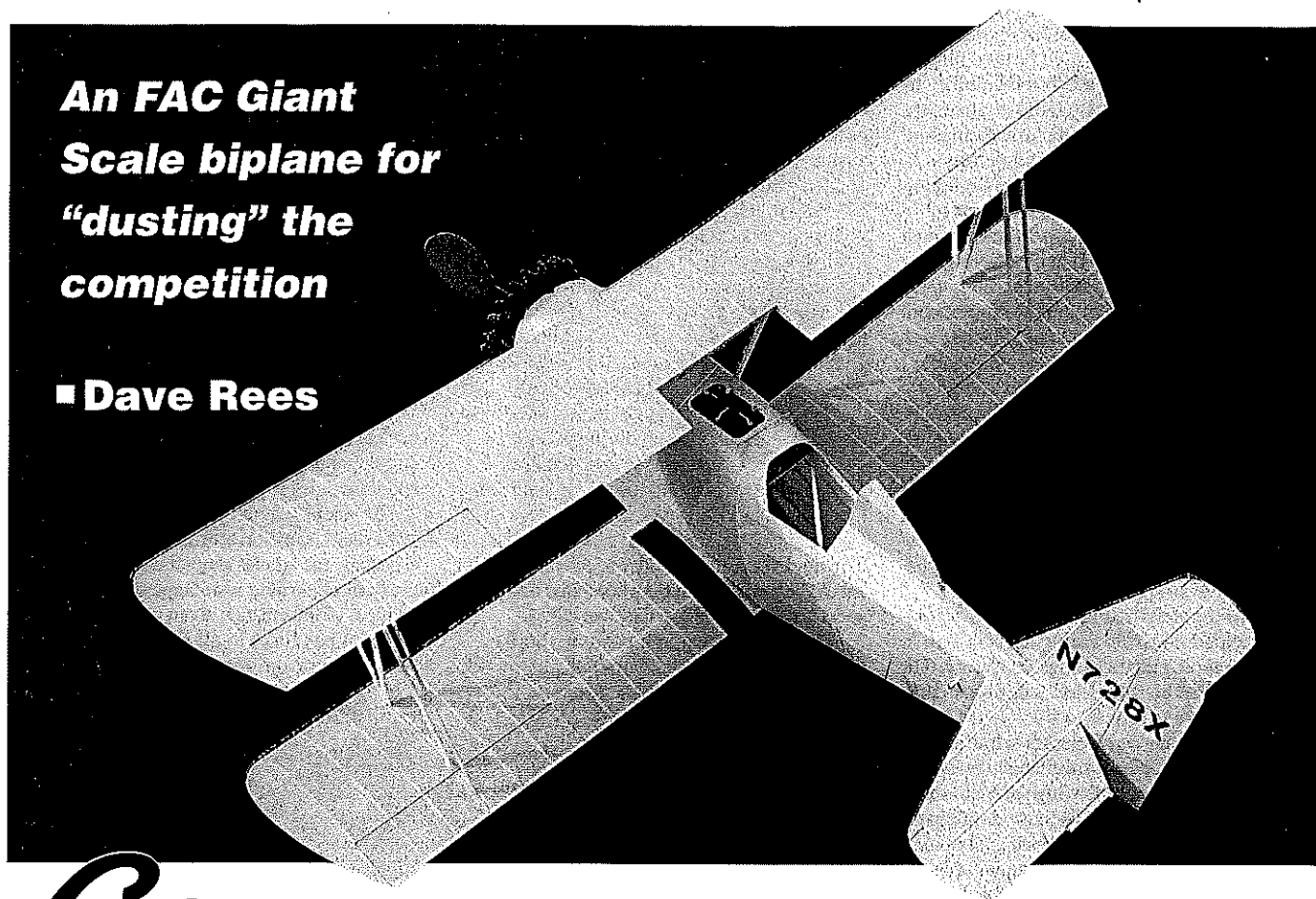


#906

**An FAC Giant
Scale biplane for
"dusting" the
competition**

■ **Dave Rees**



Grumman **AG-CAT**



Find a field with soft, long grass for trimming purposes. You can adjust the propeller pitch for the best flight profile.

The author gets ready to "dust" another field with his workhorse biplane. This is a stable, slow, and majestic flier.

