M I R A G E

A PERFECT COMPETITOR, THE MIRAGE WILL PUT YOU IN THE WINNER'S CIRCLE. DESIGNED FOR EASE OF BUILDING, IT RIDES THE LIGHTEST THERMALS. WHEN BALLAST IS ADDED, IT CHANGES INTO A MOVING MACHINE.

By Blaine Rawdon

Construction Photos by Vern Broesamle

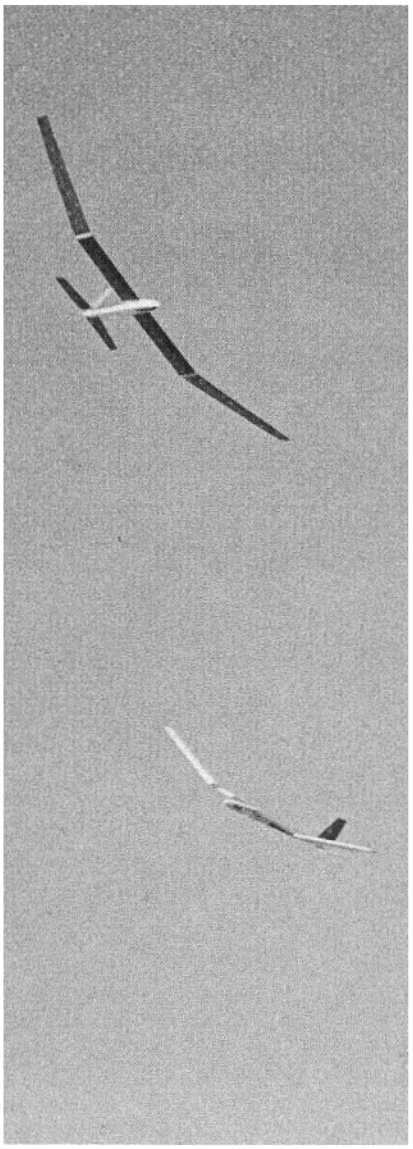
The Mirage is a first class sailplane for competition and sport flying. It provides all the features demanded by the contest flyer --- high launch, low sink rate, fine L/D, wide speed range, excellent thermalling ability, and fine spot landing capability. In some of these areas, it gives a bit away to the gargantuan battleships, but in launch, sink rate, thermalling ability, and spot landing capability, the Mirage is as good or better than the competition. In addition, the plane is terrific fun to fly! Its character is that of a light air floater with speed in reserve if the nose is dropped. With ballast, the plane changes into a moving machine, great for use in strong air.

The Mirage is a proven design. About 40 have been built here in competitive Southern California. The plans presented here are the result of a year and a half of experience with the plane. The plans are accurate, and the design is worked out. If you follow the plans, the parts will fit, and the plane will be competitive right off the board.

The Mirage is not an extreme sailplane. It is moderate in size, strong, durable, and straightforward to construct. It is easily scratch-built from materials available at the local hobby shop.

While the Mirage cannot be recommended as a first airplane for the unassisted beginner, it is so easy to fly that it does make a fine second plane.

What makes the Mirage special is its configuration. The most important feature is the wing section. It is a thick, low camber section --- that is, a semi-symmetrical section. This section is responsible for the performance of the airplane. Planes before the Mirage used similar sections, with amazing performance but, in general, they flew too fast to be competitive in the typical sink rate and spot landing contest. The design problem then was to make a light plane so that it could use the section without flying too fast. This led to a design which deviates from the "ideal" aerodynamic form to obtain a decrease in weight or an increase in strength. The wing center section is a flat, continuous panel to avoid the weight and complication of a joiner or wing rod. The fuselage is an open tube all the way to the rear so that the stab has a wide base and so that the fuselage is very strong for its weight. The rudder is offset so that it may tie in with the fuselage efficiently. The stab has a single elevator which is lighter and cleaner most of the time. Care was taken to see that the structure is strong enough everywhere, but not



overly strong anywhere. This leads to a lot of tapered structural members and a plane that is unusually strong for its weight.

