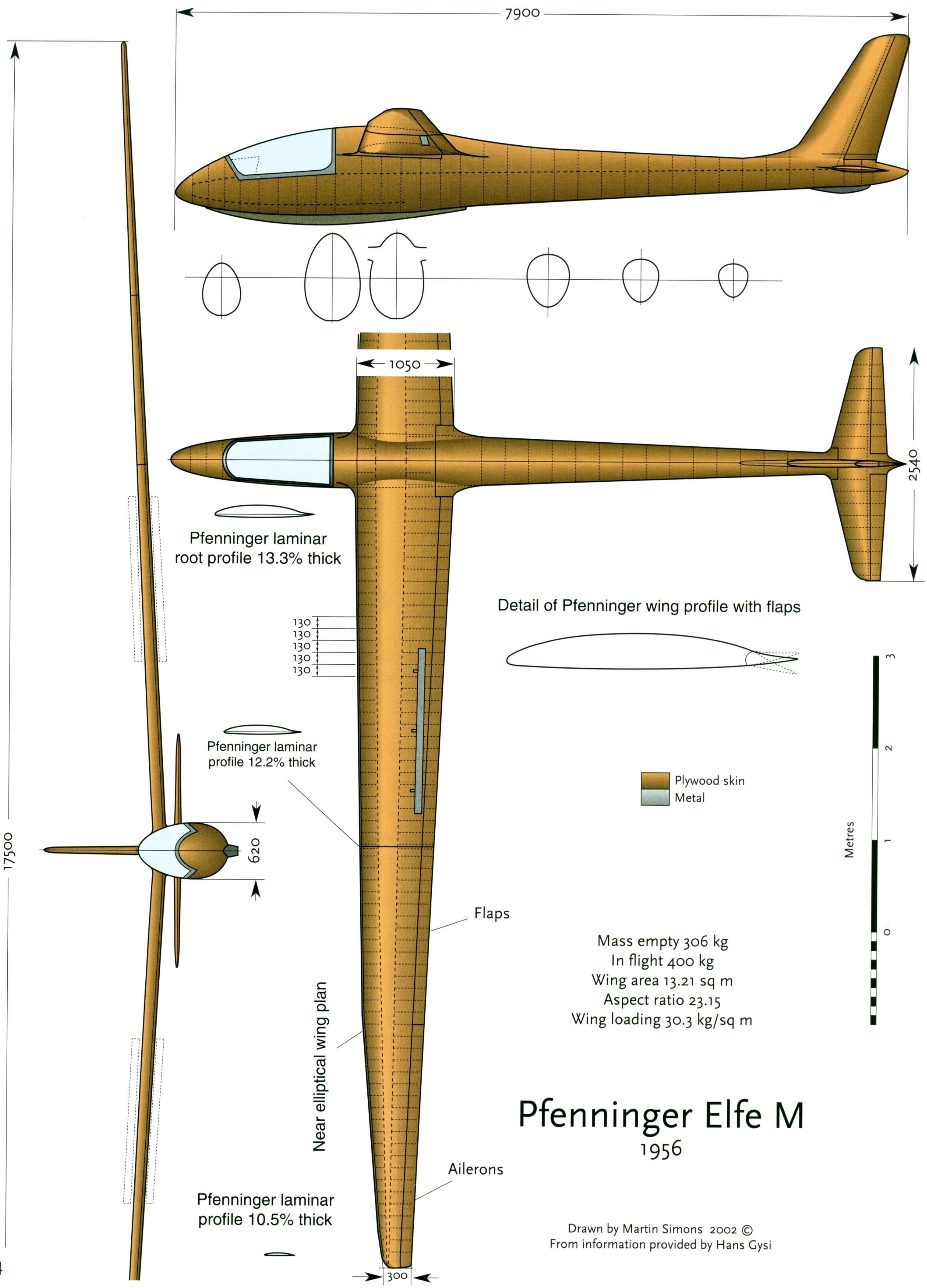

7900
1050
2540
17500
620
130
130
130
130
130
300
Pfenninger laminar root profile 13.3% thick
Detail of Pfenninger wing profile with flaps
Pfenninger laminar profile 12.2% thick
Plywood skin
Metal
Metres
0
1
2
3
Flaps
Mass empty 306 kg
In flight 400 kg
Wing area 13.21 sq m
Aspect ratio 23.15
Wing loading 30.3 kg/sq m
Near elliptical wing plan
Pfenninger Elfe M
1956
Ailerons
Pfenninger laminar profile 10.5% thick
Drawn by Martin Simons 2002 ©
From information provided by Hans Gysi

Above: The Elfe M at St Yan, 1956.

Left: The Elfe M restored and flown by Hans and Carl Gysi, nephews of the designer.

dently of the NACA 6 Series and gave somewhat different results. In particular they were thin and had a narrower low drag range, although, as with the NACA profiles, the useful range widened as the Reynolds number was reduced. It was all the more important to have variable camber in flight.

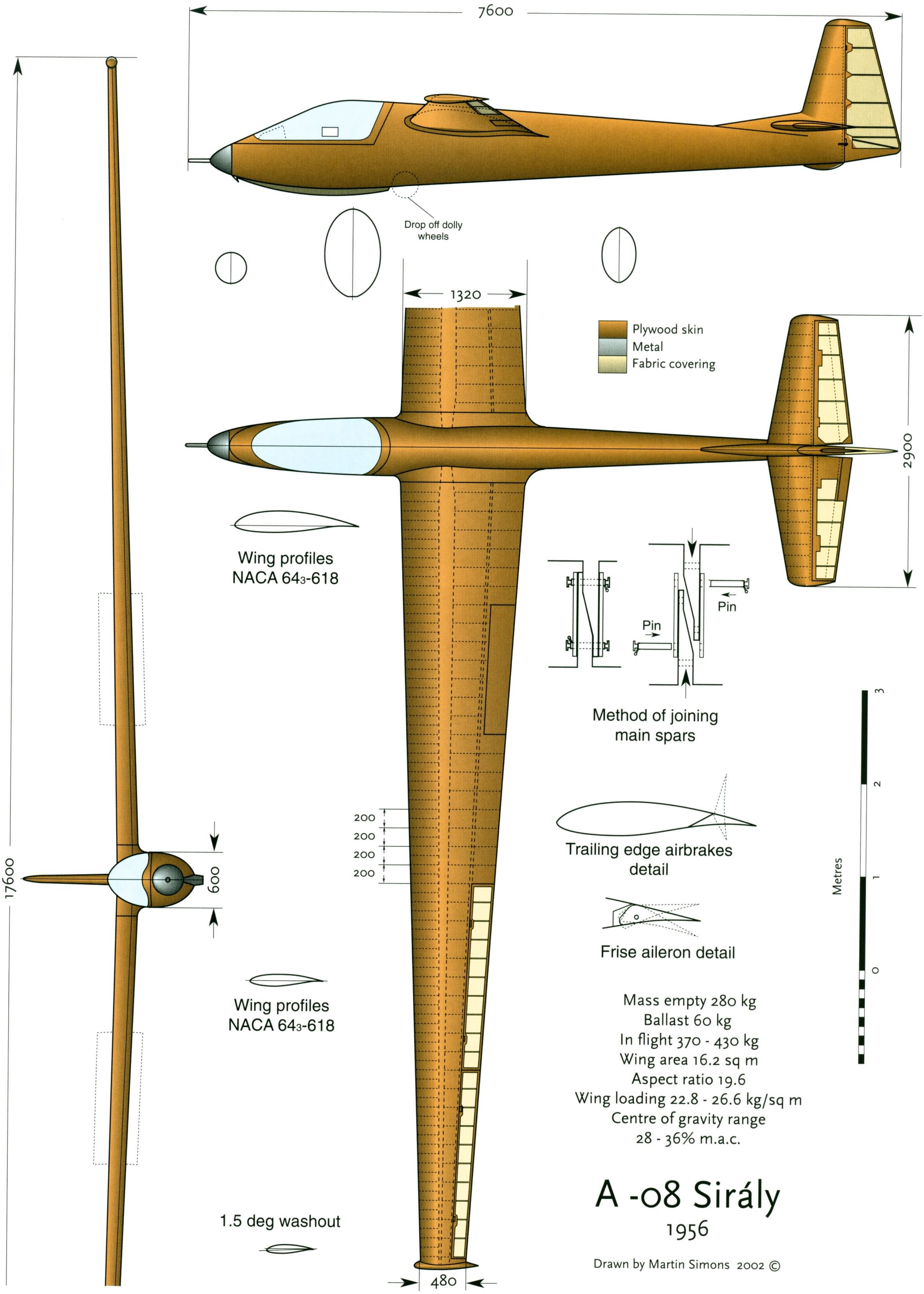
The Elfe II of 1946 - 7 was designed to take advantage of the new profiles. Unfortunately it was destroyed early in its career in a fatal accident caused by rudder flutter. There followed the Elfe PM3 (P M for Pfenninger & Markwalder) which turned out disappointingly heavy. Only one was built.

The Elfe M was Pfenninger's last sailplane design, the detailed stressing calculations and drawings being carried out by Albert Markwalder and construction by Albert Neukom.

The wing was in three sections, with a very strong main spar 330 mm wide at the root, and ribs spaced at only 130 mm. The plywood skin, laid with diagonal grain and carried back to the auxiliary spar, was 3 mm thick in the centre section, thinning to 2.5 and finally to 1.5 mm at the tips. It was impracticable to bend the 3 mm thick material round the leading edge, so a false leading edge was used with a shaped nose piece fitted after the skinning. The Elfe M had flaps across most of the span.

The fuselage was of straightforward semi-monocoque type with plywood skinning, with a moderate contraction of the cross section behind the wing, to reduce skin drag. The tail unit was constructed in similar fashion to the wings and was of comparatively small area. The undercarriage was a sprung skid, with drop off dolly for take off and ground handling.

Calculations predicted an outstanding performance. The Elfe M was hurried to completion in time for the 1956 World Championships at St Yan in France. It was flown there by Hans Nietlispach to 8th place and in Germany by René Comte to 11th place in 1960. Only the one example was completed. After 1960 the Elfe M passed through the hands of several owners until badly damaged when a powered aeroplane, running away without a pilot, crashed into it on the airfield in 1975, causing serious damage. It was subsequently repaired and restored to flying condition by Hans and Karl Gysi, nephews of Walter Pfenninger, the designer. The earlier Elfe PM 3 also has been restored to flight.


7600
Drop off dolly wheels
1320
Plywood skin
Metal
Fabric covering
2900
Wing profiles
NACA 643-618
Pin
Pin
Method of joining main spars
17600
600
200
200
200
200
Trailing edge airbrakes detail
Frise aileron detail
Metres
0
1
2
3
Wing profiles
NACA 643-618
Mass empty 280 kg
Ballast 60 kg
In flight 370 - 430 kg
Wing area 16.2 sq m
Aspect ratio 19.6
Wing loading 22.8 - 26.6 kg/sq m
Centre of gravity range
28 - 36% m.a.c.
1.5 deg washout
A -08 Sirály
1956
Drawn by Martin Simons 2002 ©
480

Right: The A 08 Siraly in flight

Below: The Siraly (Gull) competed at St Yan in 1956.

Schempp-Hirth type, there was a retracting wheel placed well aft on the fuselage and a small skid under the nose, which also could be retracted. The cockpit was redesigned and lengthened, with a different shape of canopy. No ballast tanks were provided. Despite the metal spar the Sirály 2 was structurally heavier than the Siraly 1 by 30 kg. The two members of the Hungarian team once again did not score particularly well at Leszno but the Sirály II was used to break most of the National records in the years following. Four Sirálys were built in total.

A - 08 Sirály

The A - 08 Sirály (Gull) was designed specifically to compete in the 1956 World Championships. Hungary had not entered the Internationals before and the pilots were inexperienced at this level of competition.

The Sirály was of wooden construction with the leading edge ribs closely spaced and plywood skins over the whole wing except for the ailerons. A drop-off dolly was used for take off, landings were on the rubber sprung skid. There was provision for 60 kg of water ballast. The air brakes were of the rotating trailing edge type, which had rarely been used before on sailplanes. The wing main spars were joined in a way that was new at the time, but in a modified form became widely adopted for glass-plastic sailplanes later. The spars were tapered at their ends in the vertical plane, to overlap one another inside a crosswise channel on the fuselage. Two horizontal steel pins were inserted to lock the spars together and to take the shear and bending loads.

Two Sirálys did compete at St Yan. The results were not outstanding but several Hungarian National Records were broken including a 386 km distance flight, a 200 km triangle speed of 63 km/h, and in 1959 a distance record of 430 km.

The Sirály II was prepared for the 1958 World Championships in Poland. It had spars of light alloy combined with a wooden structure and plywood skin. The air brakes were replaced with standard

L - 13 Blanik

The Blanik (named after the mountain near Prague) was designed from the beginning as an advanced training sailplane. Nevertheless it had an impressive performance and broke many two seat records both nationally and internationally, including the World Two Seat Distance Record of 921 km by Juri Kouznetsov in 1967 and the Absolute Altitude Record of 7,748 m in 1961 by the Czech pilot Hudcova Urbacka. Even more noteworthy in some respects was the trans-Andean soaring flight from Santiago de Chile into Argentina by Alejo Williamson Davila in 1964. For this flight the pilot was awarded the FAI Lilienthal Medal.

Czech pilots flew the first Blanik at St Yan in 1956 but it was severely damaged in a road mishap on the way to the Championships site and had to be returned to the factory for repairs. The team arrived eventually but too late to make up for zero scores on the early contest days. The two-seater category in World Championships was discontinued after this. The Blanik's next appearance on the international contest scene was in 1963 when two Chilean pilots, who had been aerotowed across the Andes to reach Junin in Argentina, competed, flying their Blaniks solo.

The L - 13 was a tandem two-seater of all metal construction, rarely seen in Europe although commonplace in the USA. Starting in 1935 a great deal of research and development went into the design at the LET Factory. A team including J Vesely, who reported on

Above: The Blanik had large Fowler type flaps, shown here extended. Note also the shoulder type tow releases on this early production example

Right: Blanik at Waikerie in S. Australia. After many thousands of safe flying hours, metal fatigue life limits grounded this aircraft.

some aspects of the aerodynamics at the OSTIV Congress in 1958, assisted the chief designer, Karel Dlouhy. The aerodynamic research was chiefly directed to the large Fowler flaps which were installed inboard of the ailerons. It was shown by wind tunnel tests, and confirmed in flight, that deploying the flaps allowed a very worthwhile increase in the maximum lift coefficient, without any important increase in drag. The rate of climb when circling in weak thermals with flaps partly down was improved. With flaps retracted the glide at high speeds was very good. The penalty was a weight increase for the completed sailplane of about 7.5%. Some increase in the pitching forces when the flaps were down required adjustment of the elevator trim. With flaps and air brakes, the Blanik could be landed easily in small spaces.

A very high standard of workmanship was evident throughout. A thin coat of clear varnish was applied after manufacture but other than this most Blaniks flew with no special filling, smoothing or painting of the wings. The designer claimed that laminar flow extended at least to 30% of the chord, providing the wing was kept clean.

The fuselage was built in two half shells, joined along the spine and belly with a simple riveted lap joint, almost the only noticeable protuberance on an otherwise smooth skin. The nose was well shaped with the cockpits in tandem. With the swept forward wing, the view from the rear seat was adequate, although many instructors found the seating position somewhat cramped.

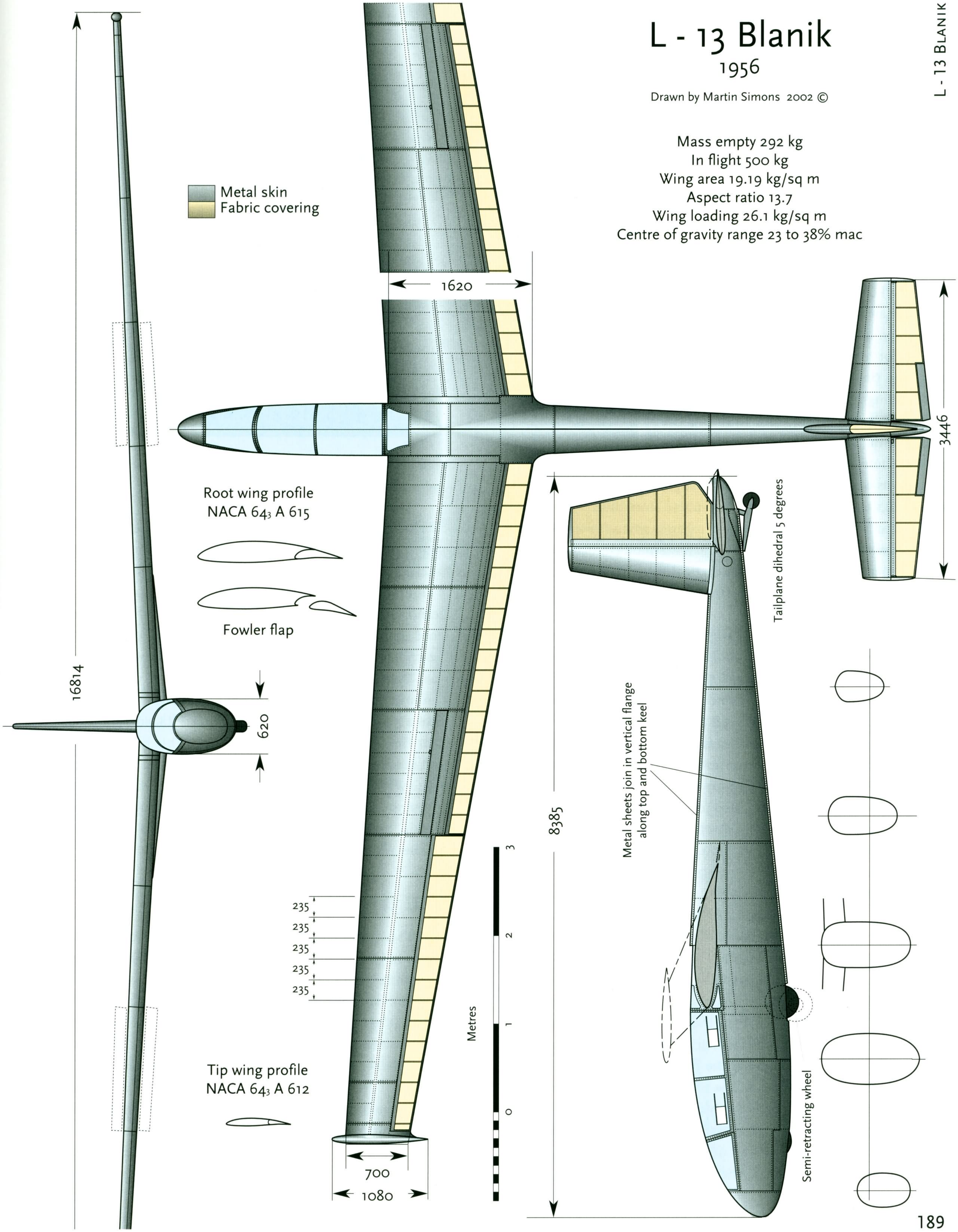
The wheel was semi retractable. This allowed landings to be made 'wheel up' without structural damage but the lack of springing

L - 13 Blanik

1956

Drawn by Martin Simons 2002 ©

Mass empty 292 kg
In flight 500 kg
Wing area 19.19 kg/sq m
Aspect ratio 13.7
Wing loading 26.1 kg/sq m
Centre of gravity range 23 to 38% mac



when the wheel was up served as a sharp lesson to a forgetful pupil pilot. There was a small rubbing block under the nose in case a bad landing caused the tail to go up too far. There was a slight dihedral on the tailplane which folded upwards for road transport.

Once the Blanik entered full production large numbers were exported, about 2000 to the USSR alone and hundreds more to other countries. The total built probably exceeded that of all other single sailplane types since the Grunau Baby. It was widely used as a basic trainer. It had the advantage that any student pilot learning in a Blanik was taught from the first to carry out full pre-take-off and landing cockpit drills, including setting flaps and trim, raising and lowering the wheel, using air brakes etc., on every flight so that these actions became automatic. Ten years previously student pilots were sometimes still being taught to fly in primary gliders. Things had come a very long way indeed since then.

The 'Urendo' ('Horrendous') two seater was in fact a very useful trainer. This example was the only one with flaps.

The Blanik was also stressed for aerobatics when flown solo, as was demonstrated in England by Ladislaw Marmol. Limited aerobatics were permitted with two pilots on board. A good many Blaniks landed with wing skins slightly wrinkled when this rule was sometimes ignored.

During the thirty or so years when the Blanik was being sold worldwide, numerous small modifications and improvements were introduced. The early Blaniks had shoulder type tow releases for winch launching, with the attachment points on either side of the rear cockpit requiring a Y forked end to the launching cable. A simple central launching hook replaced this. The aerotow release in the nose was often modified to conform to various different national standards. The metal framed canopy was divided in two but later was replaced with a single moulded form which had a better aerodynamic shape and gave a less obstructed field of vision. A tail wheel instead of a skid was an option. The basic structure was unchanged and the price remained very competitive.

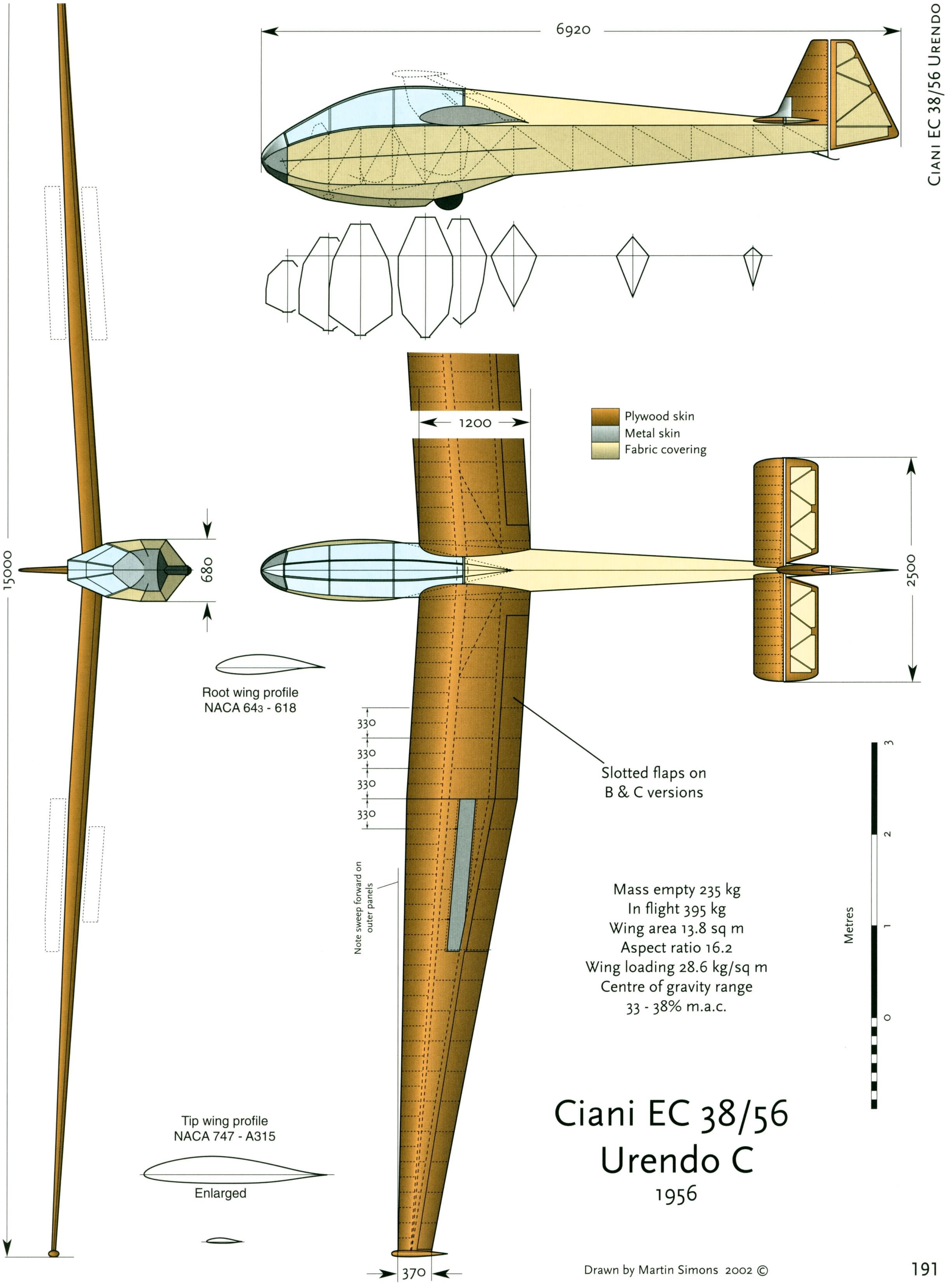
In Australia more than 100 Blaniks were imported and the type became the most popular training sailplane in the country. Almost every club had one or two in constant use, relying on them for the entire training programme. Weather conditions over most of Australia are such that soaring is possible on almost every day and flying times of training sailplanes accumulate rapidly. It came as a severe shock when a directive from the Australian Department of Transport grounded all Blaniks which had a total flight time over 3000 hours. They had exceeded the permitted fatigue life determined by the manufacturer. At the time the directive was issued, several Australian Blaniks had already exceeded 10,000 hours. There had been no structural failures or even suspicion of fatigue cracking but this did not alter the official decision. Several clubs lost their training aircraft overnight. Others whose Blaniks had not yet reached 3000 hours, were hardly less concerned since in many cases they had only a few hours left and the sailplanes depreciated suddenly in re-sale value. Some smaller clubs went bankrupt. A great deal of argument and correspondence resulted in some approved modifications for the older Blaniks but in most cases these were not performed and the aircraft were scrapped. For the others a programme of frequent inspections and checking allowed flying to continue. Those Blaniks still in use are required to go through a thorough inspection and overhaul process regularly.