Grumman AG-CAT

Type: FF FAC Giant Scale

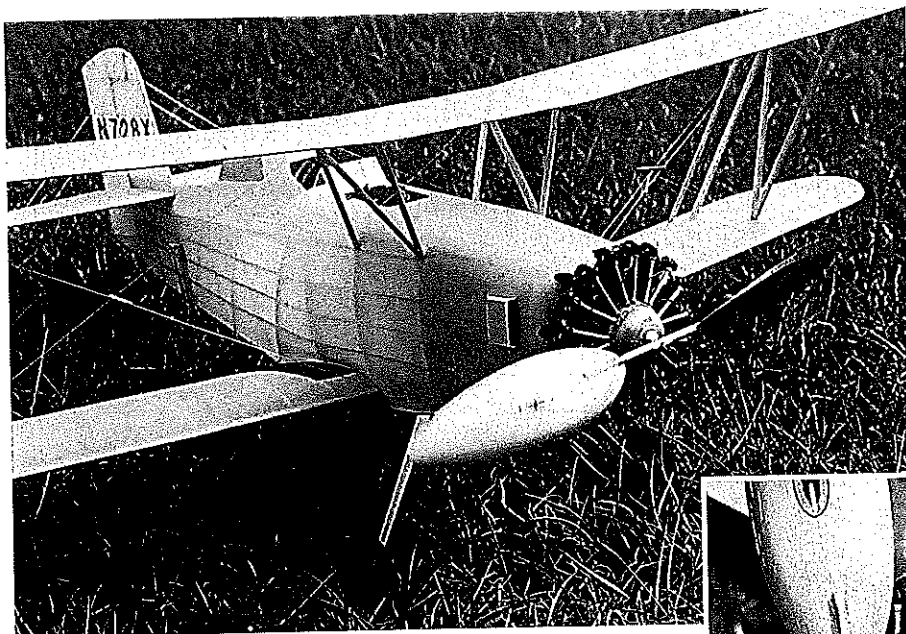
Wingspan: 36 inches

Power: Rubber

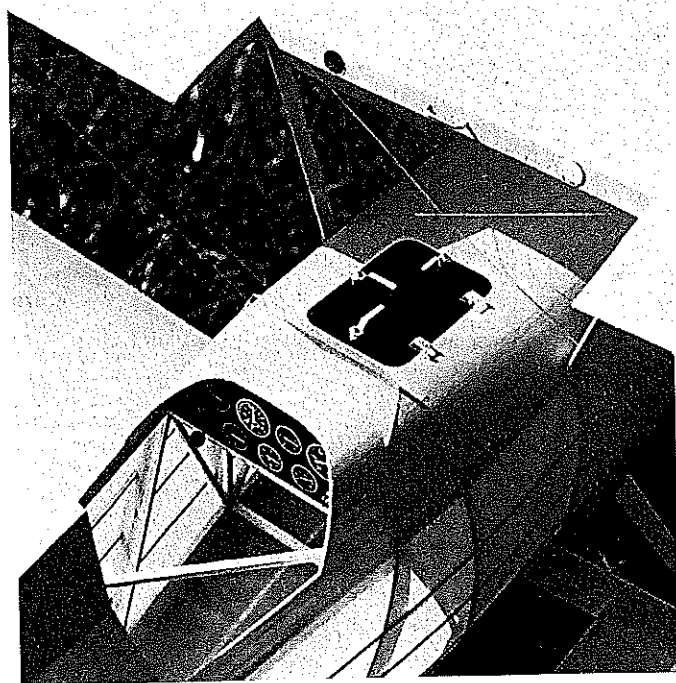
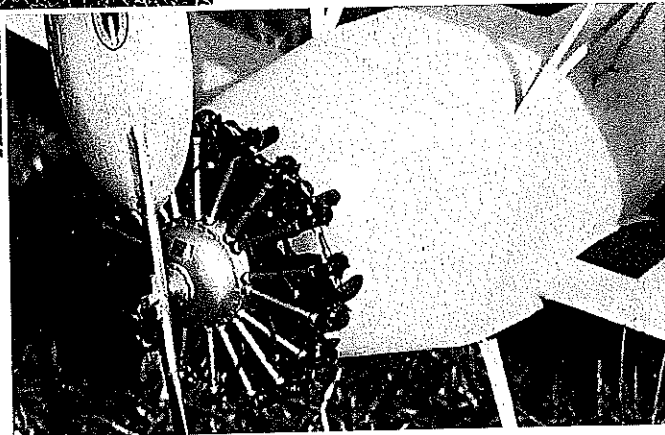
Construction: Sheet and stick balsa

Flying weight: 3.59 ounces

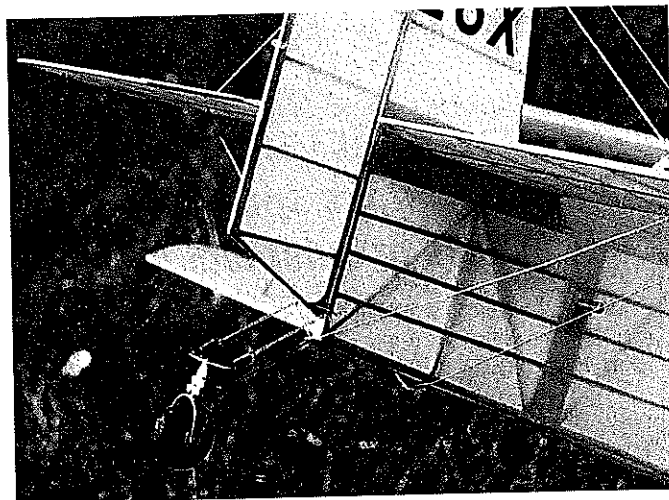
Covering/finish: Tissue and dope



The author constructed this high-quality simulated engine from nine Sig Manufacturing Pratt & Whitney cylinder kits.



