BOB BENJAMIN'S AERONCA "K"

This is the story of a special model airplane, a "no compromises" scale model intended from the beginning for competition. Flying Models *would like to share with you this account beginning with the first inspiration, through all of the research, the design and engineering decisions, the building process, and finally of what it is like to fly the result of all that time and effort in competition against the best scale modelers in the world. Many readers will be interested in this airplane especially because it is a real trend setting, edge-of-the-envelope project , an electric powered scale model that is competing without compromise or special consideration in a field that is not only dominated but actually defined by engine powered models.*

THAT SPECIAL ATTRACTION

Most aeromodelers have an interest in scale, even if only as something that they will do "someday". Likewise, most dedicated scale modelers have a personal list of favorite airplanes that we promise ourselves we are going to build. Some of these are projects that insist on being done *right now* and others are sleepers that lurk in the background and then one day emerge to dominate our attention. For me the Aeronca K was one of the latter. I first became aware of the "K" many years ago via the old Comet rubber power kit that sold, when I was a little kid, for twenty five cents, The story of this particular model really began on a quiet summer afternoon when, as a youthful model builder eagerly reading every word of a newly discovered magazine, I discovered the construction article for a single channel R/C version that appeared in 1958 in the old American Modeler. At that time I recognized it as an unusual subject, with its fully exposed two cylinder Aeronca engine and subtly awkward, "funky" lines, but a radio controlled model of any sort was no more than a faraway dream for me in those days. Even though I never seriously considered that I might ever be able to build such a model for myself, the seed of an idea was planted.

THE FULL SCALE AIRCRAFT

The "K" has never been in the forefront of the aviation scene. Although it was a legitimate production airplane and never exactly obscure, there simply were never very many of them around. A total of 357 were built beginning in 1937 when Aeronca developed the design as a conventional strut braced two seat cabin airplane to replace the single seat C-2 and the C-3 "Collegian" and "Master" two seaters that had been rendered obsolete by new CAA rulings making wire braced monoplanes a thing of the past. The "K" was a well designed airplane and made good use of the 36 horsepower Aeronca E-113 engine that had powered the C-2 and C-3, but the single ignition E-113C could be upgraded only so far, and rapid engine development during the late '30's soon left the "K" in the dust of airplanes using more sophisticated flat four cylinder engines. Although there were a few interim airplanes designated "KCA" that were essentially "K"s powered by Continental A-40 engines, by the time World War Two caught up with the American light aircraft industry, the "K" had found itself transformed into the early models of the Aeronca Chief.

When the shooting stopped, all of the light aircraft manufacturers optimistically hit the market with new post-war models designed around larger engines, and the K's that had still been desirable airplanes before the War were immediately outclassed. By the late '40's and early '50's, when sales of new light airplanes dropped off to the point that many companies failed, virtually nobody had any interest in a somewhat clunky looking pre-war design with an out-of-date engine that had barely enough power to get over the trees at the end of the airport on a warm day. Many of the remaining Aeronca K's were scrapped or simply abandoned, and by the time that I first became aware of them as a youthful model builder, they were in danger of disappearing entirely. Fortunately for our aeronautical heritage, a few survived, included NC19723, the one with which I was to become intimately involved many years later.

MAKING A COMMITTMENT

During the 1980's, when I had become an accomplished model builder and R/C flier, and many years after I had first become aware of the Aeronca K, the notion of a serious commitment to *doing scale* began to tempt me. Although I still put off building that first "real" scale job, rationalizing that I needed more precision building and flying practice, I began collecting data on interesting airplanes, the Aeronca "K" among them. In a correspondence with the late Bill Winter, I discovered that a set of "K" plans had been partially developed by Bob Lopshire. These were detailed to the point of attempting to replicate scale structure and although they illustrated a lot of good ideas, Bill and I agreed that they were probably not useful as the basis of a practical flying model, which may explain why Bob L. never finished them. At about the same time I purchased a set of the drawings used by Bob Wischer to build the ¼ scale "K" with which he competed successfully during the early '80's using a Gemini 1.20 four stroke twin engine. Even then, although I went so far as to acquire a Gemini of my own, the project remained on the shelf. The OS twin was sold in 1988 when I discovered electric power, and the Aeronca "K" remained nothing more than a quiet presence in the back of my mind.

