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Build an ARF Trainer - Part II

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In Part I of this article series, we covered the best ways to build an ARF wing. "How to Build an ARF Trainer Part I" detailed how to build the very best wing possible. In truth, most ARF trainers would fly well if a few steps were left out, as long as the wing halves were correctly aligned. However, if all the steps were followed, your ARF Trainer would be better than 99% of "First Timer" airplanes brought to the flying field.

This article, "Part II – The Fuselage Airframe" will follow the same pattern. When building the fuselage, you will not need to perform every step detailed here for your airplane to fly OK. But if you want the best flying trainer at the field and one that will be problem free and extremely durable, try to follow these instructions as much as possible.

How much you are willing to do so will determine how well your trainer will perform, how easily and quickly you will learn to fly and how long your airplane will last. Remember that all Sport Aviator photos can be enlarged just by clicking on them,

STABILIZER INSTALLATION

Photo 1 Photo 2

It is usually best to install the tail feathers first. It is easiest to install the horizontal stabilizer and vertical fin without the landing gear and engine in place. If the engine is installed, the airplane always wants to "nosedive" off the building stand with the slightest nose-forward positioning.

Having the landing gear installed makes it difficult to rotate and position the fuselage on the stand while installing the rear surfaces.

The horizontal stabilizer, the funny little wing in the back, is installed first since the vertical fin aligns from it. It is easiest to make all the alignments and measurements if the elevator is not installed during installation. The first strep is to find the exact midpoint on the stabilizer's trailing edge (photo 1). Once that is located, then draw a straight line from the trailing edge to the front as shown in photo 2. Mark the midpoint of the leading edge as well.

Photo 3 Photo 4

After finding the center on the stabilizer, locate and mark with a strong pin the fuselage center point just forward of the wing saddle (photo 3). Even better, if you have the work space, locate the center of the firewall instead of the front wing saddle. The longer the distance from the pin to the stabilizer tips, the more accurate will be the alignment.

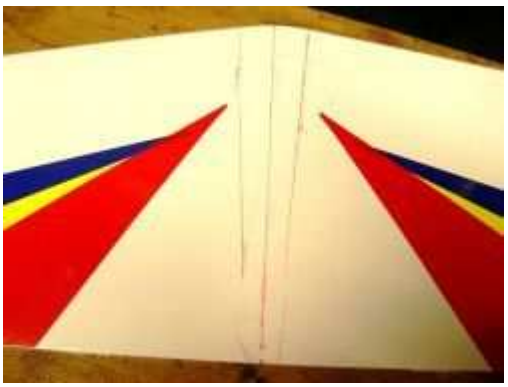
Do not use the outside fuselage edges as they might not always be equal. The idea is to use this measurement to align the elevator so that it is perpendicular to the main wing and the fuselage. Some leeway is allowed here. The elevator leading edge can be as much as 3/64 in. off and the airplane will still fly straight when elevator input is applied. If it is off by more than that, the airplane may skid slightly in a sharp turn. This is still acceptable but can show itself when flying landing approaches.

However, before you can use this measurement to align the stabilizer with the fuselage and wing, you must first center the stabilizer inside the fuselage. Use the two center marks and line you have already marked. Center the trailing edge mark in the middle of the rear fuselage and the front mark in the center of the last fuselage former (the vertical wall at the front of stabilizer slot). As a final check that the stabilizer is centered, measure from the outside rear of the fuselage to the stabilizer tip. Both measurements should be identical. Try not to be off by more than 1/32 in. as roll trim problems can result if you are.

Photo 5

Do not apply any adhesive at this point. It probably would not stick well anyway. The tail surfaces are epoxied in place using 12-minute epoxy for the stabilizer and 5-minute epoxy for the vertical fin. However, epoxy does not stick at all well to the plastic covering. It must be removed before the final installation.

Once the stabilizer is properly aligned with the fuselage and wing saddle, mark both the top and bottom of the stabilizer as shown in photo 5. Use a fine point, felt tip pen for this. The ink can be removed later using denatured alcohol.



