Avro Arrow

BY: Anton Eisele

The Arrow was the icon of Canadian aviation and the most advanced fighter airplane in the world in the early 1950s. The airplane was born during the Cold War when it was believed that the Russians threatened the world. Canada was looking for a long-range supersonic fighter to fend off intruding Soviet bombers. Unable to find an existing airframe that would suit its need, the Canadian government and Avro, a transplanted British airplane manufacturer, decided it would completely engineer and build its own fighter jet — airframe, engines and all. Four years later, on October 4, 1957, the Arrow rolled out and made its maiden flight on March 25, 1958. A total of five Arrows were built.

With a delta wing that spanned 50 ft, the Arrow could fly to Mach 1.98, but that was not its performance limit. Many engineering firsts were incorporated in the Arrow, and the world was listening. The French put in a large order for the Arrow's Iroquois engines, which they were going to use in their Mirages. Even though the airplanes were a bargain, Canada had serious difficulties financing such a huge engineering and production endeavor. Then, through twisted national and international political and business persuasion, it was decided that it was not Canada's place to enter and possibly be at the forefront of the arms race. All five airplanes — including drawings, sketches, pictures, and so on — were chopped up, burned and hauled to the scrap yard. The British offered large sums of money for an airplane or just some drawings, but no deal could be struck. Even the bomber that was on loan from the U.S. to test the Iroquois engine was destroyed. No money was ever recovered.

While that was going on, the large American airplane companies, the National Advisory Committee for Aeronautics (NACA) and other U.S. government organizations were quick to lure Avro's engineers and scientists to come work for them. The offers were not refused and Canada's Arrow experts were quickly put to work on such aircraft as the F-15, the F-16, and the lunar missions.

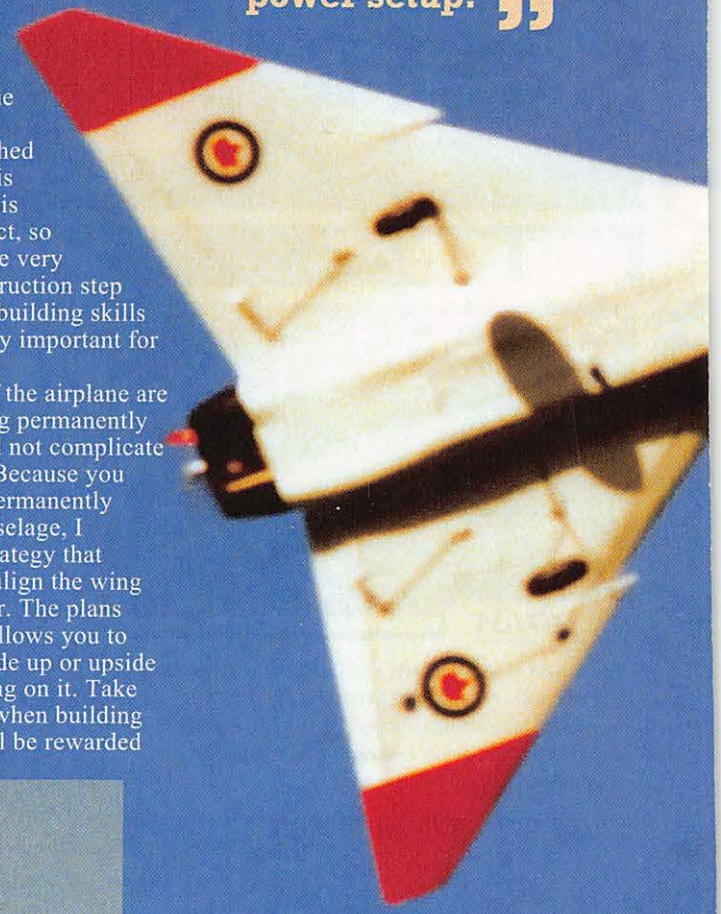
Building the Avro Arrow

This airplane took me a couple of years to design and build. This was not because the Arrow is an overly complicated design, but rather because I kept putting it on the back burner while I worked on other designs. In so doing, all the details have been worked out, so you should be able to build your own Arrow relatively quickly.