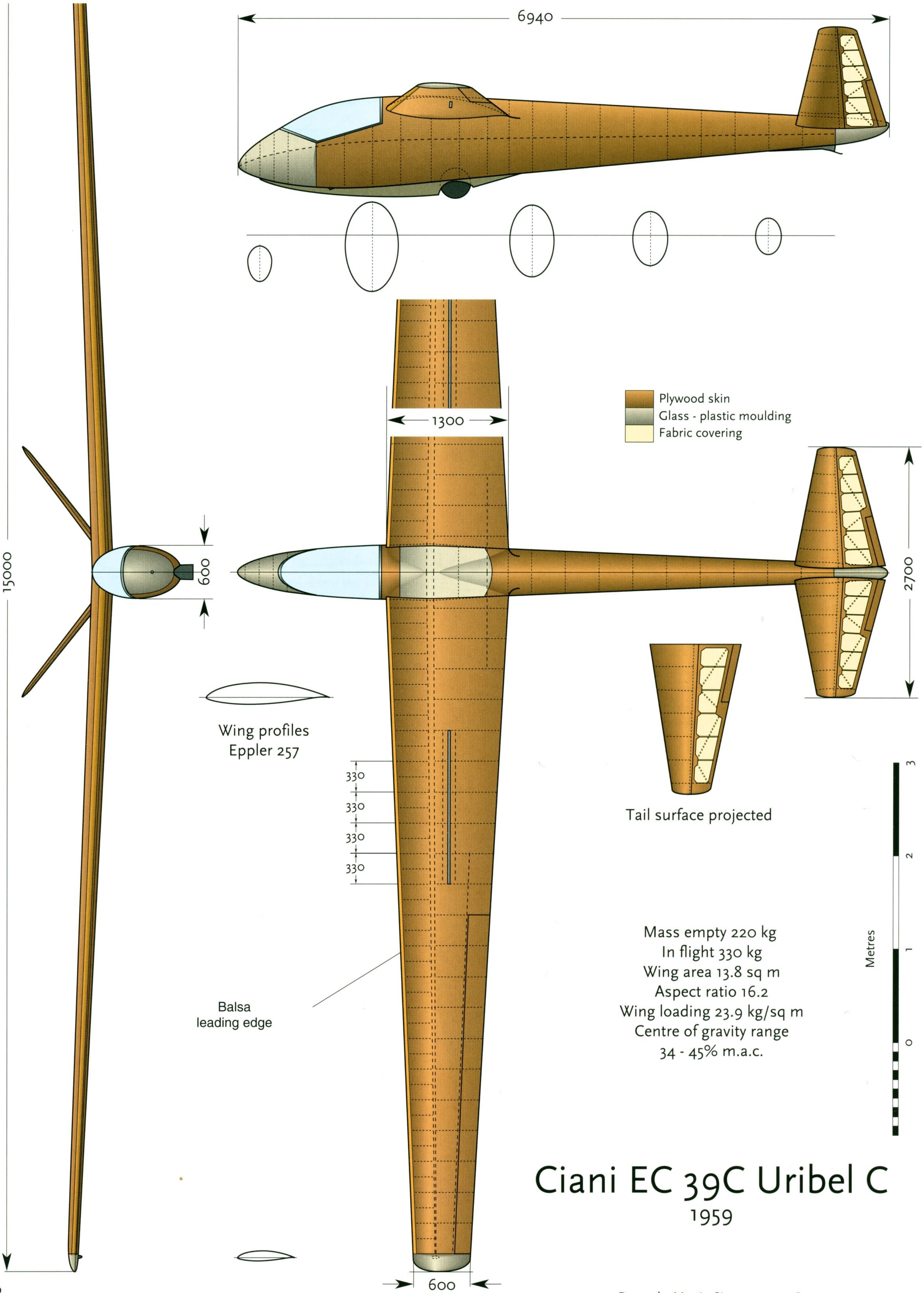
In 1988 a new version of the Blanik, the L - 23, sometimes described as the Super Blanik, was introduced. This had a stronger wing and the Fowler flaps were deleted. It was fitted with a T tail. Fatigue life was 6000 hours with an inspection schedule allowing further extensions. Production of the L - 13 ceased but a fully aerobatic version, the L - 13AC, with wing span reduced to 13.85 metres and a smaller rudder was introduced in 1997.

Ciani EC 38/56 Urendo

'Urendo' in Milanese dialect means something equivalent to 'horrendous' in English. It is rather a harsh term to apply to Edgardo Ciani's training two-seater design, the EC 38/56. It was never intended to look especially beautiful but it was a very practical and robust trainer. It had a good laminar flow wing with sweep forward, and a simple steel tube fuselage frame, fabric covered. The tip section was a reflexed form from the NACA 7 series. Large air brakes were fitted.

The wing structure was very simple with ribs from 8 mm poplar timber, lightening holes cut out and plywood strips as reinforcement. The spacing was 165 mm for the leading edge and 330mm behind the spar. There were three main variations on the basic de-


Ciani EC 38/56 Urendo
6920
Plywood skin
Metal skin
Fabric covering
1200
2500
680
15000
Root wing profile
NACA 643 - 618
330
330
330
330
Slotted flaps on
B & C versions
Note sweep forward on outer panels
Mass empty 235 kg
In flight 395 kg
Wing area 13.8 sq m
Aspect ratio 16.2
Wing loading 28.6 kg/sq m
Centre of gravity range
33 - 38% m.a.c.
Metres
0
1
2
3
Tip wing profile
NACA 747 - A315
Enlarged
370
Ciani EC 38/56
Urendo C
1956
Drawn by Martin Simons 2002 ©



Ciani EC 39C Uribel C

1959

Drawn by Martin Simons 2001 ©

Right: The Uribel was a single seat development of the Urendo, 'bel' for beautiful.

sign, with and without flaps, and with ailerons of differing pattern. Flown solo, a Urendo surprised everyone by winning the Italian national Championships in 1959, achieving the best distance flight of the meeting with 297 km.

Ciani EC 39/59 Uribel

If Edgardo Ciani's previous design, the two seat Urendo, was considered 'horrendous' by unkind critics, the Uribel was 'bello', beautiful. It began as a single seat version of the EC 38/56 with the same wing but a refined fuselage and V - tail. There were four developed versions, each being substantially different from the previous one. The Uribel A had the same swept forward wing as the Urendo, the same structure and wing profiles. There were no flaps. Five were built. The B version used the newly developed Eppler 257 profile. Professor Eppler, of Stuttgart University, described his new family of wing profiles for sailplanes in an academic paper in 1954 and gave more details at the OSTIV congress held at Buxton in England concurrently with the 1954 World Championships. The NACA 6 series profiles were designed to have a low drag range of some width on either side of an ideal lift coefficient. Sailplanes on cross-country flights are usually either flying slowly (at high lift coefficients) when soaring or much faster (at low lift coefficients) when crossing the gaps between thermals. The best wing profile should have low drag for soaring, and low drag for fast flight, and what happens between slow and fast trim is of small importance. Thus, not one but two ideal lift coefficients were required and a wing profile for a sailplane should be designed for this. It would have two distinct low drag ranges or 'low drag buckets' as they were often called. This resulted in more drag at 'in between' airspeeds but this was unimportant. The Uribel B was one of the first sailplanes to take advantage of this line of development.

The Uribel C was similar to the 'B' version but the sweep forward was removed and a simple tapered wing was used. Glass plastic mouldings were used for the fuselage nose, wing tips and tail cone and some fairings. The wing skin was 1.5 mm thick plywood, thickening to 2 mm at the wing root, over ribs spaced at 166.5 mm. The skin was not bent round the leading edge but glued to a light false spar, the extreme nose of the profile being in balsa wood, shaped and smoothed to the correct profile. Provision was made for water ballast tanks in the wings, to carry 60kg. Five of the C were built.

There was a single Uribel C with wing tips extensions to 18 metres. In the final version, Uribel D the pilot position was reclined, allowing a reduction on the fuselage cross section. Five were built.

In total, about twenty examples of the Uribel were built. One Uribel C survived in 2002, flown regularly by Carlo Zorzoli.

Darmstadt D - 34a

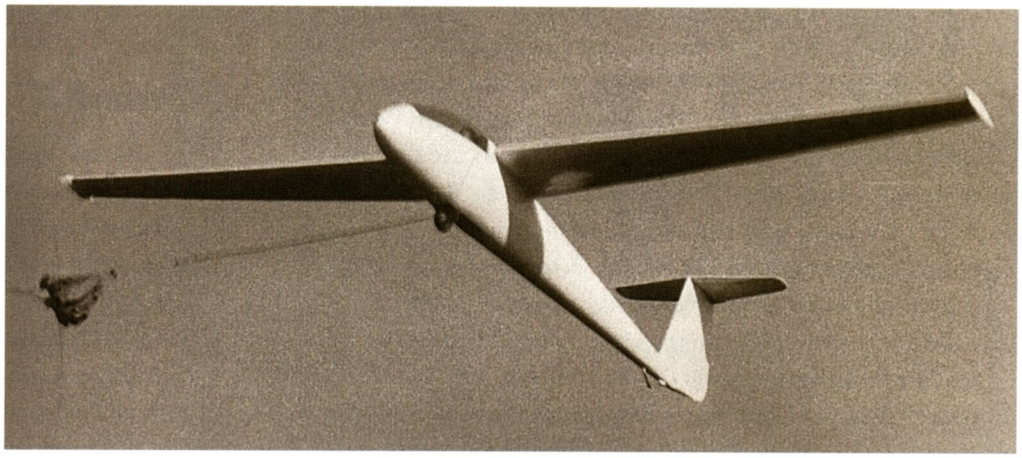
The D - 34 was the first new sailplane design by the students of the Akaflieg Darmstadt since the D - 30 and D - 31 of 1938. It was intended always as a research project, not for competition flying. The span was quite small and the wing was built in one piece without dihedral other than the taper on the underside. The fuselage was orthodox with a large, faired skid. A T tailplane was used.

The most unusual feature was the wing structure. The profile was 21% thick with laminar flow intended to prevail over 40% of the chord. To obtain an accurate form, the main spar, which was a triple box arrangement filled with plastic foam, did not occupy the whole depth available. There were relatively few ribs, these extend-

The air brakes of the D - 34 were in the fuselage behind the cockpit

Top: The Darmstadt D - 34a, with T tail, first of a series of small experimental sailplanes. Ailerons, tail and cockpit were all considerably modified in service.

Right: The D 34b Aphrodite took the basic design to a higher degree of refinement with retracting wheel and flaps for landing.



ing across the spar. The spaces between the ribs were filled with blocks of plastic foam, cut and sanded carefully to produce an accurate profile to which the plywood skin was glued. To preserve the wing surface as perfectly as possible, the airbrakes were mounted on the fuselage under the wing, as plates opening like large 'ears'.

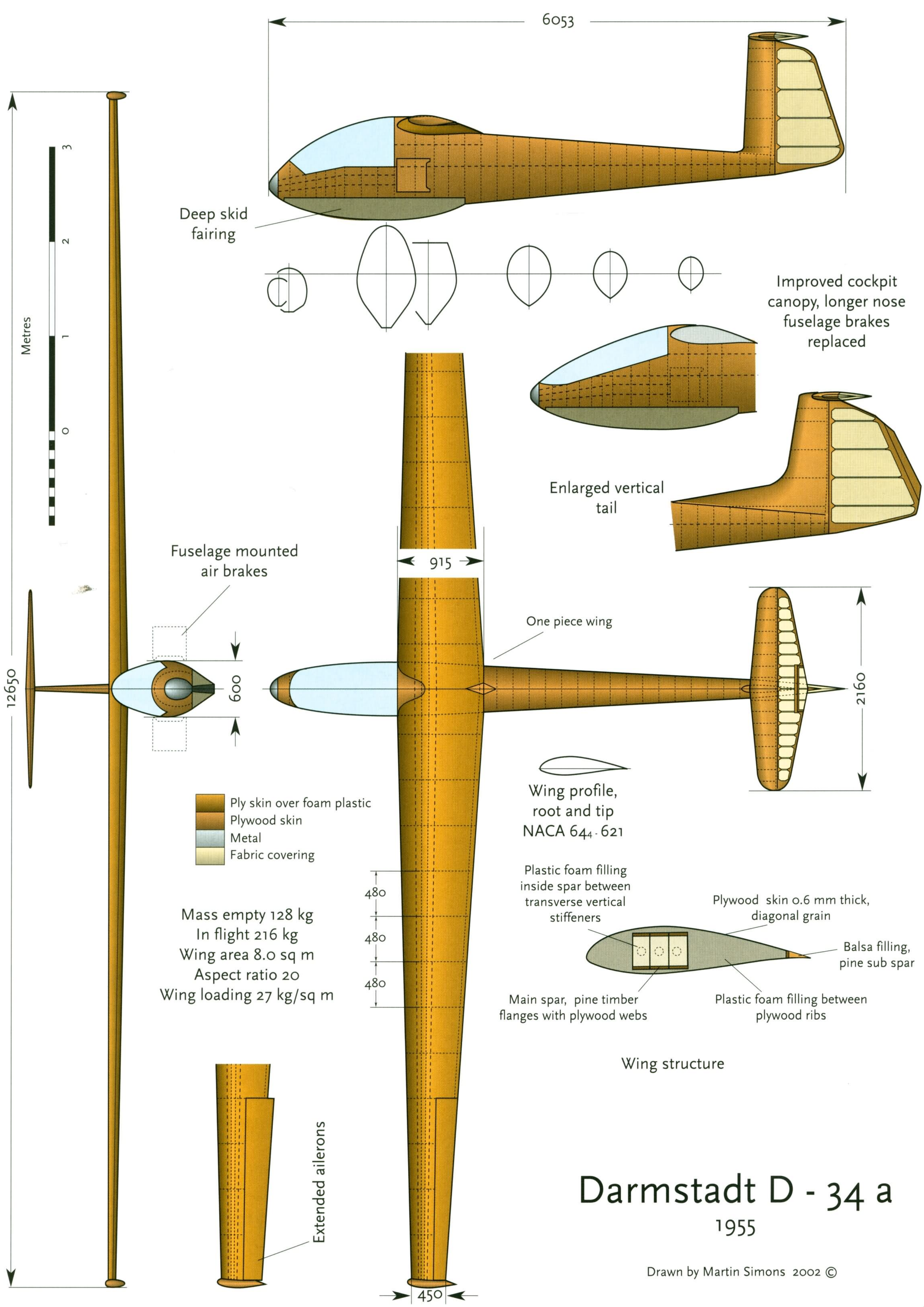
Experience in the air indicated the need for more rudder area and a dorsal fin extension. The ailerons were extended. The airbrakes were not sufficiently powerful. The cockpit canopy went through several modifications. The wing, however, appeared to hold its form well and provided useful information.

Darmstadt D - 34b Aphrodite

The new generation of Akaflieg Darmstadt students, reviewing the D - 34a built by their immediate predecessors, decided to use it as a basis for an all round aerodynamic improvement. The D 34b was a new design of the same size and general layout but with a superior performance. The D - 34a type of wing with its NACA 6 profile, box spar and plastic foam filling was accepted, but the fuselage air brakes had not been satisfactory. They were replaced with flaps capable of being lowered to 60 degrees. The fuselage shape was capable of much improvement. A retracting wheel replaced the rather ugly skid of the 36a, the nose was lengthened, allowing the pilot's seat to be slightly reclined, and the rear fuselage was lengthened to improve the effectiveness of the rudder.

The new sailplane flew in 1957. As usual with students, the personnel moved on but the sailplane remained. Its performance was measured carefully three years after it had been completed. By this time, despite the foam filling, the wing skin had shrunk noticeably and the undercarriage doors did not close fully, causing some air leakage.

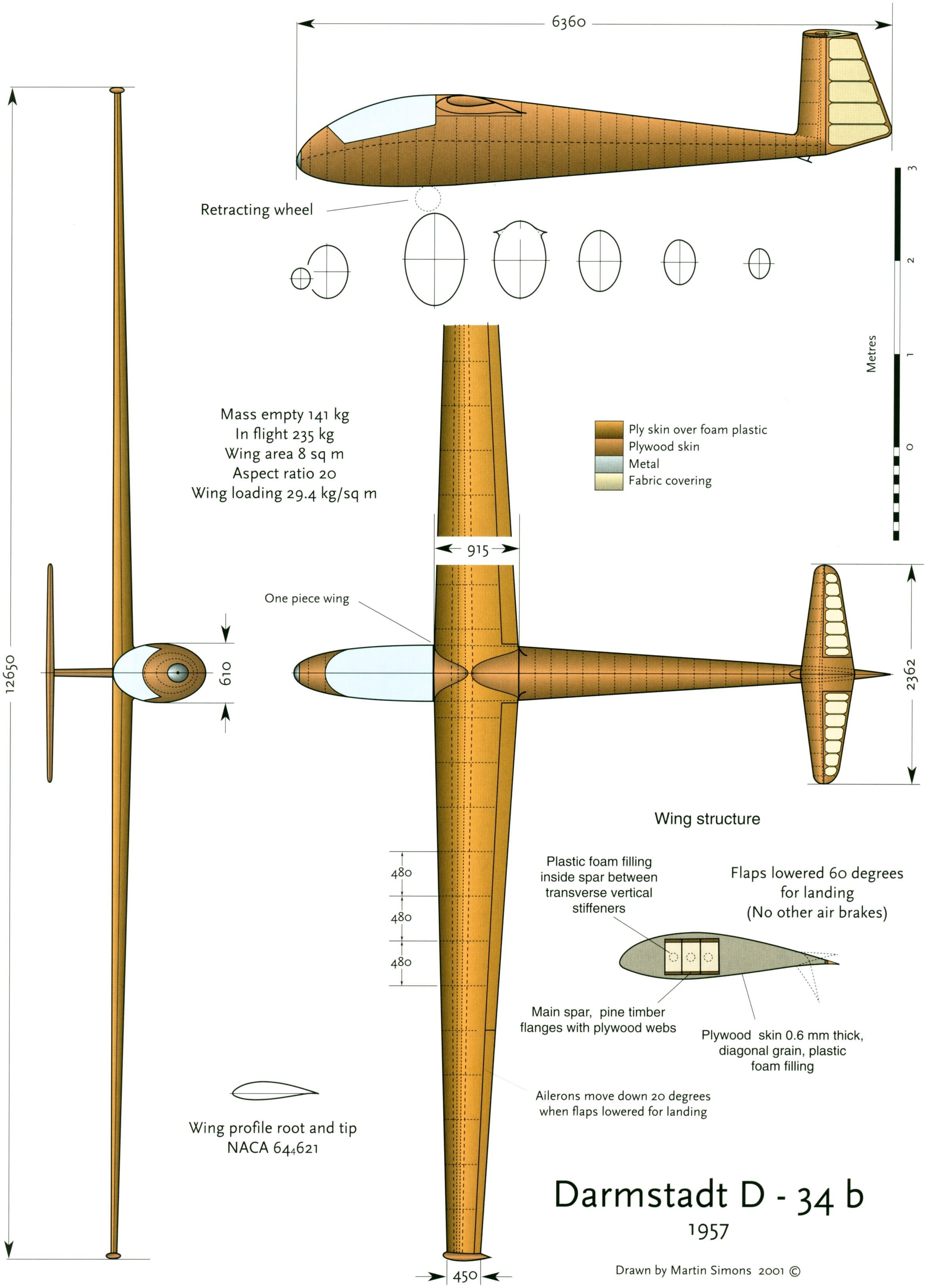
The best glide measured, in this condition, was 28.3 : 1. This was very good for a small sailplane. The same measuring group found a new Ka - 6CR, just delivered from the factory, to have a glide ratio of 29 : 1. The D 34, with a wing loading considerably higher than the Ka - 6, had a better glide at high speeds especially if the flaps were



Darmstadt D - 34 a

1955

Drawn by Martin Simons 2002 ©


6360
Retracting wheel
Metres
3
2
1
0
Mass empty 141 kg
In flight 235 kg
Wing area 8 sq m
Aspect ratio 20
Wing loading 29.4 kg/sq m
Ply skin over foam plastic
Plywood skin
Metal
Fabric covering
915
One piece wing
610
12650
2362
Wing structure
Plastic foam filling inside spar between transverse vertical stiffeners
Flaps lowered 60 degrees for landing (No other air brakes)
480
480
480
Main spar, pine timber flanges with plywood webs
Plywood skin 0.6 mm thick, diagonal grain, plastic foam filling
Ailerons move down 20 degrees when flaps lowered for landing
Wing profile root and tip
NACA 64_4621
Darmstadt D - 34 b
1957
450
Drawn by Martin Simons 2001 ©

The D - 34d was a major step towards glass-plastic construction. With the fuselage and tail of the D - 34b, a new wing with a glass reinforced plastiuc skin was built, the skin supported by a honeycomb paper core cut accurately to the required form.
Left: Preparing the D - 34d for take off

raised ten degrees. With the flaps down slightly, the D - 36 should have been able to match the Ka - 6 in the climb. The lateral control of the D - 36b was not good but the flaps proved a very effective glide control on the approach to landing. A younger group of Akaflieg members watched all this and learned from it.

Darmstadt D - 34d

In 1960 the Students of the Akaflieg Darmstadt, among them Gerhard Waibel, undertook another experiment with a small sailplane, using a radically new type of wing construction. They took the fuselage and tail from the old D 34 b, which had proved satisfactory and would enable a direct comparison of the new wing with the old one, knowing that the main parasitic drag items would be the same.

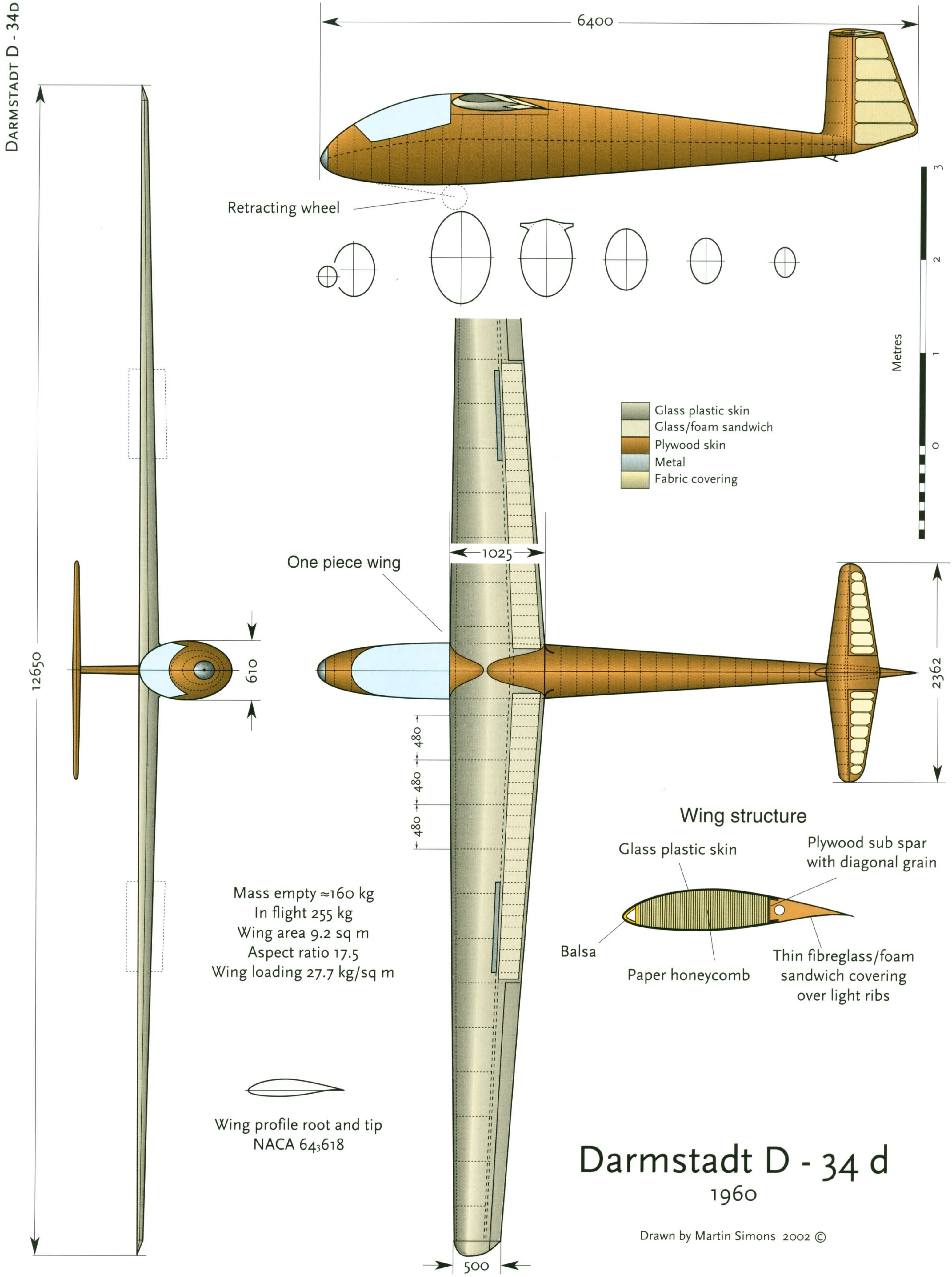
Aerodynamically the D 34d wing differed from the 34b chiefly in having a larger area and hence, lower aspect ratio, and no flaps. The profile was nominally thinner in percentage terms but since the chords were greater, the wing was actually almost the same thickness at the root.

The wing was a combination of a glass-reinforced plastic skin with a honeycomb paper filling. The ribs were used only as guides for the cutting and trimming of the honeycomb core, before laying the glass cloth, impregnated with resin, over the prepared surface. The glass skin was stressed to take the bending and torsional loads, the honeycomb stiffening the skin against buckling and secondary failure. There was a light leading edge member, with a balsa nose piece and an auxiliary spar, but no main spar. Ailerons and brakes were supported by the rear spar. Behind this the skin was a lightweight sandwich of glass cloth and plastic foam.

Great care was taken throughout to achieve a wing surface smooth and free from waves or blemishes. The waviness measured after completion was less than 0.02 mm.

Performance tests were carried out by the Scientific Flight and Research Establishment of Munich. Hans Zacher remarked: "Considering the additional wing area at the same span, the improvement of the polar (performance curve) over that of the D - 34b is remarkable. This showed, among other things, how very much the performance of laminar sections depends on the surface finish". The D - 34d best glide was 31.5 against 29 for the D - 34b. At airspeeds of 150 km/h (80 kts) the two were about the same but the 34b would have its flaps raised at this airspeed.

The main purpose of the D - 34d project was achieved in that the students gained from it their first experience with glass-fibre-reinforced plastic as a structural material. When the sailplane was retired from use, a section of the wing was taken for display at the Wasserkuppe museum.



Mass empty ≈160 kg
In flight 255 kg
Wing area 9.2 sq m
Aspect ratio 17.5
Wing loading 27.7 kg/sq m

Darmstadt D - 34 d

1960

Drawn by Martin Simons 2002 ©

Top and right: The Olympia 4 had a new 'laminar' wing with NACA 64_3 618 profile. The fuselage and tail were adapted from an ordinary Olympia. Geoffrey Stephenson at the 1954 World Championships at Camphill flew it in this form. The photograph above shows David Ince, the test pilot for Elliotts.

The EON Olympia 403 - 419 series

Early in 1954 the firm Elliotts of Newbury were still producing the Olympia 2b and 3 sailplanes that had dominated the club scene in Britain since 1947. It was recognised that now the type was seriously out of date. Slingsby had already flown the 'laminar' Skylarks 1 & 2 and interest in the Olympia, which was basically a 1939 design, was rapidly fading. Meanwhile, a group of soaring pilots at the Royal Aircraft Establishment at Farnborough, members of the Empire Test Pilots School Gliding Section, had been operating an Olympia. Knowing of the success in the USA of the RJ - 5, it occurred to them that they should be able to develop a superior sailplane. Leaders of this small band were the engineers Harry Midwood and Roger Austin. They resolved to build a laminar wing for their existing Olympia fuselage. The wing profile chosen by Midwood was the NACA 64_3 - 618, thickening at the tip to ensure there would be no tip stalling. The main spar, an I section beam with spruce flanges, did not occupy the full depth of the wing. The wing ribs were very closely spaced. Each rib had a thin outline of spruce supported with balsa wood, the grain running vertically to minimise shrinkage. These ribs

Above: The Olympia 403 in flight over Lasham

were threaded over the spar to be glued in position. The plywood skin, of constant 2 mm thickness, was laid with diagonal grain and continued right round the leading edge, glued only to the ribs and to the rearmost spar without any contact with the main spar, avoiding any hump there. Aft of the rear spar the wing was covered with fabric but the Frise type ailerons were plywood skinned.