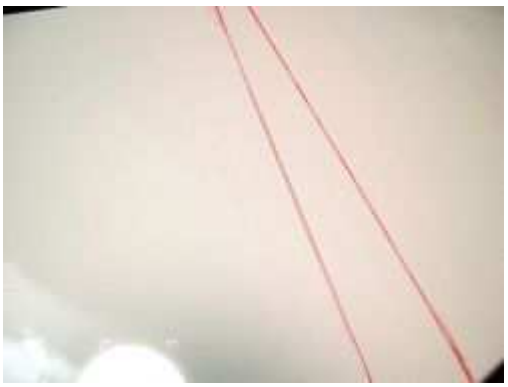


Photo 6 Photo 7

It is not easy to remove a stabilizer that you have worked so hard to align. Doing so might even cause psychological damage! But your airplane will appreciate it as will you when the stabilizer remains perfectly aligned 500 flights from now. The stabilizer top should look like photo 6 and the bottom, (you did DO the bottom right?) should resemble photo 7.

Photo 6 shows a slightly “bent” outlined on the rear, left side of the stabilizer top. That was caused by the fuselage’s having been damaged in shipment. We managed to get this ARF very cheaply because of this damage. I elected to make the repair during the installation to insure that the stabilizer would not be “tilted” vs. the wing (extremely important). Before cutting the covering, I just extended the line using a straight edge.

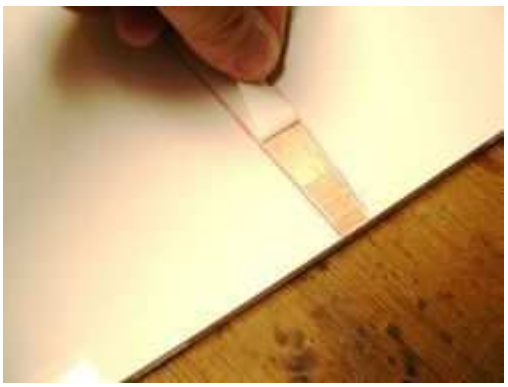


Photo 8 Photo 9

This is an important step. Do the bottom first in case you remove too much covering. Use a Hobbico® Hot Knife™ to cut 1/32 in. inside the lines you made. Leave the outside 1/32 in place to seal the stabilizer/fuselage joint so that the stabilizer covering always remains firmly fixed. Use a “dull” blade in the Hot Knife. Let the heat do the work. Do not cut into the wood as that will weaken it.

Then, carefully remove the covering by pealing it back on itself as in photo 9.

Photo 10

Some ARF models are covered with a commercial brand of heat shrink model covering. If yours is, it will probably peel back without leaving any adhesive residue. But many trainers are covered with something else and these coverings almost always leave some adhesive and color behind (photo 10). This must be removed or it will weaken the final bond.

Photo 11 Photo 12

Alcohol does not remove this covering adhesive very well. In Part I, we learned about the amazing properties in that little blue Coverite® can of Ironex™. Pour a little onto a paper towel and remove any remaining adhesive. **TIP:** Ironex is extremely volatile and evaporates very quickly. It will slowly evaporate even when the can is tightly closed if you remove the insert that says “cut this out”. To prevent this, just punch a small hole in the insert (photo 12). The Ironex will stay in the can where it belongs.

Photo 13 Photo 14

Ironex will not damage or warp the wood since it flashes off so quickly. BTW – It is a good idea to wear some breathing protection like a paint mask during this process. When cleaned, your stabilizer should look like photo 13. Ironex will also remove the felt pen ink. Do this now except for very short sections at the leading and trailing edges. These “dots” will be used to align the stabilizer when you re-install it. Make sure to remove the covering from the front of the stabilizer, well inside the fuselage so the epoxy will hold it in place against the former.

Photo 15 Photo 16

The final preparation step is to use a modeling covering iron to seal all the covering edges in place. Then use a small torpedo level located at the rear of the wing saddle to level the fuselage. Most any position will work well with flat-bottom trainer wings as long as the level is exactly 90 degrees to the fuselage. Using the rear of the wing saddle insures the 90-degree location and is also the best location to place the level if the wing is not flat bottomed. So get used to it now. If your work stand allows, rubber band the fuselage in place to keep it level during installation. But keep checking it all the time anyway.

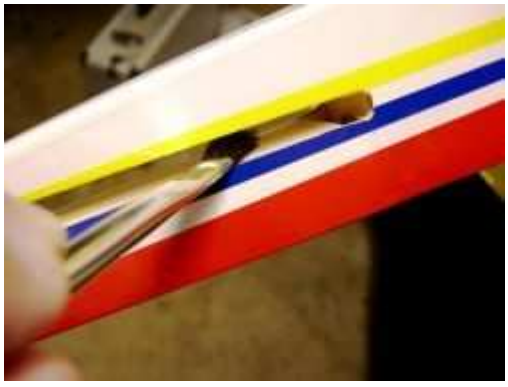


Photo 17 Photo 18

Use an “epoxy” brush, available at all hobby shops for about 20 cents, to apply the epoxy to the top and bottom of the fuselage stabilizer slots. Note in photo 17 that there is an interior mounting “plate”. Almost every ARF trainer has such a plate for extra strength. Make sure to cover it with adhesive as well as the spot where the fuselage former meets the stabilizer leading edge.

