct profile

The rest of the fuselage can now be shaped using a razor plane and sand paper, taking note of feathering in the lower 4.5mm fuselage into the upper 3mm.

## **TAILPLANE & FIN**

The tail plane is made over the plan and up-side down. Make up the trailing edge from 6mm sheet balsa and pin down over the plan. Note that the trailing edge doesn't quite go to T6. Now fit all the tail ribs except T6. Make up a short offset piece of trailing edge that fits between T5 & T6 and then fit T6. Now fit the bottom spar. Because there is a small amount of dihedral, the spar should be 'kinked' in the centre at T1. This can be done by steaming over a kettle for a few seconds.

The 3mm inner leading edge, cut from sheet balsa, can now be applied. The structure can now be removed from the plan and the 1.5mm sheeting can now be applied to the top and bottom surfaces.

Apply the outer leading edge of the tail plane and cut out the tips from solid balsa wood and shape to the finish profile.

The fin is a built up affair, similar to the tail plane. Firstly make up the fin post to the shape detailed on the plan. Now add the fin ribs F11 to F15 making sure they are 'square' to the fin post.

Cut and fit, from 3mm sheet balsa, the fin inner leading edge. Now cut to length and add the 3mm sq spruce spars to both sides of the fin. Note how far the spars extend beyond F11. This will allow the spar to be glued against the tail plane trailing edge, but not interfere with the elevator torque rod.

Now sheet both sides of the fin with 1.5mm balsa and trim any overhang. Note that the sheeting at the base of the fin should match the profile of the tail plane former T1.

Finally, add the outer leading edge and attach the top fin block, before sanding to the final shape.

To make the elevators and rudder, first cut out the 'inner core', from 3mm balsa, to the profile shown on the plan. Now cut and fix the leading edges centrally to the edge of the core. Now cut and fit the 3mm riblets. The easiest way to make these is to cut strips of balsa to the depth of half the leading edge and cut these to length so they just overhang the trailing edge. Mark the positions of the riblets using a pen on the core before fitting the strips of balsa. To taper the strips, use a razor plane and sanding block and carefully 'feather' the ribs into the trailing edge.

The rudder and elevator tips are made from solid balsa and these are cut to shape before fitting and profiling. The solid inserts at the base of the rudder and elevator, for horn and torque rod supports, should now be fitted.

The tail plane can now be glued into position on the fuselage. You will need to 'square off' the leading edge where it butts F7. Remember to make up the elevator torque rod ready to fit before the fin is positioned.

Now glue the fin into position. Note that the fin spars should only extend a short distance down the tail plane trailing edge.

To finish off, add some sheet balsa infill between F7, back towards the top of the tail plane and infill between the rear of the tail plane and the fin post. Finally sand to shape so the tail and fin 'blend' smoothly into the fuselage.

To finish, make up and fit the fin strake, Only a very few 'B version' had the fin strake but I have shown smaller B version on the plan. The later 'D' versions had a much larger strake, which helped to avoid the common problem of 'fish tailing'

### **Wing Radiator**

Now make up the wing radiator by firstly cutting out the side pieces from 9mm balsa. A pattern for this is shown on the plan. Now apply 12mm triangular balsa along the bottom and mark the positions of the formers F8 & 9. These former are not perpendicular to the sides so it maybe advisable to make this over the plan so the formers and sides are aligned about a centre line.

When the structure is aligned apply thin cyano to lock the structure in shape. Now cut out RP1 using the templates on the plan and the bottom sheeting from 9mm balsa sheet.

Now glue into position the wing dowels into F8.

RP1 and side pieces should be shaped as shown on the plan. Now turn the fuselage upside down and fit the wings into the correct location. Offer up the radiator structure and trim RP1 so it fits snugly against the wing and the dowels firmly lock home into F4. When happy, glue the radiator directly to the wings.

Now make up the front under wing fairing, back from where the wing leading edge butts against F2, from laminates of balsa. This fairing should be roughly shaped to blend into the fuselage front under sheeting. The 'building' of this fairing has strengthened the wing for the wing bolt holes to be drilled through the wing and the wing plate WP1. Now fit the captive nuts to WP1 and apply the left wing bolt. Finish profiling the fairing on the right side and when done, swap the bolt over to the right and finish the left side of the fairing.

At this point apply a wing joining bandage, starting from the nose of the radiator running forward and round the leading edge and on to the top of the wings and back to the trailing edge. Secure the bandage with laminating epoxy or PVA glue.

Now cut out the ply wing fairings pieces from 0.8mm birch ply (the cut outline is shown on the plan). With the wings still in position and the bolts loosened, slide the 0.8mm birch ply fairing piece into position between the fuselage and wing. You may need to sand a small amount of material off the wing seat to allow the fairing to sit properly. When happy with the positioning, tighten the bolts and use thin cyano to 'spot glue' the fairing along the fuselage edge. Now cut and fit the 3mm lit ply rear fairings linking the fuselage and

the back edge of the 0.8mm wing fairing. The wings can now be removed and the fairing firmly glued with thin cyano.

To make up the curved fairing infill, cut out a strip of soft 1.5mm balsa approximately 2" x 8" and trim one long edge to the profile shown on the fuselage side view. With a pen, mark the location where the fairing infill butts the fuselage. Roll the fairing into position and then glue the top edge against the fuselage and then glue to birch and lite ply fairings. The front piece of the fairing where it wraps around the wing leading edge, is made from solid balsa and shaped to blend in with the rolled sheeting.

