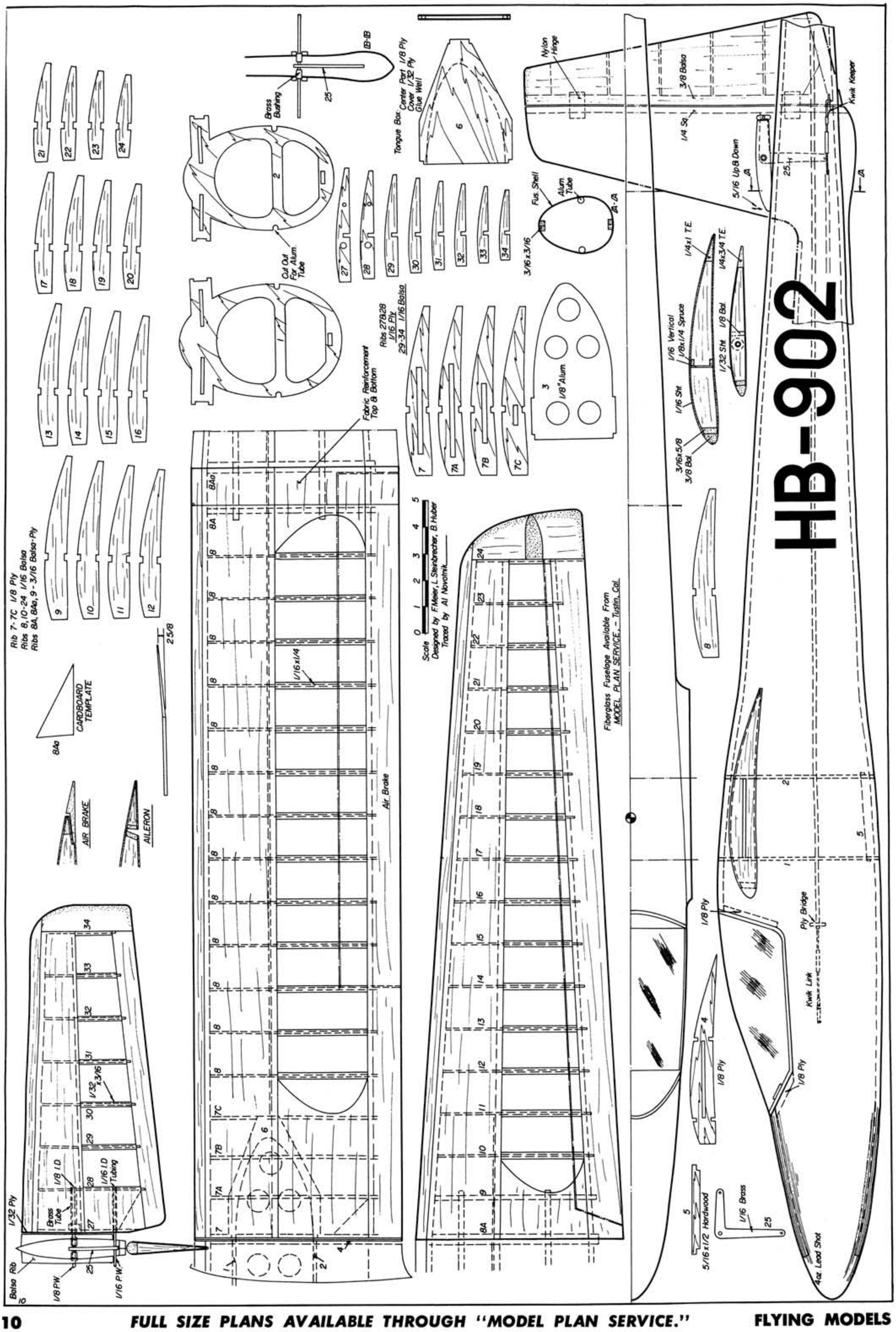

HB-902
Rib 7-7C 1/8 Ply
Ribs 8, 10-24 1/16 Balsa
Ribs 8A, 8Aa, 9 - 3/16 Balsa-Ply
CARDBOARD TEMPLATE
AIR BRAKE
AILERON
Air Brake
Fabric Reinforcement Top & Bottom
Ribs 27 & 28 1/16 Ply
29-34 1/16 Balsa
Cut Out For Alum. Tube
Brass Bushing
Tongue Box: Center Part 1/8 Ply
Cover 1/32 Ply
Glue Well
Fus. Shell
Alum. Tube
3/16 x 3/16
1/8" Alum.
Scale
Designed by F. Meier, L. Steinbrecher, B. Huber
Traced by Al Novotnik
Fiberglass Fuselage Available From
MODEL PLAN SERVICE, - Tustin, Cal.
Nylon Hinge
3/8 Balsa
1/4 Sq.
5/16 Up & Down
Kwik Keeper
1/4 x 1 T.E.
1/4 x 3/4 T.E.
1/16 Vertical
1/8 x 1/4 Spruce
1/16 Sht.
1/32 Sht.
1/8 Bal.
3/16 x 5/8
3/8 Bal.
1/8 Ply
Ply Bridge
Kwik Link
5/16 x 1/2 Hardwood
1/16 Brass
4 oz. Lead Shot
1/32 Ply
Brass Tube
1/8 I.D.
1/16 I.D. Tubing
1/32 x 3/16
Balsa Rib
1/8 P.W.
1/16 P.W.
2 5/8

A spectacular 10-foot soarer from Switzerland

The "Elfe S-3" Soarer

by Bernie Huber and Franz Meier

translated by Dale Willoughby

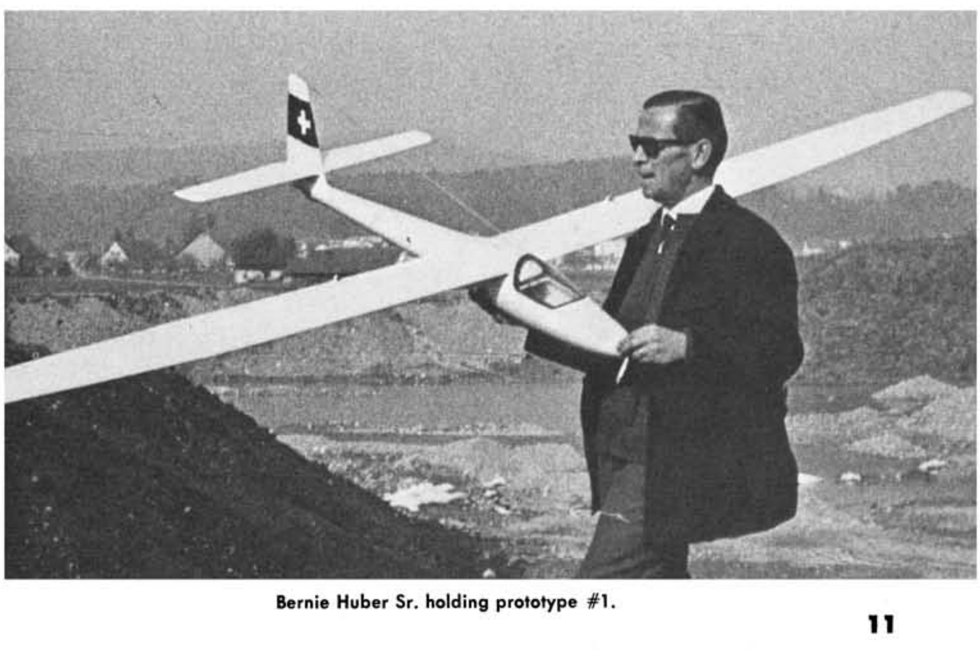
◆ Three of these model prototypes built and test flown . . . Two with new FM 1-68 airfoil, shedding interesting light on this design. The full scale "ELFE" sailplanes, from the workshop of A. Neukom, Neuhausen, Rhinefalls, are well known here in Switzerland, and gained International attention after the World Sailplane competition was held in Poland in June, 1968. Three Elfe S-3's competed in the Standard Class and placed among the first six placings in that class, while the American A. J. Smith became the World Champion in that class flying an Elfe S-3. A relatively small number of Elfe sailplanes are produced in the small factory at Neuhausen. The work force consists of two or three men, but the quality and performance of the Elfe S-3 sailplanes is outstanding.

The Elfe S-3 is a high performance sailplane with a span of 49.2 feet, conforming to the Ostiv rules for the Standard Class. It is a shoulder wing sailplane with a conventional tail, comparable in size and performance to the 15 meter "Phoebus," the Standard "Libelle" and the 15 meter "Diamant."