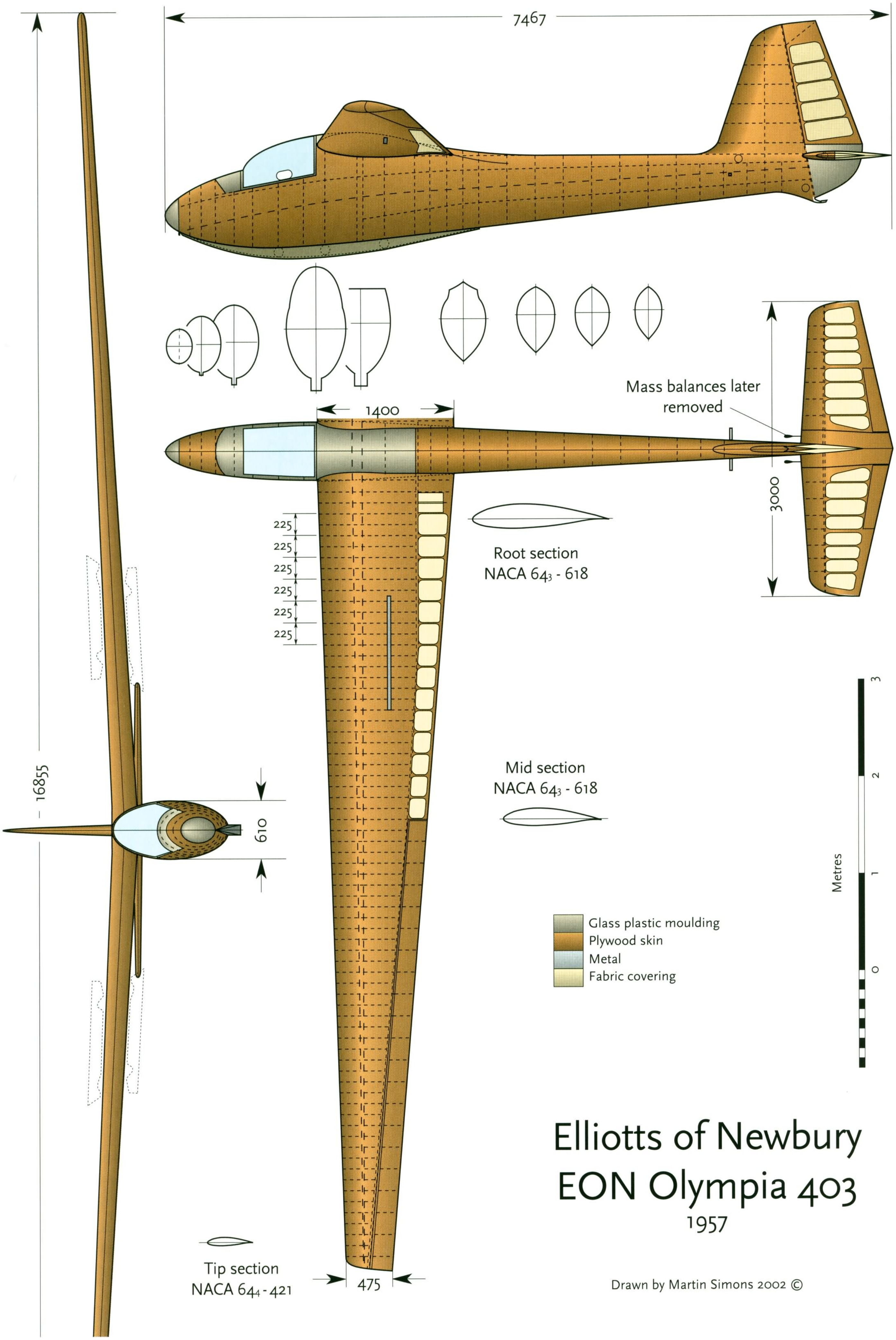
The design completed, the Farnborough group approached Elliotts and were well received. The Company offered to build the new wing. It was ready in time for the 1954 World Championships. Geoffrey Stephenson flew the Olympia 4, as it was called, to 14th place, having been unable to score on one of the four contest days.

The performance was very much as had been hoped, the best glide ratio being measured at 33 : 1. It was decided to develop the aircraft further. There were many delays, but the Olympia 401, with an improved fuselage, was built and test flown. The Olympia 402 had the original Olympia 4 wing extended to 17 metres. Bill Ivans, the American pilot, flew this in the 1956 World Championships at St Yan, and although he placed fifth the aircraft was wrecked on the final contest day when he was struck by violent wave rotor turbulence when landing in a small field. (He was injured but made a full recovery.)

The Olympia 403 flew in 1957, using almost the same wing as the 402, but with improved ailerons. The tail unit was entirely redesigned, the fixed tailplane with elevator being replaced by an all-moving tailplane and a much larger fin and rudder to control the longer wing in yaw. Early tests showed the need for full mass balancing of the elevator. Later, a much lighter tail was built and the external mass balances were replaced with an internal weight in the elevator control circuit. The undercarriage was a skid, with drop-off dolly.

The 403 proved successful in competitions, flown by Tony Goodhart to a close third place in the British National Championships in 1957. In the same year David Ince, who had been closely involved throughout as test pilot for Elliotts, used the 403 to win the first British Sailplane Aerobatic Contest at Dunstable. Only one 403 was ever built, Elliotts deciding to develop it further before going into production.

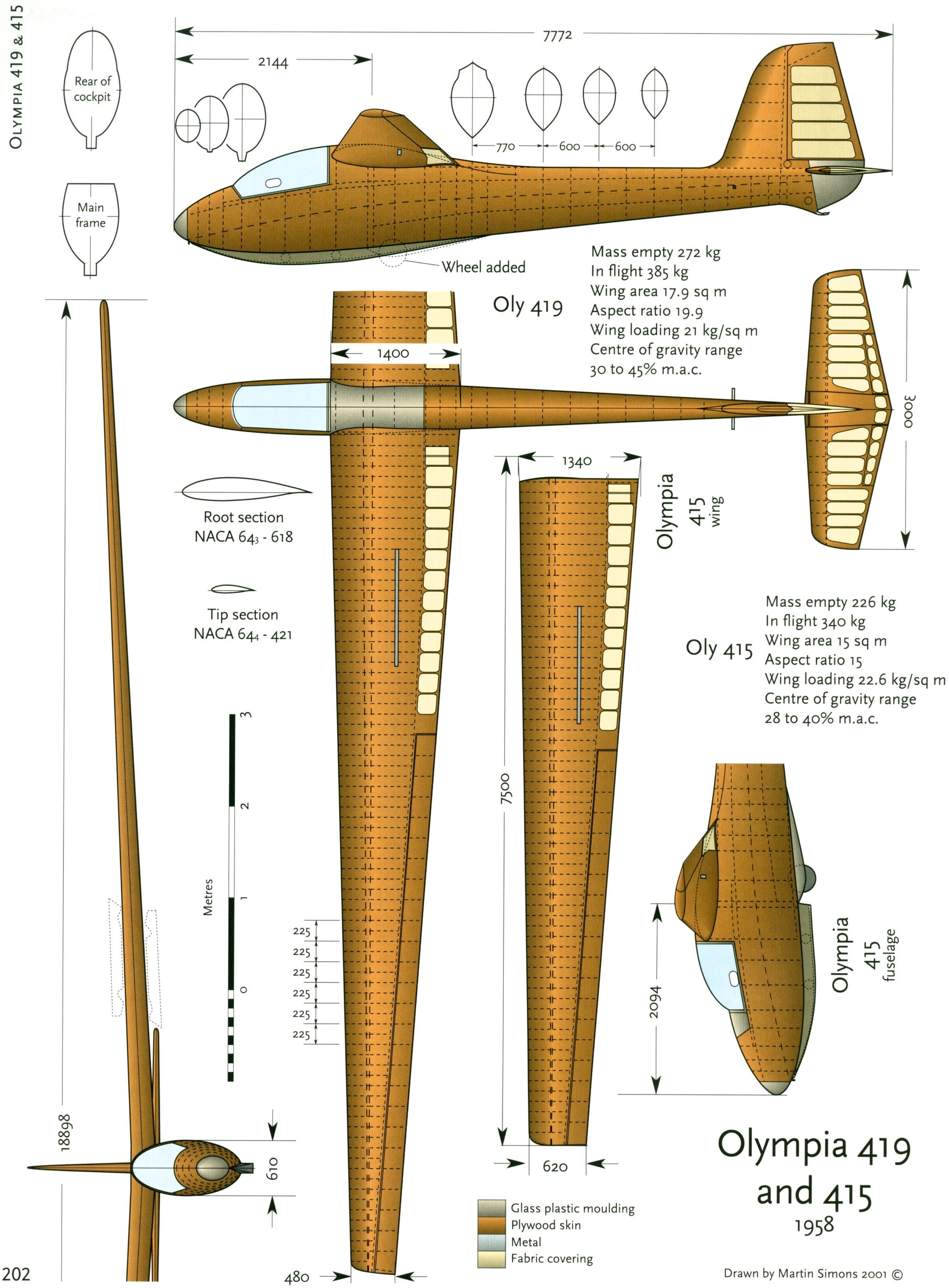
As always, the simplest way to improve the performance of a sailplane is to increase the span and hence the aspect ratio, while lowering, if possible, the wing loading. The Olympia 403 had sufficient reserves of stability and strength to allow a two metre extension of the wing to a span of 19 metres, with very few additional changes. The nose was lengthened slightly to adjust the balance. Elliotts, driven by the enthusiasm of the proprietor, Horace Buckingham, began work on two, intending them to be flown by the British team at the 1958 World Championships. At the same time, the new Standard Class having been introduced, a 15 metre version of the 419, the Olympia 415, was built, with the wings truncated to the required 15 metres, a slightly shorter fuselage, and a wheel added.



Elliotts of Newbury EON Olympia 403

1957

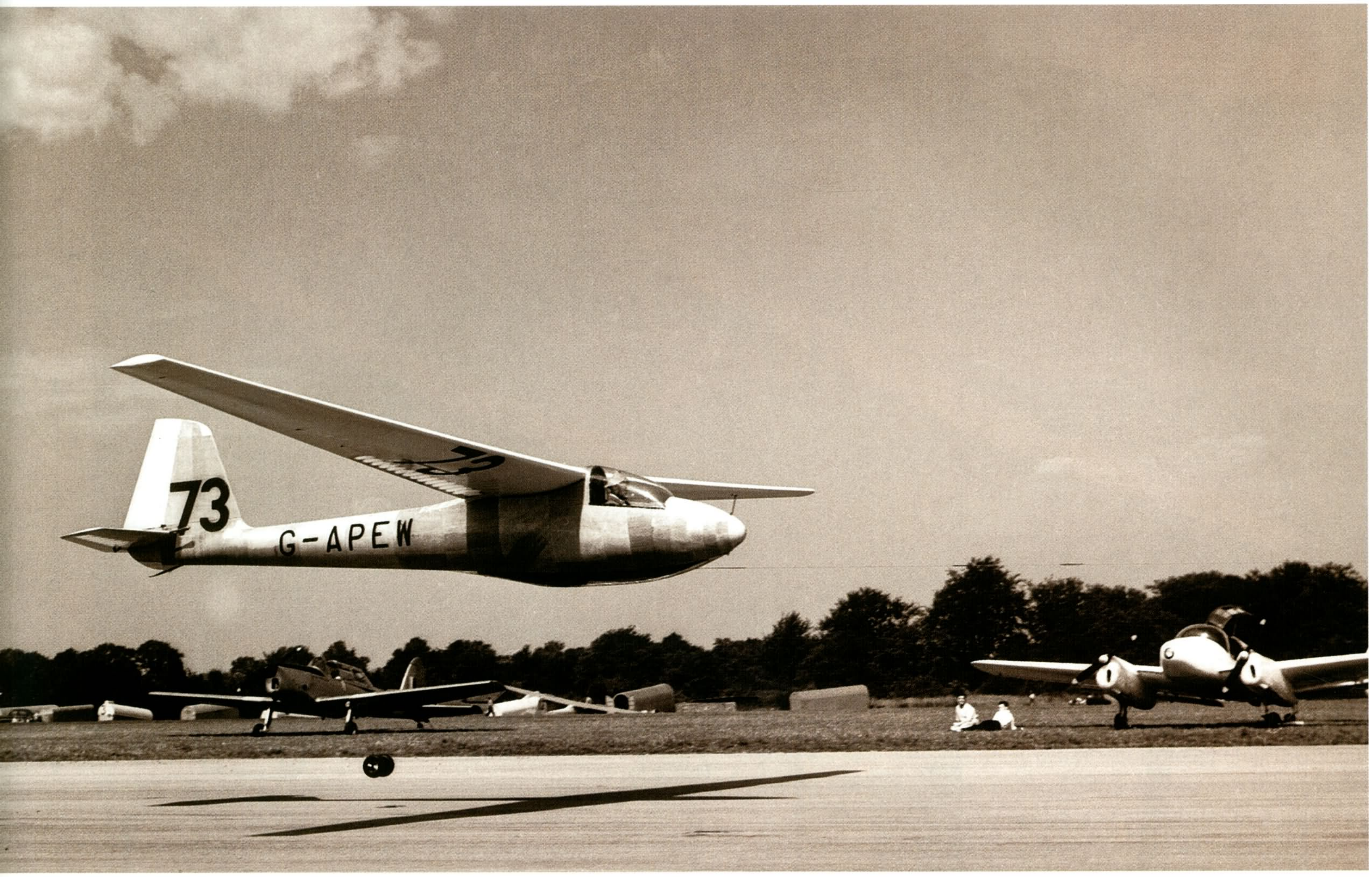
Drawn by Martin Simons 2002 ©

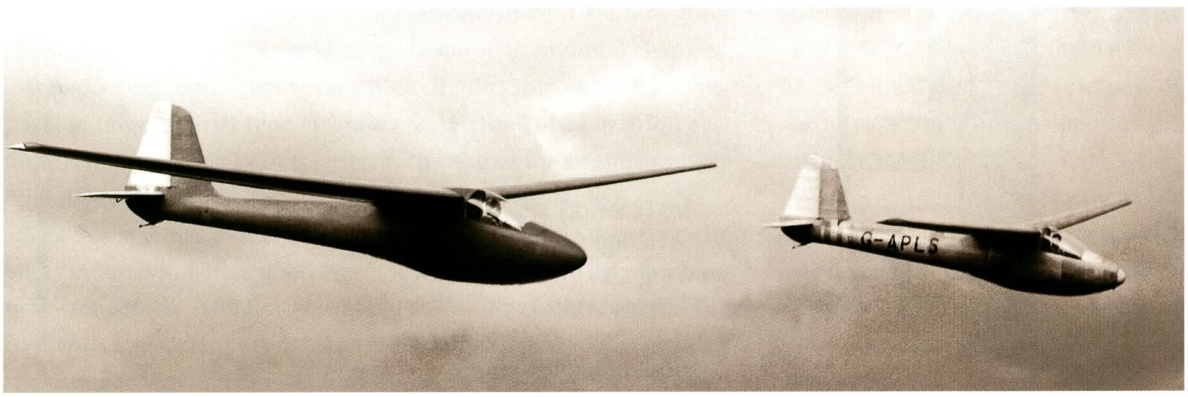


Olympia 419 and 415

1958

Drawn by Martin Simons 2001 ©

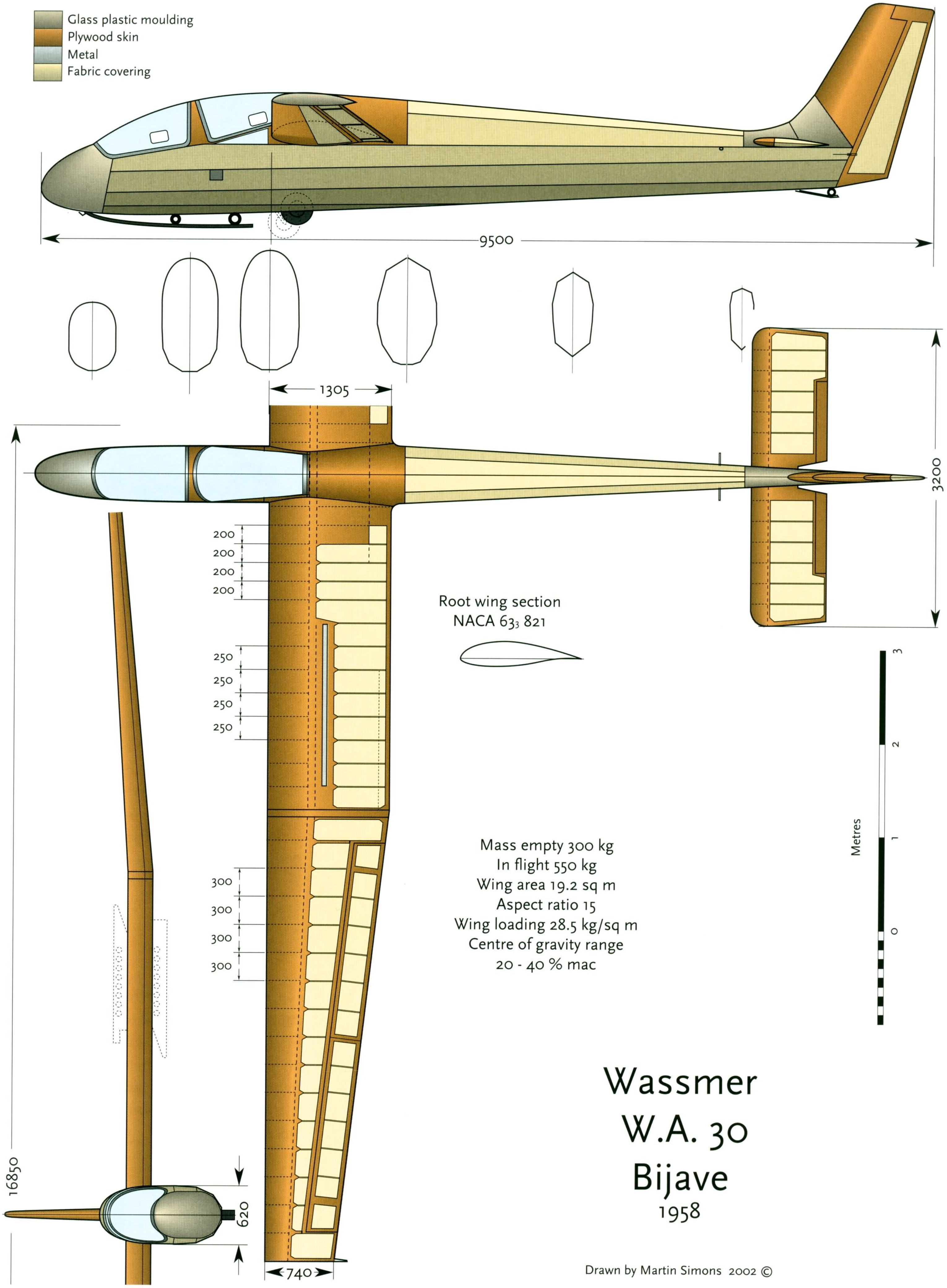




Above: The Olympia 403 used a 'drop off' wheeled dolly for take off.

Left: Olympia 419 (nearest the camera) flying with the Olympia 415, intended as a Standard Class version of the same design but without the mandatory wheel.

In the event, only one of the Olympia 419s flew at Lezsno, Tony Deane - Drummond placing seventh. He had been holding second place until a mistake on the last day spoiled his score. Nick Goodhart preferred to compete in his Skylark 3 and came second to Haase in the HKS - 3. The 415 was flown by Tony Goodhart (Nick's brother) to 7th place in the Standard Class. In the next World Championships at Cologne, Nick Goodhart, now flying an Olympia 419, might have won if he had not broken a rule by flying in cloud on one day. His score for this day was disallowed and this pulled him down to fourth place. The good results in competitions, both the World Championships and the British nationals, led to further production of the Olympia 419. Seven were built altogether, mostly with wheels or retrospectively modified to take one. One was exported to the USSR. Only the one Standard Class Olympia 415 was completed. After flying in the World Championships it was modified and, with a slightly longer fuselage taken from the 419, proved to be an excellent aerobatic sailplane. David Ince used it to win the National Aerobatic Championship for the second time. The Olympia 401 was also modified for use as a Standard Class sailplane, with a wheel. The Norwegian pilot Thor Johannessen flew it in the 1960 World Championships. It later went to fly with a RAF Club in Aden and later to Cyprus when the club moved there.

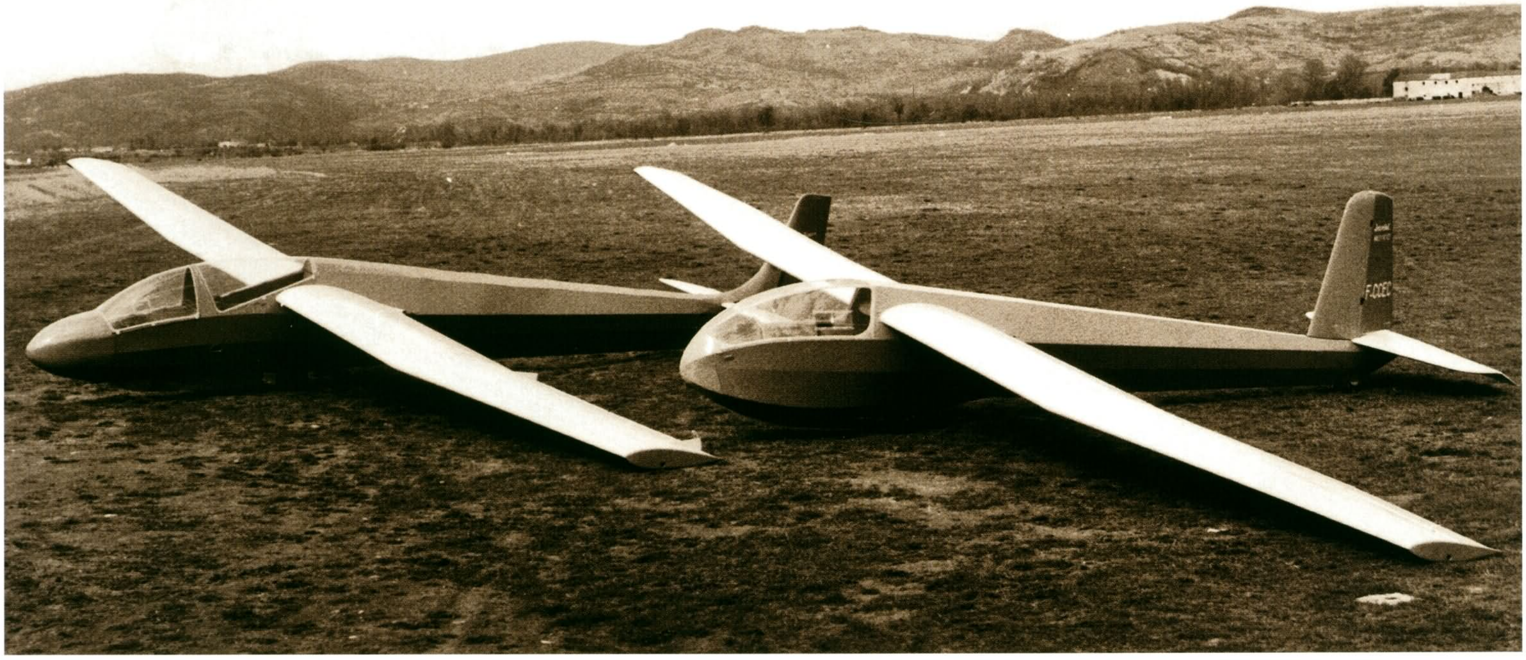


Mass empty 300 kg
In flight 550 kg
Wing area 19.2 sq m
Aspect ratio 15
Wing loading 28.5 kg/sq m
Centre of gravity range
20 - 40 % mac

Wassmer W.A. 30 Bijave

1958

Drawn by Martin Simons 2002 ©



The Bijave, (Bi - Javelot) on the left, was a popular two seat trainer which followed the single seat Javelot, shown here on the right.

Wassmer WA - 30 Bijave

The WA - 30 was the standard two seat training sailplane in France from 1958 through the next ten years or so. It was designed by Engineer Collard as a two seat version of his existing single seat Javelot, (Javelin) the name, Bijave, standing for Bi-place Javelot. It fitted well into general gliding operations since a student pilot could go from the Bijave to the single-seater with minimal changes.

It had a simple wooden wing which divided into three for transport. Schempp-Hirth type airbrakes were fitted. The aerofoil sections were from the NACA 6 series, with camber for a comparatively high lift coefficient. A best glide ratio of 30:1 was claimed.

The fuselage was a steel tube framework with fabric covering, the pilots in tandem with a good view for the instructor. The wheel was semi -retractable. The horizontal tail surface was of the all-moving type with anti-balance tabs. After the prototype was tested in 1958, the fuselage was lengthened and the wheel moved forward. Large scale production followed and more than 300 were built.

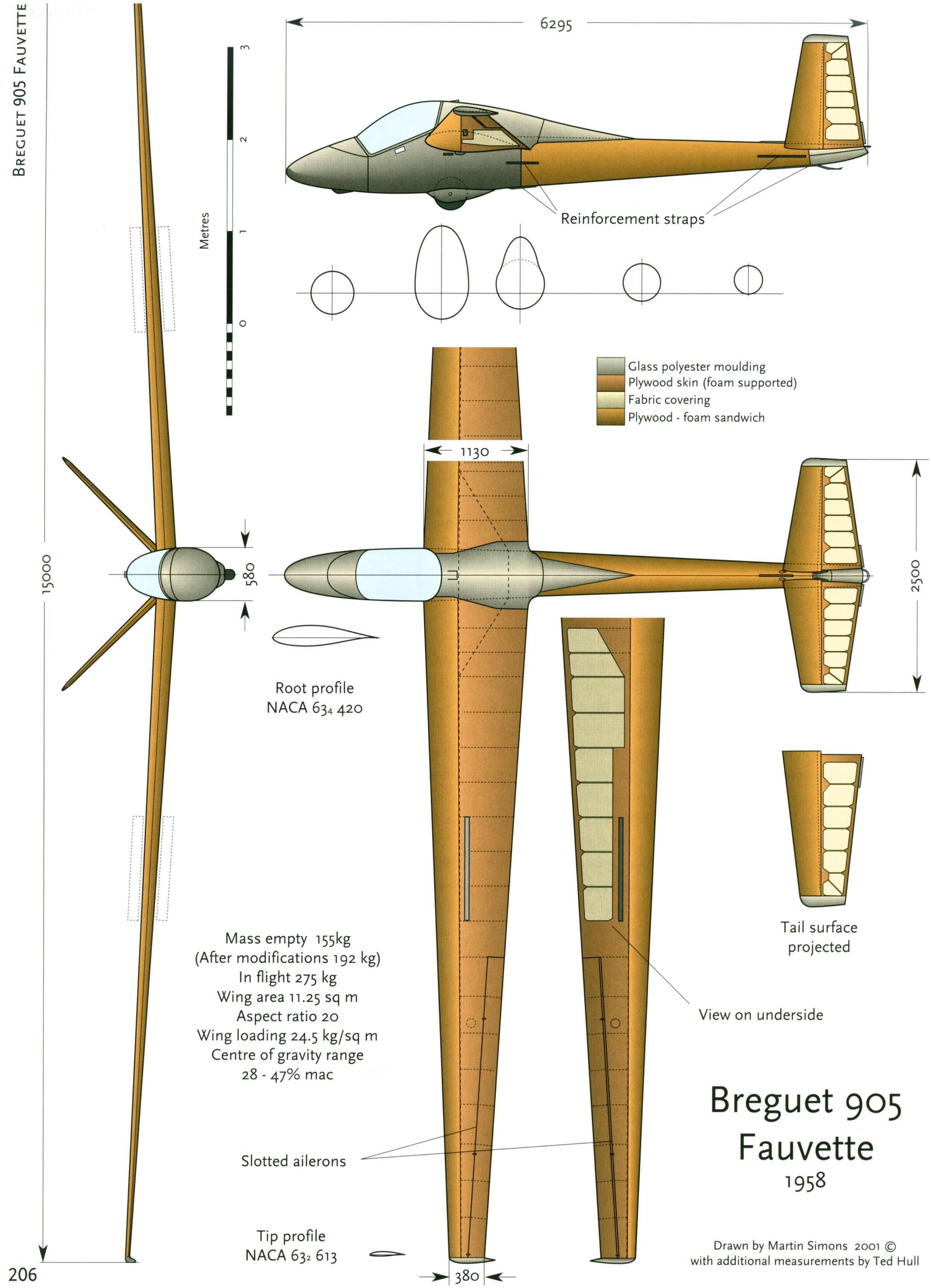
Breguet 905 Fauvette

Design of the Fauvette (Warbler) was begun in 1957 by Jean Cayla in response to the recently issued FAI specification for a Standard Class to compete in the World Championships from 1958 onwards. The general outline of the 905 was reminiscent of the Breguet 900 on which Cayla had worked with Ricard.