In an effort to retain most of the scale-like features, I had to overcomplicate the structure of the airframe a bit. However, the finished product looks great and is well worth the effort. This is not a beginner's project, so even though the plans are very detailed, not every construction step is discussed here. Good building skills and some patience is very important for this project.

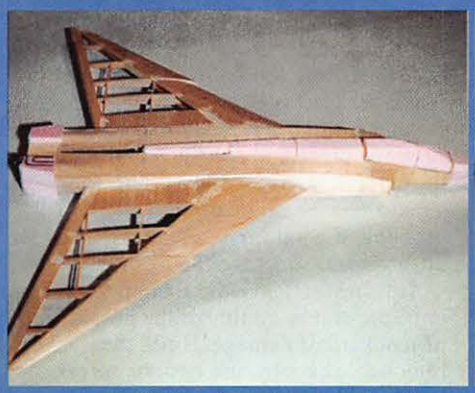
The shape and size of the airplane are such that having the wing permanently fixed to the fuselage will not complicate transporting the model. Because you only get one chance at permanently fixing the wing to the fuselage, I incorporated a design strategy that makes it difficult to misalign the wing and the vertical stabilizer. The plans also show a cradle that allows you to cradle the model right side up or upside down to facilitate working on it. Take care and take your time when building this airplane and you will be rewarded

"The Arrow took 150 to 200 ft of grass runway to get off the ground and it flew very well with the new power setup."

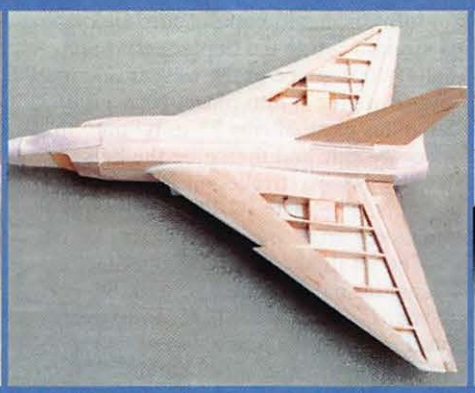


▲ This bottom view of the Arrow shows it banking sharply away from the camera. The propeller is in imperceptible in the air.

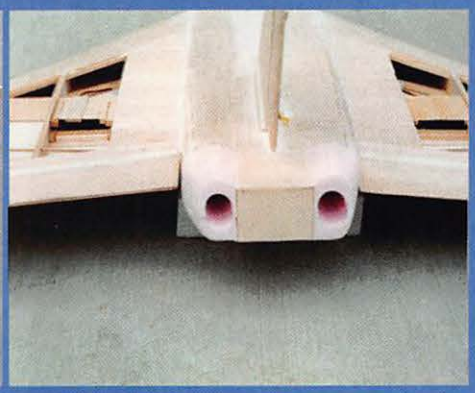
◀ The Arrow flies straight towards the camera at full speed. It has a low profile so it can be difficult to see.



▲ The frame with the unshaped pink foam. It is a good idea to do the shaping before gluing the vertical stabilizer in place.



▲ All the parts of the airplane are sanded and the bottom is already covered with film.



▲ The back of the airplane shows the air outlets. Air actually enters the front of the airplane and exits at the back after spilling over the batteries.

with not only a beautiful and great-flying model, but also a fascinating conversation piece with a very thought-provoking history.

Wing

The wing is relatively easy to build and, when finished, is remarkably strong. It is built in two pieces and then permanently glued to the fuselage. It is tapered in every dimension but the bottom, which remains flat on the building board while the top surface tapers down towards the tip. This gives the illusion that the wing has anhedral, just like the full-scale aircraft did, but without having any adverse effect on stability.

