

Piper Pawnee Brave

By Art Heenan

Sport performance highlights this fine Stand-off scale cropduster. For .40s.



PHOTOGRAPHY: ARTHUR HEENAN

I am a sheep and beef cattle farmer, in far off New Zealand. Agricultural aircraft at work, spreading their loads of superphosphate fertilizer over the hills, have always been a familiar sight to me. The sight and sound of them at work, with their low level sowing runs and wing-over like turns, has always fascinated me. One of my earliest memories is of watching a pair of Tiger Moths spreading fertilizer from a strip near our house, and it was this that kindled my interest in aircraft, and started me building models. I have been building R/C scale models for the last seven years, almost all of them my own design. Agricultural aircraft are my favourites.

I designed this model for general sport flying to stand-off scale standards, although it is completely accurate to the factory three view I worked from. A few calculations showed that a model built to 1/8 scale would suit a .40, my favourite size engine. This resulted in a reasonably compact sized model, with a wing span of 58½" and wing area of 525 square inches. The simple modern line of the Brave lends itself well to modeling, construction being reasonably simple with foam wing cores and all sheet tail surfaces. The fuselage, too, is reasonably simple, although more work.

I firmly believe that lighter models fly better, and although my Brave ended up a little heavier than I would have liked, its flying characteristics are excellent. With a little care in wood selection, I think the model can be built somewhat lighter. I duplicated the full size aircraft in using engine downthrust and positive incidence in the wing. This al-

lows the model to fly in a realistic manner and speed. The basic design of the Brave model has been kept as simple as possible, while maintaining good scale appearance. The addition of the scale detailing, and a good paint job results in a very attractive model.

The aircraft

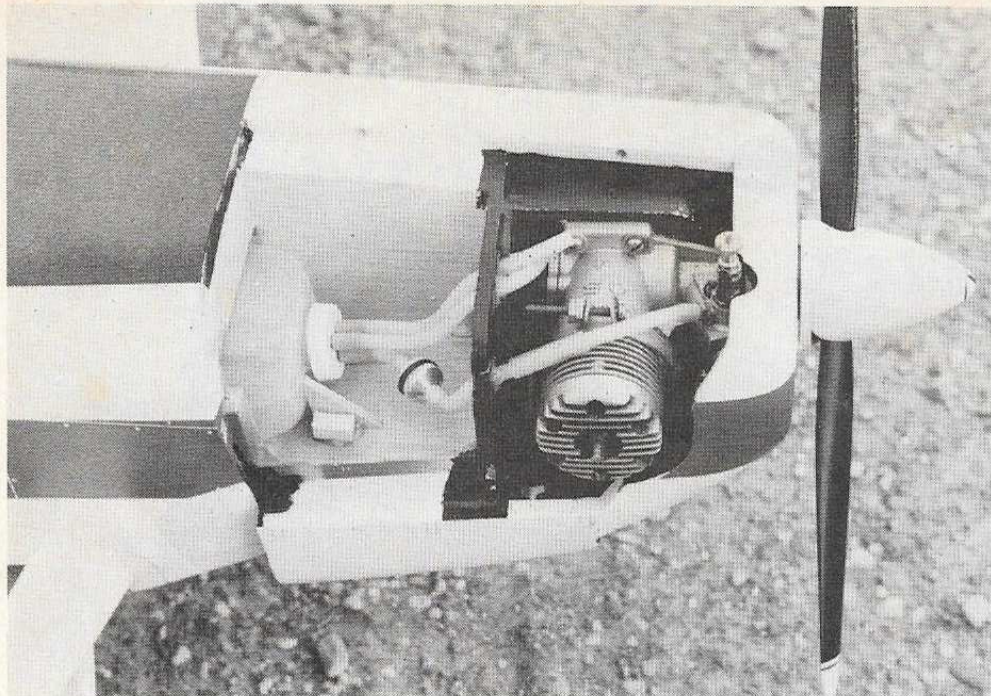
The Piper PA25 Pawnee first flew in 1959, and revolutionized agricultural aviation, the cockpit area being specially designed for pilot safety in the event of a crash. The pilot

sat high up, giving good visibility from behind the loaded hopper. This aircraft remains in production as the Pawnee D, with a 260h.p. engine.

