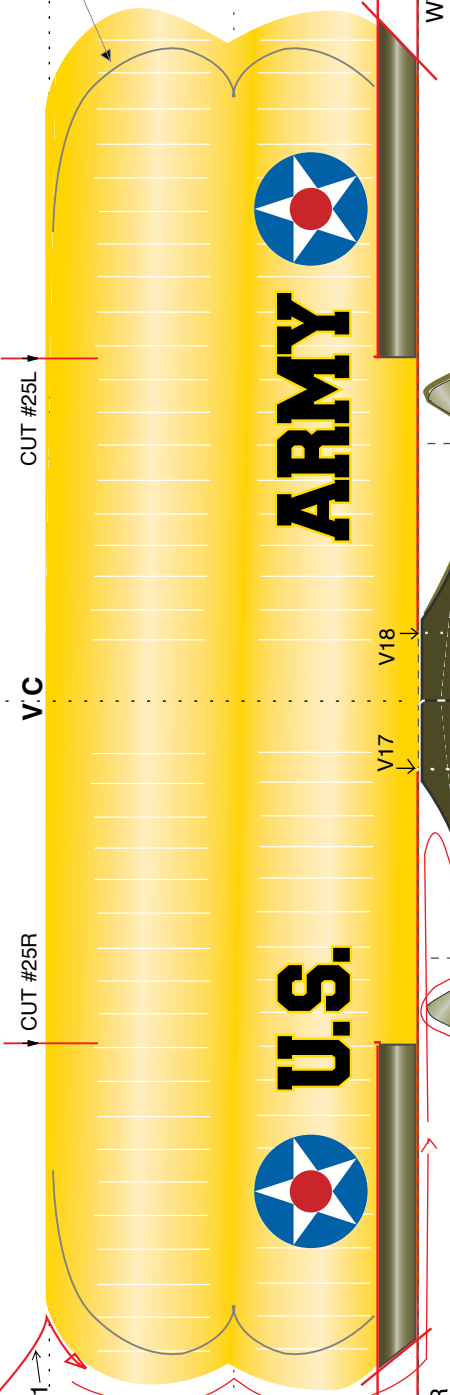


H1
 FINAL TRIM LINE
 (But be careful not to cut off ends of wing struts)

PAGE 1 OF 2
 (CUTS #7)

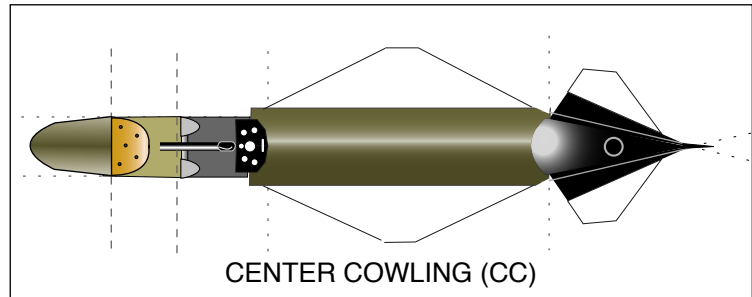


H1
 TRIM RIGHT ALONG THE OUTSIDE EDGES OF THE ENTIRE AIRPLANE IMAGE IN THE DIRECTION OF THE RED ARROWS

H2

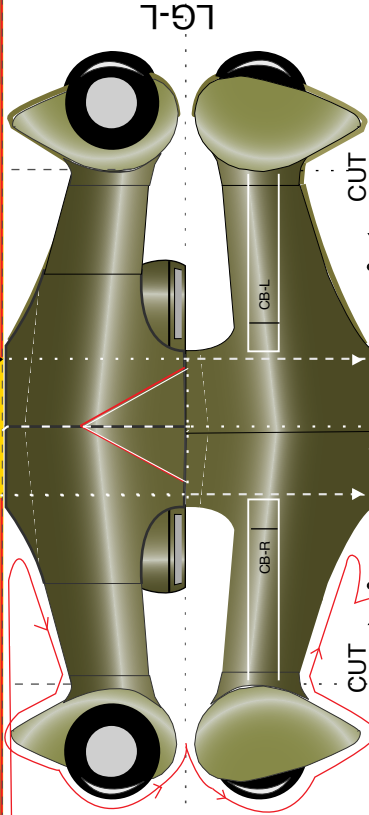
(CUTS #7) WS-R CUT → WTE-R
 WS-L ← CUT WTE-L