So, now that you can't live without a Mirage, it's time to clean off the board and get to work!

CONSTRUCTION

General Comments:

(1) Buy your wood in whole sheets, and cut your strips from the sheets. This has several advantages including lower cost, consistent stripwood from piece to piece, and a lower chance of picking a damaged piece of wood. The time involved in cutting the wood is trivial. The imperfections created by cutting your own are not important.

(2) Use the lightest wood you can find consistent with your requirements for strength and durability.

(3) Don't use epoxy glues except where called for in order to save weight, unless you have a crude joint that needs filling.

(4) Don't skimp on Titebond. Its dry weight is about 20% of its wet weight, and it is more important to connect the pieces well than to save maybe 1/4 oz. overall.

(5) If you make up your own kit before you start gluing, it will probably save time and mental energy.

Wing Main Panel

General Comments:

(1) The tip joiner receiver box is relatively highly stressed, so it must be constructed with care.

(2) It is very important that the balsa shear webs are accurately cut in order to assure a good bond to the spars. I recommend setting up a simple jig so that accurate and repeatable webs can be quickly cut.

The Steps:

(1) Pin, slalom style, the main spar in its place on the plans. Behind the spar lay a piece of 1/8" square which will serve as a prop to hold the ribs at the proper angle.

(2) Work from the center out --- go: web-rib-web-rib and so on until the last bay which you save for later.

(3) Put your pieces of trailing edge (T.E.) stock up to the ends of the ribs and mark the rib locations. Notch the trailing edge keeping in mind that a smidge too tight is better than too loose.

(4) Remove the wing from the board. Holding the ribs flush to the board at the rear bottom, slide the T.E. with glue filled notches into the ribs. The bottom of the ribs should be flush with the bottom of the T.E.

(5) Test fit the top spar. It must sit right

down on the webs, and it is nice if it is touching the rib notches too. When it's all right, glue in the top spar, and don't skimp on glue here!

(6) Glue in the turbulator spars on top.

(7) Glue on the rectangular leading edge piece. I like to use pins and rubber bands to act as a clamp.

(8) Size exactly and glue in the ply pieces for the receivers using Titebond. You can use a spare piece of 1/8" ply to make sure that the gap is the right width.

(9) Glue on the outer 1/64" ply pieces using Titebond.

(10) Glue the outer 3/16" balsa rib in, and make sure it is straight, and bumped up against the ply receiver box.

(11) Glue in the bottom turbulator, and filet the shear web joints as per plans.

(12) Sheet the center section.

(13) Glue in all the gussets, and the 1/16" piano wire at the trailing edge center.

(14) Shape the leading edge and sand everything smooth.

(15) Glass the center section.

(16) Carve out the openings for the receiver boxes in the 3/16" ribs.

(17) You may find that after the tips are done, and you attempt to plug the tip into the main, that some sanding of the tip joiner will be required. If you are like me you will manage to sand too much off, resulting in a wobbly tip which is bad. One fix is to laminate onto the tip joiner a scrap of that 1/64" ply, and then sand that down until you get it right.

The Tip Panels

General Comments:

(1) In order for the plane to be responsive to the air and to your commands, it is very important that the tips be light.

(2) It is desirable to avoid using heavy trailing edge stock in order to avoid decreasing the speed at which the wing will flutter.

The Steps:

(1) Lay the spar and rib prop as in the main panel. The tip spars are quite highly stressed at the root of the tip. You must avoid wood which has flaws of any sort in this area. Make sure that the spars are made of spruce.

(2) Glue the ribs to the spar, skipping the root rib.

(3) Glue the top spar in, flush with the rib top.

(4) Glue on the 1/64" ply tongue covers with epoxy.