In 1990 I began doing serious scale competition with the 1/6 scale Porterfield Collegiate that went with me to the 1990 Scale Masters Finals in Irving, Texas. This little airplane broke some new ground, but it was too small to be really successful in top level competition. I spent the next several years experimenting with a whole series of models to determine just how far the then-current state of the art in electric power would let me push the envelope. Although I flew some exotic retract-equipped fighters successfully, the margin of performance and flight duration necessary for a practical competition scale model that could go up against engine powered models with no special consideration dictated that I stay with a lightplane or WWII trainer type that combined generous wing area with moderate flight speeds. (This has now begun to change, but that is a story for another time.) In 1997 I first flew my ¼ scale 1941 Taylorcraft, powered by a geared Astro 90 running on 36 cells. In what was in fact the first competition for that airplane, I placed 4th in the Team Selection Trial for the 1998 FAI World Championship scale

competition (F4C) and was designated the First Alternate for the team that flew in South Africa.

DOING THE RESEARCH AND DESIGN WORK

Immediately on returning home from the Team Selection, I dragged out all of my Aeronca "K" material and began finalizing the structural design that would provide me with a no-excuses competition model, with the intent of having it ready as a backup airplane in April of '98 in the event I was called on to fill in for another F4C team member. The plans I worked from are my own, based on the scale outlines derived from the Paul Matt drawings and a lot of inspiration provided by study of both those Bob Lopshire drawings and the Bob Wischer plans. One of my decisions at that time was to find a full scale airplane of which good photos were available, to use as the subject of my model. Other experienced scale modelers will agree with me that this is what you do *first*, before cutting any wood. In examining the selection of "Foto Paak" info on Aeronca K's available from Bob Banka's Scale Aircraft Documentation, I discovered that *NC 19732* appeared to offer the best available combination of nearly original configuration and good condition, so I ordered a set of photos and began laying out working drawings using them along with the Matt drawings. As I was still not entirely satisfied that this airplane was exactly what I wanted, I continued to look around for another clean full scale Aeronca. This led to an interesting experience. At a Scale Masters Qualifier in Oregon, a spectator who happened to be an active full scale pilot and antique/classic restorer alerted me to the existence of a large collection of antique and classic airplanes in another part of the state that he understood included a complete Aeronca "K". Following up this lead I ended up in contact with the personal secretary of the owner of the collection, who relayed to me permission to visit the private airport where the several dozen airplanes were kept and answered my careful questions about the airplane I was looking for with an assurance that they did indeed have an Aeronca K in flying condition, fully restored and sporting the original Aeronca E-113C engine. My wife Teryl and I committed a day to the trip to this out-of-the-way airport, finally found the place, and were at last escorted into a cavernous hangar, past treasures that included a perfectly restored Kinner Sportster, Buhl Bull Pup, Curtiss Robin, a real Lenape powered Piper J-3P and other wonders, right up to the wingtip of an Aeronca …C-3 Master! It was explained that of course the K was in another hangar, totally disassembled for restoration. I never have been able to figure that one out.

Shortly afterwards, feeling more than a little frustrated, I used the services of the FAA to find the current owner of NC19732, the K of which I had a collection of photos, and found myself in contact with Mr. Tom Trainor in Michigan, who proceeded to solve all my problems. He advised me that *19732*, the airplane of which I had photos, was in fact a real "dog", in bad shape, with more deviations from original condition than I had suspected. He explained that '732 was currently being stripped for restoration, but that he might be able to help with photos of the his *other* Aeronca K, *NC19723*, which was fully restored and just *happened* to be on display in the EAA Museum Pioneer Hangar at

Oshkosh ! He then offered to send me a generous collection of copies of photos he had taken during the restoration, and with that promise of serious cooperation I began making final decisions about the model.

GETTING SERIOUS

Initially I had intended my "K" to serve as a backup for the 1998 F4C competition. In the event, that did not happen and in fact I realized partway through building the wings that the only way I could have the "K" ready in the nine months that were available would require compromises I was not prepared to make. In the end, the first wood was actually cut and glued for the airplane in the summer of '97, and with the effects of various delays and diversions to other projects, she first flew in March of 2001. The question I am always asked is, "How long would it have taken, without interruptions?" My best guess is about a year and a half.

