

# Royal Products

## BEECH D-17 "STAGGERWING"

### INTRODUCTION

To many, the beech D-17 "Staggerwing" represents one of the finest achievements of the aviation industry in the 1930's. Now, regarded as a classic, the Staggerwing still is in active service with many examples in mint flying condition.

The official designation of the Staggerwing is model 17. Many variants were offered with engines ranging from a 225hp Jacobs, to a 710 hp Wright cyclone. The most common variant today is the D-17s with the Pratt & Whitney 450hp engine.

The Staggerwing was designed primarily as a business type of aircraft. It combined excellent top speed, reasonable fuel economy, and surprisingly good landing and take-off characteristics. Stories abound in literature about the Staggerwing telling of short field landings, high cargo loads and excellent service records.

Specifications for the model D-17S are as follows:

1. Power: 450 hp @ 2300 rpm
2. Max speed: 240 mph.
3. Max ceiling: 25,000 ft.
4. Fuel consumption: 20-25 gal/hr at normal cruise (180mph)
5. Wingspan: 32 ft.
6. Length: 26 ft. 1.5 in.
7. Height: 8 ft.
8. Wing area: 296. 5 ft.

Many sources are available for information. Consult the popular flying magazines and:

1. "Air Progress", march 1973
2. Staggerwing. Robert T. Smith, R.S. Maney Press, Media PA 19065
3. Aviation Quarterly. 6045 Wilson Blvd., Arlington, VA
4. "National Aeronautics", November /December 1974
5. "Radio Control Modeler", December 1975.

### FUSELAGE CONSTRUCTION

- 1) Begin by mounting the tail wheel bracket to former F-13. Enlarge hole for pushrod movement.
- 2) Carefully mark the former locations on F-16, F-17's, and F-15's.
- 3) Test fit all formers F-1 thru F-14. Assemble the interlocking plywood framework without glue. Check that F-16 remains straight when you sight down it from the front or rear.
- 4) Using slow setting epoxy glue, assemble the framework. Use tape and pins to maintain alignment. Check that the formers fit where your marks from step 2 show they should. Be certain that the fuselage is not twisted. Repeatedly sight down F-16 to check alignment. Don't glue formers F-5, 6, or 8 to F-16.
- 5) When the framework is set, install engine mounts EM & F-18 spacers. Glue the lower wing fillet formers F-21 & F-22 in place. Cut out F-16 as indicated on the plans.
- 6) Assemble the two F-32 tail block sides to F-33.
- 7) Glue all the rear longerons in place. Remember that the top corner longerons are spruce. Several of the longerons are notched to fit the lower corners of F-12. Drill EM for motor mounting holes and install mounting hardware.
- 8) Add rear block F-30 after relieving it for the tail wheel.
- 9) Trial fit stab & fin and relieve F-28 & F-29 as necessary. Glue F-28's in place.
- 10) Glue parts F-35 in place. Add the two F-35A pieces.
- 11) Plank the fuselage as indicated on the plans.
- 12) Add fairing blocks F-20, F-27, F-25 and F-36. Use the top wing to space F-36 properly.
- 13) Add F-26 and F-24 pieces. glue F-19 nose ring pieces in place.
- 14) Fit F-32/F-33 assembly to rear of fuse.
- 15) Sand fuselage to shape.

- 16) Construct pushrods and trial fit.
- 17) Pin stab in place and tape & pin wings in place. Set model on a flat surface. Block up the tail so that the leading and trailing edges of the stab are the same distance from the surface. Check the wing's leading edge and trailing edge and be sure that they too are the same distance up from the work surface. Shim the wing and/or stab saddles as necessary.
- 18) When the incidence has been established, measure the distance between the wings. It must be constant throughout the span. Alter the wing saddle to establish the above condition.
- 19) Be sure the wings or stab are not skewed to the fuselage or each other.
- 20) When satisfied with alignment glue the stab and vertical fin in place. Add blocks F-29.
- 21) Add the wing hold-down blocks & dowels and drill the wings for the bolts. Be sure to preserve the alignment you established in the above steps. Fit W-28's in place and drill mounting holes.
22. Finish sand the entire aircraft and complete with your favorite finish.