Details make the difference. Note the hopper hatch, simulated wing walk, flying wires, and instrumentation.



Add as many details as you like, but watch the weight; it adds up! Here's the simulated steerable tailwheel assembly.

THE GIANT SCALE event is relatively new in the Flying Aces Club (FAC) division. Not to be confused with Radio Control Giant Scale, which is well-established, FAC rules state that the class is for rubber-powered Scale models with wingspans of 42 inches or longer for single-wing subjects and 36 inches for biplanes.

Nothing is more majestic than those large models floating over the field at the national meet in Geneseo NY. However, I had dismissed the idea of making one after looking at our minivan and the amount of stuff we bring with us.

Even if taken apart, one Giant Scale model would take the space of three normal-size airplanes—that's three events I couldn't enter! (I usually fly in too many events.)

I have been going through my Coconut Scale period the last few seasons, and now I am used to handling and transporting 36-inch-span models. So I thought, maybe if I pick the right biplane subject and use Coconut technology, I can still get everything in the minivan.

The Ag-Cat was the natural choice. If you can transport a 36-inch-span model, you can fly Giant Scale.

Crop-spraying is popular in my home state of North Carolina. At work, nobody could resist leaving his/her computer and/or cubicle to look out the windows as a seemingly fearless pilot showered the field next to our parking lot.