What actually happened was that at the same time I got the wings framed up and learned that I would not need to worry about flying in the 1998 F4C event, I found myself tempted by another project and spent the next year and more working on a ¼ scale model of Alex Henshaw's Percival Mew Gull G-AEXF. Here the story becomes even more interesting. Early in the summer of '99 Teryl and I traveled by motor home to Wisconsin to deliver another of my models, a ¼ scale Gee Bee Model "Y", to an aviation collector, since become a good friend, who had paid generously to add it to his private museum and agreed with me that paying us to deliver it as well made more sense than risking the large model by entrusting it to a commercial shipper. During our visit we spent a day exploring the EAA Museum and as you might imagine, there I found myself face to face with NC19723, the subject of this story. Much film was shot, I examined the airplane in great detail…I'll confess here that I actually *touched* her when no one was looking…and went home suitably inspired. The moment the Mew Gull, which itself ended up being purchased by my collector friend, was off the building board, the shop was cleared out and work on the Aeronca "K" that you see here was started in earnest.

THE TECHNICAL BACKGROUND

The model is built to a scale of 3" to the foot (1/4 scale), with a wingspan of 108". With a relatively narrow chord of 12.5" the wing area is a bit under 1300 sq. in. Gross weight is 16 ½ pounds and this results in a wing loading of about 29 ounces/sq. foot, which is very comfortable for a model of this size.

There was never any doubt that my Aeronca K would use electric power. My experience with other models had proven that I would be able to count on having more than sufficient power and duration at a reasonable flying weight, so these issues were never a concern. Even if the advantages of quiet operation, freedom from oil contamination, and the undeniable competitive advantage of reliable starting on demand were not compelling enough, knowing that many modelers who had been inspired by my successes with the

Taylorcraft and other airplanes were waiting for this latest project to appear in public made any other choice impossible.

The "K" is powered by an Astro Cobalt 60 standard/sport wind motor, turning an 18x12 prop through the "old" low ratio (1.63:1) gearbox. Power is from 28 of the newest version of Panasonic's 3000 mAh Nickel Metal Hydride (NiMH) cells, the purple jacket, "High Voltage" version, and is controlled through an "old reliable" Astro Model 207 ESC (speed control). The motor is a totally stock, unmodified unit, and draws about 27 amps at full throttle, static. The prop is modified from an off-the-shelf wood Zinger by my usual protocol of carving in a moderate "undercamber" (concave surface) on the prop face, the side the pilot sees, thinning the blades overall, rounding the tip with a slight sweepback cut in, and cleaning up the leading and trailing edges. This process was the origin of the now popular Master Airscrew Electric Series props and consistently results in a measurable increase in takeoff and climb power with the ability to cruise at a markedly reduced throttle setting and consequently provides a careful pilot with extra power when needed without necessarily reducing flight duration. Static RPM is 4500. The new Panasonic NiMH cells promise discharge characteristics under load very similar to those of Nickel Cadmium (NiCd) cells, and my experience confirms that they do this.

So equipped, the "K" gets off the ground so fast that I normally make my takeoffs at about half power to replicate the performance characteristics of the 36 HP fullscale airplane. In anything but very rough air, I cruise at or below half power, again to replicate the 85 mph fullscale cruising speed. The power loading in terms of Keith Shaw's formula based on input watts is 55 watts per pound, and the performance range is exactly what his predictions suggest it should be. I have not yet "run the tank dry" in flight for an absolute duration test, but all the numbers indicate a max duration of about fifteen minutes. Checking the amount of energy *replaced* by my Astro 112 D charger after many competition flights, I am confident that except in very windy conditions I have sufficient duration to perform the requisite maneuvers for TOP GUN, AMA or Scale Masters competition *twice* on one charge. Having said this, I feel that I should add that I would not change the system. Saving weight is not as issue, as this airplane at 16 ½ pounds is as light as I would want to have it with rough air handling in mind (the air is *always* rough at contests!). Likewise, I would not want to have less power available for those times when punching through gusts and turbulence is necessary.