## **WING CONSTRUCTION**

- 1) Separate the wing parts from the other parts in the kit. Also, divide the parts into upper and lower wing parts.
- 2) Glue W-7s to W-8s. When dry, trim 8 pieces of 3/32" leading edge sheeting to leading edge curve.
- 3) Draw centerlines on all ribs for both wings.
- 4) Begin upper wing construction by constructing the bottom spar over the end view of the plans. Pin 2 bottom 3-7/16" x 3/8" spars in place. Glue center joint. Then extend to the outer edge of the last UW-2 rib. Glue UW-12 above the spars centering UW-12 on the center joint. Glue, with epoxy, a UW-12 spar support. Pin tightly and recheck alignment. When dry, flip over and add remaining UW-12 support.
- 5) Construct lower wing spar using above procedure, but incorporate 2° dihedral into center structure. The parts are machined to this angle. Use parts LW-12 and spars.
- 6) The upper wing will be constructed first. Start with left panel. Pin spar assembly to plan, centering joint carefully.
- 7) Glue 9 UW-2 ribs into position. Measure from centerlines drawn previously and be certain the lines are parallel with the workbench top. Use a strip of scrap balsa to align the ribs behind the spar.
- 8) Glue into place the 3/32" shear webs between the ribs.
- 9) Glue W-10 into place aligning by using a ruler in the spar notches and being certain that the top edge of w-10 is flush with the bottom edge of the rudder. Block up the tip of W-10 to hold alignment. Check that W-10 is perpendicular to the work surface and not swept forward or backward.
- 10) Glue UW-3, 4, 5, and 6 into place.
- 11) Glue the top spar into place.
- 12) Trim UW-1 ribs for spar assembly and glue into place.
- 13) Repeat steps 6-11 for right panel.

## **THE FOLLOWING STEPS (14-29) APPLY TO BOTH PANELS SIMULTANEOUSLY**

- 14) Glue UW-1 3 pieces (4) into place. Add the two UW-14 pieces, gluing securely. Be sure UW-14 is flush with the top of the ribs. Glue uw-26 into place. Align flush with ribs.
- 15) Tack glue the scrap balsa rear rib support pieces to the ribs. There will be stress when the top sheet is applied and the supports must hold the ribs to prevent a warp.
- 16) Mark the aileron cutout on four of the W-22 sheets. Be accurate and make sure of your line
- 17) Using non-water based contact cement, attach the top skins W-22.
- 18) Again, using contact cement, attach the two top leading edge sheets. Add UW-24A and B to the tip area.
- 19) Add the tip planking and the cap strips. Glue the leading edge in position.
- 20) When dry, flip the wing over and glue two W-21, two UW-18, two UW-19, six W-15, two W-27, and one UW-11 pieces in place.
- 21) When above is dry, pin wing to work surface and block the rear of the wing as before. Be certain the spar rests flat on the workbench,
- 22) Notch the counter section ribs for the aileron torque rod. Glue into place along with scrap balsa reinforcements. Do not glue to W-21.
- 23) Relieve the ribs to accept W-16 and W-17. Glue these in place after beveling to the rib up sweep.
- 24) Bevel the rear edge of the trailing edge sheeting, UW-24A and UW-24B as shown on the plans. This is so the bottom sheeting has a gluing area on the top sheeting.
- 25) Using contact cement, add the leading and trailing edge sheeting
- 26) Notch the tip sheeting for w-27 and glue in place.
- 27) Cut off the ailerons.
- 28) Add the center sheeting and the remainder of the cap strips.
- 29) Sand wing leading edge, temporarily hinge ailerons and sand to shape.