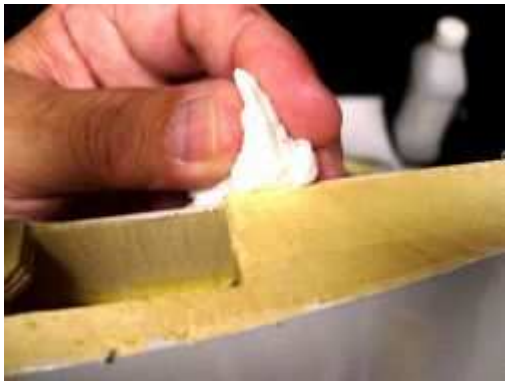


Photo 19

Use 30-minute epoxy if this is your very first installation. After your initial installation, 12- minute epoxy should provide enough assembly time. Once the epoxy is applied, use the towel trick outlined in Part I (photo 19) to remove the epoxy from the outer most 1/32 in. of all the edges. This prevents the adhesive from escaping the joint to ruin your airplane's finish.

Photo 20

You have already done all the hard work aligning and preparing the stabilizer for installation. Make sure the fuselage is still level. Note the rubber bands holding it in place on the stand. Slide the stabilizer in place from the rear and do all the aligning. This is the most critical alignment step.

Note the tape measure on the right side of the stabilizer and the small, light appliance level nearer the fuselage. It is very important to make sure that the stabilizer is parallel with the wing. If it is not, the airplane will roll every time you input some elevator. On a trainer, the wing's large dihedral will reduce this rolling effect somewhat. It might eliminate as much as a 1/4 degree misalignment. But don't take chances. Get it as level as you possibly can.

TIP: If you have a very large, level building area or island, mount the wing and then level the fuselage using two squares, one under each wingtip. This is the most accurate method. But most of us, myself included, just don't have this much building space. The level works well enough for a trainer with lots of dihedral anyway.

In this case, a slight amount of weight on the right stabilizer side was required to level it. That is what the measuring tape is doing there. Recheck everything one more time and then go away for a while. If this is your first trainer, take some time and read the Sport Aviator "How to Land" article in Pri-Fly. If you have already read that one, watch the videos about what a flight lesson is like on the Home Page. Whatever you do, stay away from this assembly until you are sure the adhesive is set up. Keep far away everything else, kids, pets, stiff breezes, coughs, falling tools and anything else that could spoil your hard won alignment.

VERTICAL FIN INSTALLATION


Photo 21 Photo 22

Once the stabilizer is secure, insert the vertical fin into the fuselage slot and mark on it where it meets the fuselage top as you did the stabilizer (photo 20A). Use the Hot Knife to cut the covering from the areas 1/16 in. lower than the line and remove the covering.

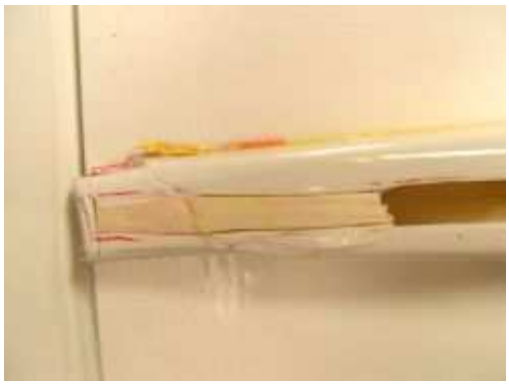



Photo 23 Photo 24

Also mark the top fuselage areas covered by the vertical fin and remove the covering as was done for the stabilizer. The underside of the vertical fin is usually not covered; it is bare wood. If it is covered, remove the bottom covering so the epoxy can adhere well.

Using another epoxy brush, apply 5-minute epoxy to the bottom of the vertical fin and the sides of the fuselage slot. Remember the towel trick on the vertical fin bottom only remove just 1/32 in. of the adhesive, not 1/16 in.

Photo 25

Insert the vertical fin into the slot and insure that it is 90-degrees to the horizontal stabilizer using two modeling squares as shown in photo 23. You can insert a small modeling pin through the

very front and rear of the vertical fin and into the fuselage top to hold those areas firmly against the fuselage top. But you will need to hold the fin in place using the squares until the 5-minute epoxy sets up.