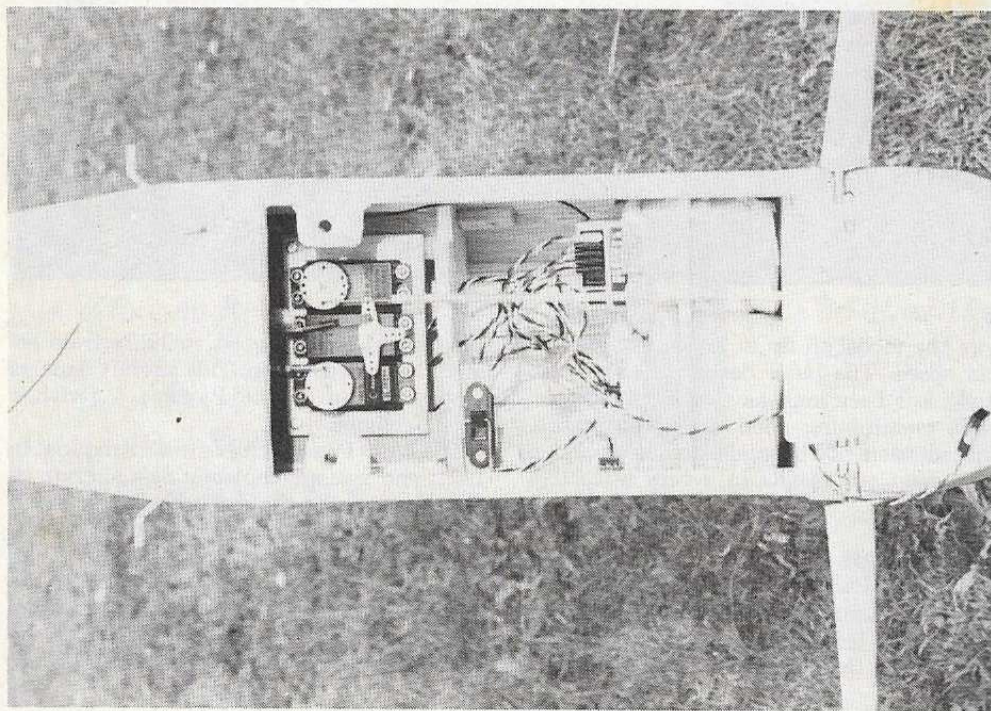
The PA36 Pawnee Brave was introduced in 1971, and was a completely new aircraft although retaining the same basic layout. Of all metal construction, it proved a success, but was rather underpowered by its 285h.p. Continental "Tiara" engine which had the propeller geared at a 2 to 1 reduction ratio. Performance was greatly improved with the installation of conventional 300 or 375 h.p.



Piper Pawnee was a natural subject for our author since he's a New Zealand farmer who's been around crop dusters all his life. His Pawnee is a sport scale ship which looks different and flies well.



Engine installation is very neat (above). Power is from an O.S. 40 with a DuBro muffler. Large fuse makes radio installation a breeze (below). Author used a Futaba radio with side-by-side servo mounting.



Lycoming engines on the Brave 300 and Brave 375.

Wing span of the Brave is 38.77 ft., with a length of 26.79 ft.

Construction

No problems should be encountered when building the model, but follow the sequence set out in the following detailed instructions. As with all models, and especially scale models, weight is of prime importance, so pick your wood carefully. I would recommend making a kit of all the components before starting construction, as this allows building to progress with no holdups. Almost all the construction was done using aliphatic resin glue.