30) The lower wing is constructed the same as the upper wing with the following exceptions. Also, use parts marked LW.

- A. Step 13 Un-pin wing and pin right hand side down. Be sure the left panel is dry. Be sure right panel is dry, and then proceed with step 14 below.
- B. Step 14 The LW-13 pieces are the fixed gear block supports. The LW-14 pieces are the gear blocks. Glue the small LW-14 block to the large grooved block. Drill hole for the gear leg. Trim small block to the correct height of the rib contour. Glue into LW-13s securely. Be sure lower edge of grooved block is flush with ribs. Add LW-26 and be sure it is flush with ribs.
- C. Step 15 Work with only one panel. When that panel is complete, repeat steps 15 thru 26 for the other panel.
- D. Step 16 Notch the center section ribs for the flap torque rod. Glue into place along with the scrap balsa reinforcement pieces. Complete remainder of step 16. See step 22.
- E. Step 20 In addition to the parts called for in this step, relieve ribs for W-16 and W-17 and install at this time. See step 23. In addition, slot sheeting for W-27, but do not install at this time. Also add scrap hardwood gear support between second and third LW-2 ribs. See exploded view on plans for placement of optional scale support strut which would affix to this hardwood structure.
- F. Step 21 Allow the panel not being worked upon to overhang the edge of your workbench.
- G. Skip steps 22 and 23.
- H. Step 26 Glue W-27 into place. Remember that W-27 in the lower wing comes out of the top of the wing.
- I. Install F-4A after wing is complete and do not install the dowels at this time.

## STABILIZER AND ELEVATOR CONSTRUCTION

- 1) Begin construction by gluing the stab perimeter together. Use parts S-1, S-2, S-3, and S-4. Pin S-8s over plan. Glue ribs, cut from 3/32" x 3/16" stock, into place. Add S-9, S-11, and S-10. When dry, flip elevators over and repeat step. Also, add the scrap balsa tie rod reinforcements to both sides. When dry, glue to S-7s.
- 2) Cut the center section stab ribs from 3/32" x 5/16" strip stock. Glue in place. Cut the 8 outer stab ribs from 3/32" x 1/2" strip stock and glue in place. Add S-5 and planking to top of stab.
- 3) When all is dry, remove from work bench and glue lower S-5 piece and sheeting on bottom of stab.
- 4) Bevel leading edge of elevators and notch the tie rod. Glue tie rod into place being sure the elevators are not out of alignment.
- 5) Sand elevator to triangular shape.

## FIN AND RUDDER

- 1) Build perimeter from pieces R-1, R-2, and R-6. Glue 3/8" thick scrap balsa reinforcement at R-1 /R-6 joint. Cut upper two ribs from 3/32" x 3/8" balsa and glue in place. Cut lower ribs from 3/32" x 1/4" stock and glue in place. Sheet the lower section with 3/32" stock. Only do one side at this time.
- 2) Pin R-4 to bench. Glue R-5 on back edge. Glue one R-9 and one R-11 in place. Cut ribs from 3/32" x 3/16" stock and glue in place. Allow to dry.
- 3) When fin is dry, flip over and sheet other side.
- 4) When rudder is dry, flip over and add ribs R-9 and R-11. Butt glue R-3 in place. Glue R-7 in place.
- 5) Sand rudder to triangular cross section and shape leading edge of rudder. Do not glue R-8 in place.

## THE FINISH WORK

The construction phase concluded with the remaining parts being stuck one to another and/or "shape" sanded. This pile of parts which may resemble an airplane, depending on arrangement must now be finished to satisfy the goal.

One of the keys to a good finish is sand, sand, sand, dust it off and sand once more. Remember that, as it's important. The first sanding is done with rougher open coat sand paper (I prefer aluminum oxide or garnet paper) 200-320 range. I glue mine to 1" x 4" x 12" blocks with spray contact adhesive or "sticky back" by scotch. It's best to sand all components prior to final assembly and is also much easier. The next sanding is done with 320-400 grit paper. After this step take a good rest, then come back and sand until tired again. Now wipe the plane down with a

clean soft rag and check it for seams, low spots, and symmetry. Then sand once more with the 400 grit.