H3



H4

CENTER COWLING (CC)



LG-L

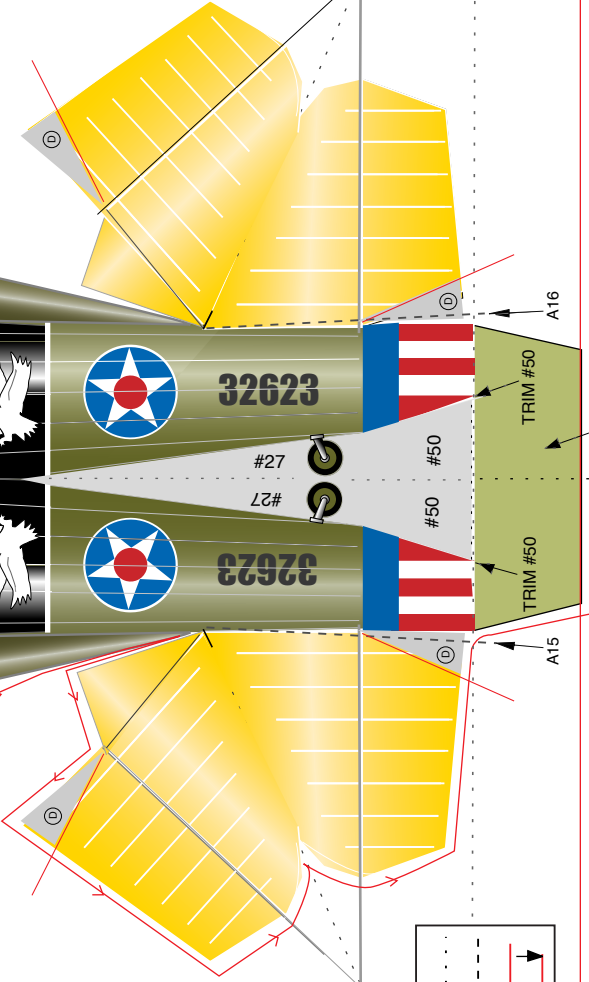
LG-R

CUT #13L

CUT #13R



U.S. Army P-6E Curtiss Hawk, one of the last and best biplane fighters of the 1930s evolved from world's fastest, a 245-mph U.S. Navy R3C-2 racing plane, both of which were predecessors to the WWII P-40 fighter of Flying Tigers fame.



H5
 OUTSIDE FOLD
 INSIDE FOLD
 KNIFE OR SCISSOR CUT
 STOP THE CUT HERE

H5

CUT #6

TEMPORARY FOLD-OVER HOLDING TAB

⊖ = DELETE

⊖ = DELETE

V:C

V:C

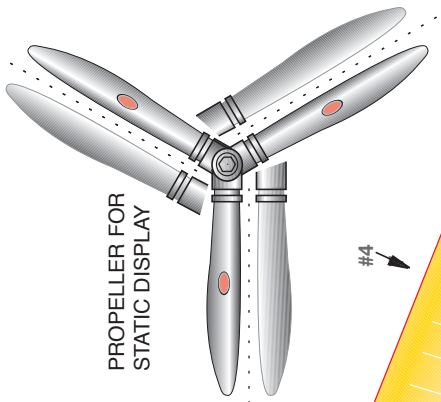
CUT #25R

CUT #25L

CUT #6

TOP

CUT #29



PROPELLER FOR STATIC DISPLAY

#4

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A11

H8

A12

CUT #30

CONTINUE THIS SLOPING CUT TO THE BOTTOM EDGE OF THE PAGE.