Specifications:	Model Elfe	Model with ailerons	Full Size Elfe
Wing area	5.77 sq. ft.	6.40 sq. ft.	124.5 sq. ft.
Stabilizer area	0.85 sq. ft.	0.85 sq. ft.	—
Wing span	9.84 ft.	118.08 inches	49.2 ft.
Aspect ratio	15:1	13.5:1	19:1
Gross weight	4 lbs.	6 lbs.	650 lbs.
Wing loading	0.7 lbs./sq. ft. (11.2 oz./sq. ft.)	0.95 lbs./sq. ft. (15.2 oz./sq. ft.)	5.25 lbs./sq. ft.

The building methods differ quite a bit from that of the other sailplane competitors in that it is built largely from wood. The wings consists of a center section 30 feet in length with two tips ten feet long. The wing shells are plywood-balsa-plywood sandwich, while the spar is machined out of high quality aluminum alloy. The front section of the fuselage is fiberglass reinforced plastic while the balance is a sandwich shell.

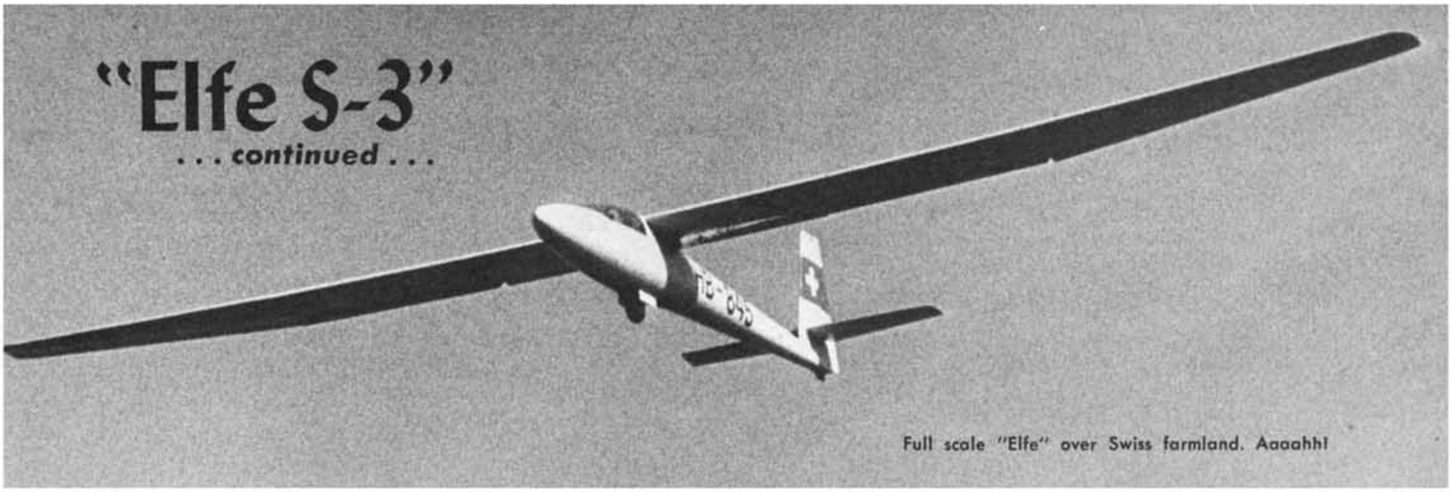
The Scale Model Version: Here at Telaves Model Engineering we built our first Elfe (the predecessor of the S-3) in 1962. We found that the flying characteristics of the first model suffered because it had a heavy wing loading and a small scale wing chord. Renewed interest in the Elfe came



Bernie Huber Sr. holding prototype #1.

"Elfe S-3"

. . . continued . . .



Full scale "Elfe" over Swiss farmland. Aaaahh!

about when Berni Huber had the opportunity to help with the calculations for the FAA License for the full size Elfe S-3. During the contacts with Mr. Neukom, the idea of a scale model was born, but the problem of duplicating the extremely curvy fuselage seemed insurmountable. The only out was a fiberglass fuselage which requires a considerable amount of work to bring to life. In our discussions of other models with Franz Meier, a top notch model builder who created the "Sabre Jet," the "Skyraider" and the "Hawker Hunter," Berni Huber hinted that "perhaps" the Elfe S-3 would make a good model sailplane. It was then agreed that Telaves Model Engineering and Franz Meier would work on the fuselage jointly, but would build two versions for comparison in performance. Telaves Model Engineering chose the version with flaps and ailerons, while Franz Meier chose just the simpler model with elevators and rudder control. This joint venture proved to be beneficial for both parties as an immediate comparison of the two model sailplanes was possible.