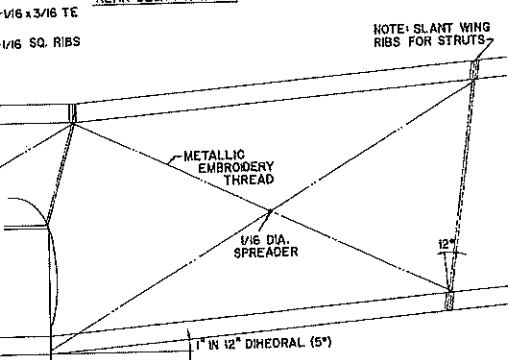
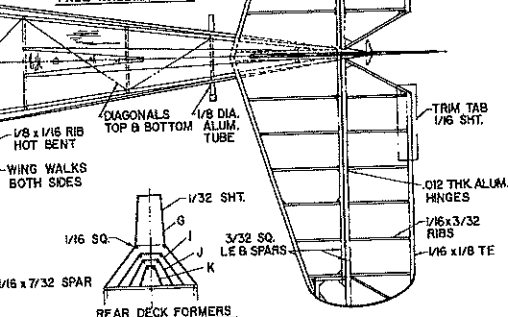
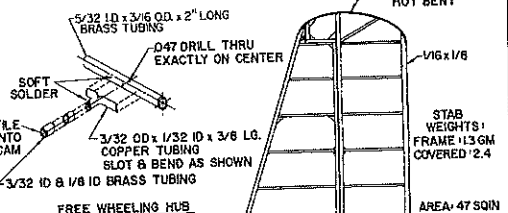
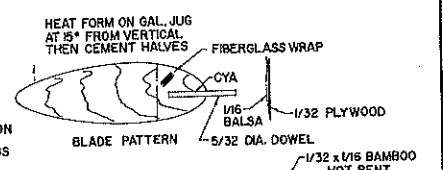
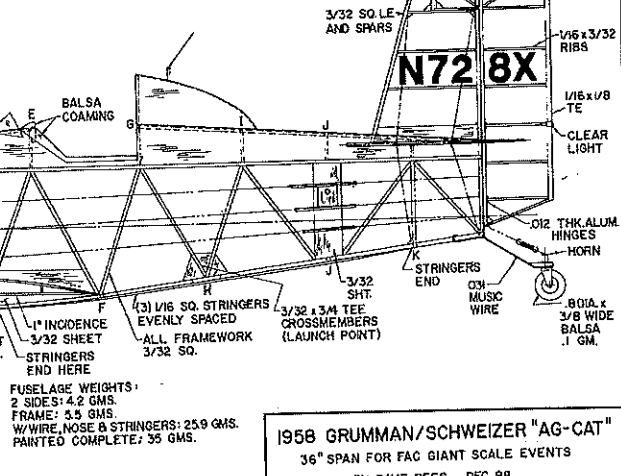
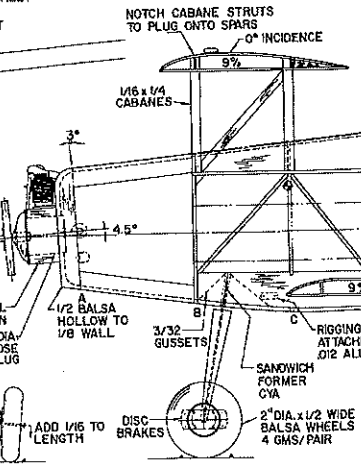
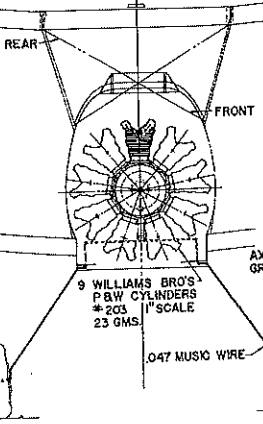
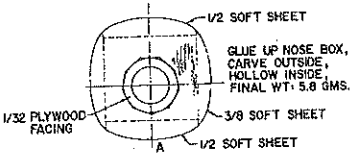
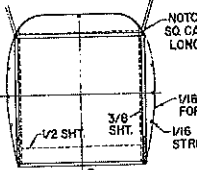
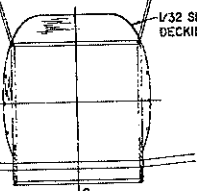
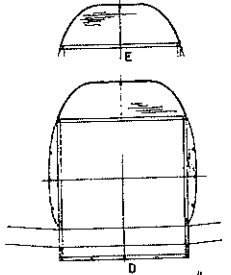
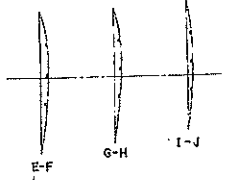
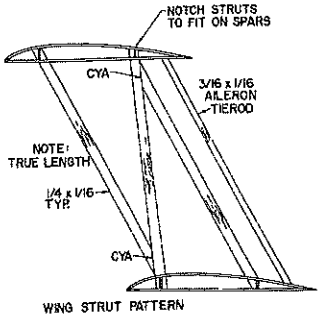
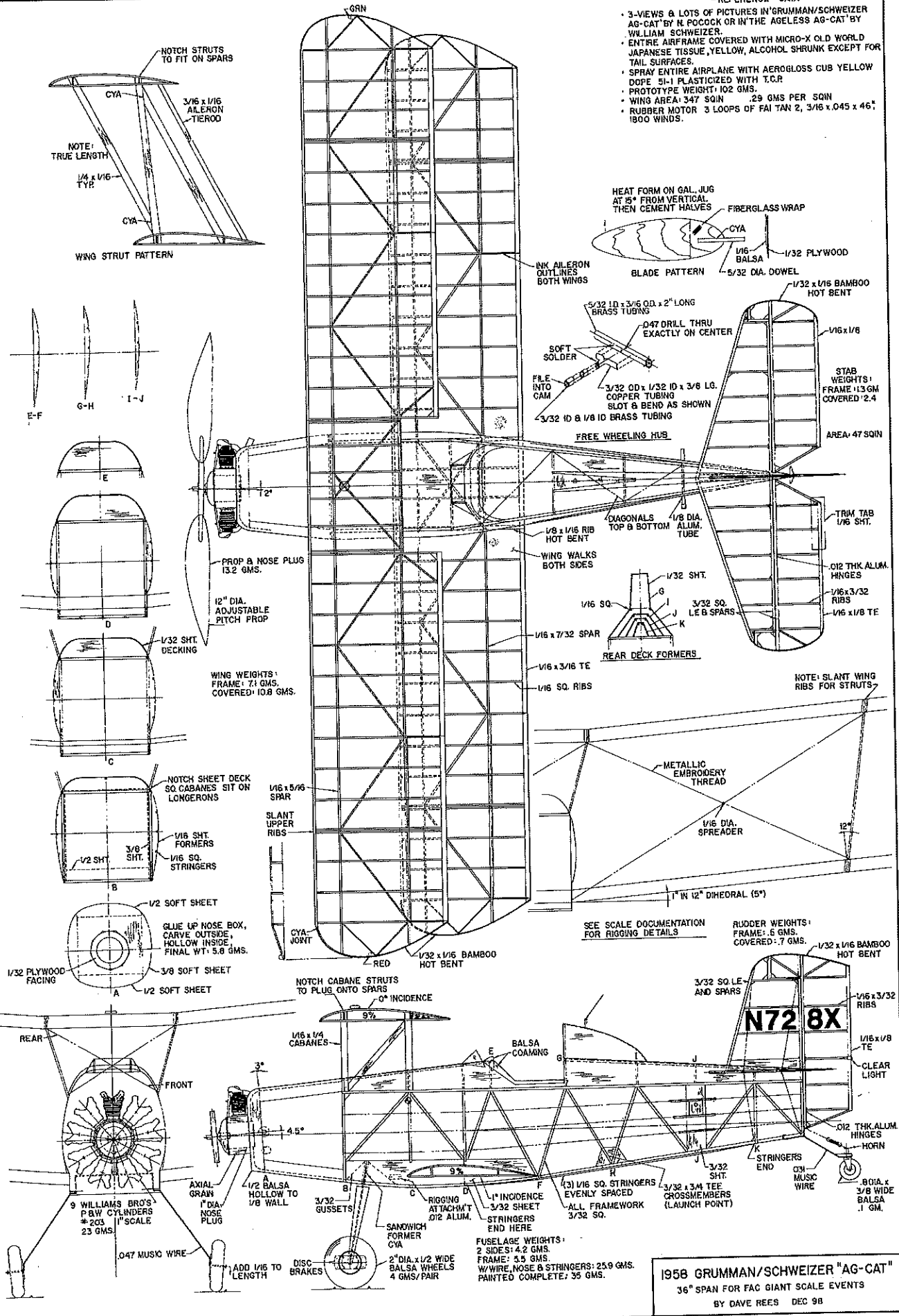
Nothing beats the sound of a big, chugging radial engine! It's quite a show!