As the "numbers" above suggest, this model leaves very little to be desired in terms of flight performance on today's electric power technology. I attribute this success to the years of practice I have had with other large electric powered scale airplanes, most notably the ¼ scale Taylorcraft that I flew at TOP GUN in 1999 and 2000, as well as several more ambitious, more heavily loaded models that include a 1/5 scale Spitfire and Zero, and my experience with the series of ¼ scale Piper airplanes built and flown by my friend Randy Smithhisler. Stated concisely, the lesson for success with electric powered R/C scale models to be flown in competition against engine powered airplanes is to choose subjects that can be built with light to moderate wing loadings and flown with moderate performance expectations permitting operation at less than full power for the

majority of each flight. Using Keith Shaw's power loading guidelines to match power to model and assuming the use of top quality components such as the Astro Flight series of motors and speed controls, designs ranging from traditional lightplanes like the Cub through WWII trainers such as the PT-19 and Ryan ST, sport designs like the Spacewalker, and early WWII – era fighters such as the Hurricane that offer plenty of wing area can be built with some assurance of success. Interested readers should also note that heavily loaded designs that are not required to perform strenuous maneuvers can also do very well…the spectacular performance of George Maiorana's TU-4 Russian "B-29 copy" makes this very clear. It *is* possible to fly "heavy metal" like the Corsair and P-51 in true scale configuration and flight performance on *today's* electric power (I have done it), but duration will suffer and I suggest that it would be very difficult to be competitive with the fuel powered jobs. As the technology progresses, this will change. Not so many years ago the performance that I enjoyed at this year's TOP GUN would have been impossible, and now it is available to anyone who wants to purchase the hardware and invest the time and effort to build a competitive airplane.

BUILDING THE AIRPLANE

With all of the research done and the photos and various drawings all at easy reach right there in my own shop, there was nothing left to do but settle back and finish building the airplane. The Aeronca K has a number of unusual features, but the actual construction work is very straightforward…just like any other model of traditional structure, you trace out balsa and plywood parts from patterns, cut them out, and sequentially glue them in place. Actually, nothing *but* traditional "former and stringer" structural design would be appropriate for an antique design like this one. The structure is not exact scale, but the placement of each component is. The ribs, for instance, are cut from balsa sheet rather than being built up from strips in a jig, but they are precisely located in the correct positions. Everything that shows through the covering or forms an outline is exactly where it is supposed to be.

All externally visible control linkages maintain correct scale appearance. The rudder operates from a working pull-pull closed loop cable system, and the elevator from push-pull tube connected to a fully enclosed horn. The ailerons on the full scale airplane use a closed loop cable system, but in the interest of reliability with a model whose wings must be assembled and removed every time it is flown, I used a pushrod system that incorporates custom made ball bearing transfer bellcranks. The lower push-pull rods to the ailerons are functional and dummy upper cables that disappear into the top wing surface complete the illusion of a cable system.

SPECIAL CHALLENGES

Every full scale subject presents its own set of unique challenges to the scale aeromodeler who wants to build an accurate representation. The Aeronca "K" offers more than you might expect from what appears to be a simple lightplane. Most modelers who build high

wing light aircraft understand the need to build a two piece, plug-in wing in order to preserve the unbroken surface of the fuselage top covering over the wing. The "K" presents an added challenge. As the overhead cabin window directly behind the windshield is so large, any non-scale interior structure would immediately be visible to scale judges. This makes the use of a stout balsa-and-plywood front spar carry-through structure a liability for serious competitors. The solution I used, in common with the other designers, is to incorporate hardwood dowels in the locations of the steel tube members of the full scale structure and drill them to accept brass tube liners into which steel rods are inserted to locate and support the wing panels. This approach requires that the struts be functional as well. As weight was an important consideration on my model, I chose to make the struts from K&S hobby shop streamlined aluminum tubing, which is accurate in appearance but not very strong. Each section was cut to length and then "stuffed" with a hard balsa strip of appropriate size. This was locked in place with thin cyanoacrylate glue flushed through the strut so that each balsa "core" would become part of a rigid composite unit. Each end of each strut section was then opened up for an inch or so and filled with slow curing epoxy. On the outboard ends 4-40 threaded rods and clevises were inserted in the epoxy to create adjustable rods ends so that rigging/wash-out adjustments could be made as per the fullscale airplane, and the inner ends received silver brazed "T" fittings of heavy tubing to allow through – bolt attachment to fuselage fittings, again replicating the fullscale arrangement. This arrangement, once built, has proven very practical both for initial adjustment of wing rigging and for easy assembly and disassembly at the field. Although I have chosen to follow the certification requirements of the fullscale "K" and not do aerobatics beyond wingovers and chandelles, the structure went through a strenuous test in the strong winds and turbulence at this year's TOP GUN with no sign of trouble.