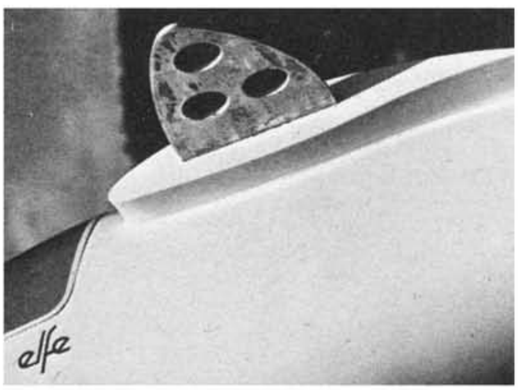
Franz Meier carved the positive mold from a maple block, then the negative fiberglass mold was constructed to form the positive fiberglass shells for the Elfe fuselage. Concurrently we got busy on the design of the wings. Franz Meier built a wing with his original FM 1-68 airfoil without ailerons or deHavilland air brakes, while a wing with ailerons and air brakes, using the NACA 6412 airfoil was designed by Louis Steinbrecher and Berni Huber. The first flying prototype was built by Berhard Huber, Senior and flown with the more sophisticated wings.

The wing area and also the horizontal tail area are slightly enlarged from the exact scale dimensions, i.e., the wing chord is about 10% larger to move the critical Reynolds Number to a slower flying speed and to lower the wing loading. We felt this was entirely justified after watching the flight characteristics of the 1962 Elfe model sailplane. All other dimensions are scaled down exactly to a one-fifth scale from the real sailplane which is built in our town by the Rhinefalls.

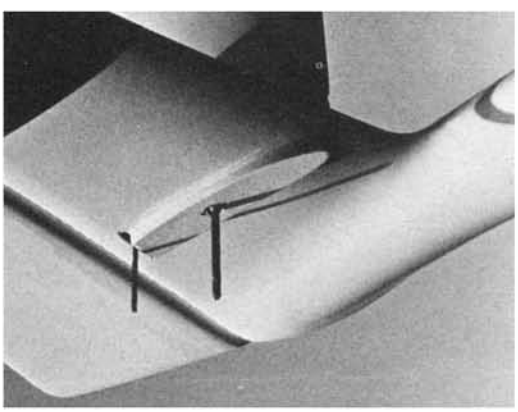
The Elfe S-3 is hardly a beginner's model, in view of the size and amount

(Continued on Page 40)

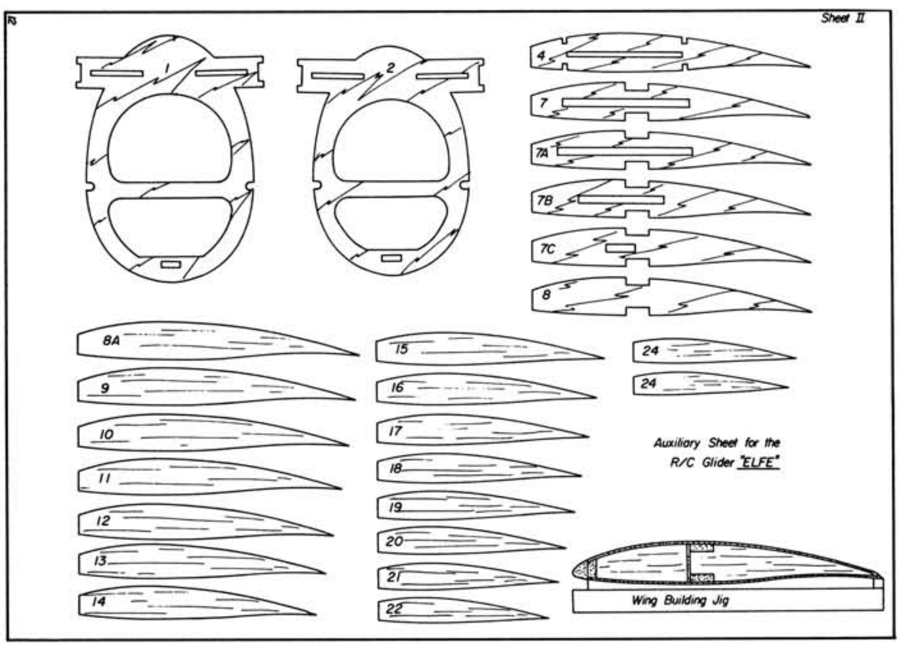
Fibreglass fuselage, canopy, plan available.