If you plan to "MonoKote" your eyeball scale, it is done at this stage on bare wood and in accordance with the directions furnished with the "MonoKote". After its all MonoKoted, go to tut final assembly step.

If you plan an ultimate scale job finish you must paint it 'cause no real airplanes are MonoKoted. (too bad, though!) You must decide what type hinges you will use now because it makes a difference. If you are going to use hinges with removable hinge pins, then install all hinges and control rods, linkage, radio gear, (according to manufacturers instructions) etc., at this time. Then dismantle it and cover it individually. If you are to use "hidden" hinges (like the no glue molded nylon ones) then cover all the separate pieces and then assemble them.

To prepare the model for covering, you dope the balsa with at least a 50/50 dope-thinner mixture. After each coat sand lightly and continue until no "fuzz" occurs after doping. (usually 3 or 4 coats). Now cover with the material of your choice (for Instance, silk, siron, nylon etc.) Check the grain (look at a corner of the material to discover the grain is parallel to the heaviest or most dense threads whichever the case! The grain must go lengthwise on each piece.

To apply the covering, cut it oversize, hold in place and spray with a fine mist water sprayer carefully working out all the wrinkles and dope it while still wet with the brush nearly parallel to the surface and lightly, lightly stroking it. If done while wet, the dope will "float" on the damp surface and dry "white or cloudy" but will require far fewer coats and the cloudy look will disappear after the 2nd or 3rd coat.

Carefully trim (with a double edge razor blade) and sand the "rough" areas but be careful not to "cut" or "sand" out the fibers over a "high" place like a rib.

When the surface remains smooth after a coat of dope (3RD or 4TH coat) it's time to thin the mixture and add talc or cornstarch for filler "body". Sand after each coat until desired smoothness is achieved. Then assemble the parts and spray paint the final colors to suit. Just remember a lot of model planes are glossy when the subject aircraft was not. This mistake costs points. As I mentioned earlier, I won't presume to advise on achieving the "ultimate scale" but if in doubt, there are volumes written on the subject. There may even be a "scale nut" in your area that can help. Don't forget the plastic modeler who knows finishes. Remember also, the plastic model is an excellent source of scale detail as well.

## AIRCRAFT ALIGNMENT

This information is included as an addition to the normal instructions in hopes that you may benefit from the information it contains. The time it takes to accurately align an airplane is replayed many, many times by the superior performance of the aircraft.

All alignment information is included on the plans. Note that wing and stab angles, thrust angles, etc., appear near their component locations. Generally, the angles are referenced to a fuselage centerline which is also drawn on the plans.

Most angles are expressed in degrees of angular offset. Don't let this stop you from using them! The least expensive conversion method is to borrow an algebra book which has trigonometry sections. Use the formulas to convert the degrees to fractions of an inch of offset. The easiest method is to use a Robart incidence meter. This device is calibrated in degrees and allows direct readings of the incidence angles.

The first step in aligning the aircraft is to transfer the centerline to the fuse sides. Usually the centerline runs parallel to a major piece of the fuse such as the top edge of the side. Use a felt tip pen and draw a line parallel to the centerline above the wing saddle and below the stab saddle.

Next, mark the centerlines of the leading and trailing edges on the stab and wing. Make a template from the plans to transfer this location.

Place the fuse on the workbench and block up so that the centerline is parallel to the table top. Now place the stab in its saddle and trim and skim it until the leading and trailing edges are at the required different angles. Let's say the plans call for 1/16" positive incidence. That means the center of the leading edge is 1/16" higher (referenced to the top) than the center of the trailing edge. It makes no difference how far up the trailing edge is from the work surface just make the Leading edge 1/16" higher. The stab may have positive, negative, or no incidence depending on the design.

