Acme Aircraft Company

48″ D-18/C-45

Photo: Ian Anderson

48″ Electric Twin

Kit Contents

- 14 sheets laser cut wood
- 2 plan sheets
- 2 vacuum formed styrene cowls

Items Needed to Finish

Balsa:

- 1/8″ sq. X 24″ – approx. 15 pieces
- 1/8″ X 1/16″ X 24″ – approx 25 pieces
- 1/8″ sq. X 24″ spruce – 1 piece
- 1/32″ X 3″ sheet – approx 4 pieces
- 1″X4″X4″ balsa block – preferably contest grade
- 3/16″ sq. X 24″ – 2-3 pieces
- 1/32″ X 1/8″ X 12″ – 8 pieces for rudder laminations
- 1/16″ X 3/16″ X 12″ – 6 pieces for wingtip laminations

Hardware:

- 1X Sullivan Push Cable .056 w/Gold-N-Clevis 36″ (Retracts)
- 3X Sullivan Push Cable .032 w/Gold-N-Clevis 36″ (Aileron, Rudders)
- 1X Dubro Micro Pushrod System (Elevator)
- 3X Hitec HS-55 Servos (Aileron, Elevator, Rudders)
- 1X Hitec HS-85MG Servo – Retract
- 1X Dionysus Design Rate Reducer – Extra Slow - Retracts
- 2X Castle Creations Phoenix-10 ESC's
- 2X Himax HC2212-0840 Brushless Outrunner motors if using a 3S Lipo
- 2X Himax HC2212-1180 Brushless Outrunner motors if using a 2S Lipo
- 2X Himax 2mm Collet style prop adapters
- 2X APC Thin-E 7X 5 Props
- 1X Robart #123 Mechanical Micro Retracts
- 3S or 2S Lipo battery – 1300 mah to 2100 mah
- Hinges – Robart Hinge Points and Dubro micro hinges used in prototype
- Pair of Dubro 2″ Super Lite Wheels
- Sullivan 0.75″ Tailwheel
- Dubro Micro Wheel Retainer
- Dubro 3/32″ Wheel Collars
- .010″ plastic for windows and winshield
- Covering material – Solarfilm used in prototype.

General Information:

Thank you for purchasing the Acme Aircraft D-18. I hope you enjoy building and flying it as much as I did. This is most definitely a time consuming build. If you can build a truss fuselage, you can certainly complete the D-18, but expect to spend 50-75 hours building and finishing her. However I think you will find that the rewards of building and flying one far outweigh the investment in time and money – she's a great performing airplane that is sure to turn heads at the flying field.

The prototype was constructed mainly of average to below average wood, and still managed to come out to 20 ounces all up including a 3S 1320 lipo battery. I believe that if the builder was to go with a fixed gear instead of retracts, pay close attention to wood selection and limit the amount of extras that a 16 ounce version could be built. This would yield a very lightly loaded plane that could possibly be flown in larger indoor venues. If this is your goal, you may also want to consider going with the smaller, lighter Himax HC2208-0870 motors. These would provide plenty of power for an aircraft of that weight. The only modification needed to use these smaller motors would be to create a 3/16" spacer between the firewall and the motor mount, since they are slightly shorter than the HC2212 series motors.

Care has been taken to keep associated parts together on the same sheet. Each sheet has a small number on the left side. Leave all parts in the sheets until they are needed. Where appropriate the sheets will be referenced in the notes below.

Shaft Reversal of Himax 2212 and 2208 Series Motors

The shaft must be reversed on your motors in order to mount it to the firewall per the plan. If not done properly, the motors may be damaged.

First, you may want to remove the metal stick mount attached to the side of the motor. This can be made much easier by the use of a heat gun. There is thread locking compound on the screws, which can be softened by heat. Heat the screws for 5-10 seconds using the gun, and then unscrew them.

Now look at the rear of the motor, which has six vents slots cut in the housing. Look carefully in the slots and find the one that has the motor shaft set screw. You will need a small jewelers screwdriver to unscrew it – again the heat gun is essential here for loosening the thread locking compound. Heat it up for ten seconds, and then see if it has loosened sufficiently, and then back it out one to two turns.

Look in the hardware bag included with the motor. You will find a "keeper collar" which looks like a wheel collar, but has a small "nipple" on one end. Take it out, back the set screw out if need be, and slide it over the motor shaft, with the nipple facing IN.