(5) Glue on the 3/16" end rib, and make sure that it is up against the 1/64" ply and that it is square in planview.

(6) Remove the wing from the board, and glue on the tapered T.E. in the same fashion as on the main panel.

(7) Glue on the leading edge piece.

(8) Glue on the top turbulator spars.

(9) Glue in the balsa shear webs, filleting when dry as per plans.

(10) Glue in the bottom turbulator spar.

(11) Glue in the gussets, and the wing tip. I would caution against fancy wing tips as they are more likely to damage performance by their weight than help with their shape.

(12) Carve out the root rib to accept the 1/8" ply tongue. Glue in the tongue with slow epoxy. I recommend slow epoxy because if you use 5 minute epoxy and it goes off white you are getting things lined up you have an expensive piece of junk.

(13) Shape the leading edge and the tip, and sand the wing smooth.

Stab and Rudder

General Comments:

(1) The idea of the stab and rudder is to be as light and strong as possible consistent with building time.

(2) Keep in mind when building the empennage that every extra ounce there will cost you three or four in the nose.

The Steps:

(1) Glue the pieces together.

(2) I glue my empennage to the fuse with epoxy because I figure that sooner or later I will need to make a field repair in that vicinity, so I might as well start out with epoxy to avoid mixing glues.

(3) Do use the tape hinge called out. Use Scotch Magic Transparent tape (the frosty stuff), 3/4" wide. Better yet, but not so pretty is 16mm magnetic film splicing tape which is mylar and very strong and sticky. It may not be pretty because it is white and may spoil you color scheme.

Fuselage

General Comments:

(1) The idea of the fuselage is to be light and strong, with reasonable streamlining. Particular care should be taken to insure that the fuse is light behind the balance point.

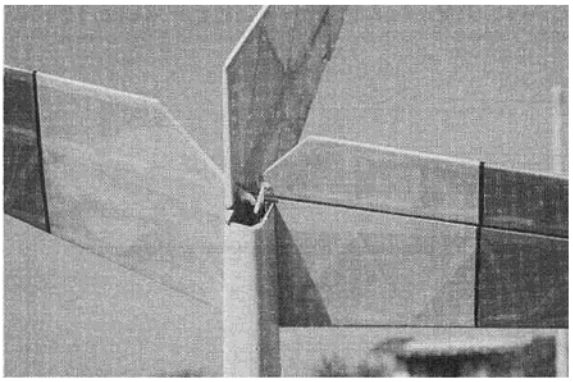
(2) The fuselage is balsa with glass because this seems to be the lightest system for fuselages of this size. It is quite rugged. I would not recommend substituting air ply. It is not worth the weight. Its biggest advantage is its low cost.

(3) You might want to use relatively light outer fuselage sides, with harder doublers on the inside to take the load from the bulkheads. If you mix densities, however, use a non-water base glue to laminate the pieces in order to avoid warping.

The Steps:

(1) Make up the sides, laminating the doubler, and the 3/16" square with the cross pieces. Let the 3/16" square stick out the rear an inch or so for the time being.

(2) Prepare the bulkheads with the



Off-set fin shows neat arrangement for concealing pushrods.

Completed "Mirage" is a beauty.