Start by cutting out all of the ribs and the plywood pieces. Lay the bottom 1/16-in. sheeting in place on top of the protected plans and then pin the 3/8- by 1/4-in. and the 3/8- by 1/8-in. hardwood spars in place. Glue the ribs and the plywood spars B5 and B6 on top, making sure they are flat on the building board and plumb. Put the top spars into place and the spar bridge B3. Cut the 1/4-in. thick balsa trailing edge with the varying width, as shown on the plans and glue it in place.

The top 1/16-in. sheeting can go on now. Try to glue the sheeting, both top and bottom, onto the front of the ribs while the wing is still pinned to the building board, as this will minimize the chance of sheeting-induced warping.

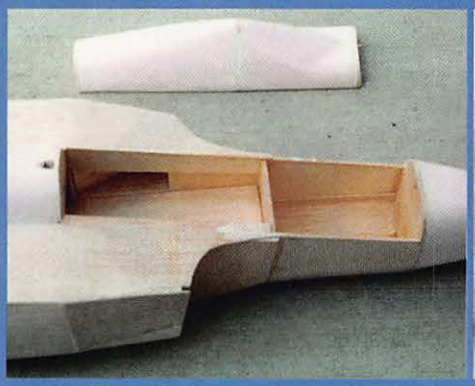
Remove the wing from the building board and glue the 1/4-in. thick balsa leading edge into place. Cut the leading edge wider than needed and trim it later. Glue the servo platform in. If you built the servo well, as shown on the plans, you will have just enough space for a standard-size servo. The servo is held in place by two small 1/4-in. blocks and the servo well cover.

Build the aileron as shown on the plans. It really helps to leave the tail end of the aileron ribs short of the sheeting; that allows the top and bottom sheeting to come in contact at the end. All that remains is to carefully shape the leading edge and sand the wing. Repeat the whole process for the other wing panel.

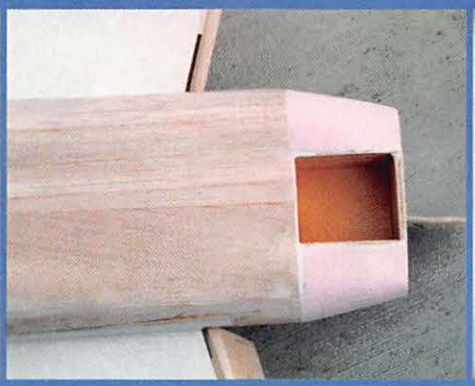
Fuselage

The fuselage is built up and sheeted with 1/16-in. balsa. Start by cutting out all the formers, the two longitudinal center pieces and the servo-and-battery tray (F3-F7).

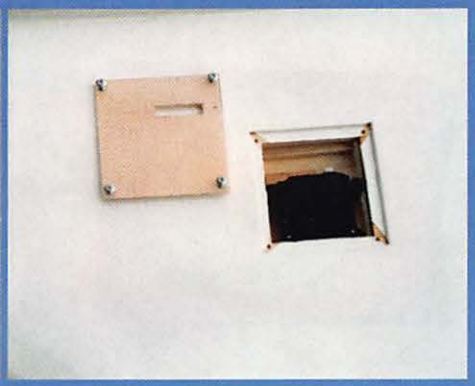
Glue all the inside formers onto one of the longitudinal center pieces. Make sure they are 90 degrees to the center piece. Now glue the other center piece onto the



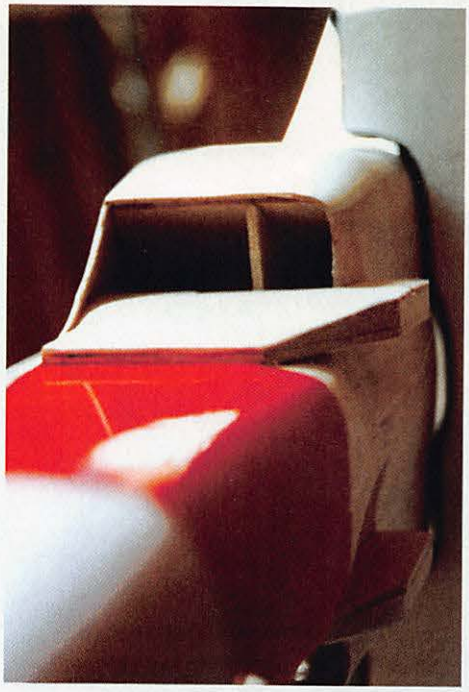
▲ Access to the front gear is quite easy if you choose to use a hatch such as this.