⊖ = DELETE

DELETE #38

VC2

(score lightly)

VC2

(score lightly)

CUT #36

⊖ = DELETE



A34

1932 CURTISS P-6E

1932 CURTISS P-6E

1932 CURTISS P-6E

STOP CUT #37

DELETE #38

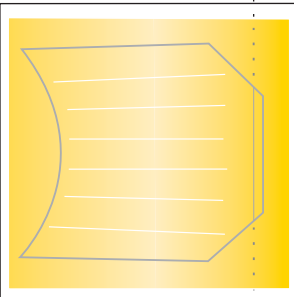
V44

CUT #36

A48

CUT #36

OUTSIDE FOLD
INSIDE FOLD
KNIFE OR SCISSOR CUT
STOP THE CUT HERE



WING CENTER SECTION (CS)

#4

7

A7

H8

A9

CUT #30

CONTINUE THIS SLOPING CUT TO THE BOTTOM EDGE OF THE PAGE.

CUT #29

Construction of Huntly's Paper Biplanes™

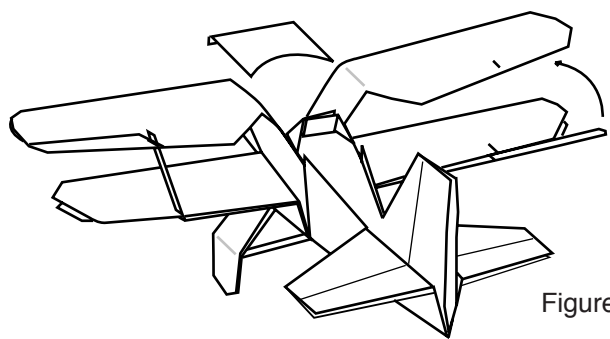


Figure 1.

The construction method used in producing Huntly's Paper Biplanes is an extension of the ancient Japanese paper-folding art known as origami – ori (to fold), gami (paper). Only, unlike the origami bird, these models can actually fly when carefully assembled and aerodynamically trimmed. Paper airplanes have been the toy art of children and adults since the invention of the airplane, but the popular and more complex biplane didn't lend itself readily to paper airplane construction...until now.

Try your hand at putting together this two-part assembly by following the step-by-step procedure, and you'll be rewarded with the fun of making and flying your own biplane fighter. It may take several tries to get it right; but for your own use, you can make extra color copies to use for practice. It helps if you are a meticulous model builder with plenty of patience and can make all folds and cuts as precise as possible. For clarity, the directions are highly detailed, but you will surely find shortcuts to simplify the process.

When printing out the PDF file of the two-page design, plain paper is ok, but coated color paper has more body. The live image will fit in a STANDARD print area, but choose MAXIMUM if available. If entire image doesn't fit on the page, print out at a reduced size (eg., 95%). Print a second set so you can refer to the call-outs while folding and cutting the first set.

Tools you will need: small scissors, pointed razor-sharp Exacto® type knife, a straightedge or ruler, scoring tool (eg., a worn out ballpoint pen), tweezers, fast-drying cement, and a small penknife or tool for applying cement.

1. If extra detail is desired, cut out the two items (shown in ruled line boxes) to fill in the gap between the left and right sides of the front fuselage and set them aside for final assembly: (1) the Center Cowling (CC) consisting of front nose and cowling, instrument panel, cockpit floor and pilot's seat; and (2) the Center Section (CS) to fill in the gap between the left and right upper wings.

First Section – Lower Wing and Aft Fuselage

2. Starting with the first page showing the lower wing and landing gear, score along vertical centerline VC.

3. With a razor-sharp knife, cut V-shape (red lines) of tongue located between the left and right landing gear (LG-L and LG-R).

4. Starting at the top of the page (as marked), score all *horizontal* fold lines H1, H2, H3, H4, and H5. These extend all the way across the page.

5. Make short *angled* score lines at the horizontal stabilizers along A13 and A14 and where the stabilizers join the fuselage along A15 and A16.