Wings

Cut the foam cores for the two main panels and the centre-section using the template on the plans. Epoxy the $\frac{1}{8}$ " balsa false L.E. and

T.E. to the cores, and shape to match. Inset the ply wing bolt plate into the lower surface of the centre-section, and glue the balsa blocks into the two of the wings, where the torque rods will be anchored in the ailerons. I used 1mm poplar veneer to cover the cores, but $\frac{1}{16}$ " balsa sheet is just as good. After covering, the L.E. and T.E. and tip blocks can be glued on, and then carved and sanded to shape. Mark out and cut the ailerons from the wings, and face the wing and aileron with $\frac{1}{4}$ " and $\frac{1}{8}$ " balsa as shown.

Sand the inboard end of each panel to the dihedral angle, and epoxy them to the flat centre section, with $2\frac{1}{2}$ " dihedral under each tip. Cut a through in the top surface for the aileron torque rods, which are formed of $\frac{1}{8}$ " diameter music wire in a plastic tube. Epoxy in place. If done carefully, the skin can be replaced over the top. Apply a 3" wide strip of fibreglass cloth around the panel joints at the centre section. If using polyester resin for

this, be sure there are no gaps where the resin can attack the foam cores.

The slots for the aileron hinges may now be cut and the ailerons temporarily fitted. Don't hinge permanently till after the model has been painted. Cut the servo well in the centre section, and line it with balsa. The servo can now be mounted and the aileron linkages completed.

The triangular fairing on the L.E., next the fuselage, is built on last. Glue ribs R1 and R2 and the $\frac{1}{8}$ " flase L.E. in place on the wings. Sheet the fairing, top and bottom, with $\frac{3}{32}$ " balsa, beveled along the rear edge, to blend in with the wing. This joint will probably be a little rough, but some "Dap" filler will soon take care of that. Finally, glue on the $\frac{1}{4}$ " L.E. and sand to shape.

I decided to build in the L.E. landing lights at each wing tip, but they may be omitted for simplicity. A hole is cut out for each light and faced off with balsa. Later, before painting, they were finished off by gluing silver foil inside, and the light covers cut from acetate sheet, bending to match the airfoil. Set the acetate in flush with the wing surface.

Tail surfaces

These are simple. Cut all the pieces from $\frac{1}{4}$ " sheet balsa, noting the direction of the grain of the tip pieces of the rudder and elevators. Join where required and round off the L.E. of the stab and fin. Sand the rudder and elevators to an airfoil cross-section. For improved appearance, I made up an internal elevator horn by silver brazing the brass horn to the $\frac{1}{8}$ " elevator joiner wire. Sleeve the wire with short pieces of nylon tube, and epoxy these to the stab, reinforcing with a scrap of glass cloth. Inset $\frac{1}{32}$ " ply into each side of the rudder at the horn/tailstrut position for reinforcement. Finally, cut the hinge slots.

Fuselage

Begin by cutting out the sides from medium $\frac{3}{16}$ " sheet balsa, and gluing the wing fuselage doublers in place. At the same time glue the $\frac{1}{4}$ " triangular stock along the bottom. Draw the datum line along the inside of each side, to assist in accurate assembly. Make up formers F2 and F6, and bolt the radial engine mount, ready drilled to match the engine, to F1. Score and crack the sides at the rear of F6, squeeze glue into the crack, and begin assembling the fuselage by joining the sides at the rear, and gluing in F6 and F3. Check the fuselage carefully for alignment and glue in the cockpit "floor". After the glue has dried install the tailwheel bracket, complete with the strut. I used a commercial tailwheel bracket, trimmed slightly, and epoxied in, upside down. Sheet the underside of the rear fuselage with $\frac{3}{32}$ " balsa, cross grain.

Glue F2 in position, and build a box, from $\frac{3}{32}$ " sheet, to enclose the fuel tank between F2 and F3. The tank is inserted into the completed model through F3, and the hole covered with scrap balsa, to prevent any fuel leaking back into the radio compartment. The tank can still be easily removed for cleaning, etc. Make up the L.G. mounting block from $\frac{1}{8}$ " ply, with $\frac{1}{8}$ " by $\frac{1}{4}$ " hardwood strips glued on, to form the channel for the

wire struts. Glue this to the fuselage and epoxy in the two $\frac{1}{2}$ " sq. hardwood anchor blocks, which also solidly brace the L.G. mount to F3. Drill out for the struts, which are retained with aluminum straps and self-taping screws. The struts are bent from $\frac{5}{32}$ " wire, with balsa fairings epoxied on.