Now gently slide the shaft to the other side of the motor using a press or vice. You will not slide it all the way, since the keeper collar is there. Once you are satisfied tighten the set screw on the motor housing, and also on the keeper collar. Put a little pressure on the

keeper collar so that it is snug against the bearing when you tighten it down.

Now attach the ply radial mount to the motors.

Fuselage Construction:

Start with the construction of the nose. Lay NF1 & 2 over the plans. Add NF3, 4 and 5 and slide in NF6. Once you are sure everything is square and true, glue the formers. You will now need to create temporary braces to keep this half of the nose from distorting. Take some 1/16"X1/8" balsa and create cross braces between NF1&2 and the formers. Make sure they will sit below the stringers, so they will not interfere later.

Now remove the nose half from the plans, and add the remaining NF3-6 and the battery tray. Make sure everything is square before gluing. With the cross braces and the battery tray, the nose should now be very stiff and should not bend.

Add most of the stringers now. You will need to soak them in hot water and ammonia or window cleaner for at least 15 minutes. You will need good flexible wood for this part. DO NOT add the bottom six stringers – those will run back to fuselage former F1. You will add those after you have joined the nose to the fuselage. Take care not to distort the formers as you lay the stringers in, especially the NF3's, as they will later join up with the fuselage.

Now build the fuselage sides. These are very straightforward with one exception – the windows. The windows are made from 1/16" balsa and are found on sheet 1. They are positioned in the order in which they lay on the plans – each one is unique. Since you will need to build a left half and a right half, you need to put some scrap balsa under the window formers when you build the right half of the fuselage – otherwise your window formers will be recessed into your fuselage exterior.

Once the sides are complete, assemble your fuselage sides over the top view of the plan. Assemble them with the fuselage upside down, that way it sits flat on the top of the fuselage. Glue the ply doublers to formers F1 and F2 and slide them into place. Note that there are no cross pieces where formers F3-F6 go – the formers themselves are the cross pieces. There are alignment tabs at the edges – after the stringers get laid in, those will be sanded down.

Once the cross pieces are in, remove the fuselage from the plans and add the formers F10-F14. Note the position of the forward most F10, as its' position will affect the placement of F8&9.

Add the 1/16"X1/8" balsa fuselage stringers. Note that the bottom rear stringers simply butt into the 1/8" sq. cross piece. Also note that the center stringer should not be added between formers F6 and F7. Add the seven F9's, so they line up with the stringers. Bevel sand F8 and glue into place. Sand the outer F9's so they transition smoothly into F8 and F10.

Glue the nose onto the fuselage assembly. Now you may add the bottom six nose stringers. Add the balsa block to the nose and sand to shape. Add the balsa block to the rear, sand to shape and then add F15.

The construction of the steerable tailwheel begins with TW1, the 1/8" piece which can be found on sheet 8. Bevel sand the edges so it fits nicely into the slot created by leaving the center stringer out between F6&7. Now locate the two 1/32" TW4's, the 3/32" TW2&3 and some scrap of Sullivan #507 cable guide. Lay one 1/32" ply piece down, and then position the cable guide and TW2&3 over it. Let the Sullivan cable guide extend down past the bottom at least 1/8", as it will be trimmed later. Glue everything in place, and then sand down TW2&3 so they are flush with the cable guide. Glue the remaining 1/32" ply piece on. Now insert the cable guide into the hole in TW1. Make sure you have it oriented correctly so that it will be vertical when the entire assembly is inserted into the fuselage. When you are sure it is oriented correctly, glue in place. Trim the excess cable guide from the bottom of TW1. Now take some 1/32" music wire, and bend it as shown on the plans. Start by bending the top view as shown on the plans, then bend at the "X" so that it matches the side view. Now you will need a Dubro Micro Wheel retainer or any scrap piece of plastic or hardwood. This will serve as a retainer to keep the gear from moving up and down in the shaft. Place it on the gear as shown in the plan, and then secure it in place with a little dab of epoxy. Now slide the gear into the assembly. With the gear centered with respect to left/right, and with the retainer up against TW1, bend the top of the tailgear 90 degrees, as close to where it exits the cable guide as possible. Bend it so that it will be pointing across the width of the fuselage. Now locate the 1/32" ply horn, and add some scrap 1/16"X1/8" spruce to it as shown. Now slide the horn onto the gear, and glue in place. To keep as much weight out of the tail as possible, Kevlar thread was used on the prototype for the tailwheel instead of a pushrod or cable.