When I began the research phase of this project, I learned that the Ag-Cat was made near Geneseo, in Elmira NY at the Schweizer glider factory. Several thousand Ag-Cats were made there from the 1950s until the 1990s.

The idea for the airplane was conceived at the Grumman factory in Bethpage, Long

—REFERENCE DATA—

- 3-VIEWS & LOTS OF PICTURES IN GRUMMAN/SCHWEIZER "AG-CAT" BY H. POCOCK OR IN "THE AGELESS AG-CAT" BY WILLIAM SCHWEIZER.
- ENTIRE AIRFRAME COVERED WITH MICRO-X OLD WORLD JAPANESE TISSUE, YELLOW, ALCOHOL SHRUNK EXCEPT FOR TAIL SURFACES.
- SPRAY ENTIRE AIRPLANE WITH AEROGLOSS CUB YELLOW DOPE 51-1 PLASTICIZED WITH T.C.P.
- PROTOTYPE WEIGHT: 102 GMS.
- WING AREA: 347 SQIN. 29 GMS PER SQIN
- RUBBER MOTOR 3 LOOPS OF FAI TAN 2, 3/16 x .045 x .46", 1800 WINDS.



1958 GRUMMAN/SCHWEIZER "AG-CAT"
 36" SPAN FOR FAC GIANT SCALE EVENTS
 BY DAVE REES DEC 98

Island NY near the end of World War II, when the company began looking for peacetime airplanes to manufacture.

The name Ag-Cat was an extension of Grumman's famous "cat" series: the Wildcat, the Hellcat, the Tigercat, etc.

A decision was made *not* to manufacture the Ag-Cat at Grumman facilities, and Schweizer was chosen as the subcontractor. The company had made subcomponents for Grumman, and it had a good workforce of excellent airplane craftsmen.

The first model produced—the G164—was my choice for this project, because it fits my image of how a sprayplane should look.

The open cockpit was enclosed when it was learned that the low-pressure area created during flight drew in the sprayed materials, making the pilot look like a snowman! I like open cockpits.

The G164 had the least bulk for the span of all the types, while presenting a reasonably long nose moment. One of the Coconut concepts is low wing loading, as achieved by minimum bulk.

The Ag-Cat is a simple airplane. It's all one color with few of the things judges like, such as guns, insignia, or panel lines. The Scale score must be boosted by one thing: the engine.

Fortunately, the 36-inch-span Ag-Cat is almost one-inch-per-foot scale; therefore, the Williams Bros. Pratt & Whitney cylinder kits can be used to great advantage.

You will spend a few evenings assembling all nine cylinders, but the result is a very nice simulated engine. Don't worry too much about the weight; my biplanes usually need nose ballast, probably because I use big, long, heavy motors.

The completed Pratt & Whitney engine weighed 23 grams, which is not bad for a 100-gram total airplane weight, less rubber. The wing loading is very low when you have 347 square inches to play with.

Your center of gravity (CG) will be in the right place as long as you don't deviate too far from my component weights.

Are you ready for an article about current lightweight airframes? Let's go!

CONSTRUCTION

Start with wood selection. Forget about the precut sticks; they are too heavy. Choose the right sheets, then strip everything from them.

Not all structural members have the same stresses, so use the lighter wood in places where the loads are less.

I weigh each sheet of wood I use, which really pays off in extra-light structures.