The wing can now be fitted. Sand the fuselage for a neat fit. The wings should be mounted with 2 degrees positive incidence. Glue the locating dowel to the L.E. of the wing. Glue the hardwood blocks to the fuselage for the wing bolts. The cowling is built on at the front by gluing the $\frac{1}{4}$ " side to F2 and to the back of the noseblock. When the glue has dried, F1, complete with engine mount, is angled slightly and installed for the 2 degrees of downthrust. F1 may be moved slightly, if necessary, to suit the length of your particular engine, with a gap of about $\frac{1}{16}$ " between the spinner backplate and the noseblock. A Fox "Slim Jim" spinner is the correct shape. Box in the fuel tank bay on the bottom and at the center, between F1 and F2.

To represent the air outlets from the rear of the engine cowling, the triangular parts of each side, which angle in behind the cowl, must be removed and replaced with custom made parts, which angle in to F2. The air outlets are really solid balsa, but when painted matte black, look quite realistic. Refer to the photos to see the shape of the fuselage here. Route the throttle cable and then add the soft balsa block cowling underside, and the bottom sheeting from F2 to F3. Complete the fuselage top next. Glue on all the top formers and the $\frac{1}{8}$ " by $\frac{1}{4}$ " stringers. F7 is drawn oversize and is sanded to fair in with the rest of the structure before sheeting or planking with $\frac{1}{8}$ " balsa. The top of the cowling is $\frac{1}{4}$ " sheet.

Carve and sand the cowling to shape before cutting free the hatch for access to the engine. I retained this hatch with a rubber band, inside. Fit the engine and then the muffler, trimming the cowl as necessary. I mounted the OS 40 on its side, for best appearance, with a Dubro muffler, slightly shortened to match the cowling. Glue the stab, complete with the elevator pushrod fitted to the internal horn, to the fuselage. Also install the fin and finish off the fuselage by carving balsa fillets for the fin/stab junction.

I would suggest leaving off the cockpit canopy structure till after the model is covered and primed. It is assembled by gluing F6a into a slot in the canopy top block and the fuselage. A simple jig, from scrap balsa, pinned in place, is handy at this stage to hold everything in alignment till the glue dries. Make the front framing from $\frac{1}{4}$ " dia. dowel, and epoxy in place. Glue strip $\frac{1}{8}$ " by $\frac{1}{4}$ " to the front of F6a for additional strength.

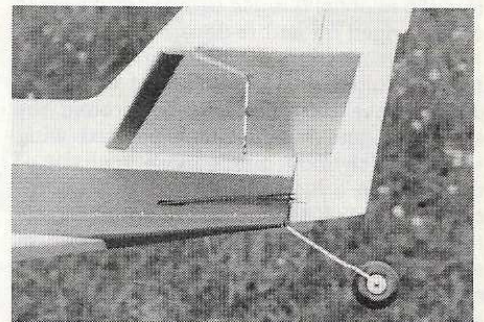
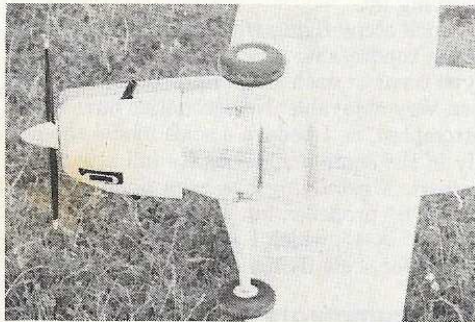
Finishing and detailing

The finishing and painting is what makes a scale model, or any model for that matter, so be prepared to spend plenty of time on this part of the project. The following is the method I use.