Aluminum alloy tongue and wing to fuselage connection on the #2 prototype.



Flying stabilizer mechanism. Approved, simple.



The "Elfe S-3"

(Continued from Page 12)

of work required. On the other hand, if the reader has a fair amount of building experience and loves these "Silent Birds," then he will be justly rewarded in the attempt to recreate a model sailplane that is now World famous. It is not difficult to fly, however, we recommend that a qualified "test pilot" be on hand for the first flights.

The fuselage is composed of two halves of fiberglass shells. The reason it is furnished like this is that the mechanism for the "all flying stabilizer" must be mounted in place before gluing the two halves together. A vacuum molded clear canopy is available. Wings, stabilizer and rudder are of conventional balsa construction. If the aileron version is built, the linkage must be engineered to insure no drag or binding in the movement. We must admit that we haven't found the best solution to "bind-free" ailerons. The prototype number 1 had a torsion bar (cardboard tube) but there was too much slack in the connections and could jam at real high wing deflections. Just for the record, let us detail the two versions for your information so you can decide which set of wings to build.

Standard Version—NACA 6412 airfoil: This version is indicated on the plans that accompany this article and is controlled only with rudder and elevator. Prototype number 3 was built in this manner using the FM 1-68 airfoil and its flight characteristics were nothing but outstanding . . . see Dale Willoughby's note later on concerning the test flights. . . . This Elfe was easy to tow with a two man winch and has ridden thermals on occasion. However, because of the additional weight of the paint, it is well suited for the slope. The relatively low wing loading and the NACA 6412 airfoil will give a good gliding angle for both thermals and in low wind conditions at the hill. This "Standard" version of the Elfe S-3 is better than originally forecast.

Improved Version with FM 1-68 airfoil: On the second sheet of plans the ribs for the improved version are given. Franz Meier built the prototype number two with airfoil, which flew so well that prototype number 3 used them also. Until now, laminar airfoils were thought not to be well suited for model airplanes. But such thoughts had not been proven and to try "then succeed" is almost better every time than just to think. With these thoughts in mind, the Franz Meier FM 1-68 airfoil was born. A good L/D at a higher flying speed was expected by the use of this airfoil, and we hoped to get the same flying characteristics as the full size Elfe S-3. It was clear from the beginning that a model with laminar airfoil would only give improved flying characteristics if an absolutely clean and smooth wing surface could be attained . . . and such a surface is nothing but good honest labor! To insure that this concept be borne out, the wing was planked entirely with 1/16" balsa. Only the center part has a spar. From experience we have learned that in time the balsa planking will sag, revealing the position of the spar, which spoils the original curve of the airfoil. Consequently, the outer wing panels and the all moving stabilizer are sparless and without a trailing edge. To stabilize the construction, a layer of Silkspan was applied to the surfaces.

First test flights were made before the final finish was applied. On the first hand launch, the glide was beyond all expectations, and it was stable on the tow winch. Subsequent flights with the now finished model, which was painted, hand rubbed and waxed, gave a more improved performance. The flight path is even and steady with no tendency to spin even on a very critical tow where the Elfe was "stalled" on the line. This improved version was a definite step in the right direction, however, it does require more construction time and care in building, but the rewards are a better performing model sailplane of outstanding appearance in the air.

The development of the FM airfoils is continuing and we hope to record our progress for future model sailplane designs. An interesting development came to light when Dale Willoughby visited Neuhausen and Fehraltorf and flew Prototype Number 3. This was during late afternoon when the storm had shielded the sun overhead. Several flights from the winch were conducted and the Elfe S-3, on its last flight, had an O.S. 09 engine mounted on a pod above the C.G. The motor run was about 8 minutes and during that time almost a thousand feet altitude was gained before the engine cut. During the descent, Dale worked a weak thermal and then brought it in gently on the mowed field near-by. Just as the Elfe was being disassembled, the sun came out briefly just before sunset. Dale picked up a wing panel to sight down its length to try to determine why the glide was so long, when he noticed that dew had fallen on the white wing panel. Upon close examination, the first third of the airfoil was scrubbed clean and shiny, but the next half of the wing chord still had visible moisture on it. And strangely enough, the last one-sixth of the chord was again without moisture! While there were no actual measurements taken of the dew (moisture) pattern, it was plain to all who saw it that the airfoil was in fact laminar to a definite point, and the air had removed the moisture from the trailing edge of the wing.