The *ailerons* on the full scale K are of the Friese type, that is, statically and to some degree dynamically balanced by being recessed into a cutout in the wing and having a significant portion of the structure located ahead of the hinge line. The purpose of this design feature is to have the upward-traveling aileron, the one "inside" the turn, create more drag than the other and hence reduce adverse yaw and the need for rudder coordination in turns. There is no way to fake this on an accurate scale model…you must build ailerons that match the correct cross section and make custom hinges to let them move as designed. This is not difficult to do, it just takes more time and effort than simply gluing in a set of hobby shop hinges. I made all of the externally visible hinge structure from 1/16" aircraft plywood and inserted metal bearings on each working joint. To supplement the differential drag created by the aileron design, I added a differential throw of about two to one ratio by using separate servos and the aileron differential feature of my Airtronics Stylus computer radio.

Another aspect of the K's structure that must be reproduced accurately in order to maintain correct appearance is the *triangular tail structure*. The fuselage behind the wing trailing edge is built not on parallel flat side frames but rather on a triangular truss that is flat at the bottom with an apex at the top. Large formers added to the uprights fill out the

shape of the fuselage and stringers added to these support covering just as with more common "square" fuselages. Again, the way to do the job right is to take the time to build the model the same way as the full scale airplane…it's not harder, just different.

The *thin tail surfaces* of the K are another story. The horizontal and vertical tail surfaces of the full scale airplane are based on outlines of one inch diameter steel tube. This scale to ¼" thick surfaces on this model…a very thin surface that requires extra effort to build accurately and strong enough to withstand normal flying. Making the surfaces thicker than scale would result in deviations in appearance that would be immediately apparent to experienced scale judges, so there is again no choice but to do it right. I used a core of stiff 3/32" balsa sheet with ¼" thick outlines laminated from strips of 1/16" balsa sheet and "ribs" of 1/8" square balsa added above and below the sheet cores in the appropriate positions and sanded flush with the 1/4" outlines. This produced surfaces that would maintain alignment when covered, but I am not satisfied that they would be rigid enough to fly without *functional* scale brace wires. I used custom made stainless steel streamlined wires ordered from AeroScale via Jerry Nelson, and I am most impressed with their appearance and structural function.

Along with thin tail surfaces the "K" also presents the challenge of the characteristic Aeronca fabric fairing of the dorsal fin. This attractive covering technique, which was employed on many of the lightplanes of the '30's and '40's, is often considered by modelers to be too difficult to attempt. It is in fact the only way to finish subjects such as the "K" and her later sisters the Chief and Champ correctly and is actually easier to do right than trying to cover the rear fuselage and vertical tail separately. I have included several photos to illustrate how it is done.

The landing gear used on the full scale "K" is unusual in that it is an oleo compression strut design rather than a simpler layout using springs or bungee cords in tension to handle landing loads. While the model could be flown with a rigid gear based on carefully bent and soldered steel music wire from the hobby shop, faired out to match the external appearance of the full scale subject, the effort necessary to make a real compression strut gear is justified by improved ground handling as well as by its effect on the judges. I used the design presented by Bob Wischer , based on telescoping sections of 4130 steel tube with internal compression springs, with modifications including the use of steel in place of aluminum for the scissors assemblies. Like many modelers, I do not have precision metal working tools at hand and enlisted the help of a machinist friend to get some of the parts fittings just right. The results were well worth the effort.

Perhaps the most demanding aspect of the "K" to reproduce was also the most obvious…there is no way to fake that completely exposed, uncowled two cylinder Aeronca E-113C engine. Using glow engine power would have provided me the obvious option of purchasing a two cylinder, four stroke engine such as the OS Gemini, which provides a close approximation of the general appearance of the Aeronca engine and an appropriate level of power. However, with electric power I had no choice but to

build a scale Aeronca engine from scratch, as none of the "dummy" engine or cylinder kits on the market come anywhere close to the correct appearance. I built a plug for the crankcase, which forms the entire forward portion of the visible nose structure on the full scale airplane, from heavy polyurethane foam and polyester resin and from that made a fiberglass mold in which a glass-resin composite crankcase was laid up. The cylinders are basically stacks of alternating diameter plywood rings cut to size using a hole saw and assembled on mandrels of aluminum tubing. The rocker box covers are carved from basswood and finished. The spark plugs are vintage Champion V-2 ¼" thread units which turned out to be nearly exactly ¼ scale. There is *no easy way* to replicate the scale engine for this model, and there is *no* way you can have a convincing Aeronca K without one. This situation pretty well sums up the overall attitude necessary to build a serious scale model of this airplane…you *have to love it*, and be willing to invest more than the average level of time and effort to do the job right.