SERVO INSTALLATION

Photo 26

Almost every ARF airplane, ARF trainers included, utilizes a 1/8 in. thick plate of “Lite Ply” to mount the servos. Lite Ply consists of two very thin plywood layers with balsa wood in between. This means that only the two very thin ply layers are really holding the servo mounting screws in place. I have seen, and have experienced, this mounting method fail several times. I have even experienced failures using 1/8 in. aircraft grade plywood plates instead of Lite Ply.

While challenging, it is not the best of fun to have to land an airplane with the rudder stuck hard over or the pitch trim so far gone that only the throttle is useful for pitch control. It is possible, but not recommended.

This servo mounting method usually fails after about 150 flights, sooner on the rudder servo if the nose wheel experiences some very hard landings. The plate stays attached to the fuselage but the darn mounting screws fall out. The fix for this is very easy.

Photo 27 Photo 28

Cut two pieces of 1/4 in. x 1/2 in. spruce spars as shown in photo 21. Insert a large modeling pin into one piece as shown in photo 22. This helps with installation. Apply some 5-minute epoxy to the top of one spar. Then insert the spar under the factory mounting plate making sure that the spar’s edge is about 1/32 in. back from the servo hole. This small space makes servo installation easier but still allows the mounting screws to pass through the hardwood spar. Finally, clamp the spar in place until the epoxy sets up.

Photo 29

Make the same reinforcement spars for the throttle servo. To be honest, the Lite Ply throttle servo mount has never failed in my experience. But since the others have, why skip this easy step?

Photo 30

Install the elevator and rudder servos. **TIP:** Don't try holding the servo in place by hand and drilling all four holes at once. Drilling accurate mounting holes this way is nearly impossible. Insert the servo in place. If possible, align the servo output arms with the control rod tubing before drilling.

Install the thin cardboard spacer that prevents the servo from touching the sidewall, and drill just one hole. Insert a screw halfway into that hole, realign the servo and drill one more hole on the opposite side. Insert another screw halfway in place. Then drill the final two holes and screw in place. Tighten all the screws until they are tight against the brass spacers inside the rubber grommets.

Photo 31

Finally, install the throttle servo using two cardboard spacers as was done on the aileron servo in Part 1. Once the fuselage servos are installed, it is time to hook up the rear control surfaces.

Mount the elevator as you did the ailerons in Part I. For complete details, read the Sport Aviator article "Installing Mylar Hinges" in the Flight Tech Section. Do not install the rudder at this time as it just gets in the way when hooking up the elevator's control system.

Photo 32 Photo 33

Select one of the long control rods with a threaded end. This is usually a 2-56 thread or its metric equivalent, about 2.5 mm. Thread one of the nylon clevises on the rod; the rod tool helps here also as it did for the aileron connections in Part I. Rotate the clevis until a small length of the threaded area extends past the inside of the clevis(photo 32). Slide the non-threaded end into the elevator pushrod hole in the rear of the fuselage. It should exit into the servo bay area inside the fuselage. If it is too short, you selected the wrong pushrod (probably the throttle rod).

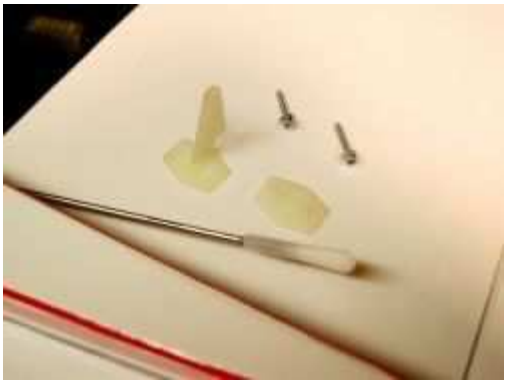
Photo 34 Photo 35

Note in photo 33 that the elevator and rudder servo arms interfere with each other. This is very common in most ARF's. These nylon servo arms are *tough*. They take the entire strain of all the air loads during flight.

Therefore, they can be tough to cut. Do not use a hobby razor knife to remove the offending arms. That about guarantees a trip to the ER and a real ER is nowhere near as much fun as the TV version. You could use a high speed rotary tool with a cutting disc, NOT the saw, but that gets sloppy and can melt the nylon a little causing drag points.

Photo 36

Instead, use a pair of wire cutters, photo 35. The cut piece tends to fly into orbit when you make the cut so aim it into a deep container (coffee can). Clip off three arms from the elevator servo and two from the rudder servo (photo 36).