Stabilizer and Elevator:

Assemble the 3/16" pieces over the plans, along with the 1/16" ribs from sheet 2. The elevator ribs taper a bit, and the rear most piece is 1/8", so you will have to prop it up with some 1/32" scrap to keep things square. Make sure the stab ribs are oriented correctly so that the cable run matches the plans. Do not add the 3/16" filler block to the top of the stab now – this will be done during final assembly. Remove the stab from the plans and run the Sullivan cables guides. Glue the guides to the exit and then sand them flush.

Rudders:

Start by making the laminated outlines using the supplied templates. Soak pieces of 1/32"X1/8" balsa in hot water and ammonia for at least 30 minutes. Run scotch tape around the templates to keep them from sticking. Use wood glue and let them dry at least overnight. Once they are dry, use the remaining laser cut pieces (sheet 8) and 1/8" sq. stock to finish them.

Wing and Nacelles:

Start the wing by making the laminated tips. Two templates have been supplied. Run scotch tape around the edge to keep the wood from sticking. Soak pieces of 1/16"X3/16" balsa in hot water and ammonia for at least 30 minutes. Use wood glue and let them dry at least overnight.

The wing assembly begins with the center section. Find ribs R1 and R2, the 3/32" servo trays, the 1/8" main spar, the 1/32" main spar brace, and W1 – 3/32" balsa and 1/32" ply. Glue the main spar to the main spar brace. You will notice that the tops and bottoms will not line up. This is because the tops and bottoms will be sanded down flush later, so use the lightening holes for alignment. I prefer to use wood glue for this step, as it affords more time to line up the pieces. Now glue ribs R1 and R2. Note that you will need to make a left and right side! Make sure you don't make two identical laminations. Glue the two pieces that make W1. Now slide R1/R2 into the slots in the main spar. Slide the servo trays and W1 in place as well. When you are satisfied that it is perfectly square, glue all the pieces. Add the 1/8" sq. spruce/hard balsa spars. Make sure they stop half way between R1 and R2. Take a piece of scrap stick stock, and cut it so that it fits perfectly between the forward most section of R2. This piece will keep this portion of the ribs from being bent to one side while constructing the wing, and will be removed later.

Remove ribs R3-R13 from the sheets. You will build one wing half at a time. Do not cut off the support tabs on the bottom of the ribs, these serve to build the wing straight and will build in two degrees of washout at the tips. Tilt the center section so that the bottom of one of the outboard sections of the main spar sits flat on the board. Make sure it is perfectly lined up with the plans and perpendicular to the board. Lay the 1/8" sq. rear spar down on the sheet, and loosely place the ribs in place, and then lift the spar up into the slots, making sure it butts up against the center section rear spar. You may have to put shims under the bottom spar to keep it in place. Since it is difficult to ensure that the forward 1/8" sq. bottom spar - the one running from R7 to R13 – is seated properly in the notches while it is on the board, you may want to consider leaving that one out for now, and adding it once you can take the wing off the board. The same goes for the bottom 1/16"X1/8" spar forward of the 1/8" sq. one. Test fit the forward outboard 1/8" top spar. Once you are satisfied that everything is square and true, glue them in place. Add the 1/16" trailing edges, both top and bottom.

Add the 1/16"X1/8" balsa spars that run forward of the wing/aileron junction. These will help secure the 1/8" balsa Aileron Leading Edge to the wing. Take two Aileron Leading Edges and very carefully spot glue them together at each end. Don't use too much glue, as you will need to take these two pieces apart later on. Bevel sand the ends so that they fit nicely into the wing. Don't worry if there is excess material above or below the balsa spars – this will be sanded flush later. Take a ruler or straight edge, anything reasonably flat and not too thick. Using shims or scraps place it under the trailing edge of the wing, and under the rear section of R13. If the straightedge is porous, consider putting a piece of wax paper or plastic wrap to keep the aileron from becoming glued to it. This will form a platform on which you can build the ailerons – it will maintain the line of the trailing edge. Lay the 1/16" aileron trailing edge on the straight edge, in the approximate location. Take the aileron ribs out of sheet 3 one at a time, and place them between the Aileron Leading Edge and the trailing edge. These aileron ribs are not symmetrical from top to bottom, so make sure you don't invert them. They are "up" as they sit in the sheet. Take a scrap piece of 1/32" balsa and place it between A1 and R8. Do the same thing for A6 and R13. This will keep the proper spacing between the wing and aileron. When you have the aileron ribs in place and are satisfied with their placement relative to the wing, glue them to the ALE and the trailing edge. Then glue the top 1/16" aileron trailing edge.