Begin by sanding the entire airframe to a nice, smooth finish. Fill any gaps, holes, etc., with "Dap" spackling compound, which sands easily to match the balsa. Brush on



In flight the Pawnee looks very realistic (above). Underside of fuselage (below left) shows landing gear mounting, under wing hopper and fairings and muffler cut out. Wheels are 3" diameter P.B. Aeroscale. Tail assembly (below right) uses simple construction, but does good job of duplicating scale-like structure.



two coats of clear dope, all over, sanding after each to remove the "fuzz". Cover the model with lightweight tissue, laying each panel in place, and then misting water on to dampen the tissue. The water will make the tissue adhere temporarily to the model. Now, using your fingers, smooth the tissue out, lifting where required to remove any creases. When the tissue is smoothed out, brush on clear dope over the entire panel. After completely covering the airframe in this way, put aside overnight to dry out completely. One coat of straight dope thinners is now brushed on, this softens the dope slightly and really bonds the tissue to the wood.

I use a mixture of clear dope and talcum powder to fill the surface and obtain a nice smooth finish. Two coats will be required, with more on any bad patches. Sand after each coat is dry with about 320 grade paper. When satisfied with the result, finish off with one coat of clear dope. I would recommend spraying the model with grey car primer at this stage, primarily to hide the grain of the wood.

Now is the time to get busy and add the detailing that makes a scale model come alive. Build the canopy framework, as described previously, and paint the cockpit interior. Please include at least a pilot, and an instrument panel for him to look at. I also included the seat back, the headrest with its framing, and the pilot's safety harness. The canopy glazing can be done with two pieces of flat acetate sheet, the windscreen and side windows from one piece, and a separate piece for the rear. Cut each piece $\frac{1}{8}$ " oversize and inset the thickness of the acetate into the framework for neatness. Glueing the glazing in place is not a job I like, but it has to be done. I use 5 minute epoxy for this, and find strips of selotape (Scotch tape) as well as the hands to hold everything in place while the glue dries. The small skylight windows will

have to be molded to obtain the correct shape. Carve a balsa block to shape for the pattern, and finish it with a coat of dope and two coats of dope/talcum powder filler to make a smooth finish. I held the acetate sheet in front of an electric heater till it softened and then stretched it over the balsa pattern. As soon as the glazing is in place mask off all the areas of the canopy that will remain clear, to protect from scratching, paint, etc. I use selotape for this. Any gaps around the canopy edges should be filled and sanded now.

I made the hopper fill hatch from sheet styrene, and its opening linkage was detailed with pieces of brass and plastic tubing and wire. The wire cutter, up the front of the windscreen, was made from a strip of aluminum attached top and bottom, to tabs of aluminum epoxied into the airframe. The cable from there to the top of the fin is white shirring elastic. The position of the dummy exhaust pipes are shown on the plan. The pipes were made from plastic tubing epoxied in place. The tubing was held in place with pins. Make the steps on the fuselage from brass tubing bent to shape and epoxied in place. The under wing dispersal equipment will vary between aircraft, depending on whether it is used for dusting or spraying. The dust box and fairings, front and rear, which I duplicated are simple $\frac{3}{8}$ " wide balsa structures. To enable the L.G. struts to be removed easily I mounted the front fairing on hinges at the front, so that it can be swung out of the way. A screw secures the rear.

The dummy wing flap hinges were made from thin ply, slotted into the wing, with a pin pushed through, glued, and cut off for the hinge pivot. When it comes to making the scale details I find that a little thought and imagination are the main requirements in producing good results.

For several years now I have been painting

Pawnee Brave

my models with ordinary gloss enamel paints, with good results. The one disadvantage is the longer drying time required between coats. All the paint should be sprayed on a scale model. Aerosol cans are okay if you don't have access to a spray gun. Remember that paint is heavy, so apply several light coats instead of one or two heavy ones. The large registration letters on the fuselage were masked off when spraying the red trim, but the small lettering around the cockpit was done by hand with a small sable brush and thinned enamel. The panel lines were drawn on using a draftsman's pen and thinned grey enamel. One advantage of using enamel is that if a mistake is made with the lettering, it can be wiped off and re-done.