The fuselage longerons take the most shock loads and torque from the motor when wound, so I use eight- to 10-pound/cubic-foot balsa for them. The cabane and interwing struts also need that weight.

Next in strength are the fuselage uprights' crossmembers and diagonals and wing leading and trailing edges; go with six- to eight-pound balsa. The tail members also fall in this category.

That's basically it—six- to 10-pound is the range. The blocks at the nose area can be four- to six-pound, but they are hard to find.

Here are some sheet weights for these grades: $\frac{1}{16} \times 3 \times 36$ —10½ grams, six pounds/cubic foot; $\frac{3}{32} \times 3 \times 36$ —21 grams, eight pounds/cubic foot; $\frac{3}{16} \times 3 \times 36$ —27 grams, 10 pounds/cubic foot; $\frac{1}{8} \times 3 \times 36$ —28½ grams, eight pounds/cubic foot.

Be careful of nonhomogenous sheets; they can be too hard in one place and too soft in another, but still give the correct overall weights. Look for nice, even sheets.

The full-scale Ag-Cat was made essentially like a model is constructed, so building up the parts won't present any challenges.

Fuselage: Build the sides, one on top of the other, using Ambroid cement as an adhesive. It's plenty strong for a model this size.

The fuselage has each bay stiffened with diagonals, so it will not buckle under the torque of a fully wound motor.

I have added a hard-point where you will launch the airplane. Launching with a fully wound motor can be tricky on a breezy day, and I find myself scrunching the fuselage. A little reinforcement is worth the weight penalty.

The formers and stringers on the sides and bottom, along with the $\frac{1}{32}$ sheet areas on top complete the fuselage structure. Assemble a box of light $\frac{3}{8}$ and $\frac{1}{2}$ sheets, as I show in dotted lines on the section view. Use white glue for added strength and toughness under impact.

Shape the outside and sand smooth, then hollow to a $\frac{3}{32}$ -inch wall from the inside. I use a very sharp gouge for this operation, which results in a surprisingly light structure.

I noted many of these component weights on the plan, when I remembered to weigh them.

Notice the slight downthrust angle so the final downthrust won't look so bad. Cement the whole box to the front of the fuselage frame with white glue.

Landing gear on the Ag-Cat is a modeler's dream—no extra braces!

Bend up the .047 ($\frac{3}{64}$) wire over the plan. The sandwich former is an important structural member in an airplane this size, so proceed carefully.

Position the two sheets, then squeeze them in a vise to make dents for the wire. Score them slightly deeper with the end of the same wire.

Saturate the halves with ZAP@ cement, and quickly squeeze in the vise until cured. No gaps, please. This will stay on the wire, but you must mount it firmly.

Remove the $\frac{3}{32}$ cross-stick where the gear fits in the fuselage, and cement the sandwich in its place. Add the big gussets, to transfer the loads to the wing saddle.

Cement scraps of $\frac{1}{32}$ sheet to the wire legs, and cover with copy paper and white glue. This will absorb a great deal of abuse and not split off.

Engine: Purchase nine packs of #20300 or WB-203 engine cylinder kits for Pratt &

Whitney from Sig Manufacturing (401-7 S. Front St., Montezuma IA 50171-0520). They cost approximately \$3 each.

Each pack comes with a small pattern for making the crankcase, which I made from balsa.

The rubber runs through the case in our model, so make it with a one-inch-diameter hole in the center. Make the case with the grain running axially, so it won't crush, and face it with $\frac{1}{32}$ plywood cemented with ZAP@, to prevent splitting.

Now you can begin assembling the cylinders. I moved the ignition-harness assembly behind the pushrods and omitted the intake manifolds, to save weight. These would get knocked off easily during flight anyway.

The cement is critical. I used a styrene solvent from Plastruct, available from HO train stores. It leaves no residue and fuses the parts together so they're like a one-piece molding.

Cement each cylinder to the crankcase with ZAP@. The center part of the crankcase is also the removable nose plug, which you can make normally using the grain running axially.

The quality of the engine is very good when it's completed.

I like balsa wheels because they're lighter, but try Dave Brown's Lite Flite two-inch-diameter wheels if you live in an area where there is not much grass. The weight penalty is small, but you will have to bush the holes to fit the wire.

Wings: There are many wings to be built; fortunately, all ribs are alike.

I start by making an accurate template of the wing cross-section from aluminum roofing flashing. The template can be laid on a six- to eight-pound piece of $\frac{1}{16}$ sheet, and the ribs can be sliced off quickly. There are 58 ribs, so the method must be fast.

Select and strip all the sticks for leading edges (LE) and trailing edges (TE) and spars from eight-pound wood, making sure there are no hard spots or tendencies to bow; those are sure ways to produce warps.

I design wings made in one piece rather than glued on each side of the fuselage. This removes all mismatch, and the wings are much stronger when covered through the center-section.