Locate nacelle formers N3&N4. Glue N3 to N4, the center hole will line up, not the sides. Locate N1 and N2, and RN1 and RN2. Like the center of the wing, this is another part where care must be taken to glue the formers to the correct sides of each other. Assuming that you are building the right wing half, you would glue RN1 to the left/inboard side of N1 and RN2 to the right/outboard side of N2. The tabs at the rear of these formers will line up, and they will lock into the main spar. Double check you have it correct before gluing. Then, glue the 1/32" ply N1D to the right/outboard facing side of N1. Slide the N1/RN1 and N2/RN2 assemblies into the slots on the main spar, and add the N3/N4 firewall. When everything is square and true, glue everything with a liberal amount of glue.

Glue the 3/16" sq. leading edges in place, making sure they mate nicely with the sides of N1 and N2.

At this point, remove the right wing half from the board. Add the bottom forward spars and then repeat the above steps for the left wing half. Remember to double check which side you glue RN1/RN2/N1D to R1/R2 as it will be reversed from the previous wing.

Once you have the left side at the same point as the right, it is best to deal with the retracts now while you have easy access to everything. Run the Sullivan .056" cable housing through the holes in the rear of R1/2/3 and the hole in the main spar. Make sure the cable housing is flush with the front of the main spar. Glue the cable at the main spar first, and then pull it back through R1/2 a little – this will keep it from interfering with the wheel when the retract is in the up position. Install the retract servo – you will need the largest horn that comes with the HS-85MG and should use the outermost holes. You may want to put some scrap balsa on the back of the servo plate where the servo mounting screws protrude to reinforce it. Take the gear legs off of the Robart retracts, and bend them as per the plans. You will need to file a flat spot on the leg in order to keep the gear straight – there is more about this in the spec sheet that comes with the retracts. You will also need to modify the gear for 85 degree movement, instead of the default 90 degrees. Again, this is outlined in the spec sheet that comes with the retracts. Alternately, if you don't want to change it to 85 degree mode, you could simply bend the gear legs back about 5 degrees at the point where they exit the retracts. Locate the 1/16" ply retract plates. Slide the retracts into the plates from the bottom, with the control horn facing rear. Mark the position of the retract holes on the ply plate. Make very small pilot holes using a t-pin or very small drill bit. Be careful, as there is not a lot of material around the holes. Carefully screw the retracts into the plates using very small wood screws. Back them out, and then CA the holes to reinforce. Slide the plates into N1/N2 and make sure they fit – you may have to sand a little off the side of the plate to get a proper fit. Take your Sullivan .056" cable, and cut it into two pieces. Tin one end of each pieces with solder – about 1.5" worth. Make sure there are not solder globs on the outside of the cable. Make a z-bend in the tinned ends of the cables. Slide them into the retract control horns – you may have to enlarge the hole just a little. Now slide the cable through the housing, and slide the retract plate into its' slot. You should be able to freely move the gear up and down by moving the cable at the center wing bay. Make sure there is no binding or rubbing occurring. Once you are satisfied with the movement, line up the retracts in the nacelles, and glue the plate using 30 minute epoxy. Now hook up the servo, and set the end points. You may hear a little buzzing when it is in the down position, this is fine. You need to keep some pressure on the retract so that it remains in the locked down position. Make sure that the retract is not just down, but down and mechanically locked.

Sand the 3/16" sq. leading edge, at least in the sections around the nacelle where the wing is sheeted. Now sheet the center wing section where shown on the plans. Add the aileron cable guides. A 1/16" sheet pushrod exit piece can be found on sheet 3. With 1/32" balsa, sheet up to, but not over the main spar as shown on the plans. The right side of the plans show the sheeting for the top of the wing, and the left side shows the sheeting for the bottom. You may find it's easier to sheet the inboard leading edge areas with several pieces instead of one big piece. Now sand the main spar down flush with the sheeting. Don't worry about the spots right next to N1&2, as those will be covered by the nacelle. Add the 1/32" sheer webs to the outboard wing panel, between ribs R7&R11.