In an attempt to meet the underlying intentions of the specification, much thought was given to the practicalities of the sailplane as well as performance. For the sake of ease of manufacture, repair and replacement of parts, the structure was divided into sub-components, each built separately before being brought together for final assembly. The wing spar and 'D' nose with root fittings were one component, rear ribs, brakes and ailerons to be added. The skins of the D nose were of sandwich type, two layers of 0.6 mm plywood with 8 mm of plastic foam 'Klegecel' filling, without any of the traditional nose ribs. These skins were formed by vacuum bagging in female moulds. This ensured a good and stable aerodynamic form for the forward part of the wing. Behind the spar the skins were of plywood supported by an inner lining of Klegecel. The structure was very light. Each wing, complete, weighed only 34 kg. Wherever appropriate, plastic mouldings were used for fairings, easily replaced if damaged. The fuselage was in three sections, a welded steel tube centre frame, a nose section also based on a steel frame but with fibre reinforced plastic shells to give aerodynamic form, and a conical tail boom of ply-foam sandwich, to which the V - tail was attached.

Apart from factory production, the Fauvette was to be marketed in kit form. To bolt and glue together the various parts would require little work. There would be considerable savings in shipping charges for exports since the kits would take little space.

After flight testing in April 1958, the Br - 905 flown by Camille Labar competed in the World Championships at Lezsno. Labar placed 9th of 24 competitors in the Standard Class. Cayla was disappointed that his new sailplane did not win the OSTIV Design prize. Favourable reports came from many pilots. The Fauvette was easy to fly, with light controls and crisp response to the ailerons. An unusual feature of the V - tail was that application of rudder caused a noticeable rolling motion as well as yaw. The relatively



Breguet 905 Fauvette

1958

Mass empty 155kg
(After modifications 192 kg)
In flight 275 kg
Wing area 11.25 sq m
Aspect ratio 20
Wing loading 24.5 kg/sq m
Centre of gravity range
28 - 47% mac

Drawn by Martin Simons 2001 ©
with additional measurements by Ted Hull

Above: The Br 905 Fauvette at the World Championships in 1960 at Butzweiler Hof, Cologne.

Right: The Breguet 905 'Fauvette' was a lightweight Standard Class design incorporating many components of fibre reinforced plastics. The plywood skins were supported by plastic foam.

large twisting forces arising from the high aerodynamic centre of the tail surfaces caused this. It was possible to initiate a banked turn with rudder alone.

Among other outstanding flights, Tony Goodhart, flying a Fauvette in France in 1959, broke the British National Distance Record with a flight of 617 km, landing near Pau in the foothills of the Pyrenees after launch near Fontainbleau. (This broke his brother's distance record flown in a Skylark III a few weeks before.)

The Breguet Company established a production line for a batch of fifty. There were exports to Britain, Belgium, USA and Canada but a disastrous accident brought everything to a halt. On August 11th 1969 a Fauvette lost its entire tail unit during an aerotow and crashed, killing the pilot. An investigation showed that bonded joints at the end of the tail boom had failed. All Fauvettes were grounded and most of them never flew again.

A scheme of modifications was developed and some owners did have the required work done. Wooden and metal straps were bolted in place to reinforce the bonding in the tail boom. There was some increase in structure weight. In 2002 some five or six of the modified Br - 905 remained in service in Britain, one in Canada, with one or two other examples elsewhere.

The Bregeut 906 two-seater, Choucas (Jackdaw) developed from the Fauvette, did not win any orders. The Breguet Company soon after this decided not to produce more sailplanes.

Niemi Sisu

Top: The 'Sisu' was flown in the 1963 World Championships by Dick Johnson.
Above: Johnson with the Sisu.

The Sisu has been described as the most successful American competition sailplane ever produced. It was the first glider ever to achieve a distance flight of more than 1000 km. Alvin H Parker achieved this World Record on July 31st 1964 with a flight from Odessa in Texas to Kimball in Nebraska, 1041 km. He had intended a 1000 km goal flight to Julesburg in Colorado but on arriving near the town found it surrounded by thunderstorms and decided to make sure of the 1000 km by gliding out to Kimball, landing on the airfield there. The flight had taken 10.5 hours and was made in conditions less than perfect for most of the time. He used 43 thermals, achieving an average ground speed of 99 km/h. Sisu is the Finnish word for perseverance.

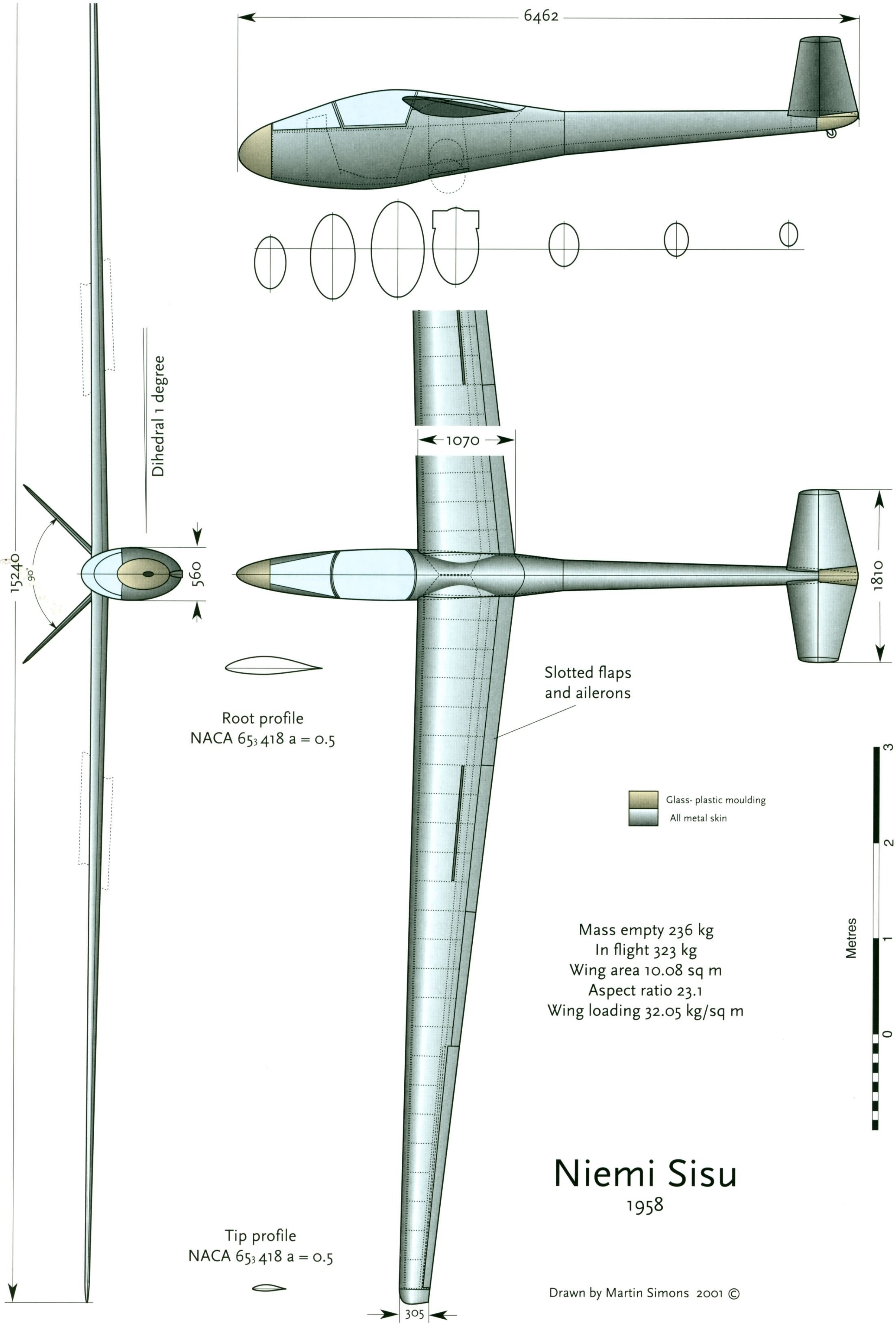
Leonard Niemi was the designer and first constructor of the Sisu, which flew first in December 1958. In the American tradition the prototype was home built and all in metal. Niemi wrote, "A new sailplane which is to be built by an individual necessarily becomes a compromise between what the designer would like to design if unlimited facilities were available and what can be designed considering the limitation of home workshop equipment, time and money. The objective was simply to create a sailplane which would exceed the RJ - 5 in total performance and at the same time include as many new features as the aforementioned limitations would allow."

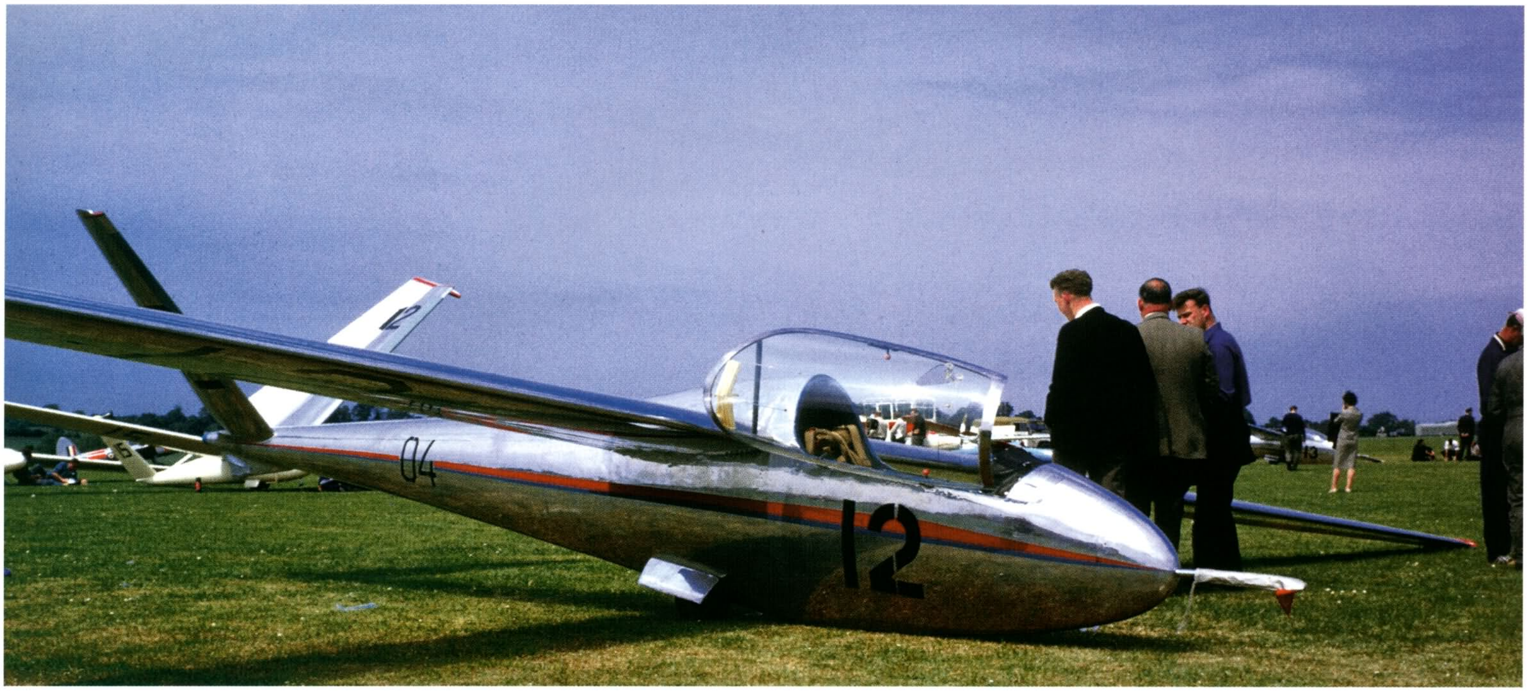
George Coder assisted Niemi in the construction work.

The wing profile was chosen from the NACA 65 series with laminar flow to 50%. The camber line was chosen in accordance with the NACA formula (a = 0.5) to distribute the load chordwise rather more towards the front of the profile than usual, reducing pitching moments and tail loads. The smoothness and accuracy of the wing was assured by using heavy gauge alloy skins. The prototype wing was without internal spars or stringers except for a light leading edge and an auxiliary member at the rear to carry the ailerons, flaps and air brakes. There were relatively few ribs. Niemi was concerned to produce a wing skin that would not buckle under load and would be stable enough to take the inevitable filling and smoothing that would be necessary. The wing was swept forward to control tip stalling without the need for any aerodynamic twist.

The cockpit was large enough for a tall pilot and the seat was only slightly reclined. The cockpit canopy required only one moulding, the forward portion being a simple curved transparent panel. The wheel was fully retractable into a sealed well. Behind the wing the fuselage contracted to a simple conical tail cone, with a V - tail.

On his first extended cross-country flight in 1959 Niemi ground looped his prototype when landing in a field with mesquite bush. Repairs were not completed until just before the 1960 US National


6462
Dihedral 1 degree
15240
90°
560
1070
1810
Root profile
NACA 65₃ 418 a = 0.5
Slotted flaps
and ailerons
Glass- plastic moulding
All metal skin
3
2
1
0
Metres
Mass empty 236 kg
In flight 323 kg
Wing area 10.08 sq m
Aspect ratio 23.1
Wing loading 32.05 kg/sq m
Niemi Sisu
1958
Tip profile
NACA 65₃ 418 a = 0.5
Drawn by Martin Simons 2001 ©
305



The A - 15 at South Cerney. This was the first appearance of the type in the west and showed that the USSR had made great advances in sailplane design

Championships, in which, as some reward for his help, George Coder flew the Sisu. In the weeks after these Nationals, Dick Johnson carried out performance tests, establishing the best glide as 41:1.

Niemi had not expected to construct more than one Sisu but results were so good that he decided that it should go into production. He sold the prototype and entered into an agreement with the specially formed Arlington Aircraft Company to build more. The production version, Sisu 1A, incorporated changes to the wing structure to lighten it. The skins were of a slightly lighter gauge, stiffened by a series of plates and stringers. The plain flaps and ailerons were slotted to improve their effectiveness. The alterations may have reduced the performance by one or two percent but there were advantages in terms of handling and low speed soaring ability.

The extraordinary KAI 14 entered by the USSR at South Cerney. The poor forward view from the cockpit contributed to accidents

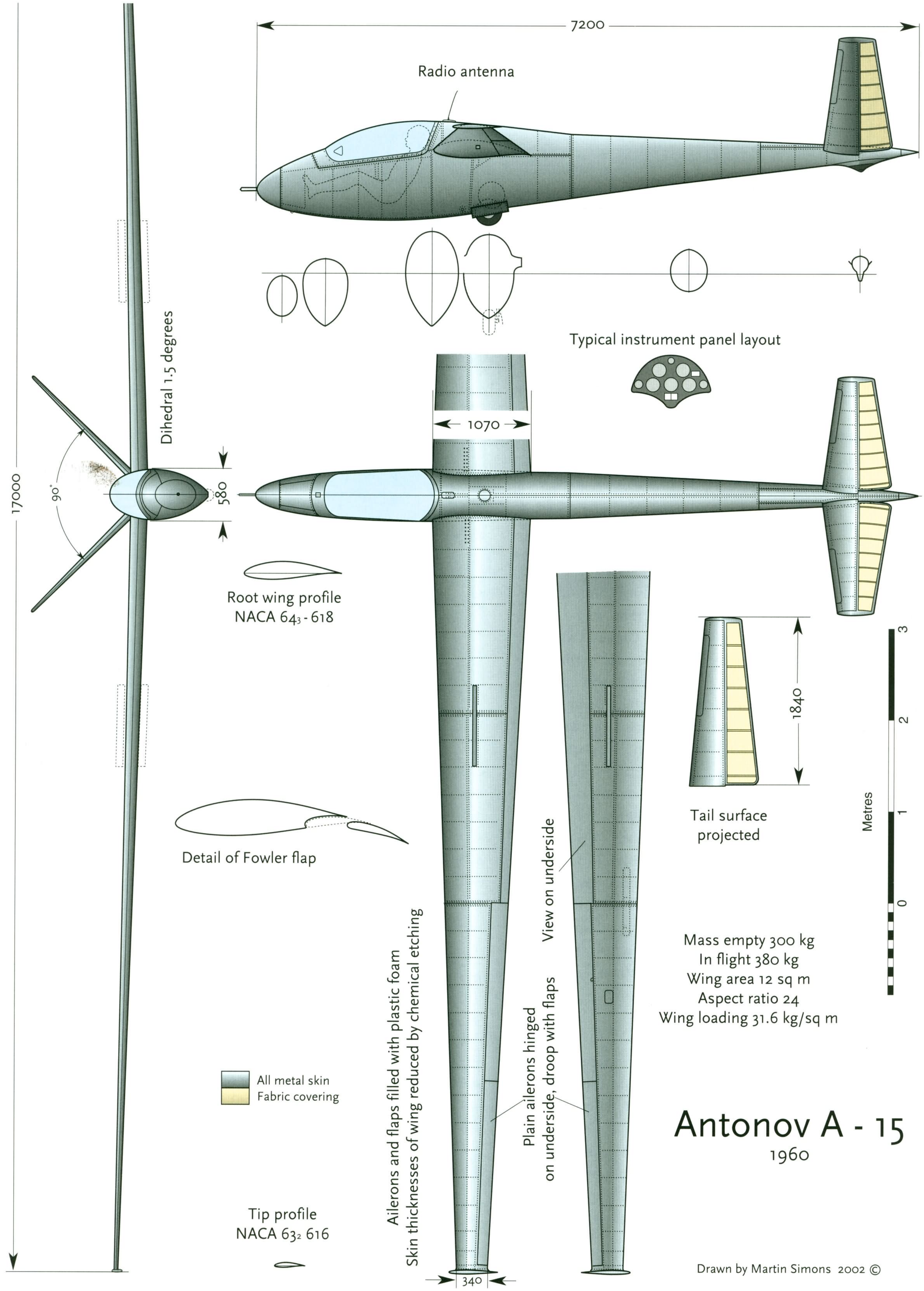
The Sisu was expensive and not many pilots could afford to buy one. Four were built at Arlington, after which production was taken over by Astro Corporation at Greenville, South Carolina. Another six were built there, a total including the prototype of eleven. In 1965 it was decided to build no more.

Before the 1964 1000 km flight, Al Parker broke the World Record for goal flight distance in 1963 with 788 km, and broke the goal flight record again in 1969. Bill Ivans set the US 100 km triangle speed record with 134 km/h in 1967. Flown by various pilots, Sisus won the US Nationals in 1962, 65 and 67. Dick Johnson flew a Sisu at the World Championships at Junin, Argentina, in 1963, placing 4th. At South Cerney in 1965 the Sisu did less well in rather feeble English conditions. The only serious criticism of the sailplane was that it did not climb well in weak thermals.

Parker's distance record breaker was donated to the Smithsonian Institution Aviation Museum and remains there on display.

Antonov A - 15

Oleg K Antonov had been involved in sailplane design from 1930 and had a long series of successful aircraft to his name, including the A - 9 of 1948, featured earlier in this book. The A - 11 and - 13 were developments of this earlier type, all of metal construction. With the A - 15 Antonov broke with his previous tradition and, with assistant Constantinovich, designed the sailplane in metal, using NACA laminar profiles. With a V - tail, large Fowler flaps, a semi-reclined pilot position and a retracting wheel, the A - 15 was fully comparable with existing competition sailplanes outside the USSR. There was provision for water ballast. The best glide was claimed as 40 : 1. The wing loading was comparable with that of the American Sisu and was suited to strong soaring conditions. The first flight was



Mass empty 300 kg
In flight 380 kg
Wing area 12 sq m
Aspect ratio 24
Wing loading 31.6 kg/sq m

Antonov A - 15

1960

Drawn by Martin Simons 2002 ©

Left: The Sagitta was always notable for its generous cockpit canopy. Below: In 1965 the Sagitta competed in the Open Class World Championships.

in March 1960 and in June of the same year the A - 15, flown by Mikhail Veretennikov set the World Goal Flight record of 714 km, which was not broken until 1963 by Ben Greene in a Standard Austria with 733 km.

The first international appearance of the type was in 1965 when four of the A - 15 were entered in the World Championships at South Cerney in England. Two were flown by Hungarian pilots Thuri and Petroczy, the others by the USSR pilots Chuvikov and Veretennikov. Both the Hungarians scored better than the Russians, but all found the English conditions difficult. On the sixth day Thuri and Chuvikov managed to place second and third in the day's race, beaten by Spänig in the all-glass D - 36. Petroczy was involved in a mid air collision on Day 5, but his aircraft suffered only minor scratches and he flew on to achieve 6th place for the day. The sailplane he had hit, the Edelweiss flown by Jean Paul Cartry, lost part of his wing but was able to get back to base to land safely.

Also at South Cerney were two of the KAI - 14, all metal Russian Standard Class sailplanes. These aroused much interest because the pilots were almost lying flat in the cockpit with a very low canopy. That these aircraft were unsuited to landing in English fields was quickly demonstrated. One broke its tail off on the first day, landing in crops. It was repaired by the RAF but lost three scoring days. The very restrictive cockpit canopies were replaced by a domed form which at least allowed the pilots to see something directly ahead. Even so, the other KAI 14 was damaged beyond repair on Day 2.

Alsema Sagitta

The Sagitta (Arrow) was one of the very few modern sailplanes designed and built wholly in the Netherlands. It was the result of three years work by Piet Alsema, who designed and built the prototype and flew it early in July 1960.

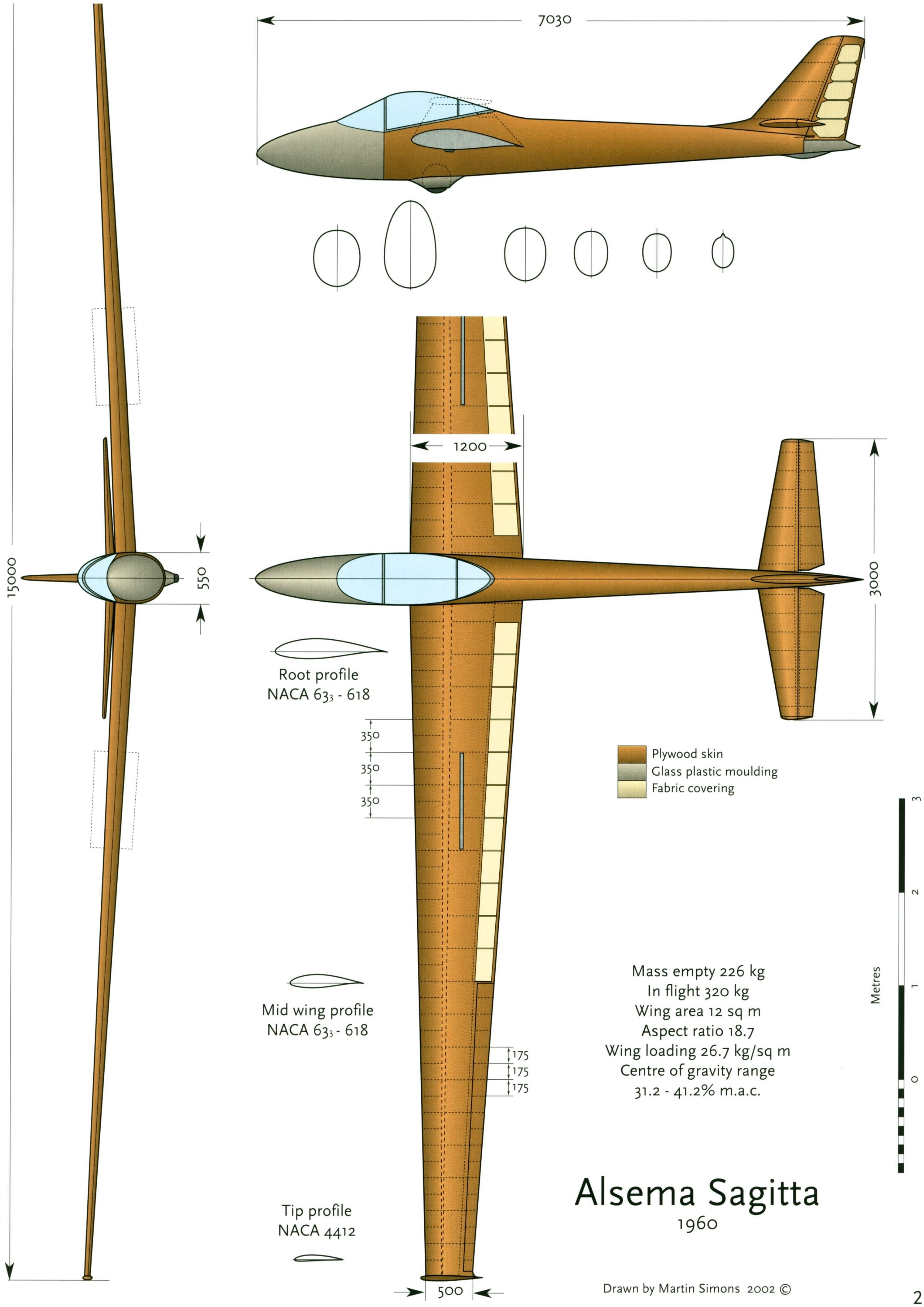
It was of straightforward wooden construction with plywood skins for the wing except the rear 25% of the chord, which were fabric covered. A notable feature was the large cockpit canopy, which gave the pilot an excellent, all round view. Like a fighter air-

craft or the Polish Jaskolka sailplane, the canopy slid back on rails to open. The nose and tail cones were glass-plastic mouldings. The best glide was measured at 27.5: 1,[44] which did not compare very favourably with other Standard Class sailplanes, especially the Ka - 6CR which had by now come to dominate the market. Twenty of the Sagitta were produced during 1960 - 61 by NV Vliegtuigbouw at Teuge, the Company founded by Alsema to manufacture and market the type. Most of those built were exported.

EON Olympia 460 - 465

Elliotts of Newbury, led by Horace Buckingham, recognised in 1960 that the Olympia 415 they had built by cutting down the wing of an Olympia 419, was not likely to capture a share of the market for Standard Class sailplanes. It was decided to attempt the design of a new Standard Class type, with a better performance than the old 415 but a lower cost in keeping with the Standard Class spirit. The outcome was the Olympia 460, which had a wing similar to that of the Olympia 415 but mounted in a high shoulder position and with

45 - Sailplane & Glider Feb 1997 p 60, Dec 1997 p327, see also S & G 1996 p 53.