Needless to say, a model of this degree of sophistication cannot be covered and finished using an iron - on plastic material. Over the years I have used most of the fabric and paint products on the market and have selected the Stits Process products as marketed by Chip Mull's F&M Enterprises as the clearly superior choice. With the exception of the very smallest models on which dope and synthetic tissue are a better choice, I now use Stits products exclusively on all of my airplanes. The Stits Process is based on a polyester fabric that is FAA Certified for full scale use. The very lightest of the several grades of fabric is selected for models. Attached with a proprietary adhesive cement, it is physically pulled semi-taut during application, then heat shrunk in a series of careful steps. Several coats of a clear sealing material are brushed on, followed by a sprayed, aluminum pigmented sanding base. This is followed by a sprayed color finish. The advantage of the Stits materials is that in addition to being easy to work with, all of the sealer, primer and paint materials are totally non-shrinking and create a permanently stable finish that will neither sag with age or warp light structure. The fine details of covering and finishing using Stits materials, as well as doing rib stitching, sheet metal panels and other surface details would require their own article to describe fully. I have included basic information on these aspects of the project in the various photo captions.

THE PROOF IS IN THE FLYING

Since my "K" was first test flown in March of 2001, I have had the opportunity to fly her in two competitions prior to writing this material. Flying at TOP GUN 2001 in a continuous crosswind that was the cause of numerous accidents with other models, I was able to place Seventh in Designer Scale with a static score tied for third highest in that class. A few months later, in July, Teryl and I took the airplane to Muncie, IN for the US World Scale Team Selection Trial which was held in the form of an FAI Class competition within the context of the AMA Nationals. We finished Third and secured a place on the US F4C (R/C Scale) Team that will represent our country in July, 2002 at the World Championships in Toronto. The "K" also finished First in Expert at the Pacific Electric Scale Championships in Chilliwack, BC, Canada and Eighth at the Evergreen

Scale Masters Qualifier in Aurora, Oregon, and will compete in the US Scale Masters Championships on October. This is an excellent first season of competition for any new scale model, and especially so for one using a power system that many modelers still do not take seriously.

My Aeronca K was built from CAD based drawings which were completed only to the very basic extent necessary for me to lay out the structure on them. There is a lot of detail work and incorporation of modifications made during construction left to do to make the plane suitable for sale to other modelers. This will include a supplement sheet providing complete full size parts patterns arranged to be contact glued directly to standard size balsa and plywood stock for cutting. Fiberglass parts including the chin cowl, engine crankcase and wheel pants will also be available separately. I would appreciate hearing from you care of FM or by email via my website at www.rcmodel.com if you are interested. If there is sufficient response I will make a finished CAD plan set available for sale.

PHOTO CAPTIONS

1-2-3: Here is the "K" parked on the grass at TOP GUN 2001 between rounds. The airplane finished 7th in Designer Scale in spite of consistent strong crosswinds.

4: Bob with the "K" at his home field near Olympia, WA, with the Airtronics Stylus transmitter close at hand, during a practice session for the FAI Team Selection. That's the 18x12 flying prop on the front of the airplane.

5: A view looking down on the airplane while parked on the grass at TOP GUN.

6: A view showing both the overhead cabin window and the very narrow nose that was designed to fair smoothly into the case of the Aeronca E-113 engine, which constitutes the entire nose of the airplane. The dummy replica engine is *very* important to this model.

7: Those thin tail surfaces with the fabric faired vertical fin and the exact scale flying wires. Notice that the horizontal tail is built in two separate section joined to the fuselage with tubing and rod inserts, just as with the full size airplane.

8: A close-up of the nose showing the unique "Y" exhaust of the Aeronca engine. Note also the streamlined wire brace on the landing gear and the curved pitot (airspeed indicator) tube on the left jury strut.

9: Overhead in flight…you can't tell the difference.

10: Head – on, out of the sun, makes a dramatic view.

11: Banking past the strip. Flying low and close for these shots is easy with this airplane.

12: Covering with Stits PolyFiber, just as with any other fabric, begins with cutting pieces oversize and laying them in place.