BILL OF MATERIALS

Fuselage			
2	3/32x3x48	med-light	sides
1	3/32x3x36	med-hard	doublers
1	3/16x3x36	med	bottom and rear stringers
1	3mmx6x12	lite-ply or 3/32 ply	bulkheads and canopy tray
1	2x3x3.5	med	nose
1	3/32x3x36	med-light	top and bottom
1	3/32x12	piano wire	wing hold-downs & tow hook
1	1/4 triangle	med-hard	gussets
2	8-24	nylon or steel	ballast hold-down screws & wing nuts
1	1.5x4x3/32	ply	tow hook holder
1	3x4x1/16	ply	tow hook holder
1	1/4x3/8x5	spruce	servo rails
2	5/16x5/16	med	pushrods
1	2oz. x 8x30	glass	glass
-			misc. pushrod hardware
Stab and Rudder			
1	1/4x3x36	med-light	stab and rudder
1	1/8x1/4x18	spruce	fin spar & fuse reinforcement
Wing			
2	1.25x5/16x36	med	main trailing edge
2	1x1/4x36	med-light	tip trailing edge
1	1/8x3x36	med	turbulator spars
1	1/4x3x48	med-hard	leading edge
1/2	1/16x3x36	med	planking
2	3/8x1/8	spruce	main spars
4	1/8x1/8	spruce	tip spars
1	1/32x3x36	med	tip webs
1/2	3/32x3x36	med	main webs
1	1/8x3x36	med	main webs & center ribs
1	1/8x6x12	ply	tip joiners
1	1/64x6x12	ply	tip joiners
2	3/32x3x36	med-C grain	main ribs
3	3/32x3x36	med-light C grain	tip ribs
1	2x1/16	piano wire	trailing edge center reinforcement
1	3/16x3x36	med	4 ribs
1	2oz. x3x20	glass	planking glass
1	12x18x24	iron	kitchen sink

MIRAGE
Designed By : Blaine Rawdon

TYPE AIRCRAFT
Thermal Sailplane
WINGSPAN
112½ Inches
WING CHORD
9" Center — 6" Tip
TOTAL WING AREA
915 Square Inches
WING LOCATION
High Wing
AIRFOIL
Semi-Symmetrical
WING PLANFORM
Constant Chord — Tapered Tips

DIHEDRAL, EACH TIP
9-9/16"
OVERALL FUSELAGE LENGTH
48½ Inches
RADIO COMPARTMENT AREA
(L) 8¼" x (W) 2" x (H) 2"
STABILIZER SPAN
28 Inches
STABILIZER CHORD (incl. elev.)
6⅞" (Avg.)
STABILIZER AREA
192½ Square Inches
STAB AIRFOIL SECTION
Flat
STABILIZER LOCATION
Top of Fuselage
VERTICAL FIN HEIGHT
7¾ Inches

VERTICAL FIN WIDTH (incl. rudder)
6¼" (Avg.)
REC. ENGINE SIZE
NA
FUEL TANK SIZE
NA
LANDING GEAR
NA
REC. NO. OF CHANNELS
2
CONTROL FUNCTIONS
Rudder & Elevator
BASIC MATERIALS USED IN CONSTRUCTION
Fuselage ..... Balsa & Ply
Wing ..... Balsa, Ply & Spruce
Empennage ..... Balsa & Spruce
Wt. Ready-To-Fly ..... 33 Ounces
Wing Loading ..... 5.19 Oz/Sq. Ft.

wing tie-downs and the servo rails.

(3) Glue to one side the two "servo" bulkheads perpendicular to the sides. When dry, glue the other side to the bulkheads. Make sure that the sides are very well lined up, in order to avoid a crooked fuse.

(4) When dry, glue in the front bulkhead and the rear bulkhead. I like to use drafting tape as a clamp. If your two sides are made of the same wood, the fuse should be bent equally on both sides.

(5) Make up a temporary bulkhead for the very rear of the fuselage and tack it to the 3/16" square at the rear, making sure that the fuse is all lined up.

(6) Cut out the 3/32" x 3/16" crosspieces and glue them in, using drafting tape as a clamp.

(7) Glue on the bottom sheeting, 3/16" and 3/32".

(8) Glue in all the triangle stock. I would recommend using fairly hard stock, but it's not critical. In any case, make sure the joints are good, even if you have to use epoxy to fill gaps that you can't get rid of. Do not leave out the crosspiece of 1/4" x 1/8" spruce at the top of the rear bulkhead.

(9) Rough out the noseblock, sand smooth the two faces where it meets the fuse. Glue it on. Temporarily tack the canopy tray to the fuse, and glue the front canopy former to the tray, using the block to line things up. Glue the canopy to the tray. Cover the canopy with tape to protect it, and shape the noseblock to its finished contour.