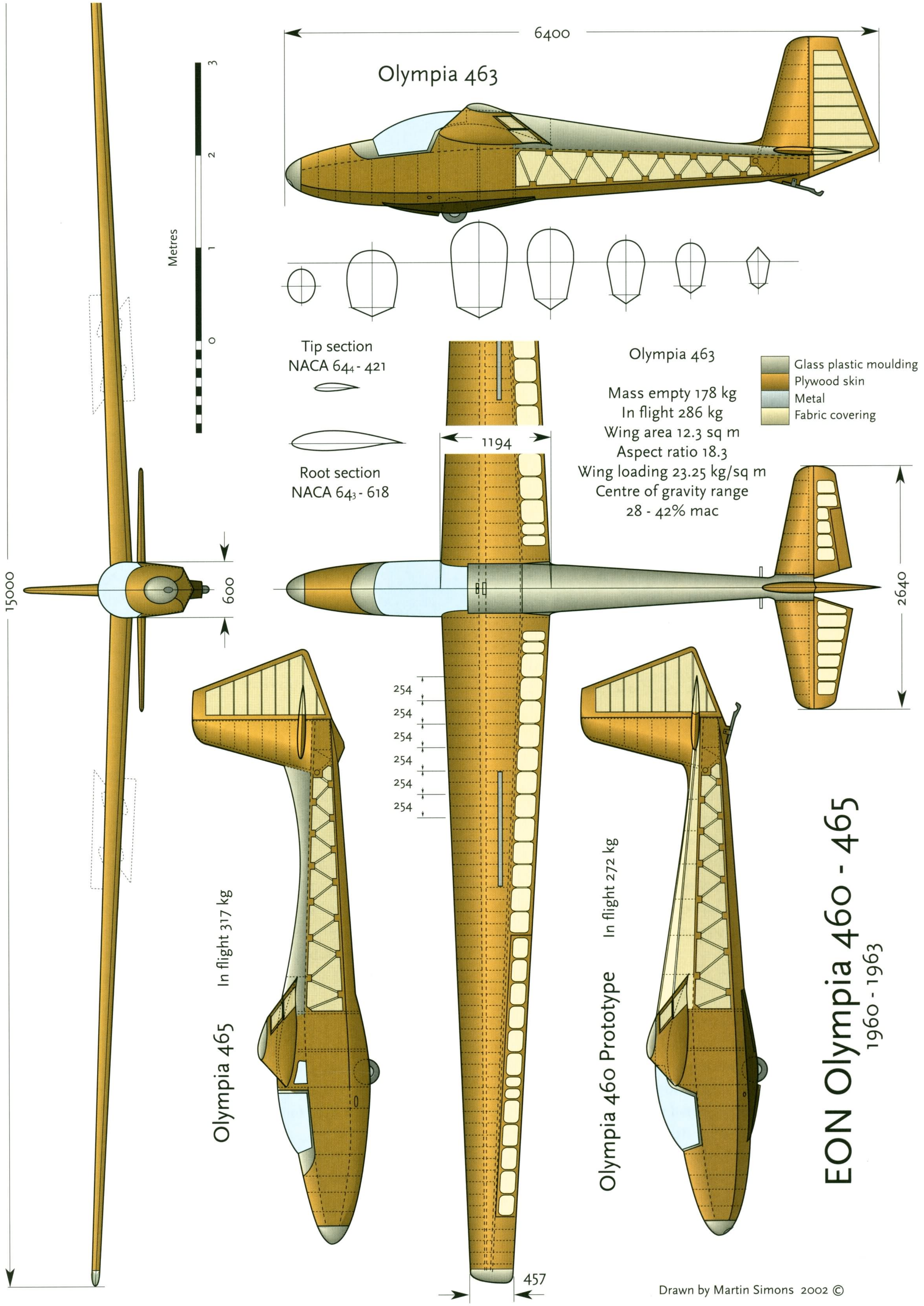


Mass empty 226 kg
In flight 320 kg
Wing area 12 sq m
Aspect ratio 18.7
Wing loading 26.7 kg/sq m
Centre of gravity range
31.2 - 41.2% m.a.c.

Alsema Sagitta

1960

Drawn by Martin Simons 2002 ©



Drawn by Martin Simons 2002 ©

Left: The end of the Elliott Olympia 46 series came with the 465, flown to 9th place by Tony Deane Drummond at South Cerney in 1965. Below: The Olympia 463

higher aspect ratio. Frise type ailerons were used, as before. An important feature was the use of light alloy members to reinforce the main spar. These were bonded to wooden veneers so they could be glued into the main structure.

The fuselage was open framed, fabric covered behind the wing with a plywood skinned nose, with some small glass-plastic mouldings for wing tips and nose piece. The seat was only slightly reclined. The wheel was ahead of the laden centre of gravity so no nose skid was needed. The all-moving tailplane of the Olympia 403 - 419 series was replaced with a fixed stabiliser and elevator, folding upwards for road transport as before.

Early flight reports suggested that the aircraft handled well and the performance was up to expectations. Production was started but on the second aircraft a new wing with an aspect ratio of 18 replaced the original, to reduce the wing loading. Several further of the 460 series were built, with some different features, including one with the original aspect ratio but modified outer wing profiles.

The design settled down at number 5. The Olympia 463, as it was now known, began production in 1963. A large glass-fibre moulding replaced the fabric covered decking behind the cockpit. The aspect ratio of 18 was retained. Forty-eight of this type were produced.

In preparation for the 1965 World Championships, to be held in England, two special versions, called Olympia 465, were build, with new fuselages and in one case a new wing. The pilot's seat was more reclined, allowing a reduced fuselage cross section, and the all-moving tailplane was re-introduced.

One 465 competed in the World Championships in 1965, and, flown by Tony Deane- Drummond, placed ninth.

Production of the 463 series ended soon after the death of Horace Buckingham in 1965. The existing orders were filled but no more sailplanes were produced in Newbury. A few years later the factory, which had reverted to furniture manufacture, closed altogether.

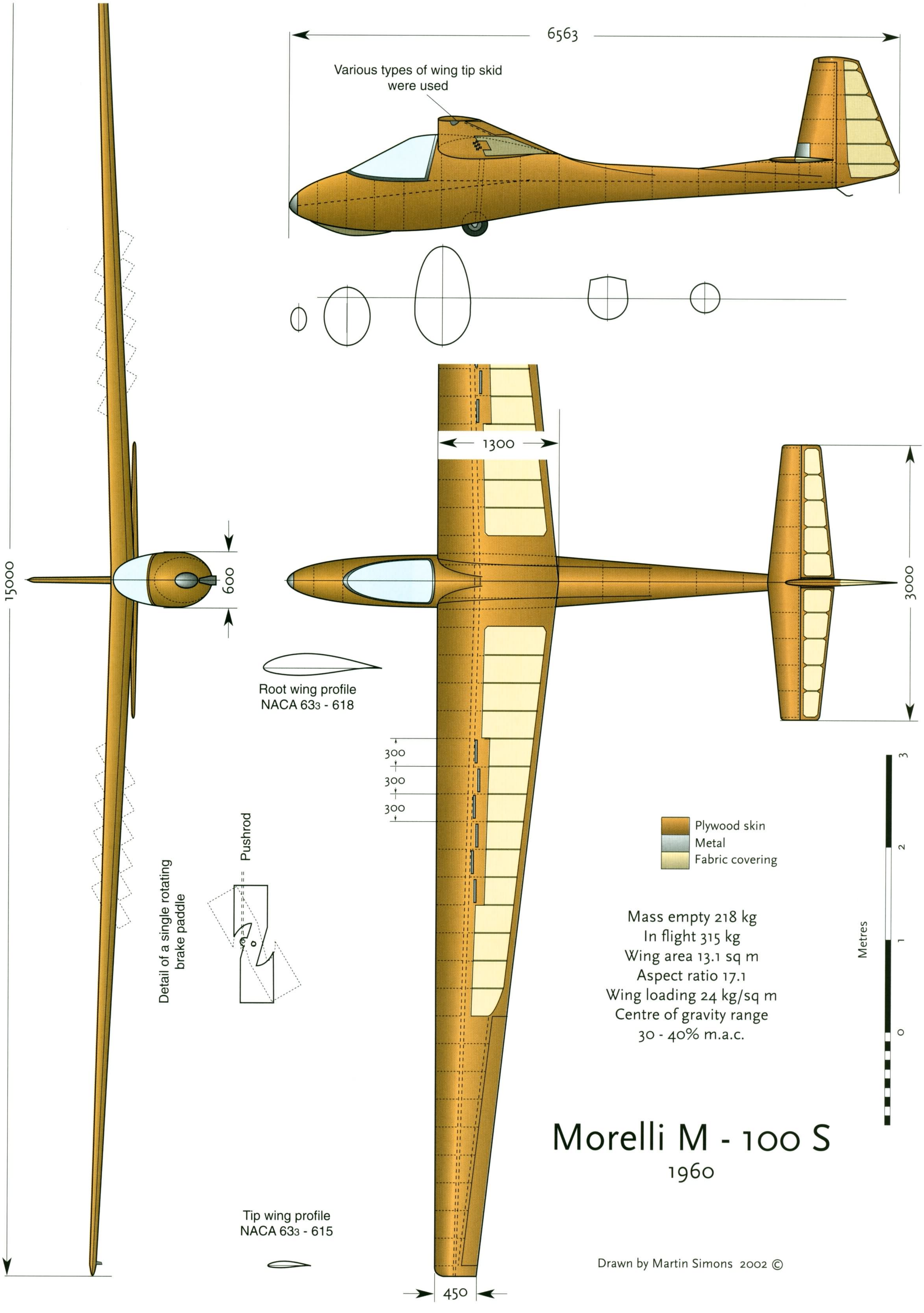
After forty years of service, in 1996 an Olympia 463 suffered a wing failure during a winch launch, causing a fatal accident. Corrosion of the metal bonded to the spar was held to be responsible. All of the remaining Olympia 460 - 3 series were grounded while major inspections were carried out. Only about half were considered worth restoring after the investigations. The necessary work was not done on all these.[45]

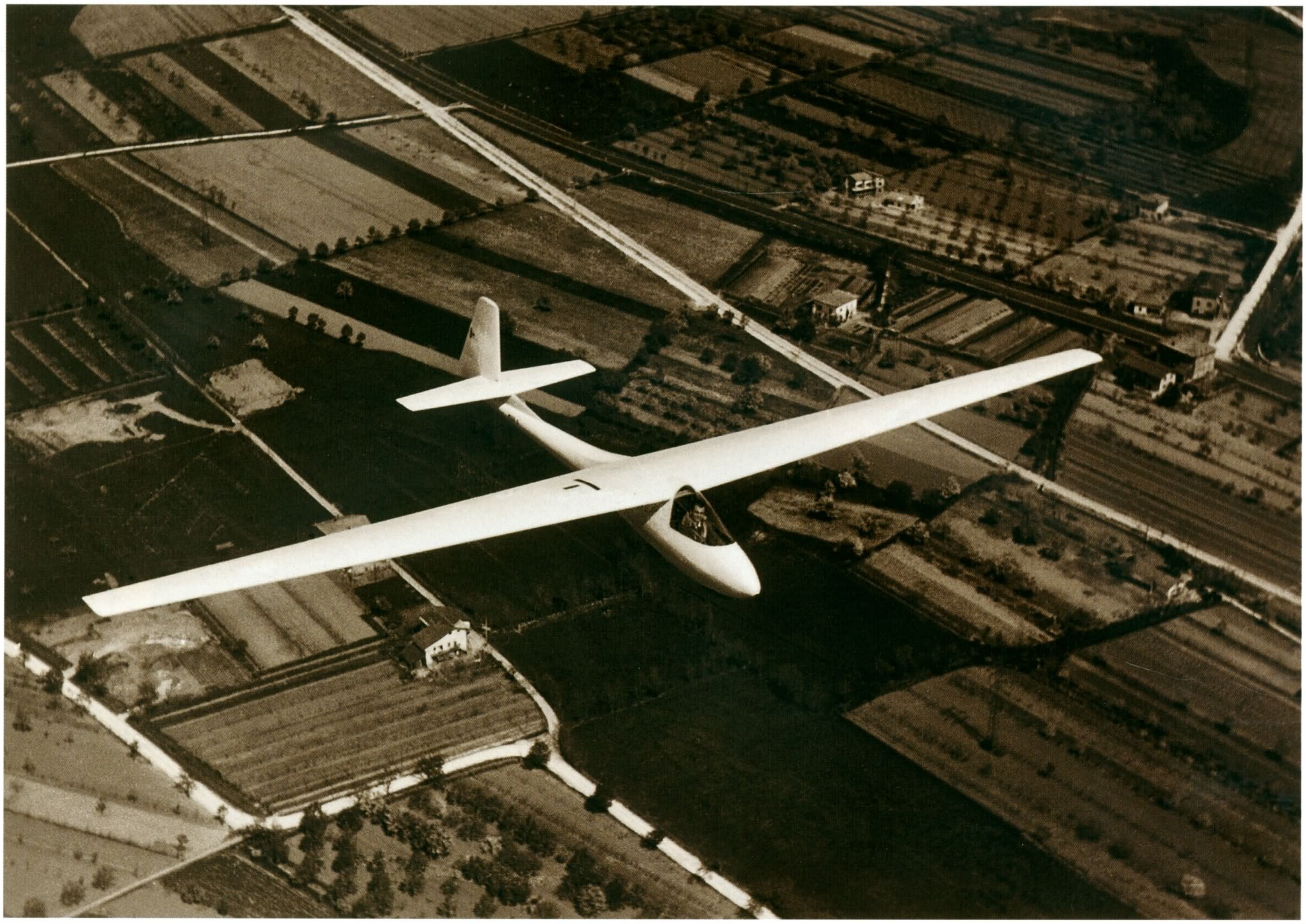
Morelli M - 100

In 1956 the Italian Aero Club held a design competition for a single seat training sailplane, suitable for series production. It was to be suitable for training and early badge flights, robust, easy to maintain and repair. The winner was the M - 100, 14.25 metres span, designed by the Morelli brothers Alberto and Pietro. It was of wooden construction with NACA 6 series profiles, a straight tapered wing and a T tail. The fin and rudder were similar to the Veltro by the same designers. The prototype was built at the Officine Nicoletti factory in Turin and test flown in June 1957. Extra area was added to the vertical tail, extending it above the tailplane.

At this time the FAI Gliding Commission issued the specification for the Standard Class competition sailplane and the Aero Club requested that the M - 100 should be brought into line with these re-

45 - Sailplane & Glider Feb 1997 p 60, Dec 1997 p327, see also S & G 1996 p 53.


6563
Various types of wing tip skid were used
1300
3000
15000
600
Root wing profile NACA 63₃ - 618
300
300
300
Pushrod
Detail of a single rotating brake paddle
Plywood skin
Metal
Fabric covering
Mass empty 218 kg
In flight 315 kg
Wing area 13.1 sq m
Aspect ratio 17.1
Wing loading 24 kg/sq m
Centre of gravity range
30 - 40% m.a.c.
Metres
0
1
2
3
Morelli M - 100 S
1960
Tip wing profile NACA 63₃ - 615
Drawn by Martin Simons 2002 ©
450



Above: The M - 100S prototype flown over Trento by one of its designers, Alberto Morelli.
Right: The M - 100S at South Cerney in 1965.

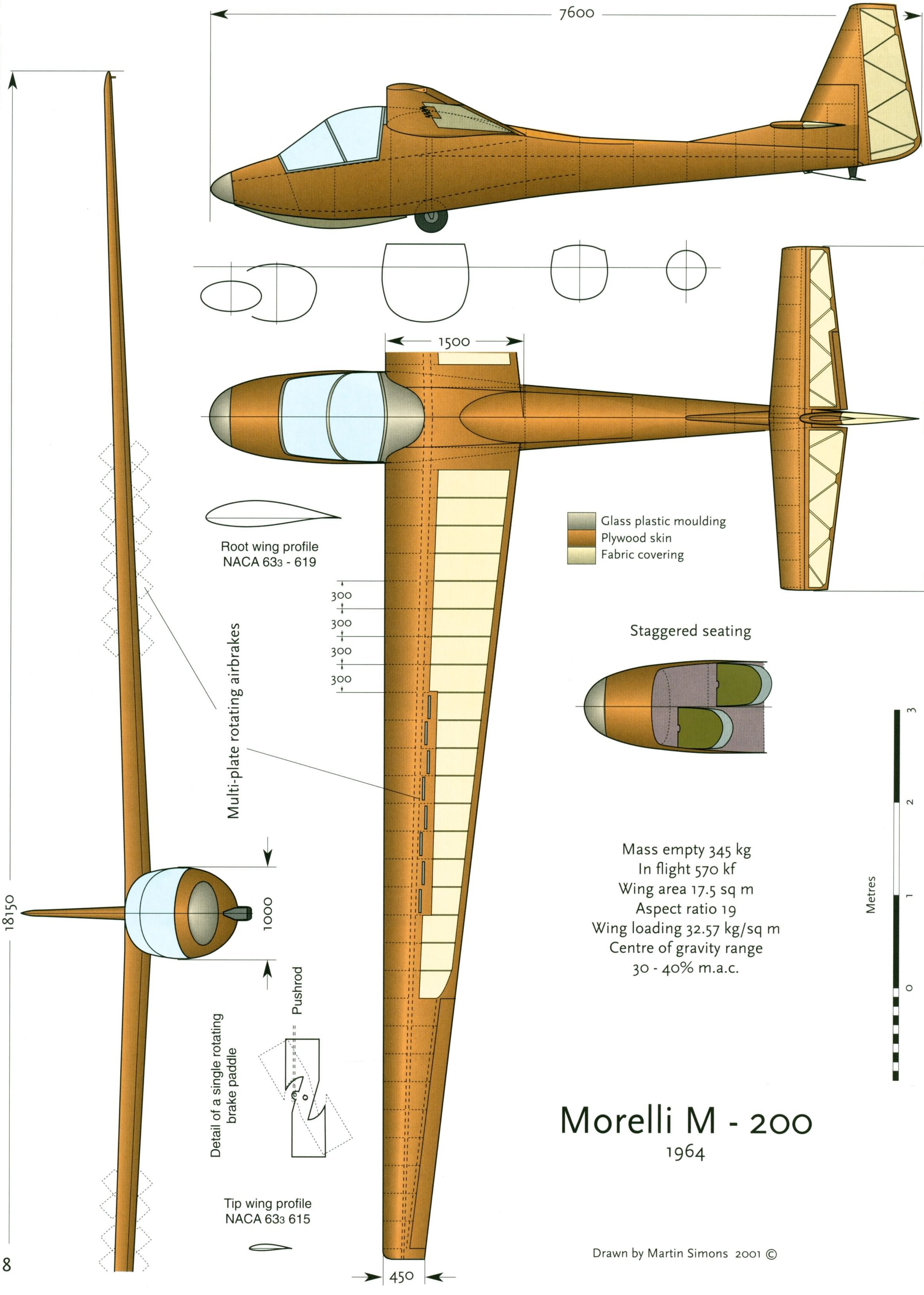
quirements. A fairly thorough re-design followed. The M - 100S made its first flight in 1960. The wing, now of 15 metres span, was swept forward slightly and the wing root section thickened to 18%. The tailplane was mounted lower on a sub fin, with a taller vertical tail to improve its effectiveness. Airbrakes of the rotating paddle type were enlarged to conform to the speed-limiting requirement. This entailed testing the sailplane in prolonged vertical dives with the brakes open to ensure that the airspeed did not rise above the maximum or 'red line' figure. A special feature was that rigging and de-rigging the M - 100S was very quick and easy, taking a crew of four only one minute, providing that all the components were arranged ready to hand before starting the clock.

Production began at Aeromere and Avionautica Rio. Eighty-three were built in Italy. Carmam in France built another 140. The M- 100S competed in the World Championships in 1960, flown by G. Silva to 8th place. The results in 1963 and 65 were less impressive but the M - 100S was considered competitive with the Ka - 6CR in performance and handling.

Morelli M - 200

The M - 200 two-seater was derived directly from the successful M - 100. The wing was created by projecting the lines of the M - 100 wing inwards. That is, the outer 7.5 metres of the two-seater wing were identical to the M - 100, only the inner part was new, with appropriate main spar, from laminated beech, and skinning to carry the extra loads. The assembly system was the same, and, like the single-seater, very easy and quick. The air brakes, of the same multiple pattern as the M - 100, were increased from six to eight plates.

The fuselage is remarkable chiefly because the seats were staggered in the same way as the Australian ES - 52 Kookaburra of 1954. This

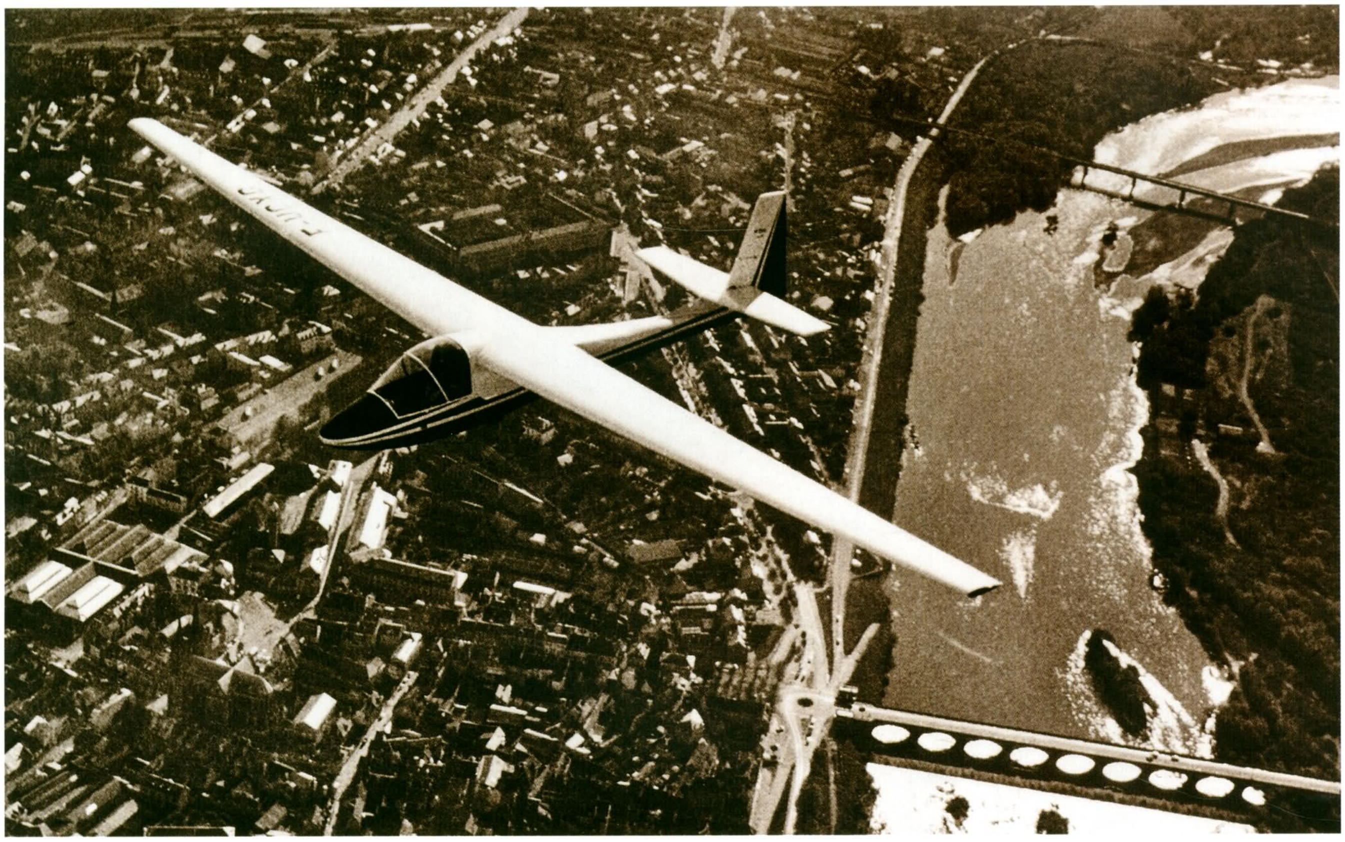


Mass empty 345 kg
In flight 570 kf
Wing area 17.5 sq m
Aspect ratio 19
Wing loading 32.57 kg/sq m
Centre of gravity range
30 - 40% m.a.c.

Morelli M - 200

1964

Drawn by Martin Simons 2001 ©



The M - 200 was a successful two seater with staggered seating like the earlier Australian Kookaburra.

Below: M - 200 at Tibenham

allowed both pilots good vision and the comfort of additional elbow room, while having most of the advantages of side by side seating for communication between the instructor and a pupil. Only one set of instruments was required and flying solo from the left hand seat was permissible without needed trimming ballast. The cross sectional area of the fuselage was less than that required for a true side-by-side cockpit. The Morelli brothers reduced the fuselage drag further by contracting the cross section behind the cockpit.

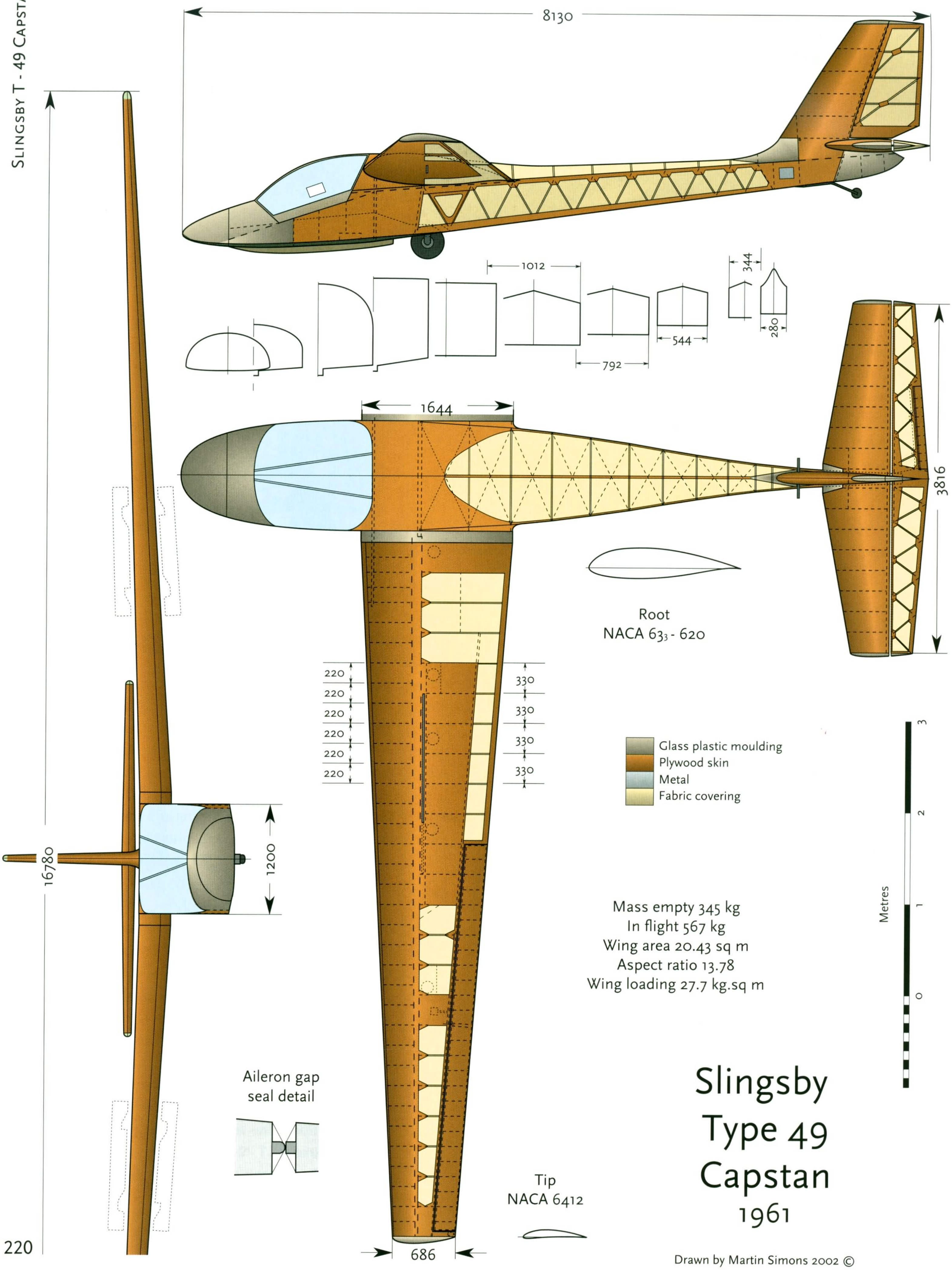
Various minor changes of detail were made, including a one-piece cockpit canopy and several different designs of wing tip skid.