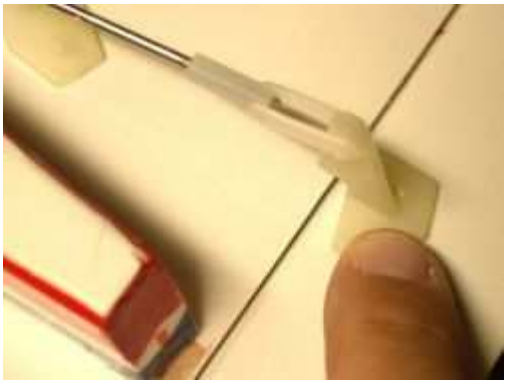


Photo 37 Photo 38

The nylon control horn uses two screws and a nylon plate for mounting (photo 37). The idea is to position the control horn, on the side that the rod exits, and exactly, *exactly,* place the holes over the hinge line. It is OK if the horn is at a slight angle to the hinge line (photo 38) as long as the holes are centered over the hinge line. In order to make the control horn exactly parallel to the hinge line, the elevator control rod would need a bend and bends cause flex. You do not want flex in your control rod.

Once the control horn is properly positioned, mark one hole, only one, through the hole onto the elevator using a felt tip pen. Use a small hand drill to drill a 1/16 in. hole through the elevator. Insert one screw through the control horn and the elevator. Place the flat nylon plate on the other side of the elevator and tighten the crew about 80%. With everything in place and aligned, mark the other hole and drill it also. Then insert the other screw.

Most likely, the elevator's tapering on each side threw off your alignment a little and the second screw will not be aligned with the second plate hole. Fortunately, the elevator is constructed from balsa wood and the hole can be very slightly enlarged so that everything fits. Once it does, tighten both screws until the control horn is firmly in place but do not dent the balsa by over tightening.

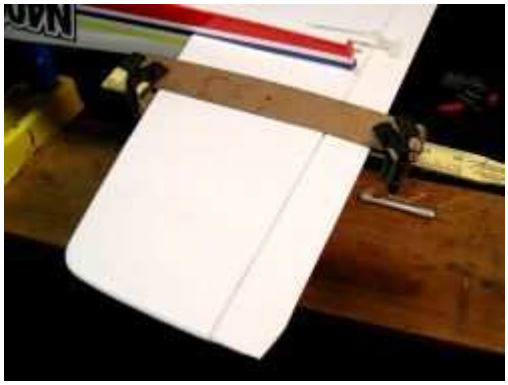


Photo 39 Photo 40

Use two straight pieces of hardwood, leftover from when you cut the servo reinforcement rails maybe, that are long enough to span the elevator and stabilizer along the chord (width). Clamp these in place, top and bottom, using two hobby clamps. This insures that the elevator is in the neutral position. Hook the nylon clevis to the nylon control horn.

The control rod will extend past the servo arm. Turn on the transmitter and on-board radio system. Make sure the elevator trim is centered. Mark the control rod where it passes under the centered servo arm. Remove the control rod from the fuselage and make a 90-degree bend at the mark.

But now the control rod will not conveniently slide back in to the fuselage from the rear. Reality can be a bummer sometimes. You will have to remove the nylon clevis. And this *after* you had so carefully set everything in neutral. **TIP:** *Count the number of turns* required to remove the clevis. Then slide the control rod back into its sleeve from the servo bay. Connect the servo as shown in photo 40 and use one of the locking clamps included with the ARF package.

Reinstall the clevis the same number of turns it took to remove it. The elevator should still be locked into position. If the clevis does not fit into the control rod horn, usually the second one from the top but follow directions, screw the clevis in or out to fit. Do not force it as that simply causes the elevator to move once the clamps are removed.

TIP: the control will be slightly off center. If it is off center towards the fuselage, then insert the clevis end with the pin into the control horn from the outside. If the bias is opposite, insert the clevis so that the fixed pin part is from the inside. Why? The slight tension this causes will keep the clevis in place even if it opens. Any tendency for the clevis to open is also reduced with this hookup.

The rudder control installation is just a repeat of how the elevator was installed. Make sure that the rudder servo's output arm has two sides as shown in photo 36. The other side will be used for nose wheel steering. In fact, the brass piece seen in photo 36 is for the nose wheel control rod.

The next part of this series covers engine choice and installation plus all the little final assembly steps, such as the fuel tank. See you there.

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