▲ Here we see the motor compartment at the very back of the model. It is left open to provide cooling air onto the motor.



▲ Here you see one of the two elevon servo access hatches that are built into the bottom of the wings.



▲ The "jet" intakes are built into the sides of the fuselage. The air is ducted over the batteries as it leaves the rear of the airplane.

formers, again making sure everything is straight. Slide the poplar servo-and-battery tray piece in the former openings and then glue it into place. Now glue the outer parts of ribs F3 to F7 onto the fuselage side and then glue the balsa 1/4- by 1/8-in. stringers into the outside formers. The plate F7-F8 goes on top of the motor area.

The jet intake is made from the triangular balsa brace F3C and the former F3B. Glue the brace onto the fuselage with the brace's top flush with the fuselage center piece cutout. F3B adjoins the corner of the fuselage side and F3. These air inlets serve as ducting for battery cooling.

The next order of business is to cover the beast with 1/16-in. balsa. Start with the bottom and then do the sides. Note the servo access hatch at the bottom of the fuselage. Leave the top unsheeted for now. Use water on the balsa to facilitate bending of the sheeting if necessary.

I glued the wings on at this stage, but you might choose to leave them off and do as much shaping and sanding as you can before making the model more cumbersome to handle.

Cut the notches for the wing spars (B5 and B6) into the side of the fuselage in front of formers F5 and F6. Test-fit the wings to the fuselage, making sure that the spars fit into the cutouts in the fuselage center pieces. The outer rib will not sit entirely flat on the side of the fuselage. That is okay, as long as spars B5 and B6 butt flat against the center fuselage piece and are flush with the tops of their respective formers. The wing should now be aligned properly. This is probably a good time to install the rudder pushrod and sheet the top of the fuselage.

It is best to leave the foam parts off until the end to minimize the possibility of inadvertent damage. Build the removable canopy and battery access hatch as shown on the plans. To get the angle of the canopy formers on the platform right, you might want to cut a small angle guide from some scrap plywood. The two "intake air dams" are not simply decorative, they serve as skid pads if you choose not to use an undercarriage. Build them separately and then glue them onto the fuselage.

The airplane cradle should be built now, so you can rest the fuselage on it for the next step. Cut out the vertical stabilizer from 1/4-in. solid balsa and glue it in place. It should be self-aligning. Flip the airplane around and finish the radio access hatch.

Now comes the time for all of the foam work. I used the pink stuff because it can be shaped without having little

▶ The Arrow is seen here fitted with the landing gear and is sitting on the runway just before its second flight.

▲ The decal template gets taped over a piece of covering material. Use a new #11 Exacto blade and a clean smooth cutting board to cut out the decal.

▲ Here is the maple leaf cut out and ready to apply to the airplane.

▲ This photo shows you what a completed roundel looks like when it is applied to the wing.

▲ You can see the landing gear extending from the model as it makes a low pass for the photographer.

▲ Another low pass for the camera shows the landing gear is out of character, but it can be removed. A bungee launch system works well to get a fast smooth launch.

pieces break off.

Fill the seams and coat the skin of the airplane thinly with lightweight drywall fill, such as Poly Instafill® from LePage, and sand the whole machine to get it ready for covering.

Radio Installation

You either need to put the elevon servos in the wing and pull the cable through the wing servo-cable guide, or route an extension cable through that guide before covering the wing. The aileron servos are held in place by gluing 1/4-in. blocks on the servo sides. The servo well cover will hold them in place. There is just not enough space in the wing to do a traditional concealed servo mount. Of course, if you use wing aileron servos, you can mount them on the platform.