Align the wing the same way. A method to use, where dowels are employed on the leading edge, is to drill the dowel holes in the bulkhead higher than necessary (toward the top of the fuse in a low wing design). Now, when the wing is put in place, the trailing edge will stick up off the wing saddle. Using a rat tail file, elongate the holes downward until the wing is at the correct incidence. If there is a gap along the wing saddle use balsa, ply, or filler to close. If you want to use wing seating tape, be sure to make all your measurements with the tape in place.

The wing and stab must also be checked to be sure they have the same length extending out from the fuselage. Use a balsa stick or yardstick and be sure that if the total wingspan is 70" that 35" minus 1/2 the fuse width, extend on each side of the fuselage.

Next, be sure the wing and stab are not skewed on the fuselage or to each other. Use a piece of non-stretchable string and tie a loop in one end. Pin through the loop attaching the string in the exact center of the

fuselage. For the wing attach near the tail. (Near nose for stab) Measure out to one tip and then go to the other tip. It must be the same distance. Do this for the wing and stab.

The last thing to check is that the wing and stab are not tilted. Carefully sight from the front and be sure that one tip of the stab does not droop lower than the other.

As you can see, these 5 parameters must be completed taking into account the other 4 as one is being worked upon. Usually, we establish the stab incidence, equal extension, skew first, and then glue the stab in position while sighting from the front with a straight rod resting on the wing.

The last difficult area is the fin and rudder. Be sure the fin is perpendicular to the stab. A large right triangle is necessary for this step. Also, sight carefully from the front to be sure that the fin is inline with the top centerline. Sight from the front and make sure you see the same amount of each side of the fin.

Motor offset is difficult to measure. If the Robart gauge is used, it is easy. In case you don't use the gauge, about the best method is to draw the thrust line on the nose or nacelle and then extend this line with a stick. Measure from the crankshaft to the stick and compare with what the plans call for. Remember that thrust angles may be altered with skims or oversize motor mount holes. When you verify that the thrust is correct, fill the unneeded part of the hole with epoxy to maintain strength.

We are sure that if you take the time to complete the above steps you will have much more satisfaction from your new model.

Lastly, turn the radio on and operate all the surfaces one at a time to insure that they move in the proper direction, do not bind, do not interact with other controls and do run smoothly. When you have satisfied all these requirements, put the outfit on charge all night before you go fly.

When you get to the field, don't be afraid to ask an expert to fly your plane for you if you are a novice or if you haven't flown in awhile.

If you decide to fly it yourself, plan your flight from takeoff, through climb out, turns, pattern, approach and landing with careful consideration given to wind direction, runway orientation, other traffic and relative position of the sun.

I have seen everything mentioned in this chapter cause a scale job to crash when not done properly, so if you will carefully tend each one of these points, your odds will be much, much better. Don't you agree?

## **BALANCE AND FLIGHT**

There before you, is the result of these many efforts, all of the work is done, you say. Nay, say I. All of what is done, anyone could do. What lies ahead is important for it makes an almighty difference.

This phase begins with the model ready for flight and ends with a successful landing. Begin with the airplane assembled as if to fly, set it on a smooth surface. With a plain unbroken background and go around behind the craft and "eyeball" it. Very carefully check to see that the rudder and vertical fin are perfectly aligned. In the case of twin rudders, measure them accurately. Is the horizontal stabilizer parallel to the wing? Are there any warps in any of the flying surfaces? Is the fuselage straight? If the answer is yes to all these questions, you are in great shape. If not, adjust it so it is. You know what must be done to align surfaces but wait awhile to do that while we consider warps.

Warps are crooked or "bent" surfaces. They cause most accidents. It isn't necessary as they can be fixed. On any wood airplane which has been doped or painted with any of several different paints the problem is to soften the paint and twist the surface opposite the warp, then let it harden again.