13: After the Stits fabric is attached using Poly Tak adhesive and pulled tight, the edges are sealed using an iron.

14: The mysterious tail fillet is easy…the entire fuselage side, including the vertical fin, is covered with one piece of fabric running from the tailpost all the way to the nose. Here a cutout has been made for the elevator horn. If the horizontal tail had been permanently assembled to the fuselage, a narrow slit would be made in the fabric to allow it to rest as shown here with the tail covered separately.

15: The fabric is attached at all edges, beginning with the fin trailing edge, then along the bottom longeron, at the nose, and finally along the fin leading edge and top stringer. This last operation requires that you *PULL* and *STRETCH* the fabric.

16: After heat shrinking. See…it *really does work.* In this shot the edges have been trimmed and reinforcing tapes have been added per fullscale practice.

17: All sheet metal skin areas on the full size airplane are represented using lithoplate (printing plate aluminum) on the model. All of the photochemically fixed image from the printing process must be sanded away to clean metal to avoid interference with subsequent finishing materials. Here the belly skin that fits between the landing gear legs has been transferred from a card stock pattern and cut out.

18: The door and all of the lithoplate sheet metal work on the nose are in place. The lithoplate is attached using a slow curing epoxy, spread very thin on the inside surface of the metal. At this stage of finishing, the Stits fabric covering has been sealed and given a couple spray coats of PolySpray aluminum pigmented sanding primer.

19: Ribstitching, which is the process used on the full scale airplane to lace the fabric to each rib to prevent pulling loose under air loads, can be simulated in several ways. I use thin beads of craft glue applied with a home made syringe to represent the short lengths of cord that remain outside the fabric at each stitch.

20: Just as on the fullscale subject, narrow strip of pinked-edge tape made from the same fabric as the covering are attached over the rib lacing to seal and streamline the job. Stits makes scale size pinked edge tapes available. I am

using Stits PolyBrush fabric sealer to attach the material.

21: The last step in a scale fabric covering job is applying the edge tapes… a wider tape is applied all around the outside edges of each flying surface, working forward from the rear. This provides a finished appearance and eliminates any exposed edges that might be lifted by airflow in flight.

22: Here is the cabin area of the fuselage fully built up and sealed with a couple of coats of clear nitrate dope, ready for fabric covering.

23: The same cabin structure has been covered with Stits fabric. All contacts of fabric with structure, such as at stringers and longerons, are reinforced with fabric tapes just as are the ribs where lacing has been applied, and the entire surface is sealed with Poly Brush. This Stits product has the same function as clear dope on more traditional fabric coverings.

24: After the fabric and all tapes and other reinforcements are sealed with clear PolyBrush, everything gets several coats aluminum pigmented Poly Spray and a thorough wet sanding after each coat. Here Katie is inspecting the quality of my sanding while protecting the shop from those “mice” she thinks might hurt the airplanes.

25: Stits finishing products are among the easiest to spray of any I have ever used. Here are the DeVilbiss automotive touch-up gun and the Paasche airbrush I use for all of my scale model finishing.

26: Almost there…! The entire airplane has been shot with Stits PolyTone in custom matched Loening Yellow. The rudder and elevator servos were masked off during painting. You can see the wing strut attachment fitting and the landing gear fairing attached in place, and the steel wing support rods temporarily fitted.

27: Here is the tail at the same stage of assembly after the main finish has been sprayed. You can see the flying wire attach fittings on the vertical fin trailing edge and on the lower longeron.

28: After all the main paint work has been done, the windshield is cut from card stock patterns and carefully attached using fine beads of slow curing epoxy. I make a practice of covering the entire surface of each section of clear plastic with a double layer of masking tape, inside and out, just as fullscale components are protected by a protective sheet during assembly. This can be removed after all attachment and detail work is done and all trim and covers are airbrushed with finish color. Here I am using the craft glue syringe to add simulated windshield cover rivet heads made from tiny glue dots.

29: Here the dummy engine cylinders are being made up using several sizes and thicknesses of plywood discs assembled on ¼" aluminum tube mandrels.

30: The cylinder heads are made of larger discs, just like the cylinders, and sanded to their unique shape. The rocker box covers were carved from basswood. Here the sub-assemblies are glued together and the first rocker box has been sanded to final shape. Next step will be sealing with clear nitrate dope and finishing prior to final assembly.