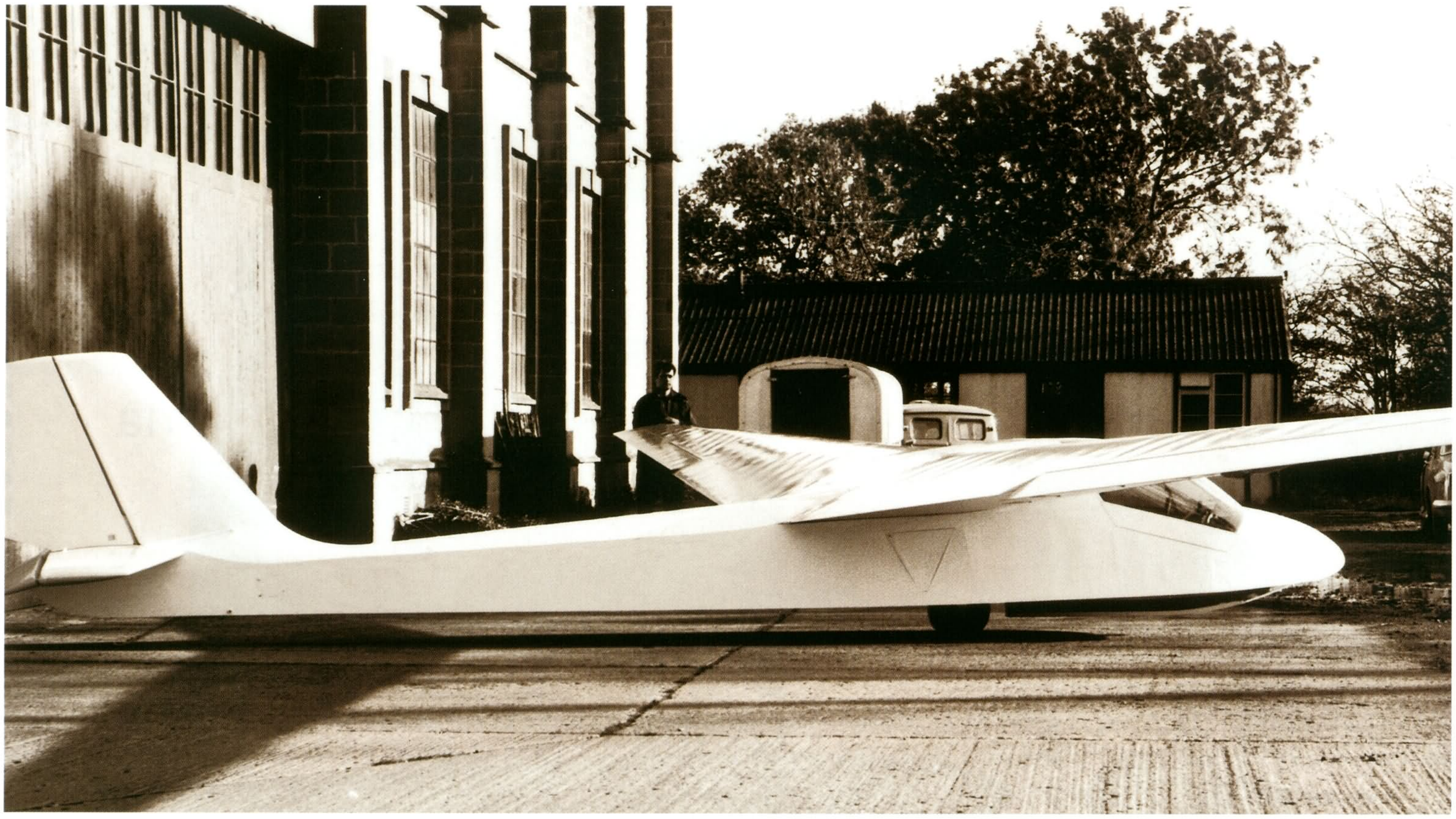
The M - 200 prototype was built in the workshops of the Turin Polytechnic and was first flown in 1964. Four more were produced in Italy. The French Company CARMAM subsequently built 59 more, marketing them under the name Foehn, by which the M - 200 became widely known.

Slingsby T - 49 Capstan

Most British gliding clubs in 1960 were still using the old Slingsby T - 21 Sedbergh for basic training. It had many excellent characteristics and inspired great affection among those who had learned to fly this way. But it could not be used to introduce beginners to modern techniques of cross-country flying nor to the characteristics of laminar flow wings. It could be aero-towed, providing the tug was not too fast, but with the open cockpit and lack of any elevator trimmer this was not very comfortable. A modified version, the T - 46 or T 21 - C, which had a shoulder wing and enclosed cockpit, did not please many. It was still, aerodynamically, a big Grunau Baby. The T - 42 Eagle had not proved popular as a basic trainer, partly because it was big, rather heavy and costly, partly because the seats were in tandem. Many instructors greatly preferred the side by side seating arrangement. Slingsby had produced the single seat T - 45 Swallow, which was now being used for early solo flights. What seemed to be needed was a side by side two seat trainer that would lead a beginner naturally to the Swallow, and which could also be used for aero-towed launches and cross-country exercises.

The T - 49 followed Slingsby's established methods, the wings being skinned with Gaboon plywood with the machined leading edge member as on the Skylarks. The wings were mounted high on the fuselage. The cockpit was enclosed by a large transparent canopy, formed in three sections. The seats reclined slightly. The rest of the fuselage was rather like the T - 21, a wide, fabric covered open frame behind the wing. The tail unit was straightforward with a fashionably raked fin. All else was orthodox.


8130
1012
344
544
792
280
1644
3816
Root
NACA 63₃ - 620
220
220
220
220
220
220
330
330
330
330
Glass plastic moulding
Plywood skin
Metal
Fabric covering
1200
16780
Mass empty 345 kg
In flight 567 kg
Wing area 20.43 sq m
Aspect ratio 13.78
Wing loading 27.7 kg.sq m
Metres
0
1
2
3
Aileron gap
seal detail
Tip
NACA 6412
686
Slingsby
Type 49
Capstan
1961
Drawn by Martin Simons 2002 ©



Above: The prototype Capstan at the factory, showing the original smaller vertical tail.

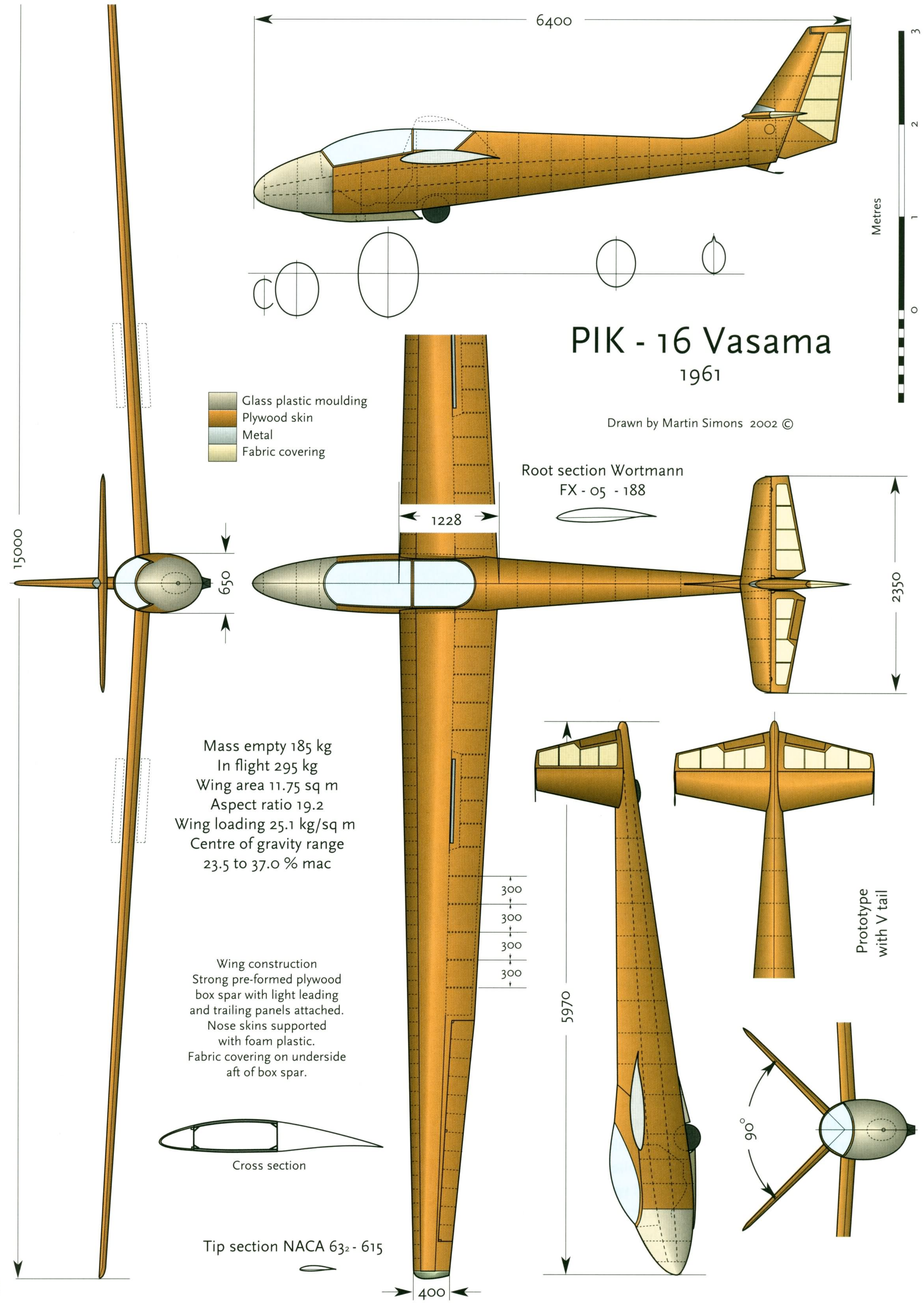
Right: The Slingsby Type 49 'Capstan' (named after a brand of cigarette) was intended for advanced training and cross-country flying. The British Gliding Association used this aircraft for advanced training of instructors.

Test flights did not go entirely as hoped, the vertical tail areas needing to be increased to aid spin recovery, but sufficient orders came in for production to begin.

The British Gliding Association needed a two seat sailplane which would tour the various clubs with the National Coach, arranging instructor courses and check flights. The Imperial Tobacco Company had been persuaded by Walter Kahn to give some financial help to soaring, among the many other sports they sponsored. The funds for the BGA two-seater were provided and the name of a leading brand of cigarettes, Capstan, was applied. Whether Slingsby intended it or not, all the T - 49s produced were henceforth Capstans. Thirty-two were sold, with a few exports. Some clubs, which used only winches for launching, found the Capstan did not serve them very well and continued using the T - 21 for another decade or so. When these old aircraft were finally phased out, the replacements were usually imported tandem seaters.

PIK - 16C Vasama

In 1964 one of a series of OSTIV courses was held at Varese in Italy for pilots from various countries to fly and compare nine different Standard Class sailplanes and one or two others. After twelve days of flying, discussing and testing, it was agreed that the PIK - 16C Vasama (Arrow) which had won the OSTIV prize in 1963, was "A glorious, very high performance glider, beautiful, effective controls, pleasant to fly, a true OSTIV award winner."


PIK - 16 Vasama
1961
Drawn by Martin Simons 2002 ©
6400
Metres
Glass plastic moulding
Plywood skin
Metal
Fabric covering
Root section Wortmann
FX - 05 - 188
1228
15000
650
2350
Mass empty 185 kg
In flight 295 kg
Wing area 11.75 sq m
Aspect ratio 19.2
Wing loading 25.1 kg/sq m
Centre of gravity range
23.5 to 37.0 % mac
300
300
300
300
5970
Prototype
with V tail
Wing construction
Strong pre-formed plywood
box spar with light leading
and trailing panels attached.
Nose skins supported
with foam plastic.
Fabric covering on underside
aft of box spar.
90°
Cross section
Tip section NACA 63₂ - 615
400

The Vasama was highly esteemed by an international group of pilots attending an OSTIV conference at Varese in Italy in September 1964. Soon afterwards VH - GPC was imported to Australia.

One of the features favouring the Vasama was its use of a new type of wing profile designed by Dr F X Wortmann of Stuttgart. In the NACA 6 series profiles, the pressure gradient over the wing reduced as the flow moved aft, until a chosen percentage such as 30 or 40% was reached. After this the pressure was allowed to recover linearly to the trailing edge. At the minimum pressure point, usually close to the maximum thickness of the profile, there was a rather sudden change from decreasing to increasing pressure. Wortmann argued, and proved in the University wind tunnels, that if the change from falling to rising pressure was made more gradual, the laminar boundary layer, especially at Reynolds numbers appropriate to sailplanes, would persist, albeit in a rather delicate state, for some distance beyond the minimum pressure point. A useful saving in drag would result. A new series of wing profiles was developed. Even more than previously, accuracy of the wing was necessary. As more and more sailplane designers became convinced, Wortmann sections began to replace the NACA 6 series. The PIK group, Tuomo Tervo, Jorma Jalkanen and Kurt Hedström who designed the Vasama, were among the first in the world to take up these developments. Their wing used a Wortmann profile extending from the root as far outboard as the inner end of the aileron. From there the section changed to the well proven strongly cambered NACA 63_2 615.

The wing structure was also unusual, resembling the Zefir 2A in some respects but using Finnish timbers, closer grained and stronger than the pine or spruce used in other countries. A very strong, preformed plywood box spar carried the main bending and twisting loads. In front of this a light plywood-plastic sandwich wing nose was attached, and behind it a light framework of ribs with plywood skin on the upper side, fabric covering below. The ailerons were plywood skinned on both sides.

The fuselage was a plywood skinned monocoque. The pilot seat was only slightly reclined. On the prototype the cockpit canopy was a small bubble, neatly faired in but slightly restrictive for a tall pilot. The obligatory wheel was in front of the balance point so there was no skid. The tail unit was a V type.

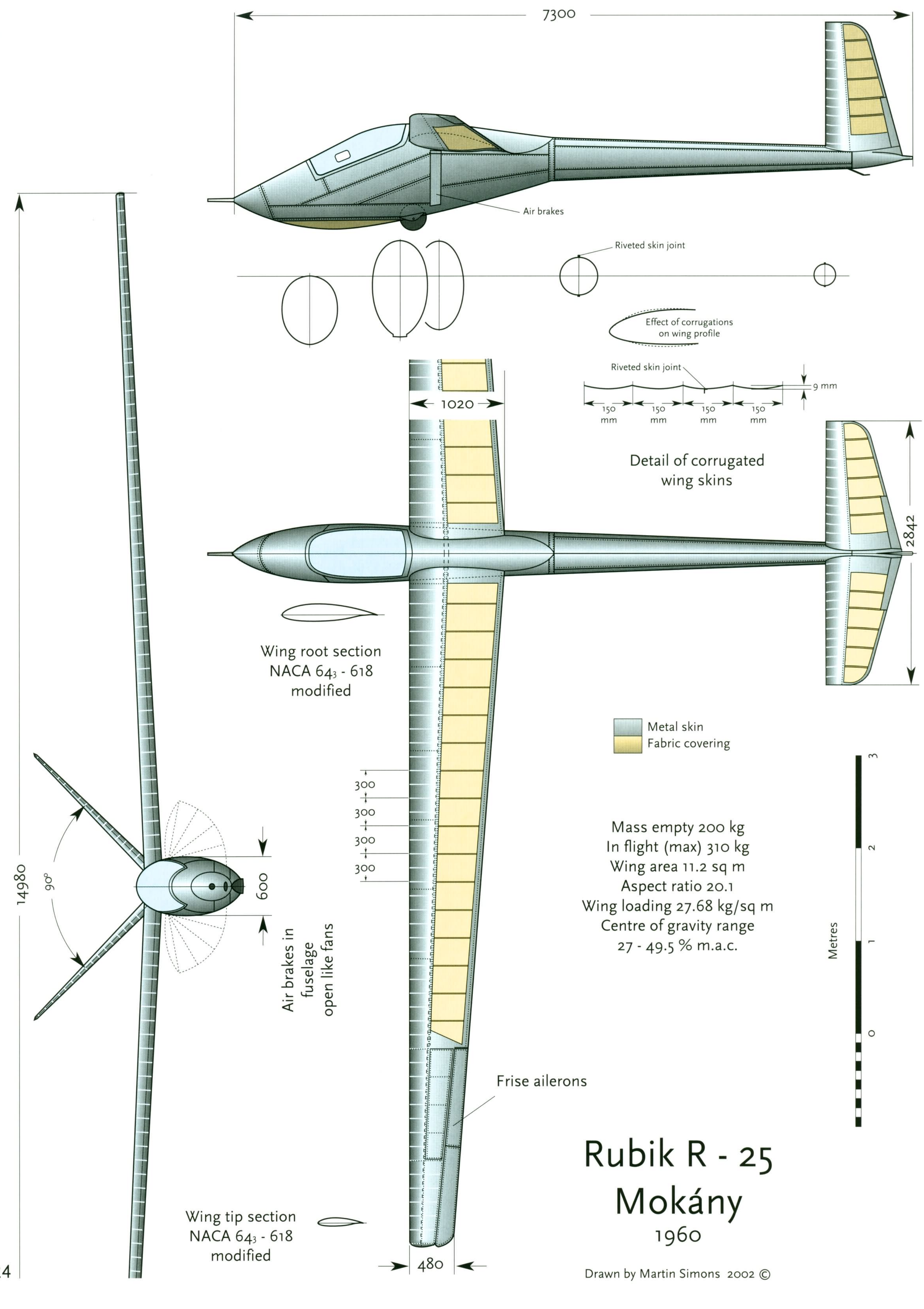
After flight tests in June 1961 the fuselage and tail were re-designed. The wheel was moved back, so a forward skid was now needed. The cockpit canopy was greatly enlarged and the V - tail replaced by a normal tail with a raked fin. Two aircraft were sent to Argentina for the 1963 World Championships and for submission to the OSTIV Jury.

In the Championships at Junin, J Horma, the Finnish pilot, placed third, an outstanding result. The other Vasama finished 14th. Winning the Design Prize was an additional reward for the PIK team. From the start of production in 1962 until 1965, fifty-two of the Vasama were produced, including the prototype.

Rubik R - 25 Mokány

The Mokány (Plucky) was one of a series of all metal sailplanes that began with the R 23 Gébics (Shrike) of 1957. The Gébics was a 13 metre span single seat training sailplane designed under Erno Rubik's supervision as an experiment. The glide ratio was about 21: 1. It had a 'pod and boom' fuselage with a V - tail, a rectangular wing

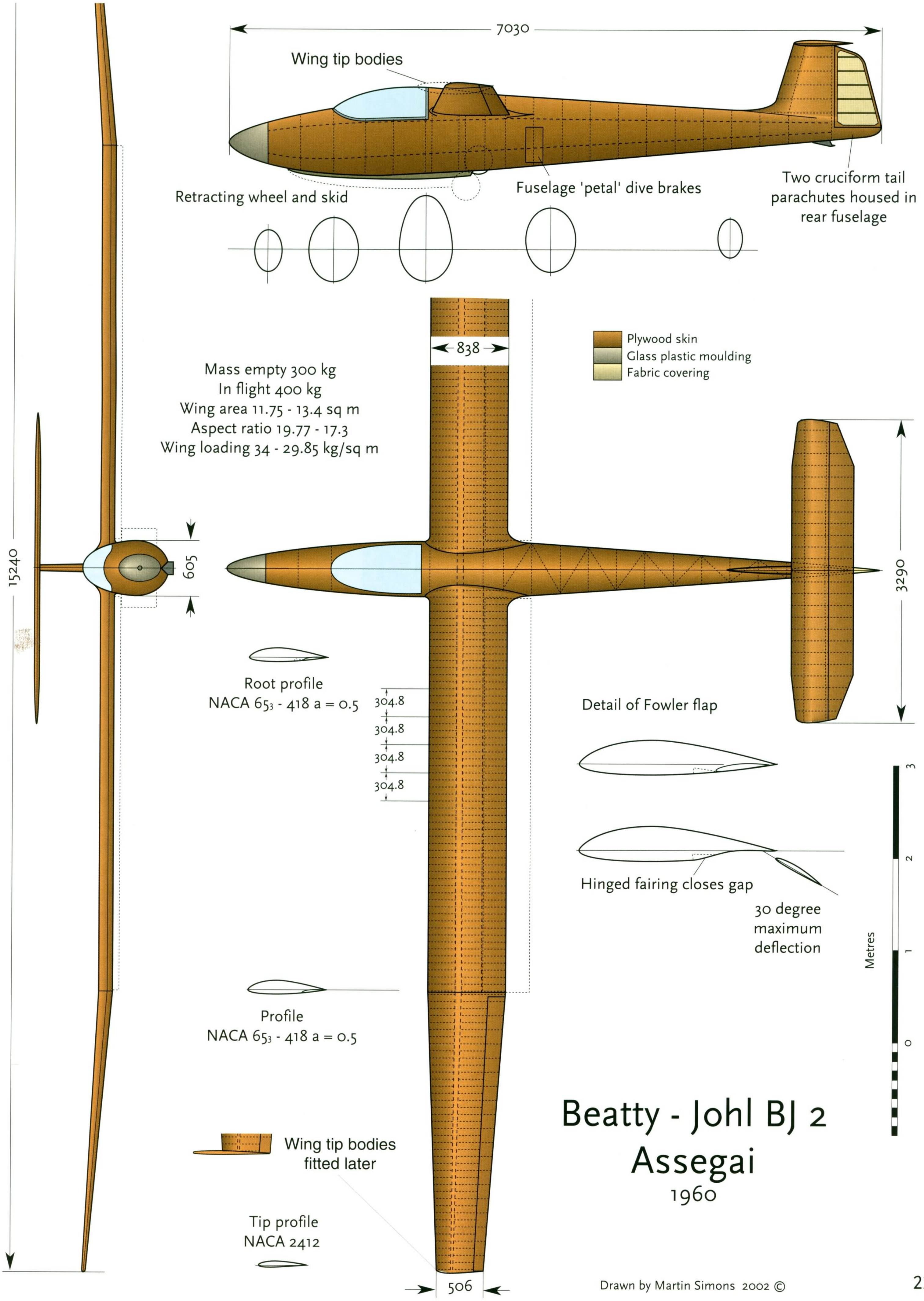
The R- 25 Mokany, all metal with corrugated skins.



Rubik R - 25 Mokány

1960

Drawn by Martin Simons 2002 ©



Beatty - Johl BJ 2 Assegai

1960

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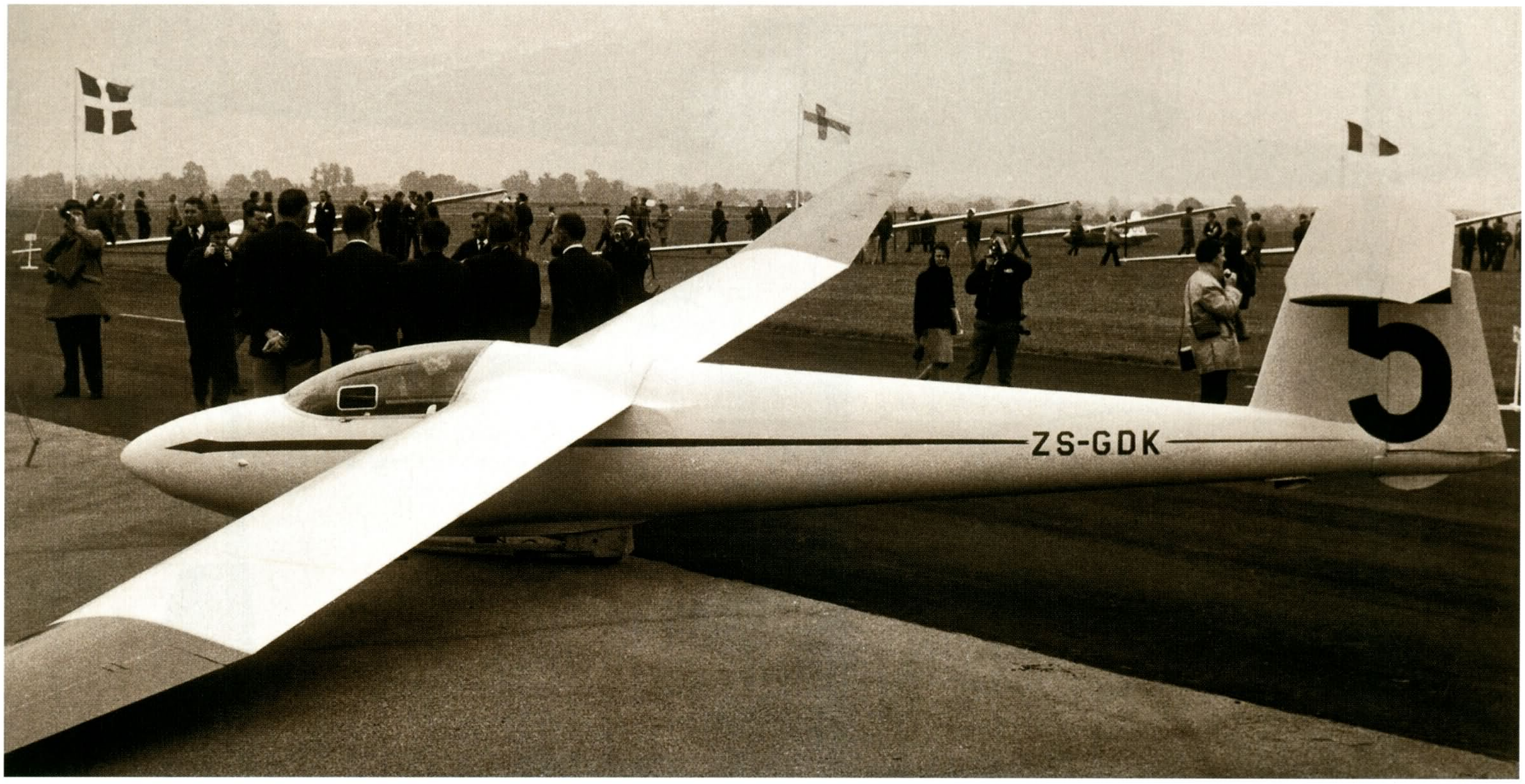


Above: The BJ - 2 at South Cerney in 1965. The weak conditions of an English summer did not suit the South African sailplane

Left: The 'Assegai' had large Fowler flaps. The wheel and skid retracted in flight.

plan and non-laminar Göttingen 549 wing profile. The wing skins ahead of the main spar used the simple form of corrugations that were used on several later sailplanes. The air brakes were of the fuselage fan type.