(10) Glue on the top sheeting.

(11) Razor plane the fuse corners to shape, then sand things down nicely. Don't finish sand yet because you have still to glass the thing.

(12) Glass the forward portion of the fuselage with two ounce glass. Note the dotted lines on the plan which show the extent of the glass. Note that you can cover the whole shot with one piece of glass.

(13) Trim whatever needs to be trimmed, and sand it for the last time.

Covering

I recommend MonoKote. All of the torsional rigidity in the wing comes from the covering, and MonoKote seems to be the most rigid. I would also cover the fuse with MonoKote since it is rugged, light, easy, and works fine over glass.

Some comments on color scheme: Dark wing bottoms seem to be the most visible at really high altitudes. You might also add a chrome band around the fuse, and maybe a strip on the rudder, so that if you lose sight of the plane it will flash occasionally.

Finishing Touches

Make the pushrods. I strongly recommend the balsa rods called for in the plans. Balsa has two big advantages: it is lightest, and it does not change size relative to the fuse with changes in temperature. This means that you can learn the trim settings on your transmitter and count on them all day long and from week to week.

Do make up blocks of lead ballast. I make blocks by melting lead in an old tin can on my gas stove. Simply pour the lead into a form made of lumber scraps with an aluminum foil liner. Be careful when you do this — be ready for such unlikely disasters as the bottom of the can falling out — wear shoes and pants!

Prepare the plane for flight. Get the C.G. in the right place. Make sure the wing is straight except for equal washout on both tips. You can do this by sighting from behind the trailing edge. Get the rudder and elevator pointing straight, with the correct throws. Shake the airplane to see what you forgot to fasten in properly. Check to make sure that the wings are of equal weight. If not, add weight not at the tip, but rather at the joint between the main panel and the tip where it will have less effect on the moment of inertia. If you are going to do it right, put it ahead of the spar as well.

Flying, At Last!

Give the thing a hand toss to see if the laws of aerodynamics still work. If you didn't get out on that thermal you flew through, you might cheat and put it up on a winch or high start. There is really nothing to it. On launch the plane is not sensitive to trim --- too much up and the plane mushes, too much down trim and it goes up faster. In any case it should go up about as well as a Paragon, with about two-thirds the line tension.

The big thing with this plane is the speed range. This means that in thermals while circling you should really slow it down. Just floating around at minimum sink speed you want to be significantly above stall speed --- it will take awhile to figure out the very best speed, but it isn't crucial. For best L/D you want to move about 10% faster than minimum sink speed. In sink or heading upwind you want to go faster. The plane will really move if you put the nose down.

If you are flying on a day with strong lift and sink, or a day with wind, you will want to broaden the speed range further at the expense of the lowest speeds by ballasting the airplane. Just don't get carried away showing off the plane's speed because you just may blow the wings off. Don't exceed 60 mph and you will be okay.

When working thermals, try to determine the thermal size and center. If the thermal is very small, as is often the case at low altitudes, don't hesitate to bank the plane steeply to get into the core. The plane seems to fly cleanly at bank angles as high as 45°.

The best spot landing approach for this plane seems to be of the rectangular type. Fly by your head downwind with some extra speed at about 10 feet and 15 seconds. At 8 seconds or so, depending on the wind, start your about-face. Work the turn as necessary to lose altitude or keep it. Then come right down to the deck and line it up. Then nail the spot. If you are stretching, make the turnaround gently and come down to the deck later. And vice-versa.

I like to practice my landings from a hand launch. A hard toss will give you 30' easy, and a full approach can be made. If the day is good it is fun to do a little circuit of the field, and try to work lift. It is not all uncommon to get out from 20' with this plane. If you get tired of bending over to pick the plane up, it is very easy to play catch with yourself!

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