If you are planning to fit a retractable tail wheel, now is the time to fit the support bracket between the fuselage sides. On the prototype, I used a small Eflight steerable retractable nose leg and directly linked this back to the rudder with a pushrod to avoid adding another servo.

Once happy that the tail wheel assembly works and steers, the rear lower sheeting can be applied. Note that you will have to cross sheet the balsa on the curved part between F4 & F5.

## **Cowl**

Mark the position of the motor mount and drill the mounting hole into F1. For the rack type motor mount that are provided by 4-Max.co.uk, an extension block (from scrap ply) is used to bring the motor forward and with some 1.5mm ply packing on the left side, will give the correct side thrust. Fix the mount into position.

The top cowl sides can now be cut out from laminates of 12mm balsa, trimmed and fitted. Now fit the 12mm triangle balsa and the top of the cowl from 12mm balsa. Now trim the front edges, so the nose ring NR1 sits square to the motor. Using the back plate from a spinner, centralise the ply nose ring about the motor before marking its position on the balsa edge and then glue into position.

Begin to shape the cowl with a razor plane, blending it back into the fuselage to achieve a smooth flowing shape.

The lower VAC form cowl can now be trimmed and offered into position. When happy, make up 9 hard wood blocks and mount these in the position shown on the plan. Using masking Tape, secure the cowl back into position and fix with a 2mm self tapping screws into each mounting block.

Finally 'blend' the laminated 12mm bottom balsa sheeting, into the cowl.

## **COVERING**

It's up to you when you fit the canopy, but cockpit detailing and fitting could be done before cover. The P51 is approximately 1/7<sup>th</sup> scale so there are a number of WW2 pilots available. I used the latex type available from J Perkins stockists which when painted look pretty good....

The prototype was covered using silver Easycoat from J Perkins and using 600 carbide paper, the shiny surface was removed ready for painting.

Fit all the control surfaces with pin hinges and secured with glue and pins. Fit all the servos and the all the control horns. For the elevator and rudder pushrod control rods I used on the prototype 9mm dowel and 2mm x 150mm pushrod ends.

## **FINISHING**

To add a little more detail, make up some exhaust stacks as shown on the plan. These are simply made from shaped balsa and 6mm dowel or plastic tube glue in at an angle.

The prototype scheme was based on Capt. Eugeniusz Horbaczewski P-51 B Mustang "PK-G", FB-387, from 315th (Polish) Squadron. I have cheated a bit here as the scheme I used shouldn't have a fin strake.

The main colours are Dark sea grey and Dark Green for the top camouflage and Light Grey for the under surface.

For the squadron markings and decal I got Lee from Pyramid Models to make up a set so if you want the easy route, give him a call and he should be able to help.

The C of G position should be achieved without any ballast

## **FLYING**

Now there's an old saying that if its looks right it will fly right and with the P51 with that deep dihedral, you can pretty well guarantee its going to be a very stable platform; but just how good?

Well the first flight occurred back in May 2013 in its unpainted form.

As I mentioned earlier the model required no ballast and in fact the batteries had to be moved back through F1 to achieve the C of G.

The test flight took place at the Hasting MFC club field in very blustery conditions and a nasty cross wind. Now, for a maiden flight it would have been sensible to maybe wait for the wind direction to change or at least the wind to drop slightly, but I don't do sensible especially if you've decided today was the day for the test fly!

I also think that testing a model in extreme conditions will show up any vices far better than on a calm day.

So without further a'do, the model was lined up diagonal to the runway and full power was applied with a hefty amount of up elevator. Not really to be recommended but I only had 15m to take off in before hitting the rough grass.

Because of the strong wind she was off in 10m and climbing with gusto. After climbing to a 100m or so the P51 was circled back into wind and trimmed out for level flight at around half power. Only very minor trim changes were needed and she was flying hands free.



Once trimmed the P51 felt rock steady, even in the strong wind condition and before long, some surprisingly smooth low passes were made almost oblivious to the cross wind conditions; a real pussy cat and pretty darn perfect if you ask me!

The model I have to say installs great confidence and the feeling that one can pretty well do anything with this model. She has a lot of characteristics similar to that of a Spitfire and for that reason she is a dream to fly.

The electric set-up supplied by 4-Max has immense power but use it sparingly and you could have 12 to 15 minutes of flight time.

The landing proved to be a non event and even though it was a cross wind approach, she tracked straight parallel to the runway weather cocking towards the right, but still only requiring aileron and elevator control to bring her safely on to the ground, albeit she tipped on to her nose on roll out.

Anyone building the P51 will not be disappointed with the flying performance, but as this is a scale model, producing a scale flying performance is the order of the day. The model will perform most manoeuvres expected by a single engine WW2 fighter. Barrel rolls and loops are a delight, but the model excels at a low fast pass, pull up into a half roll and reversal.....brilliant. Landing the model feels very smooth and predicable. With the flap deployed there is very little pitch change, so much so, I had to do a low pass to check the flaps had deployed! (They had!). I suggest you try a little exponential on the elevators so there is a little more movement at the full up to avoid running out of elevator and nosing over when the wheels touch down.

Once on the ground and rolling out, keep a little up elevator fed in and she will stay on her wheels with out a problem.

There are no real vices with this model...it goes where you point it and does what you ask of it...The P51 was known as the Cadillac of the skies, and if you slow the model too much she will feel sluggish and a little wallowy.....just like Cadillac I guess. Enjoy!!!