The Aileron and flap version: The ailerons and airbrakes are only indicated on the plan, as the mechanical linkage is not fully developed. In addition to requiring more glider pilot skill, there is much more mechanical engineering required. The addition of two more servos brings the wing loading up. The full house version is very sensitive to control movements and when Berni Huber, who is a full size sailplane pilot, flew the model, he was astounded at the controlability of the model Elfe. Each turn must be flown with rudder and aileron to be clean. The Air brakes are very effective and spot landings are much easier. The only disadvantage of this version is the higher weight, but it would be at home on the slope where maneuverability is a key factor in flight. The Elfe has a ± 4° aileron deflection and the sensitivity is nearly that of a powered model. However, in a banked turn, where the load on the wings caused a flexing of the wings, the inability to withstand a twisting decreased the deflection of the aileron and caused a loss of directional control, to a degree bordering on undesirability.

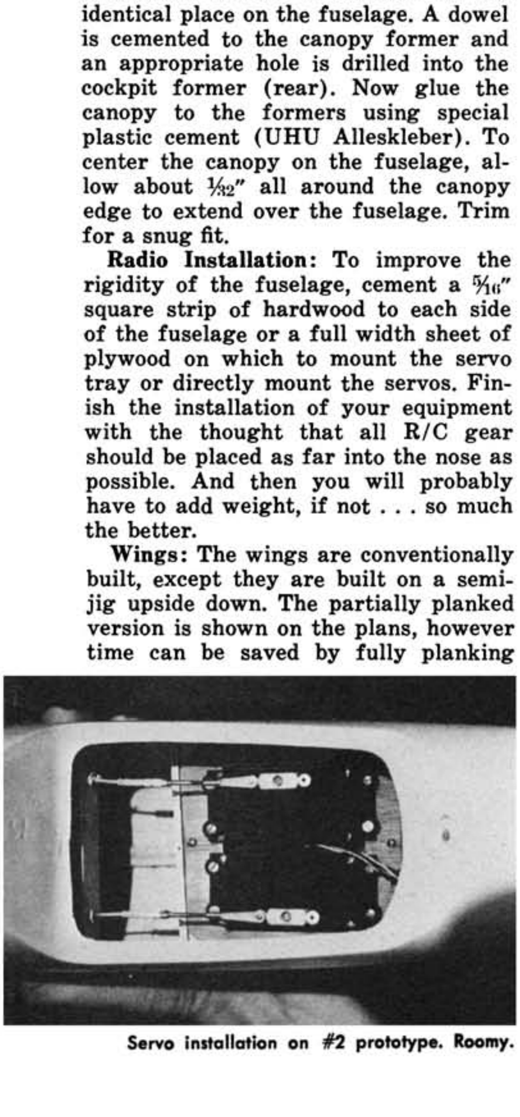
Building the fuselage: Cut out formers #1 and #2 first, then make the wing-tongue #3. Fit the formers into the fuselage halves by holding the left fuselage half on the plan and mark the position of both formers on it. Now transfer this mark to the right half of the fuselage. Next make a cardboard template of the formers, omitting the "arms." Use this template to mark the interior location of both formers, then by the cut and try method, always trying them at the precise marked position. If some material must be removed from the former (due to a change in the shell thickness), do not sand just at one spot, but all around the former. When the formers fit and the fuselage halves contact all around the perimeter, cut out the horizontal slot for the aluminum wing tongues.