Pin down the LE and TE using a straightedge, to avoid scallops. Glue in all the lower ribs from $\frac{1}{16}$ square balsa. Notice that the lower wing has two pieces of $\frac{1}{16} \times \frac{1}{8}$ where the wing saddle fits.

While all this is drying, bend up the $\frac{1}{32} \times \frac{1}{16}$ bamboo wingtips over a hot soldering iron. They are tricky to bend, because they match the *upper* rib curvature as well as the plan view. Cement the wingtips to the LE and TE with ZAP@. Lay in the $\frac{1}{16}$ sheet spars and glue them to the ribs.

Put in the $\frac{1}{32}$ sheet diagonals, and make sure to glue them to the lower ribs and the two spars. Cut several strips $\frac{3}{16}$ -inch wide, then when cut to length, trim off a little height so each piece will fit against the rear spar. These diagonals stiffen the wings—particularly in torsion.

Slice off a pile of upper ribs from $\frac{1}{16}$ sheet, and cement them all in place. A

hypodermic syringe filled with Ambroid helps make all these joints neat.

When making the lower wing, two pieces of 1/16 x 1/8 fit the fuselage saddle. They must be hot-bent, to match the rib upper curvature. These pieces can be slightly harder—roughly eight pounds/cubic foot. Remember to slant the rib pairs to match the outer strut slant.

Both wings have one inch/foot dihedral (approximately 5°). Cut through the spars, LE, and TE; bevel them, and glue joints with CyA. Applying 1/32 patches over the spar joints help prevent breakage.

When dry, remove the wing from the plan and repeat the process for the next wing. While it is drying, sand the LE and the TE into an airfoil shape. Be careful; it is easy to knock a rib loose.

Stabilizer and Rudder: These are simple to make, as was the full-scale aircraft's tail. Don't worry about strength—two sets of bracing wires will do an excellent job of stiffening the assembly.

The tips are all hot-bent bamboo, just like the wings.

Notice the 3/32 x 1/4-inch-wide strip in the center of the stabilizer—the rudder will mount to it.

When dry, sand all the edges round. Make slots in the spars for the aluminum hinges using a #11 X-Acto™ blade, as shown on the plan.

Propeller: This is a very important part of the Ag-Cat's performance. If you feel the

adjustable one I used is too complex, use one of the 11- or 12-inch-diameter plastic versions.

I am a confirmed "tweaker"; nothing bothers me more than not being able to adjust things in the endless search for better performance.

The adjustable-pitch propeller will allow settings to suit the flying weather. For a calm day, set the pitch high and the motor seems to take forever to unwind. On a breezy day, lower the pitch until it penetrates the wind.

You must get into the habit of inspecting the propeller before launching, to make sure it has not changed from the previous flight and landing.

The blade dowels are moistened and inserted into the tube at the start of the flying session. They hold well for a day or two. If you find a setting you think works best, glue it with CyA. However, you will lose the ability to change a broken blade at the field.

I always make a duplicate set of blades, in case one is broken. To make a set, cut a piece of 1/2 plywood and a piece of 10-pound/cubic-foot balsa for each blade. Soak the pieces in water and wrap them around a glass gallon jug at 15°, using strips of cloth to hold them in place.

Put the whole thing in the oven at 250° for an hour, and let it cool slowly.

Remove the blades, and cement the balsa ones on top of the plywood ones with ZAP®. The balsa provides a softer medium to sand into an airfoil curvature. Plane and sand all the blades until they look good, then glue the 5/32 dowels into the slots with CyA.

Wrap the blade with five-ounce/square-yard fiberglass, to strengthen it for roughly the inner two inches; this is where they break.

Paint the blades with clear dope several times, to obtain a good finish, then spray on a coat of silver. The dowels will be too tight in the hub tubes at first, so scrape and sand until you achieve a snug fit.

You may notice that I am a bobbin person; if you are an S-hook or a crocket-hook type, feel free to use what works best for you. The same goes for latch-type freewheelers.

Covering: My philosophy is *low-shrink*; that says it all. It allows you to build light structures that don't need to be strong enough to withstand the shrinking tissue.

The airplane also lasts longer before succumbing to warps—particularly in the tail parts. This is important! It's where all your adjustments are made. You can't tolerate changes here.

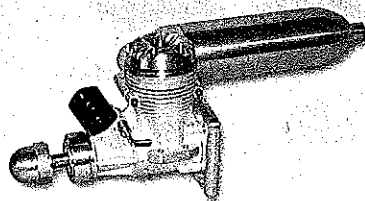
Start by covering the tail. It is almost flat, so you can do a good job of pulling the tissue taut. I ask you *not* to shrink the tissue, so do the best job you can.