The Mokány was Rubik's development of the Gébics into a Standard Class competition sailplane with laminar flow wing profiles, but retaining the corrugated skin. The profile could not have been accurate enough to maintain laminar flow to the theoretical 40% chord position. The V - tail was all-moving with anti-balance tabs. Fuselage fan air brakes were used to avoid the complexities of installing them in the wing, which was fabric covered behind the main spar. It is unlikely that these brakes would have been sufficiently effective to meet the Standard Class speed limiting criteria. A best glide ratio of 28:1 was claimed. Only one was produced. Many of the components used in the R - 25 were identical with some of the R - 27 training single-seater of 1961. This in turn shared 80% of its parts with the Gobé two-seater.

Beatty - Johl BJ - 2 Assegai

The BJ - 2 Assegai (Spear) was designed by the South Africans Pat Beatty and his friend W A Johl in an attempt to widen the speed range of a sailplane by using large Fowler flaps. The wing was of wood, built in three sections. The centre-piece, 9.17 metres (30.1 ft) long, was of rectangular plan with the NACA 65 series profile, and the flaps. This centre section had no dihedral. The outer parts of the wings tapered to the NACA 2412 profile at the tips, with 5 degrees of dihedral.

The ribs were machined to the exact profile required, and spaced at 76 mm (2.75 ins). The wing skins were formed from laminated spruce 4.5 mm thick, formed in a press before gluing to the ribs and main spar. Flaps and ailerons were of much lighter construction, skinned with 1.5 mm plywood with diagonal grain.

The flaps were supported on arms, sliding in guide rails on the under side of the wing, five such guides on each side. When deployed they increased the total wing area from 11.75 to 14.04 sq m, nearly 20%. The maximum deflection was 30 degrees down.

The fuselage was a straightforward semi-monocoque construction with some additional internal cross bracing. There was a glass-plastic moulded nose cone. 'Petal' type air brakes were fitted in the fuselage behind the wing but these were relatively ineffective. Two cruciform parachute air brakes were housed in a compartment at the base of the rudder. . The wheel and skid were retractable.

The BJ - 2 was heavy for its span. It was designed for South African conditions and the wing loading with flaps retracted was high. This was compensated when the flaps were deployed, but still high compared with contemporary European sailplanes such as the Standard Austria.

Soon after completion in 1960 Beatty won the South African National Championships with the BJ - 2. In the same year he also made some outstandingly fast flights round closed courses; 108 km/h for the 200 km triangle and 102.28 km/h for 400 km. He had hoped these would be recognised retrospectively as World records. At the time they were flown the FAI had not yet established the rules for triangular circuit flights. When they did so, neither 200 nor 400 km triangles were included. The triangles for record purposes had to be 100, 300 or 500 km. There was some further disquiet in South Africa when the FAI decided not to recognise records for triangles if the flights were made before 1st January 1963. This meant that some recent national records in that country (not flown in the BJ - 2) were faster than the nominal World Record figures.

In 1965 the BJ - 2 was taken to England to compete in the World Championships where it was flown by Boet Dommisse. As with most of the other heavy and fast sailplanes, the English conditions did not suit the aircraft and Dommisse did not do especially well, although he did at least make a score every day which is more than many of the other Open Class contestants did.

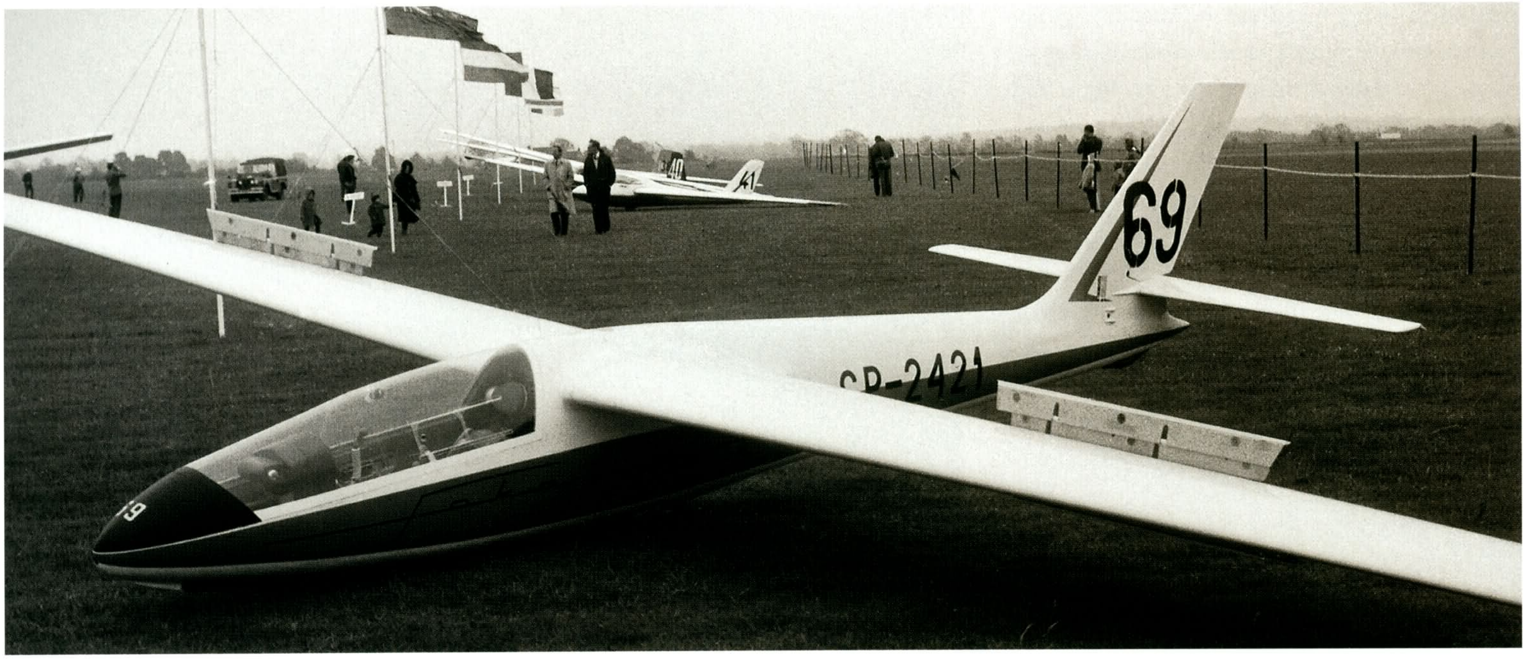
A Swiss registered Foka 4 flying over England. The wheel, set far into the belly, made ground handling rather difficult. This counted against it in the OSTIV Design Prize judgment

A difficulty with the use of Fowler flaps on a sailplane is that when the flaps are deployed, they reduce the effective aspect ratio, in the case of the BJ - 2 from 19.77 to 17.3. High performance sailplanes generally require very high aspect ratio wings because at low airspeeds the vortex drag created by the wing tips amounts to more half the drag of the entire sailplane. Any decrease in the aspect ratio reacts badly on the rate of climb in a thermal. But in addition, such flaps create a marked change of the effective wing chord at the outer end of the flap. A strong vortex forms at this point, adding its strength and drag to that already existing at the extreme tips. The Fowler flap, while decreasing the stalling speed and turning radius, creates a lot of additional drag, tending to increase the rate of sink. In a weak thermal, Fowler flaps are usually more hindrance than help.

Beatty continued with his work and in later years produced the BJ - 3. This took the development of variable geometry sailplanes a stage further. His last project was more unusual still, involving a wing profile that could be altered substantially in flight by changing the curvature of the upper skin. In the long run, the structural complications and difficulties for the pilot in managing such aircraft, proved too great.

SZD - 24 Foka

The SZD - 24 was originally called 'Delfin' (Dolphin) but this was changed to Foka (Seal) at an early stage in the design process. Among the group of engineers at Bielsko Biala , the SZD, there was an 'in house' design competition for a Standard Class sailplane, which was won by W. Okarmus and P. Mynarski. The prototype was expected to fly in the World Championships in June 1960 but as the deadline approached things had to be rushed. The major inno-



The Foka flown by Popiel in Standard Class at South Cerney in the 1965 World Championships. Jan Wroblewski won the Open Class in a Foka against much bigger and more expensive sailplanes, including the glass-plastic Darmstadt D - 36. Makula in another Foka was fourth.

vations were a very reclined pilot position, allowing a greatly reduced fuselage cross section, and the use of a plastic foam - plywood sandwich for the wing and tail skins. The wing profiles were from the NACA 63 series, changing at the extreme tip to the NACA 4415. Glass-plastic mouldings were used for part of the front fuselage. The first flight was on 2nd May. Adam Witek had only 27 flights totaling 25 hours flying time in the aircraft before taking it to Cologne (Butzweiler) for the contest. Witek astonished himself and everyone else by winning four of the six contest days, placing second on one. A seventeenth place on the penultimate day dragged him down to third behind Huth in the Ka - 6BR and Münch of Brazil in a Ka - 6 B. The Foka was not entered for the OSTIV Design Prize because it was recognised that more work needed to be done on it. In particular the stability in pitch was poor, the airbrakes probably did not meet the speed limiting requirement, and the take off roll was too long because the wheel did not project enough to allow an adequate tail down attitude on the ground.

The second prototype, SZD - 24A had enlarged airbrakes. To achieve correct balance 1.5 kg of trimming ballast was required. The canopy was of poor quality. Distortions in the transparent plastic ruined the view forward and made landings very difficult. The skid wore out very rapidly because it rubbed on the ground, the wheel being behind the centre of gravity.

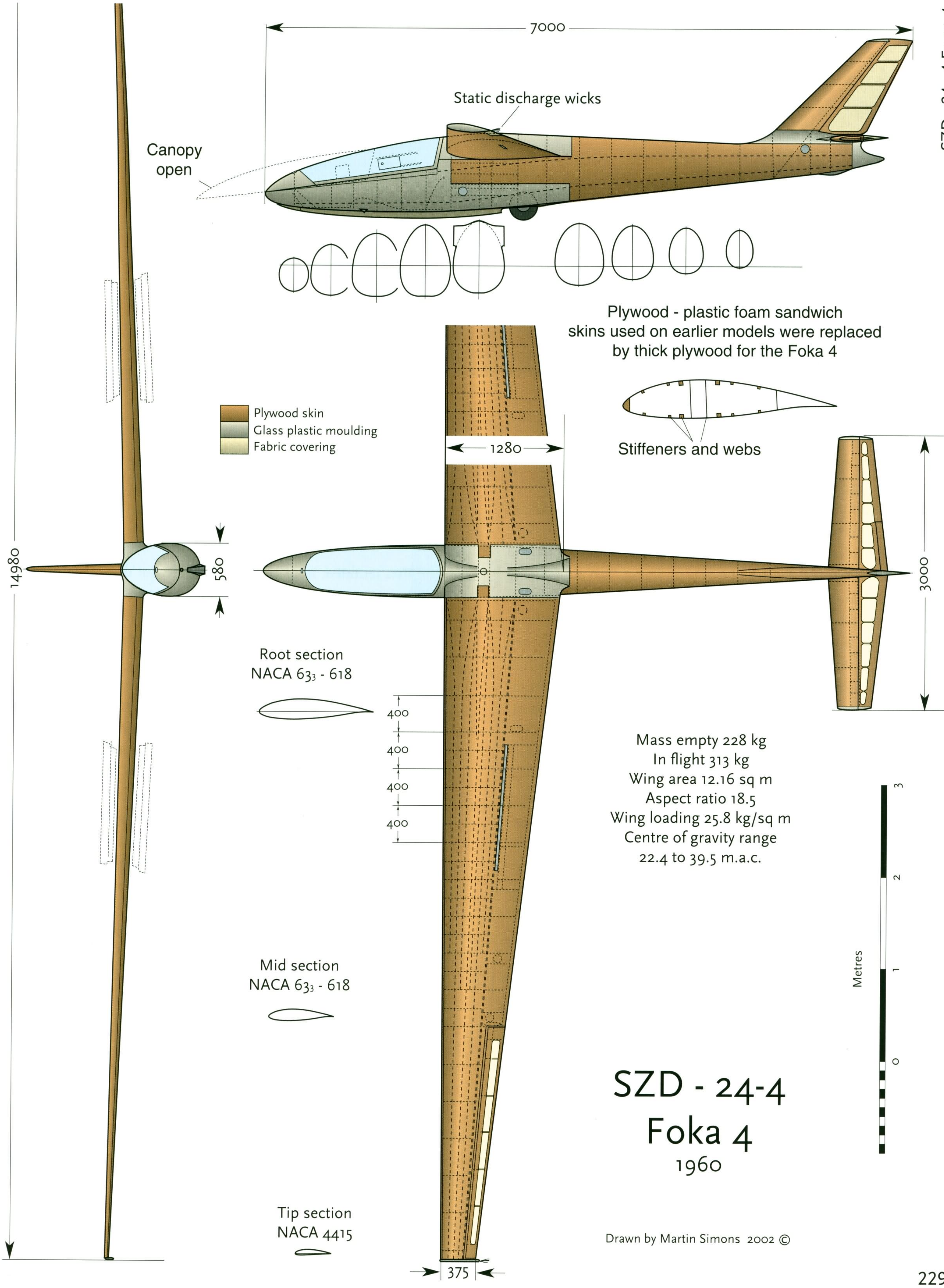
Five further prototypes were built for extensive testing. The tailplane was enlarged by 10% and lightened by using plywood instead of plastic sandwich for the skins. The lead ballast was no longer needed. The canopy was improved by moulding in a section of two-dimensional curvature in the critical area which the pilot needed to look through, near the nose. The skid was reinforced.

The SZD - 24C was the first production version, first flown in September 1961. This had a simplified wing structure and the wheel was lowered by 45 mm to improve ground clearance and aid take off, with other improvements of detail. This was followed by yet another model, the 24 - 2, but this proved slightly inferior to the 24C version and was abandoned, as was a further experiment with a honeycomb filled wing, the Foka 3.

The final model, which entered production and became widely known and outstandingly successful, was the SZD-24-4 or Foka - 4. The sandwich wing skins were changed to thick plywood, with important savings of weight and simplifying production. The wings were built in female concrete moulds, the skins laid in place first, ribs and internal spars and stiffeners next with the various control rods and brackets before the pre-joined and formed underside skins were glued on. The surface accuracy of the wing remained excellent. The glide ratio was measured at 34: 1, less than had been hoped but better than other Standard Class sailplanes of the time. The first Foka - 4 flew in February 1962

In 1962 a Foka flown by Camille Labar won the French National Championships and Jacques Lacheny took the European Cup at Angers. The polish pilot J Piecewski took the Foka to the 1963 World Championships in Argentina and three others were flown by Argentinean, Swedish and Belgian pilots. Meanwhile, Jan Wroblewski set a World Record of 682 km for the out and return task, Pela Majewska set a feminine World Record speed of 62.3 km/h for the 300 km triangle, beaten on the same day by Adela Dankoska with 82.5 km/h for the same task.

The pinnacle of the Foka - 4's success came at the World Championships in Britain in 1965. The Polish Team elected to fly two Fokas in the Open Class as well as entering two in the Standard Class. In the Open Class they were competing with the Darmstadt D - 36 all glass-plastic sailplane and others like the Yugoslavian Meteor, larger in span, much more expensive and equipped with retracting wheels


7000
Static discharge wicks
Canopy open
Plywood - plastic foam sandwich skins used on earlier models were replaced by thick plywood for the Foka 4
Plywood skin
Glass plastic moulding
Fabric covering
1280
Stiffeners and webs
14980
580
3000
Root section
NACA 63₃ - 618
400
400
400
400
Mass empty 228 kg
In flight 313 kg
Wing area 12.16 sq m
Aspect ratio 18.5
Wing loading 25.8 kg/sq m
Centre of gravity range
22.4 to 39.5 m.a.c.
Metres
0
1
2
3
Mid section
NACA 63₃ - 618
SZD - 24-4
Foka 4
1960
Tip section
NACA 4415
Drawn by Martin Simons 2002 ©
375

In 1963 at Junin, Polish pilots Makula and Popiel in Zefirs placed first and second in the Open Class Championships. This one was flown by the Argentinian pilot Hossinger who placed fifth

Below: A rare picture of the Zefir 1 in take off mode with flaps down

and flaps. Jan Wroblewski won the Open Class from the D - 36, and Edward Makula placed fourth. In the Standard Class, for which the Foka had been designed, the Poles did not win but achieved an extremely creditable third and fourth against Henry of France in the Edelweiss and Ritzi of Switzerland in the Standard Elfe.[46] Altogether about 200 Fokas were built for local and export markets.

The Polish success in 1965 was almost certainly due in part to their having developed a technique of team flying. Two pilots flying the same task and communicating constantly by radio, can sample more air. Whichever finds a good thermal first, can call the other over. Together they are likely to achieve a higher average speed than the lone pilot. Even so, much was owed to the outstanding qualities of the sailplane they were using. Pair flying in major competitions became routine practice in later years, requiring a discrete radio frequency for each team.

When it came to awarding the OSTIV Prize, the judging panels considered the Foka not to conform to the spirit of the original requirement for a club sailplane. The fuselage was still very close to the ground and vulnerable in rough field landings. The almost supine position of the pilot still made it difficult to see directly ahead, even with the revised form of canopy. It was easy to lose sight of the tug aircraft below the nose, which could be extremely dangerous to both aircraft. For the experienced pilot, however, the Foka was delightful to fly.

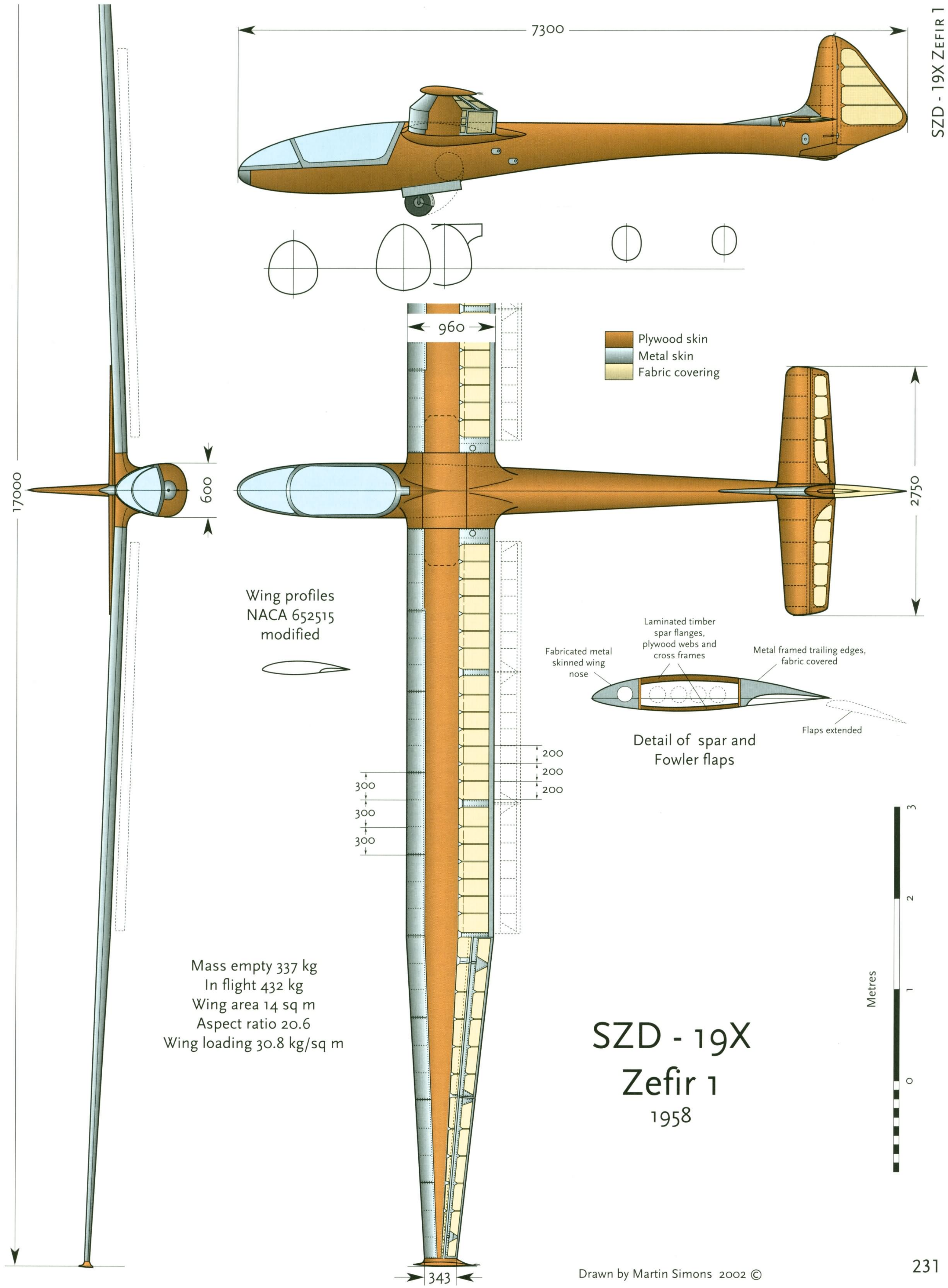
SZD - 19X Zefir 1

The SZD team at Bielsko Biala began design work in January 1957 on a new 'Open Class' sailplane to be flown in the 1958 World Championships scheduled for Leszno. The chief designer was Bogomil Szuba. The sailplane that began to appear on the drawing boards during the year was more complex than any the group had produced before. When manufacture began it was soon obvious that the prototype could not be finished in time for the competitions. The Polish team flew the old, but well proved, Jaskolka. In fact the first tentative hops of the Zefir were not until December 1958 and serious testing began in January 1959, continuing with many delays and difficulties over the next few months.

The SZD - 19X was a very ambitious project with a wing unlike anything seen before on a sailplane. The main spar, with very wide laminated timber flanges, plywood webs and cross members, occupied a third of the wing chord. It was shaped to conform exactly to the aerofoil section above and below. Ahead of this heavy member, the wing nose was entirely constructed of metal with pressed ribs and flush riveted light alloy skins. Behind the massive box spar, the framework of the trailing edge portion of the wing, with very large Fowler flaps, and the ailerons, was of light alloy. Metal work was unfamiliar to the established sailplane factories so the metal parts were built as a sub-components at the Mielec aircraft works. Delays were caused by the necessity of making many structural tests.

The fuselage also was a composite structure. The centre section was a strong welded steel tube frame carrying the wing and the hydraulically operated retracting wheel. The tow hook for both winch and aerotows was attached to the undercarriage, and the wheel well was carefully sealed. The load-carrying part of the nose, the seat and control supports had light alloy frames and inner skin. Reclining the seat to a degree not tried before reduced the cross sectional area. To enclose and fair all this there was a light plywood moulded shell. The cockpit canopy was in two sections, with telescopic struts supporting it when opened. The rear fuselage was a plywood skinned semi monocoque structure, and the tail unit was of orthodox wooden type. The tailplane was coupled to the flaps to re-trim the sailplane automatically when the flaps were down. A hydraulic pump from the cockpit operated the flaps. Other than the flaps, there were no air brakes.

46 - Not the Elfe M.



SZD - 19X Zefir 1

1958

Mass empty 337 kg
In flight 432 kg
Wing area 14 sq m
Aspect ratio 20.6
Wing loading 30.8 kg/sq m

Three views of the Zefir 2, one of the most complex and expensive sailplanes of its time, and a World Championship winner.

Ready for take off with the pilot and parachute in the cockpit, the Zefir 1 had a mass of 432 kg. Various small components, such as the canopy locks and the flap mechanism, failed during early tests and required further work to be done. The pilots found the sailplane difficult to manage during aerotowing because of the attachment so far back on the undercarriage. Forward view on tow and during landing approaches was restricted because of the reclined seat and an imperfect canopy. An airbrake was very much needed. The small vertical tail was not adequate. The hydraulic controls were slow in action and required too much effort by the pilot.

It became clear after these experiences that further work on the SZD - 19X was not worthwhile, although the performance was good. It was decided to concentrate efforts on the SZD - 19 /2, the Zefir 2. Only one of the SZD 19X was built and this was preserved at the SZD factory.

SZD - 19 - 2 Zefir 2A

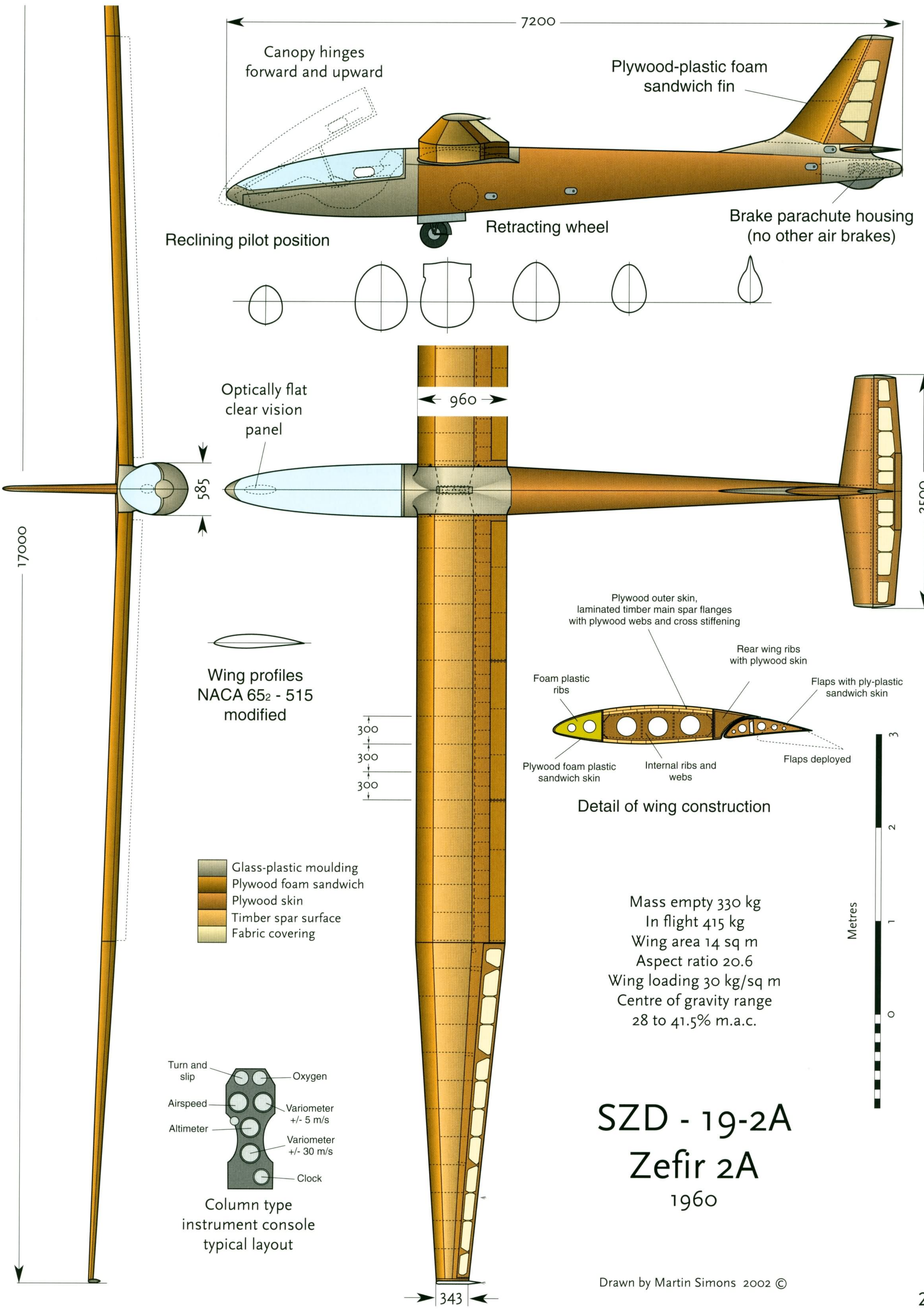
The SZD design team learned a great deal from the problems of the Zefir 1. They began a new design based on the same wing plan form and profiles but changed almost everything else. The composite metal and wood wing construction was abandoned, the fuselage shape completely revised, the hydraulic control drive for the flaps and undercarriage replaced by manual systems. There was a serious effort to reduce the weight. It was decided to use a parachute airbrake. The Zefir 2 was really a new aircraft with the same name.