Any weathering desired can be applied now. I limited this to dirt stains under the wings above the wheels, stains around the dust box, and to the black painted wing walks which look much more realistic if misted with a little white, well thinned. To cut the gloss off the paintwork spray the entire model with a well thinned coat, or two, of semi-gloss clear polyurethane. This is very effective, producing a very realistic appearance. Matt polyurethane can be used in places also, such as on the wing walks, and the anti-glare panel in front of the cockpit. Before flying the model, I would also recommend that the model be waxed with a paste type car wax. I find it is much easier to clean down after flying, if this is done.

Radio installation and balancing

I always leave the radio installation till after the model is finished, so the radio can be positioned to achieve the correct balance point. Fit the engine, muffler, tank and propeller first. The model should balance at 30% of the wing chord, which is 2.7" back from the L.E. The radio compartment is large enough for any installation, and no problems should be encountered here. I fitted my trusty FUTABA radio with a mixture of S17 and S23 servos, on a plywood tray at the rear of the compartment. The receiver, ni-cad and internal switch fitted in neatly, forward of the servos. Leave room on the fuselage for the aileron servo and its linkage, when the wing is mounted in place. Use 1/4" sq. hard balsa for the rudder and elevator pushrods. The control surfaces should be set up with the following movements: ailerons - 5/8" up and 7/16" down, bending the torque rods forward at the servo end, to achieve the differential movement; rudder - 3/4" each way; and the elevators 5/8" each way.

The ready to fly weight, was 5 1/2 lbs.

Flying

The first flight took place in far from ideal conditions. The wind was quite strong and gusty. After a very short take off run a gust of wind lifted the Brave into the air at an impossibly steep angle, with the left wing low. However, the required corrections were instantly applied and it climbed out safely. Large circuits were flown to check out the trim and control responses, and give the pilot time to calm his nerves, before landing safely. No more flying took place that day.

Flight performance was much as expected.

A little right rudder is required to keep the take off straight, as well as a little up elevator to stop it nosing over from the drag of the grass. Some down elevator trim seemed indicated during the first flight, but was later removed after a few flights had gained the feel of the model. No other trim changes were needed. Apart from the take off, all normal flying is done at about 1/2 throttle, which flies the Brave in a realistic manner. The controls are responsive at all times, and low speed characteristics are good, with no tendency to drop a wing. Keep the airspeed up on final approach, till familiar with the model. Total flights to date exceeds 40, with no faults showing up.

Much of my flying with the Brave consists of low topdressing runs, with steep wing over type turns at each end, in prototypical manner. Very enjoyable. No aerobatics have been attempted, as I believe a scale model should fly in the same manner as its full size counterpart. Most flying has been done using a 10" x 6" propeller, but I have recently tried and 11" x 4", which I feel may be the better choice for scale flying.

Final comments

I have only one minor criticism of my

Brave to pass on. The wire L.G. struts are inclined to deform in a heavy landing, which causes the balsa strut fairings to crack. Perhaps a change could be made to a tempered aluminum L.G. I also feel that with a little more care on my part it could have been built a little lighter, as I used much heavier wood than was required when constructing the fuselage.

While I chose to model the 300hp version, a Brave 375 can easily be built from this plan. I believe that the only change required would be to lengthen the engine cowling by about 3/4", forward of F2, and fit a 3 blade prop. A 10" x 4" should be ideal for flying.

For the competition minded readers, I have flown my Brave in three contests to date, with a first and a second placing. It also placed sixth in Class 2 Scale (stand-off scale) at the 1980-81 New Zealand "Nationals", from 27 entries, scoring high static points.

In conclusion, when building and flying this model I hope you will have as much enjoyment from it as I have. I would be very pleased to receive any comments you may have regarding this design. Arthur Heenan, Fortification, No 1 R.D., Wyndham, New Zealand.



Details such as panel lines, canopy molding, cockpit instruments and pilot really add to realism (above). Muffler and head cutouts in cowl are only giveaway that this is a model taking off (below). Distinctive plane.