6. Trim off bottom of page at cut line #6.

7. Make knife cuts (#7, shown in red) along wing struts WS-L and WS-R and along lower wing trailing edges WTE-L and WTE-R, but stop these cuts at arrows pointing to landing gear dotted bend lines V17 and V18.

8. Cut off end tips of struts, as shown.

9. For landing gear cross brace, make open-ended, elongated cuts CB-L and CB-R inside the landing gear main struts.

10. Make an outward fold (as opposed to an inward fold) at the vertical center line VC along the full span of the page so that the printed side remains “up” and the blank side is folded inside the page out of view.

11. So you may cut around the entire image outline of both the left and right sides of the airplane simultaneously: With the page folded in half and while looking at the right side of the plane (showing “U.S.” on the lower wing), following the red arrows, begin cutting with scissors closely along the edge of the entire image starting at the top left corner of the page at cut #11. Proceed around the lower wing, the landing gear (but not into the notch between the inside and outside struts), into the cockpit, over the headrest, along the fuselage, around the horizontal tail, along the folding tab to the bottom of the page.

12. Unfold the VC fold and lay the page flat.

13. With razor knife, make 1/2" cuts #13L and #13R into the cockpit and stop at the little white arrowheads.

Folding Operation – First Section

14. Starting at the top, make outside folds along H1 and H2.

15. In accordion style, make an inside fold along H3, then an outside fold along H4 and hold them together with a paper clip.

16. Make angled folds A13 and A14 on the horizontal stabilizers to bring the top and bottom surfaces together.

17. Again, fold together the left and right sides of the fuselage, including lower wings and landing gear along vertical center fold VC.

18. Fold the left and right horizontal stabilizers at fold lines A15 and A16 down alongside the aft fuselage while folding and tucking in the little triangular holding tabs. These two bends establish the correct (+2°) angle of incidence of the horizontal stabilizers relative to the wings.

19. With the left and right sides of the airplane, including fuselage, wings, landing gear and empennage still folded together along fold line VC, score along bend lines V17 and V18 located between the left and right landing gear.

20. Fold the left and right landing gear at A17 and A18, along with adjacent left and right lower wings, down along each side of the lower half of the fuselage.

21. Spread out the lower wings and landing gear to a level position, then temporarily spread open the landing gear from the lower wing at fold line H3 and pry out the V-shape

tongue, which will later serve to lock this first section with the second section, yet to be addressed.

22. With a pointed knife, pick open and pry out the cross braces CB-L and CB-R from the underside of the main landing gear. These two short cross braces, when joined together at their inboard ends, keep the landing gear from sagging when the plane is resting on its wheels.

Note: To make the two wing struts and landing gear cross braces more rigid and stay straight, score and crease the inside surfaces lengthwise and coat with cement before placing them in their final positions. Also, for added thickness, you can briefly slide a piece of coat hanger wire inside the leading edges of the lower wings, horizontal and vertical stabilizers and landing gear. Then mold and shape with fingers to round out the creases for greater rigidity.

23. Carefully align together the outboard and inboard surfaces of the landing gear wheels and struts and slide cement inside the aft edges to close the gaps and keep the sides together. (For wheel thickness, you can cement an average size shirt button inside the wheel fairing.)

24. Spread out landing gear and wings to form the appearance of the aft bottom half of an airplane with fixed landing gear.

25. Separate the top side from the bottom side of the lower wings. Then only on the top surface of the lower wings, make scissor cuts #25L and #25R starting at the trailing edges of the left and right lower wings, cutting 1/4" toward the front, as shown in red.

26. Partially close (fold) the top and bottom of the left lower wing together. Now bend the wing strut upward and slip it through cut #25L of the lower wing so to serve as a main support member between the upper and lower wing. Do the same on the right lower wing. (See Figure 1.)

27. Before joining the left and right landing gear cross braces together, trim the bottom edge of the fuselage along the trim line starting from the bottom of the black "eagle" panel to the tail wheel and stop. Make a 1/4" scissor snip upward from the bottom edge just in front and one just behind the tail wheel.

28. Then, align the left and right cross braces CB-L and CB-R to form one continuous cross brace, overlap by 1/8" and cement the ends of the two braces together.