The paint can generally be softened two ways. It can be heated or dissolved. To heat it, use steam. If a small surface is the problem, a teakettle over a stove does nicely. If a large surface is warped, the outlet behind a steam cleaning plant will do the job. You apply both sides of the warped surface to the steam until good and hot, then hold opposite warp, remove from steam and allow to cool well. Wait awhile, and then check again. Do this until the warp is gone.

To dissolve the paint, use more coats of paint over both sides of the warp. This doesn't work on all paint, but has been done successfully with dope and lacquer. I have also seen guys fasten the surface down in proper position and paint until it will stay. That's the hard way.

Now that all the warps are gone, reassemble the plane, put it on a true flat surface and measure the distance from that surface to leading edge of wing, then from the surface to trailing edge of wing at same station (chord point) and verify that it agrees with the incidence shown on the plans. Do the same for the tail. If it doesn't agree, do whatever is necessary to make it agree.

Next check the thrust. Fasten a string to the centerline of the plane back near the tail and compare the distance to each prop tip with the prop horizontal insuring that the offset agrees with that shown on the plans. Then vertical for down thrust.

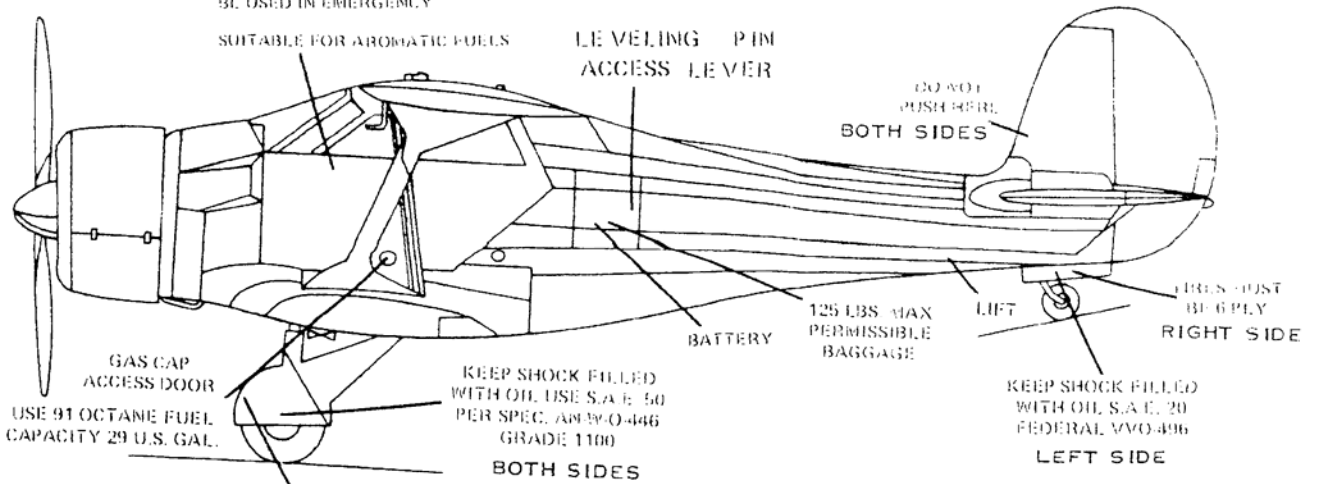
Now, check the balance point to be sure it is exactly as shown on the plan. If not, add weight or relocate the radio in such a manner that it agrees with that shown.

**U. S. ARMY UC-43  
A.A.F. SERIAL NO. 4476068**

**STENCIL PLACEMENT FOR MILITARY**

CREW WT. 400 LBS.

SERVICE THIS AIRPLANE WITH 81 GRADE FUEL. IF NOT AVAILABLE T. O. 00-5-1 WILL BE USED IN EMERGENCY



TIRES MUST BE 6 PLY  
INSIDE FAIRING  
BOTH SIDES