Start the nacelle construction by adding formers NT1&2 and NB1&2. NT1&NB1 get glued to the back of N4. NT2&NB2 slide into the slots in N1&2. Pay close attention to the plans regarding which way to orient NB2 – the small notch should be on the inboard side. Add NT3,4&5, making sure it is straight before gluing. Turn the wing over and test fit NB5 – you may have to trim some of the 1/32" sheeting to get it to fit. Take some scrap 1/16" balsa and use it to raise NB5 off of the 1/32" sheeting by 1/16". This will provide space for the stringers you will lay in later. When you are satisfied with the fit, glue in place. Add NB3&4, if you got NB2 oriented correctly then NB3&4 will be correct. Add NB6&7. NB7 is slightly larger than NB6, and goes in the outboard position.

Note on the plans that the stringers are all numbered, and those numbers show the path of each stringer. Stringers 4&14 terminate at the leading edge of the wing. Stringers 3&15 start at NT1, run along the wing sheeting aft of NT3, and butt into the side of NT4. Stingers 8, 9 and 10 end at NB2. Stringers 13&5 run along the bottom wing sheeting, much in the same way that 3&15 did. They end at NB5 – this is why you raised NB5 up by 1/16". 6,7,11&12 end at NB5 – they simply butt into the former and then get sanded flush with the it. Stringers 3,5,13&15 all provide a hard edge for the covering to attach to. However, they do not run along the sheeting near the leading edge. You will need to add some balsa along the wing sheeting in these areas. You can use either balsa stick stock soaked in hot water and ammonia, or you could cut small strips of balsa sheet across the grain so that it is very flexible. Either way, just run them from where stringers 4&14 terminate, to NT3 on top and NB6&7 on the bottom.

The rear of the nacelles is formed with laminations of 3/16" laser cut balsa. The easiest way to sand them to shape is to first lay some masking tape down on the wing sheeting. Then with a small amount of glue, tack them to the tape. Now sand them flush with the formers and round the edges to shape. The masking tape will help keep you from sanding into the 1/32" sheeting. When you are done, peel off the tape, and then peel the formers off the tape. Don't glue NB8 to the wing at this time – cover the wing and nacelles first, cover NB8 separately and then glue it to the wing. NT6 can be glued to the wing at this time. This same technique can also be used for the 3/16" balsa filler that goes on the top of the stabilizer.

Add the wingtips and the wingtip supports. The wing is now ready for final sanding and covering. Robart hinge points were used in the prototype for the ailerons, and I would highly recommend them. Be sure to add some small blocks of balsa to support the hinge points if you do use them

Covering:

Covering is very straight forward, with the exception of the nacelles. I found that the easiest way to cover them is by covering smaller areas instead of trying to do the whole top or bottom at once. However you do it, DO NOT use the heat gun on the material where it joins the wing – it will cause the material to pull off the wing/nacelle joint. An iron works much better, as you can apply pressure to the material to keep it in place while it is being shrunk.

Balance and Control Throws:

For the first flights set the balance 0.5" behind the main spar.
For the rudders, use the maximum control throw you can get - you will need it for takeoff. Make sure the rudder horns and elevator are not interfering.

Elevator throws: 5/8" up and down.

Aileron ½" up and down.

You shouldn't put too much expo in the elevator and ailerons – only about -20-30% - otherwise it will feel a little mushy with small inputs.

Flying Notes:

Be sure to advance the throttle slowly on takeoff. If you advance the throttle too quickly, it will be difficult to keep her straight on the runway. You will need a lot of right rudder during the takeoff run. Let the speed slowly build and then gently rotate into a climb. You may find you need a little opposite aileron during a turn to keep it from turning in. She looks best cruising around at ½ throttle, but you can also do some mild aerobatics if you wish. Loops, rolls and wingovers all look really nice and big. Stalls sometimes tend to drop a wing, but there is plenty of warning beforehand, and you really have to try to get her to stall. With a relatively light loading, she likes to float a bit on landing, so just be aware of that. Keep about a ¼ throttle until short final, and then you can back it off completely. I think you'll find she's a joy to fly, with no bad habits.

I hope you have enjoyed building and flying the Acme D-18/C-45 as much as I have. If there is any room for improvement in this kit, I would be happy to hear any input or feedback you may have. Thank you again for choosing Acme, I truly appreciate your business and hope you will buy more Acme kits in the future.

Schuyler Greenawalt
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