Second Section – Upper Wing and Forward Fuselage

29. On the second page showing the upper wing, front fuselage and striped rudder, trim off the top of the page along cut #29.

30. Trim off bottom of page at an angle by cutting along sloping cut line #30 from the left outboard edge of the page down to the center bottom of the page. Do the same on the right side.

31. With a razor-sharp knife, make a 1/2-inch cut #31 in the bottom of the nose section to receive the locking tongue from the first section.

32. Starting at the outboard ends of the upper wing, score along fold lines A7, A9, A11 and A12, but stop the score lines at the inboard ends where the dotted lines cease.

33. Score along fold line H8 all the way across the page.

34. Make a short score line along fold line A34 located between the left and right sides of the vertical fin and rudder.

35. Score along vertical center line VC2 the full span of the page and fold page in half so that both left and right sides of the airplane can be trimmed simultaneously with scissors.

36. Looking at the left side of the fuselage and left upper wing, start at the bottom edge of the folded page at about 3/4" up from the crease of the center fold VC2, make a 5/8" horizontal cut #36 inward along the cockpit sill, and following the direction of the red arrows, trim closely up and around the windshield borders and stop at the top edge of the engine cowling. Delete gray panels (D).

37. Turn the page around to the opposite edge of the edge just cut and, starting at the trailing edge of the striped rudder, begin cut #37 trimming closely with scissors along the edge of the entire image in the direction of the red arrows...around the fin and rudder, along the aft edge of the wing group, along the outboard wing panels down to the bottom edge of the page that had been trimmed off with cut #30.

38. Open along fold VC2 and lay the page flat. With razor knife, cut out the two gray shaded panels marked "DELETE."

Folding Operation – Second Section

39. Make outside folds A9 and A12.

40. Make outside fold H8 all the way across the page.

41. Make outside folds A7 and A11, which allow the smooth bottom surface to overlap and enclose the other folded panels. Temporarily hold all these folds (steps 39, 40 and, 41) together with a paper clip.

42. At the double sided rudder, make an outside fold A34 to bring the left and right sides together.

43. Again, fold along fold line VC2 bringing together the left and right upper wings, left and right inner fuselage sides along with left and right vertical fin and rudder.

44. On the underside of the two upper wings, score fore-aft bend lines V44 along the inboard ends of the left and right upper wings (where they join the top of the inboard wing struts). Then, tentatively fold the two upper wings down alongside the fuselage at these bend lines. These folds should be level with the line of thrust, because they establish the proper (+2°) aerodynamic relationship with the horizontal stabilizer.

Joining Operation

45. With both sections partly spread open along their vertical centerline folds, slip the locking tongue of the first (lower wing) section into the knife slit #31 of the second (upper wing) section. With the inner fuselage nested into the outer fuselage,

secure them together by closing the temporary fold-over tab (on the aft end of the first section) over onto the aft end of the inner fuselage of the second section.

46. With landing gear and lower wings folded down out of the way, spread open the upper wings, exposing their top sides. Starting at the outboard edges, trim around the left and right wing tips. Trim any mismatched or overlapping edges of the center wing notch and windshield..

47. With the point of a razor-sharp knife, pierce a cut #47 (in red) about 1/4" along the inboard border of the aileron in the upper left wing, being careful not to cut through the wing's trailing edge. Thread the tip of the wing strut from the lower wing through this cut and pull until the lower and upper wings are parallel. (Figure 1) However, in the final alignment, the upper wing remains flat (with no dihedral) while the lower wing is to be adjusted to have a modest 2° upward slope (dihedral) from the inboard wing joint outward toward the wing tip. Do the same with the right wing.

48. Now use the windshield pieces to pull and hold the left and right sides of the fuselage together to within 1/2". Make two A48 creases, then overlap and cement the fronts of the left and right windshield pieces together as shown in Fig. 1.