The rudder servo is screwed onto the F3-F6 platform, as shown on the drawing. That platform can also be used to secure the receiver and the servo battery. Due to the distance between the motor and the batteries, a heavy-gauge motor cable is recommended. The batteries and electronic speed controller (ESC) get plenty of cooling, as the air flows through the jet inlets and out the back in flight.

Finally, balance the aircraft as shown on the plans.

Finishing

Your choice of color scheme is limited to white and red with some anti-reflective black. You can look at the various Web sites that are available on the airplane to get an idea of how the original Arrows were painted, but the best thing to do is to get the book called Arrow by Boston Mills Press. It has many great pictures and the whole story to boot.

I covered the foam parts with low-heat plastic covering and the rest of the airplane with Oracover®, of which I am very fond. The Canadian Air Force markings—a maple leaf surrounded by a circle—were cut out from covering material. You can photocopy the decal from the plans, cut off most of the excess paper and tape the template onto the desired covering. With a new #11 blade, carefully cut along the lines of the symbol you are making. It is best to work with a small piece of covering so you can rotate the thing as you are cutting. Of course, you need to do this on your cutting board.

Flying

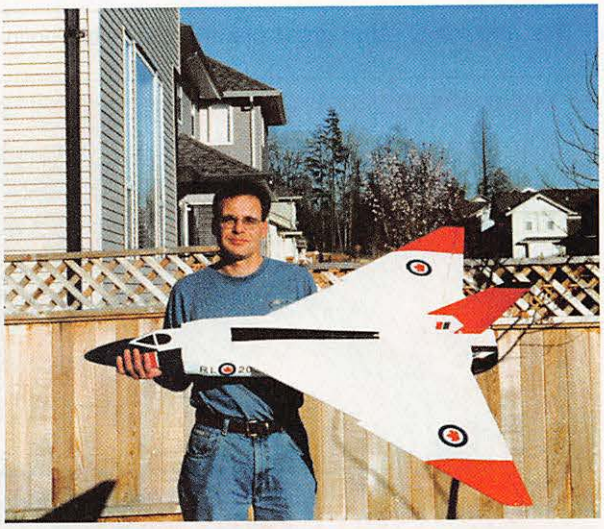
The maiden flight of my Arrow was by hand-launch because the model did not yet have landing gear. The Arrow is not an easy airplane to hand-launch due to its size and lack of graspable area. For its first flight, the Arrow was powered by an overpowered Mega 22/30/3 motor that was pulling 70 amps from a 6S2P 4200-mAh (Lithium Polymer) LiPo battery pack. It turned a 9 x 6-in. gas type propeller at what must have been 20,000 rpm. The airplane went into an almost vertical climb. It was fast and had ample power. After trimming the airplane a bit, I flew it for some low passes for picture taking.

The first flight showed me that the Arrow flew better than expected and balanced right where I calculated it should. With the batteries starting to drain and after having tested the uneventful stalling characteristics (predictable and wings-level), I decided to grease the model in for a landing. The Arrow kept on gliding, almost reaching the end of the airfield before touching down. I now knew that it glided well, too.