Slit through the tissue for the aluminum hinges, and install them in one side of the stabilizer and rudder with CyA. Before installing, make sure the aluminum's grain is lengthwise! (The hinges will break if it's crosswise!) Set the tail aside for painting.

These were the easiest wings to cover I

We race to win;

and win... and win... and win... and win... and win...



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OS61 SXWC	OS140 RFX
OS65 VRM	YS61 ST-H
OS65 VRDF	
OS91 VRDF	
OS140 RX	
YS61 ST-H	

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OS32 FX	15,500	16,500
OS40 FX	13,700	15,000
OS46 FX	14,400	15,800
OS46 SF	14,000	15,700
OS61 FX	11,700	13,000
OS61 SF-P	12,400	13,900
ST GS 40	13,600	15,000
ST GS 45 ABC	14,600	16,300
TT Pro 46	14,000	15,100
TT Pro 61	11,400	12,300
Webra 40 GT	13,800	15,200
Webra 50 GT	14,600	15,900

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have seen in a while. There won't be any wrinkles the way the tips are made.

When both wings are covered, shrink the tissue with alcohol until it's taut. The structure is torsionally resistant enough to withstand the shrink forces.

The fuselage has no flat surfaces, so it will keep you busy and demonstrate your covering prowess. Pay particular attention around the saddle for the lower wings. Attach the tissue roughly 1/8-inch all around the wing cutout—kind of a quirky contour. The fuselage also gets the alcohol shrink treatment.

Anyone who has flown FAC events for a while knows that the coloring in tissue fades under ultraviolet light. In time, it loses the

brilliance so necessary for a good score from the judges. I know the rules state that painted and tissue colors are supposed to get the same points. The brilliance factor is intangible.

For some time, I have used an overcoat of colored dope to make the tissue colors more brilliant and durable. Forget the clear dope. The vehicle in color dope is the same thing. Just spray on an even coat.

I have tried most colors in the AeroGloss chart, and they all enhance the colors very well. It's like colored tissue—only better!

Control the shrinkage with a plasticizer such as TCP, or distortion will result. I set a weight target, so I don't get out of control with the amount of spraying I do. Six or seven grams are all I allow on an airplane this size.

Final Assembly: As with all biplanes, getting the wings on right is the hard part. Here's one way to do it.

The painted lower wing should slip into the hole for it in the wing saddle. If it doesn't, trim the opening carefully until it fits snugly. Check for perfect alignment in all directions, then cement fast with white glue.

While this is drying, make two wing-alignment fixtures from 1/2-inch-thick blue foam. Copy the wing positions from the plan side view, and make a cutout for each wing. The wing struts are first. They should have been made and painted matching the plan.

Slit the tissue at the wing-attachment points and slide the struts in place. Make the same slits on the underside of the upper wing, and push the wing onto the struts.

If things line up well, try the cabane struts for fit. I used the foam fixtures near the fuselage, to help keep the wings parallel from the front view. This is a careful process—don't rush things.

When you are satisfied, squirt CyA in each joint and it's together forever. Notice how strong the wings become when they are joined and braced like this! Light wings *can* be strong enough in a biplane!

The tail is the easy part. Cut the respective slots, and cement fast with white glue when the alignment is good. Note that the rudder attaches to the center of the elevator.

CyA the hinges in the elevators and rudder, so all is permanent.

That's the sequence.

Details are the part I like best. Each modeler can put on as much as he or she wants. Buy one of the reference books, because there is a limit to how much can be shown on a plan.

Flying: Use the rubber sizes listed if you have controlled the weight as you have built the model, and the weight is close to the total shown.

As weight goes up, the motor can be shortened to produce more power; however, adding more rubber could overload the carefully designed structure. Proceed with caution.

You need a "soft" field—grass or high weeds—until the Ag-Cat is flying safely, even if it means driving some distance. You have spent a great deal of time on this project, so don't lose it during trimming. The Ag-Cat flies very slowly, which makes trimming much smoother.

With a slightly taut motor, balance the airplane with your fingers. Your fingers should be close to the airplane's CG position, at least to start out. Ballast as needed. Crank in 300 turns, and see how it flies at a medium-pitch position on the propeller.

Adjust flying surfaces as required. Slowly increase the winds while correcting bad characteristics.

As the Ag-Cat climbs high enough, notice what happens in the glide phase of the flight. Fine-tune the adjustments to optimize the glide. My Ag-Cat climbs out at a steep angle, but slowly, which really looks strange!

Try adjusting the propeller pitch last, until you see which pitch works best and gives the longest flight.

When adjusting the propeller, make sure the blades are not twisted off the dowels. The dowels really stay put in the hub. I grab the dowels with a smooth-jawed pair of pliers to turn them, rather than risk putting the load on the blades.

I am sure you will like this big, slow-flying Ag-Cat. MA

Dave Rees

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