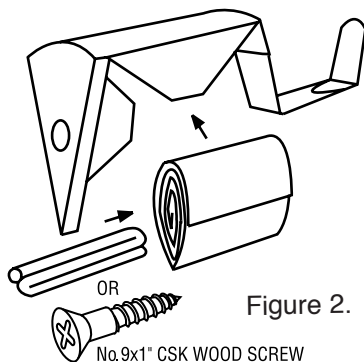
49. With the blade of a small knife, slide a little cement between the aft fuselage and the horizontal stabilizers and inside the left and right sides of the vertical stabilizer and rudder.

50. Trim around the outline of the the bottom of the rudder and fuselage along the trim line #50 from the bottom aft edge of the rudder forward to the tail wheel and stop.

51. With fingers and thumb, squeeze the top and bottom edges of the fuselage to make the two sides bulge out to give the fuselage some width. Then slip in a little cement along the top and bottom open edges while holding them slightly together.

52. In the inside bottom of the of the front fuselage (nose section), add a little weight, such as a 3-inch length of coat hanger wire folded twice down to three 1" lengths (or use a #9 x 1" countersunk wood screw or a dime) and cement it into the bottom of the nose starting at about 1/8" in (aft) of the front edge of the nose. (But first read "option" item at end of step #53.)

53. For extra detail, take the Center Cowling assembly (CC), that was cut out and set aside earlier, and trim around the assembly including flanges. Bend at dotted lines on the flanges, front nose section, instrument panel, cockpit floor and seat. Now, with this CC assembly configured as shown in Fig. 2, it can be slipped into the front nose section, under the bottom edge of the windshield and cemented into the gap between the left and right inside surfaces of the nose and fuselage while aligning the floor and seat with the cockpit opening. (Option: To help the



nose section keep its shape, roll up a double layer of 1"x10" strip of paper around the weight (#52) as shown and cement it inside before placing the CC assembly into final position.)

54. Align all airfoils (wings and tail surfaces) parallel with line of flight as much as possible, except for the horizontal stabilizer, which should have about a two-degree upslope toward the trailing edge. (Step #18)

55. Slide a little cement along the inside trailing edges of the lower wings. Also, slip a little cement along the leading edge of the underside of the upper wings to close the gap between the wing reinforcing fold and the bottom surface of the upper wing.

56. Score and trim the wing Center Section (CS) and cement it over the gap between the top sides of the left and right upper wings.

57. When you're satisfied with the alignment of upper and lower wings, secure the wing struts in place with a touch of cement underneath where the struts pierce through the upper wing. Then snip off the tips of the struts flush with the top surface of the wings.

58. For extra rigidity, you can slip in and cement short lengths of broom straws inside the leading edges of the landing gear and wings and lengthwise inside the fuselage. If extra weight is needed, cut one or two 1/2" lengths of hanger wire and cement it/them onto the top of the engine cowling about 1/4" in (aft) from the front edge of the nose.

59. Align all components as well as possible and trim with cuticle scissors as needed to provide neatness to the appearance.

Flight Test (Trimming and flying the U.S. Army P-6E Fighter Plane)

The flight characteristics of the fighter plane make it purposely unstable, which makes it such a nimble aerobatic fighter. The initial test flight path for this paper airplane should be a straight-and-level gradually descending glide to the ground.

For the test flight, hold the plane with thumb and forefinger at the belly under the cockpit and hand-launch it across the room with a fairly strong thrust. If the plane banks to the right, bend the trailing edge of the left aileron tip upwards. If it banks to the left, bend up the right aileron. If it noses down, bend the elevators slightly upwards and vice versa until you get the plane to fly reasonably straight. Then, with a little tweaking, you can get it to do loops, steep turns and other aerobatic maneuvers.

A light thrust should give you a gradual shallow glide. A strong thrust will make the plane soar upward momentarily, even into a loop, before leveling off into a moderate glide.

After a few trial-and-error flights, you should be able to fly this indoor fighter like a pro, and without danger of damaging furniture, lamps or computer screens.

Good luck and happy landings.

Note: For information about other models and further usage of these copyrighted Huntly's Paper Biplanes, contact Huntly Briggs at (323) 469-7792.