Next, glue the ⅛" square balsa stringers to the fuselage shell. Glue these in without stress, by making a saw cut every so often at the curved areas. Only epoxy cements will stick to the fiberglass shell, unless you have some better adhesive. Next, cut the stabilizer lever (#25) from fiberglass sheet or brass. Your electronics shop has printed circuit board which is just fine for this part. Epoxy the piano wires to it, but if brass sheet is used, we recommend a metal grommet be used as a bearing. While the original used aluminum tubing to route the control wires from the servo to the control horns, the use of Dan Pruss's Nyrods should be considered. It is even feasible to use the ordinary ¼" square pushrods. Next drill holes for the all flying stabilizer axle and lever. Test for freedom of action prior to cementing the fuselage halves together. No changes are possible after the cement dries. When satisfied that the linkages work well and freely, sand the edges of the fuselage so that it contacts uniformly all way around, and then mix up a good batch of Epoxy. Spread Epoxy on all edges of one half. Now Epoxy in formers #1 and #2 with the wing tongues installed and also hardwood block #5 (which is the tow line hook base). Spread Epoxy around the rest of the formers and join the two shells with tape. Work from the nose section toward the tail and be sure the shells are aligned correctly as the vertical stabilizer (fin) must be at a 90° angle to the wing tongues. No twisting here. We suggest that heavy twine or rubber bands be wrapped around the center-section where the wing tongues protrude in order to get a stronger joint at that point. Strips of masking tape were used to hold the sections together. Let the fuselage cure for 23 hours and try to make some sort of a jig with books or weights to keep it in the desired position. Check the alignment periodically. When cured, sand the joint carefully and fill any holes with a second application of Epoxy, or "Stuff." Add rib #4, mount the small spar and plank the wing fillet with 1/16" balsa. When dry make a good fillet with your wet finger and Epoxy. The brass bushings (stabilizer bearings) are added through the open end of the fin. These MUST BE PARALLEL TO the wing tongues. If not adjust until they are straight without stress.

Canopy: Cut the excess material from the canopy and mount two supporting formers (sides) and also a former at each end according to the curve of the assembled fuselage. When they are ready to assemble, mount a small magnet to the front former with epoxy. A little steel washer is mounted at the identical place on the fuselage. A dowel is cemented to the canopy former and an appropriate hole is drilled into the cockpit former (rear). Now glue the canopy to the formers using special plastic cement (UHU Alleskleber). To center the canopy on the fuselage, allow about 1/32" all around the canopy edge to extend over the fuselage. Trim for a snug fit.

Radio Installation: To improve the rigidity of the fuselage, cement a 5/16" square strip of hardwood to each side of the fuselage or a full width sheet of plywood on which to mount the servo tray or directly mount the servos. Finish the installation of your equipment with the thought that all R/C gear should be placed as far into the nose as possible. And then you will probably have to add weight, if not . . . so much the better.

Wings: The wings are conventionally built, except they are built on a semi-jig upside down. The partially planked version is shown on the plans, however time can be saved by fully planking the wings without a great increase in weight. Make the choice between the NACA 6412 and the FM 1-68 airfoil, remembering that the latter will take a bit more time, but perhaps a little better performance. Cut out all parts first. Especial care in preparation of plywood ribs #7 to #7C and the tongue boxes #6 is necessary. The wings are built in an upside down position, i.e., place the ribs on the plan with the curved portion DOWN. A 3/16" x 1/2" balsa strip is mounted 3/16" from the airfoil trailing edge and is used as a building jig. Pin the 1/4" x 1/8" spruce spar to the plans in the position indicated and then add the ribs, plywood ribs and wing tongue box in that order. Next mount the 3/16" front spar, the trailing edge and the other spruce spar. When dry, remove from the building board, turn it over and glue rib 8A in using the cardboard model shown on the plans as a dihedral guide.



Servo installation on #2 prototype. Roomy.

The wing tip panels are built in the same manner. Note that these panels are built with a washout of 3/8" at the trailing edge. To get this, the balsa strip that is used as a jig tapered from 1/2" at rib 9A to 5/64" at rib #24. Next cement the 1/16" balsa between the spruce spars to form a "D box" section. This is important and use a good grade of balsa, with the grain running vertical to the spruce spars. When dry, begin the wing planking. Begin at the trailing edge (top and bottom), pin the wing back into the building jig and cement the bottom sheeting. Turn over and repeat the same process on the top. When planking the outer wing panels, remember to use those tapered strips appropriately. Next cement the 3/8" leading edge as well as the balsa capstrips (if used). Plan next to join the wing panels together. First check the dihedral angles for uniformity of each wing and sand the root ribs as necessary to make them identical. Now drill holes for dowels (part #26) and add the outer wing panels to the center section. Sand the wings thoroughly and set aside to dry, preferably in a place flat and away from falling tools.