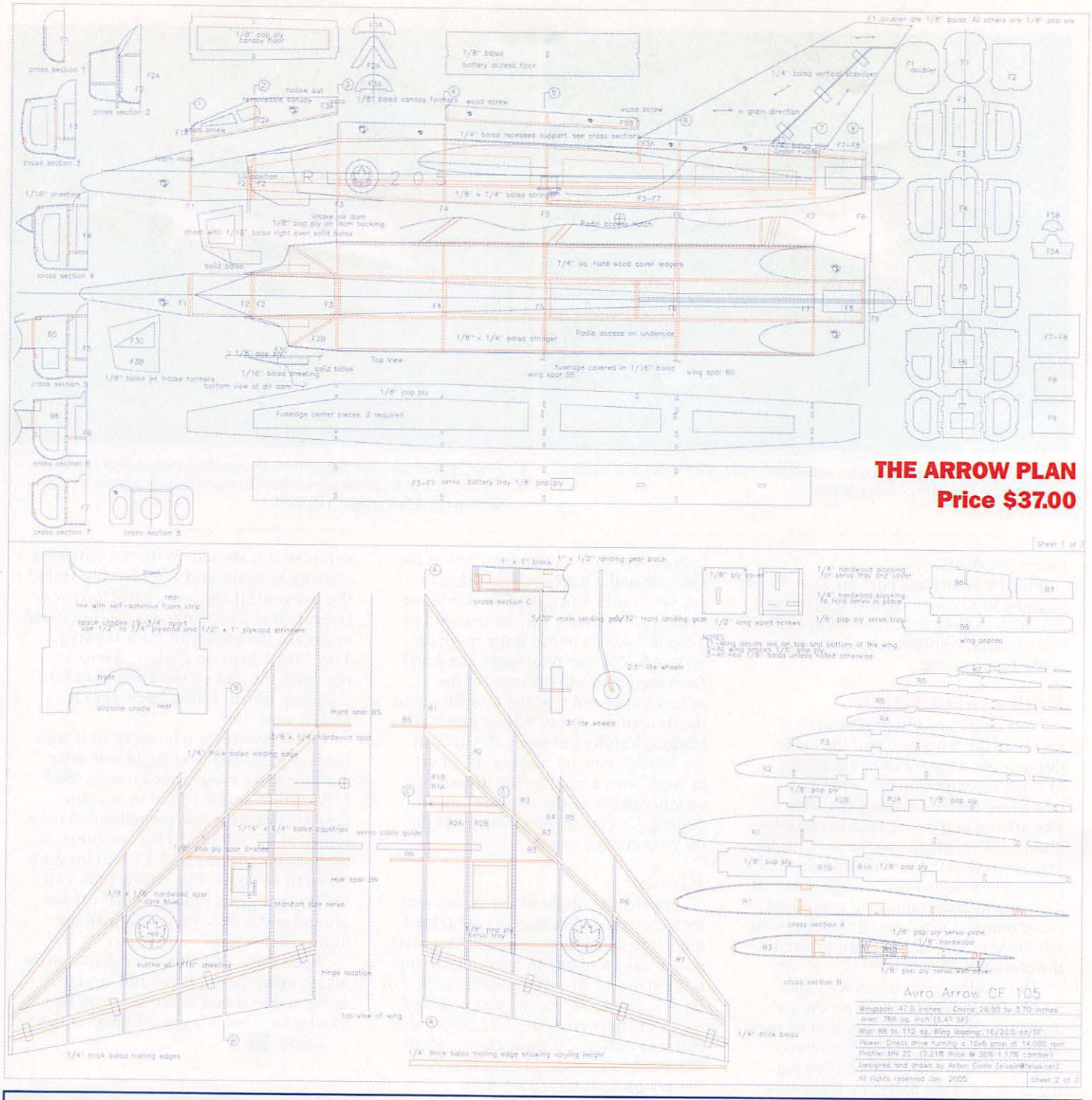
I took my creation home to fit it with landing gear. The next flight was done with the same motor, but I used a 4S2P LiPo battery and a 10 x 6-in. electric type Master Airscrew propeller that only turned at 13,500 rpm. This combination brought the Mega 22/30/3's current draw down to 40 amps. The Arrow took 150 to 200 ft of grass runway to get off the ground and it flew very well with the new power setup.

Since then, I've flown the Avro Arrow many, many times. It is a fun airplane to fly and to watch in the sky with its jet like looks. This is a great-flying airplane.

Enjoy! QF



► Anto proudly holds his creation up for a photo. Notice that the model is quite large in size and is a very unusual subject for electric power.



This and many other great plans are availble online at kionapublishing.com/catalog or call now at 1-866-627-0456