Stabilizer and rudder: As with the wings, the stabilizer and rudder follow conventional building practices, but they are not built upside down. Cut out all ribs, drill holes for the brass tubes in ribs #27 and #28. Assemble the stabilizer but do not fail to put a 1/32" strip under the rib T/E for prior to cementing them together. Add the brass tubes on each side before planking. Next drill the hole for the holding screw in the larger piece of tubing. Wheel collar retainers are used to hold the stabilizers in place. Slide the tubes, including the collars into the ribs, mount the stabilizer to the fuselage, align, and cement thoroughly. Construction of the rudder is pretty much self explanatory. However, make sure the rudder control horn is so placed on the finished rudder that the pushrod holes are lined up WITH THE HINGE

The cockpit view, full scale "Elfe" design.

LINE and not as shown on the plans. If installed as shown on the plans, you will have more throw in rudder deflection to one side than the other.

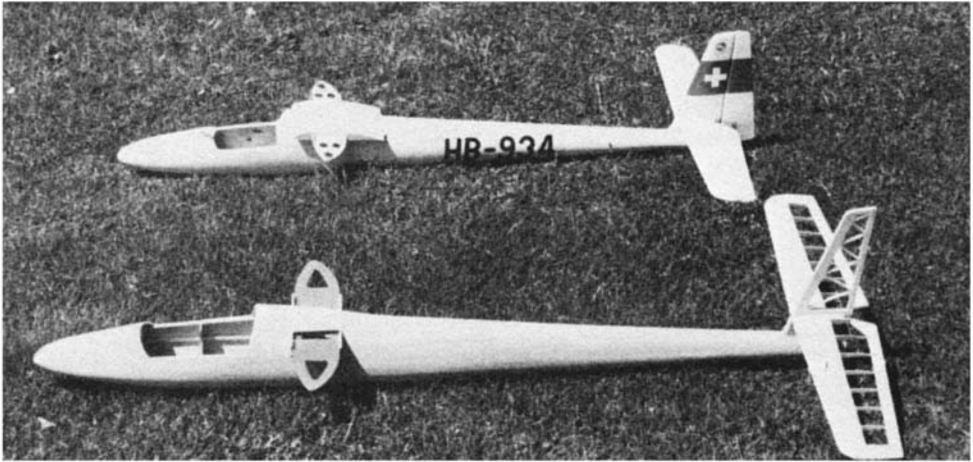
Finish: Silron was used to cover the wing with the open structure. If the fully sheeted version is used, iron on Super MonoKote for a lightweight, high gloss finish. A high quality finish on the fuselage is gained if the fuselage is first primed with grey auto primer, then wet sanded (grit 400) thoroughly before the second coat of white lacquer is sprayed on. The red Swiss insignia was sprayed on also. But the identification numbers are made of black decal sheet or MonoKote.

Flying: Balance carefully at the C. G. location, shown on the wing drawing and then try a few hand launches. If the model glides well at least 100 feet, try to winch it up. The position of the tow hook depends upon the weight of the model, but for a good launch on the test flight of prototype No. 3, it was placed directly under the leading edge of the wing. Remove the tow hook when flying at the slope. A straight launch while under tow will help the "test pilot" to gain the most altitude with the least sweat. The "Elfe" is very sensitive to controls, especially at high towing speeds, so try not to over-control.

Post Script: The Number 1 prototype used air brakes and ailerons. Both controls were very positive and effective. The rectangular center-section of the wing was made in one piece to house the servo mechanism, and the outer wing panels were mounted via wing tongue boxes, which accounted for some of the weight. Frankly, the Number 2 and 3 prototypes flew better than the Number 1, just by means of rudder and elevator controls, mainly because of the aileron linkage problem, which we did not solve. Maybe you can! Good flying and may you thrill to the sight of this beautiful scale sailplane wheeling in a thermal high overhead. . . .

Franz Meier and
Telaves Model Engineering . . . ●

Arrangements have been made with Model Plan Service, Box 824, Tustin, California 92680, U.S.A., to provide the fibreglass fuselage portion of this model. Tentative price was $35.00 for the plans, the molded canopy and the white fibreglass fuselage, F.O.B. Tustin, Calif. Contact them for further details.



Paul Denson, a chemistry teacher in the San Diego area built the Elfe S-3 fuselage from good old balsa. The prototype fibreglass fuselage is seen in the background. The Elfe S-3 design appeared in December '69 FM.