The wing was constructed in three sections, the main load bearing member being a large box spar with laminated timber upper and lower flanges, with the essential internal crosswise stiffeners and webs. This very elaborate, strong and weighty member, the laminated flanges built in female moulds, occupied more than 40% of the wing chord over the entire centre section. A light nose section with plywood-plastic sandwich skin over accurately cut foam plastic ribs was attached in front. Large Fowler flaps with sandwich skinning and the light, fabric covered, un-slotted, ailerons, were fitted behind, with ribs and skinning to close all gaps. Great care was taken to maintain the wing contours accurately, sanded to templates, filled, painted and polished.

The fuselage was reduced in cross section by reclining the pilot as had been done with the Foka. The control rods were diverted down each side of the fuselage, the pilot almost lying rather than sitting on the inside of the fuselage shell. Glass plastic mouldings were used for the entire nose section and cockpit, the tail cone and other fairings. The rest was a plywood shell of the usual kind. The wheel was retractable with a sealed well and doors closed and locked electrically to prevent unintentional opening in flight with resultant air leakage and drag. The braking parachute was housed in the tail cone. There were no other air brakes. In case of need, the parachute could be jettisoned.

The tail unit was simple with a plywood skinned stabiliser and fabric covered elevator mounted slightly above the rearmost part of the fuselage, below the rudder. The fin, raked back in the latest fashion, was skinned with ply-sandwich material. The rudder was fabric covered.

The Zefir 2A made its first flights in March 1960. Two were completed for entry to the 1960 World Championships, scheduled for early June at Butzweiler near Cologne. Adam Zientek the SZD test pilot, hastened through an abbreviated programme. The cockpit canopy was not satisfactory, distorting the view ahead for landing. An optically flat segment was introduced but the result was never fully satisfactory. The undercarriage also gave trouble, with some belly landings resulting. The brake parachute had an alarming habit of not opening when needed, or breaking away completely when deployed for a


7200
Canopy hinges
forward and upward
Plywood-plastic foam
sandwich fin
Reclining pilot position
Retracting wheel
Brake parachute housing
(no other air brakes)
Optically flat
clear vision
panel
960
585
2500
17000
Plywood outer skin,
laminated timber main spar flanges
with plywood webs and cross stiffening
Rear wing ribs
with plywood skin
Foam plastic
ribs
Flaps with ply-plastic
sandwich skin
Flaps deployed
Plywood foam plastic
sandwich skin
Internal ribs and
webs
Detail of wing construction
Wing profiles
NACA 65₂ - 515
modified
300
300
300
Glass-plastic moulding
Plywood foam sandwich
Plywood skin
Timber spar surface
Fabric covering
Mass empty 330 kg
In flight 415 kg
Wing area 14 sq m
Aspect ratio 20.6
Wing loading 30 kg/sq m
Centre of gravity range
28 to 41.5% m.a.c.
Metres
0
1
2
3
Turn and
slip
Oxygen
Airspeed
Variometer
+/- 5 m/s
Altimeter
Variometer
+/- 30 m/s
Clock
Column type
instrument console
typical layout
SZD - 19-2A
Zefir 2A
1960
343
Drawn by Martin Simons 2002 ©

Above: The HP - 11a. with retractiong wheel, seen in 1964

Left: The HP 12, flown in Standard Class in 1965, was designed and built by Schreder a year later than the HP - 11

landing. A single towhook for aerotowing as well as winch launching was mounted on the undercarriage, retracting with the wheel. This created difficulties. An aerotow hook was fitted in the nose for safety. It was too late for all these faults to be corrected. Zientek was obliged to hand the Zefirs over to Edward Makula and Jerzy Popiel.

At the Championships the Zefirs, like the Fokas, attracted intense interest. The Zefir pilots had learned to work as a pair, exchanging information by radio, which undoubtedly helped them to achieve excellent results. They flew together, scored almost the same as one another and, sometimes, landed out together. Makula won four of the six days, was second on a fifth and 10th on one day. Popiel twice shared first place with Makula, was second to him on two days and third once, but like his partner dropped back to tenth on the one bad day. They finished second and third at the end. The competition was marred by the cancellation of one marginally flyable day because of a highly controversial interpretation of the rules. The contest jury was divided. In the end the day was declared 'no contest' and all points scored were wiped out. The Polish pair believed they would have won the Championship if all scores made on this day had been allowed.

Back in Poland the SZD made further modifications to the design, producing the SZD - 19 - 2A Zefir 2A. The horizontal tail area was increased and the brake parachute was changed to the Kostelezky type, which could, when all worked correctly, be deployed and retracted as required.[47] The undercarriage mechanism was further simplified.

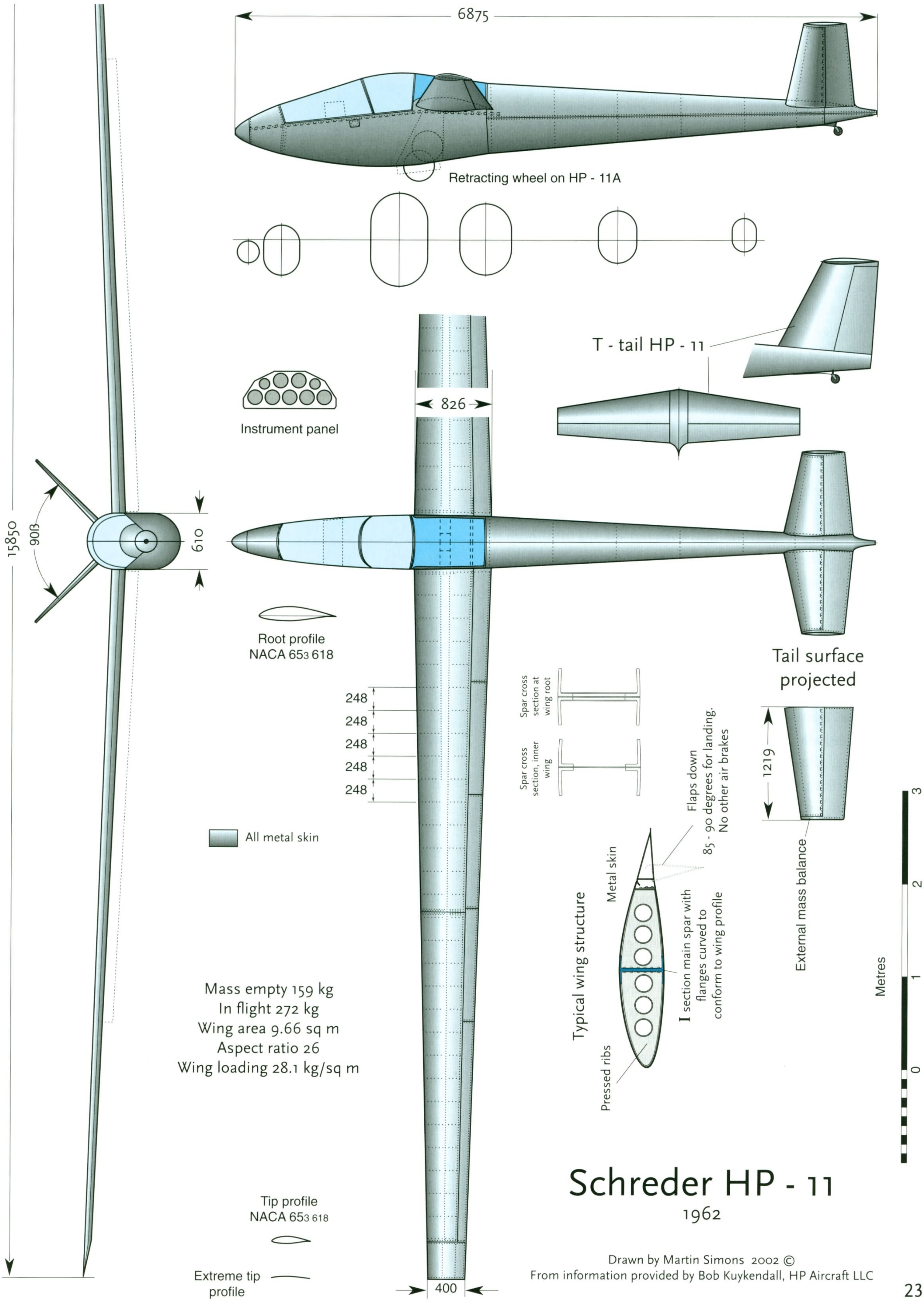
In 1963 at Junin, Makula and Popiel achieved the double win that had narrowly eluded them in 1960. It was noted by one technical observer that, after a few days in the Argentinean sun, the light nose sections of the Zefir wings were beginning to show signs of shrinkage. Twenty two of the Zefir 2A were built, most of them being exported to Argentina, Romania and the USSR.

Schreder HP - 11

Richard Schreder would design and build himself a metal sailplane, fly it, win or nearly win some competitions, perhaps break a record, and start on another project immediately. He seemed to have no difficulty in producing a new sailplane every year. He was not merely an outstanding engineer and constructor but a fine contest pilot. In this last capacity he is remembered for causing a minor diplomatic incident during the 1960 World Championships held at Butzweiler near Cologne. On the third contest day, which was a free-distance task, he reported on the radio that he was over the Baltic Sea at 600 feet. No more was heard until the East German police telephoned. Schreder and his HP - 8 sailplane had landed safely, on what was, at that time, the wrong side of the so-called Iron Curtain. Fortunately he was quickly released and missed no contest days. (Some German pilots on other occasions were not so fortunate.)

The HP - 8 was flown in 1958, a 15.6 metre, V-tailed, all metal sailplane with retracting wheel and a best glide ratio about 37:1. Schreder broke several World Records with it. The HP - 9 was sold before completion, and the HP - 10 flew in 1961. This, in an effort to produce the perfect profile surface, had an ingenious wing with skins of pre-formed light alloy honeycomb panels. These, however, could not easily be made for a tapered wing. The HP - 10 wing therefore had a rectangular plan form. Despite some losses in efficiency because it did not approach the ideal elliptical shape, Schreder won the US Nationals and sold the rights for kits to be marketed.

47 - See further notes under HKS - 1 above.



Schreder HP - 11

1962

Drawn by Martin Simons 2002 ©
From information provided by Bob Kuykendall, HP Aircraft LLC

The SGS 2 - 32, regarded as the 'Cadillac' of Schweizer sailplanes. This was the 1000th sailplane built by the Schweizers. It was capable of carrying three adults.

The HP - 11 flew in 1962. After placing third with it in the US Nationals, Schreder was again selected for the US Team. At the Argentinean World Championships he came third in the Open Class, beaten only by the very expensive and complicated Polish Zefirs.

The wing profiles were from the NACA 65 series, the aspect ratio high at 26, and the wing loading also high though not excessive. The only air brakes were the wing flaps, which could be lowered to 70 degrees. Such flaps are excellent for approach control when landing but they cannot be used as speed limiting brakes. The operating loads for the pilot become too great, and structural failure is possible if they are forced down at high airspeeds.

The fuselage cross section was oval with flat sides, a minimum of double curved panels in the cockpit area, and a simple tail cone with V - tail. A T-tailed version was available although rarely adopted. The cockpit canopy required only one moulding, the rest consisting of simple two-dimensionally curved panels.

The structure of all Schreder's designs was simple and elegant without any sacrifice of aerodynamic efficiency, providing the constructor's workmanship was as good as Schreder's own. The wing main spar was built up from alloy flanges and plate webs, with pressed ribs and alloy sheet skins. The spar flanges were supplied rolled to the aerofoil section curvature. All external riveting was countersunk and flush.

Following his excellent result in the World Championships, Schreder found himself deluged by requests for plans and parts. He could find no established firm to take on the responsibility of manufacture and marketing, so did so himself. (He was diverted from his next project, fitting a small rocket motor to the HP - 11 which, he believed, would be capable of launching the sailplane to 2000 ft in a matter of 70 seconds on a gallon of kerosene. The motor would then be fully retracted. The rocket launched HP 11 apparently never took off.) In the comprehensive notes supplied with the kits, Schreder described simple methods of straightening the spar flanges if they sprang after rolling and tapering, and for bending the skins to fit round the leading edge of the wing.

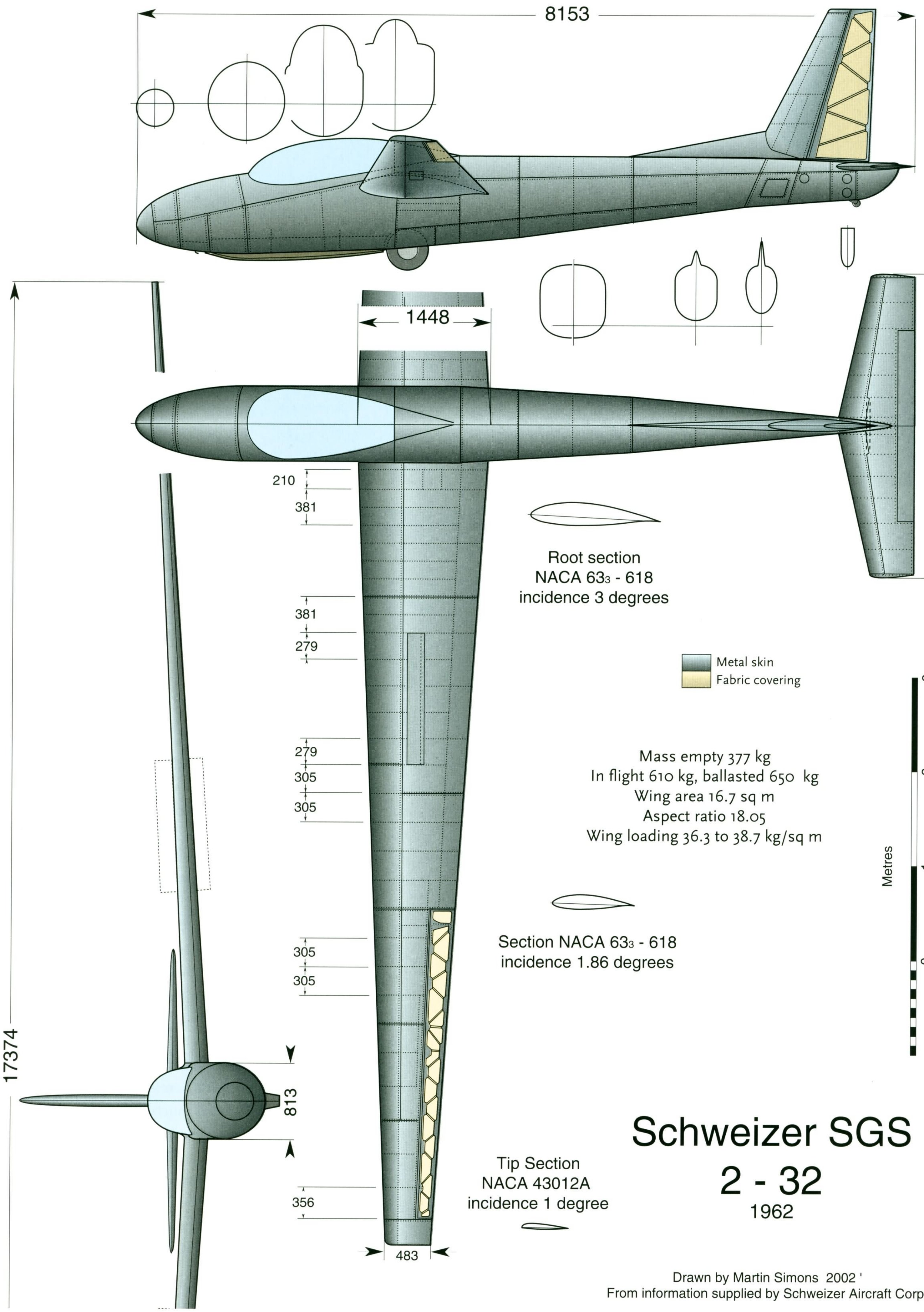
Early in 1964 Schreder reported that thirty two HP 11 or HP 11A (with retracting wheels) were under construction, or already completed, by different persons in the USA. The total reached at least forty and would have been greater except that Schreder soon had other plans on offer. He continued producing new sailplanes, first the Standard Class HP - 12 in which he competed at South Cerney in 1965, placing fifteenth. The HP 18 flew in 1976. Kits for this were produced in large numbers. Nor did Schreder stop at number 18.

Schweizer SGS 2- 32

The Schweizer Company in Elmira, NY, built their first laminar flow wing in 1958, to see if they could produce a low drag surface in metal, using the simple production methods for which they were equipped. The wing of the experimental SGS 1 - 29 was of rectangular plan, using the NACA 63_3 - 618 profile. It was fitted to a standard SGS 1 - 23 fuselage. Comparison flights showed that the 1 - 29 in bare metal finish was superior to the 1 - 23. After doing the requisite filling and painting, Paul Schweizer flew it in the 1959 US Nationals in Kansas. He found he could keep pace with a Ka - 6 in the tasks, making up for losing in the climbs by better glides.

It was decided then to produce a new high performance two-seater. The hope was for sales of 200. Having made the decision, the 2 - 32 came to be regarded as the 'Cadillac' of Schweizer sailplanes. The 17.4 metre (57 ft) wing was straight tapered, using the 63 profile unchanged to the aileron root, tapering thereafter to the 43012A at the tips. The Schweizers had used this (non- laminar) tip profile on several earlier designs, and knew it would behave well at the stall. The fuselage was generously wide, there being enough space in the rear seat for two adult passengers. The allowable flying mass was increased to accept the load. The 2 - 32 might even have been called the 3 - 32 in accordance with the Company's custom of including the number of seats in the nomenclature. The original tailplane, of the all-moving type with anti-balance tabs, was rectangular in plan. The vertical tail was swept back for the sake of a stylish appearance.

The prototype was flown in July 1962. The rudder and tailplane areas were increased afterwards and the tailplane tapered. Production plans were delayed until sufficient interest was shown by likely buyers. The lengthy and costly process of certification under US laws was completed only in June 1964, by which time some limited



Schweizer SGS 2 - 32

1962

Drawn by Martin Simons 2002 '
From information supplied by Schweizer Aircraft Corpn.

At Junin in 1963, The Siren 'Edelweiss' placed second in the Standard Class. On the right is shown the pilot's reclined position in the cockpit

production had already begun. Sales were slow, a total of 87 being built over a ten year period. The target of 200 was never achieved.

The 2 - 32 was widely used for passenger flying to give people an introduction to soaring. To be able to carry two people in the passenger seat was especially useful in this respect. In addition, the 2 - 32 was an excellent and robust sailplane for general soaring and proved itself capable of outstanding flights too. In a 2-32 the English pilot Anne Burns broke the feminine altitude record with a (solo) wave flight to 9,515 metres (31,231 ft) in 1967. Paul Schweizer himself set a US National record speed for the 500 km triangle, which only just missed being a world record. Joe Lincoln broke several US National records and the World Out and Return record with a 651 km flight in 1970. The feminine two seat altitude record was broken with 10,809 metres (35,463 ft) by Helen Nutt and a passenger in 1975.

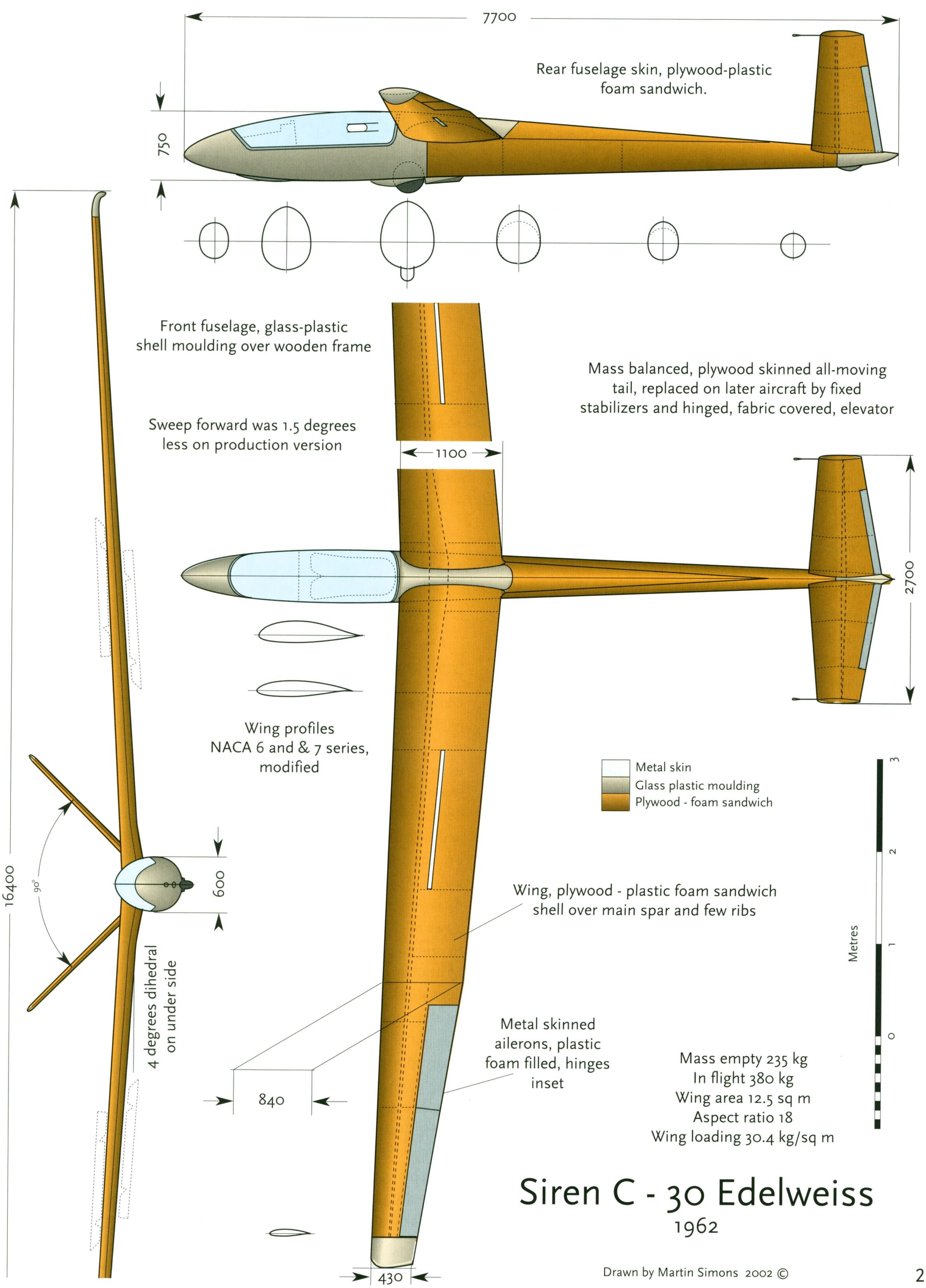
The 2 - 32 sailplane never made a profit for the Schweizers. Some of the components proved valuable in other ways. The wings were used by Lockheeds for a 'quiet' military surveillance aircraft, the Q Star, and later for the YO - 3A. A high altitude drone for LTV Electronics used much of the 2-32 airframe, with a turboprop motor. The tail cone and tail unit were incorporated in the SGM 2 - 37 motor glider, which was adapted for surveillance use as the 2 - 37A. The work that went into the 2 - 32 was commercially worthwhile after all.

Siren C - 30 Edelweiss

The French Aero Club became aware, after the 1960 World Soaring Championships, that French sailplanes were not keeping pace with developments. A new type was needed to compete in the Standard Class. Jean Cayla, who had designed the Br - 901 which twice won the World Championships and the Br - 905 Fauvette, left the Company when Breguet closed the sailplane division. He joined the firm of Siren, producers of components for light aeroplanes, and began working on the C - 30. One of the first decisions was to make the pilot recline even more than in the Polish Foka and Zefir. The fuselage cross-sectional area was thus reduced to the absolute minimum. The benefits would hardly appear at low speeds but the parasitic drag saving would show up in the 'penetration' glides. The pilot in such a position has an excellent view upwards and to the sides, which is very good for circling in company with other sailplanes in thermals. The difficulty arises in landing when the view directly ahead and down below the nose is inevitably very limited.

The front fuselage was moulded in glass reinforced plastic with reinforcing floor boarding running back for some distance behind the cockpit. The rear fuselage cone was a sandwich construction of plywood and 'Klegecel' plastic foam with several cross frames and spruce longerons to improve stiffness. An all-moving V - tail with anti-servo tabs was fitted. External mass balancing was necessary. As required by the Class rules, a wheel was fitted, faired as much as possible, with a very small nose skid in case the tail should come up on landing. The cockpit canopy was a two metres long moulding. The instrument panel with all its necessary plumbing and wiring, was built into the canopy to allow easy access to the cockpit when it was open.

The double tapered wing was swept forward, the leading edge making an angle of 88 degrees with the aircraft centre line. The



Siren C - 30 Edelweiss

1962

Drawn by Martin Simons 2002 ©

skin was a plywood-Klegecel sandwich over a strong main spar with a minimum number of ribs. The tips were moulded in glass-plastic, with a downward bend, chiefly to provide a rubbing contact protecting the ailerons from contact with the ground. The ailerons themselves were skinned in light alloy with plastic foam filling.

The ES 59 'Arrow' represented a major advance in performance for Australian pilots, and was chosen by Jack Iggulden for the World Championships in Argentina, 1963. The Arrow was then sold to the USA and flown there successfully for many years.

A highly unusual feature was the provision for ballast weights up to 65 kg total to be carried inside the leading edge of the wing roots, adjacent to the spar. This might have been challenged under the Standard Class rules but since the ballast could not be jettisoned in flight, it was not forbidden. The pilot could decide on a given day whether or not to carry the extra mass, so might hope to gain a few points more than rivals who had no such choice. Nothing prevented any pilot from packing extra weights in the sailplane if desired. Oxygen cylinders for instance, might be installed on one day and omitted on another. Nobody checked this kind of variation. Providing a pilot did not load the sailplane above its designed and certified maximum permissible mass, it would be accepted. (Weighing the aircraft as they were towed out to the launch point, did not yet seem necessary. It did become so in later years.)

Two Edelweiss prototypes flew in September 1962 and soon afterwards were shipped to Argentina where, in the southern hemisphere summer, the World Championships ran from 11th to 23rd February. Jacki Lacheny and Camille Labar were the pilots. They arrived in time to do some practice flying. In the contest it was soon established that the Edelweiss was fully competitive. Lacheny scored consistently throughout although not winning any single task. He scored well enough to place second of the 38 entrants. Only the redoubtable Heinz Huth was ahead of him in his Ka - 6. Labar also scored well but had one poor scoring day, which pulled his final place down considerably to 17th.

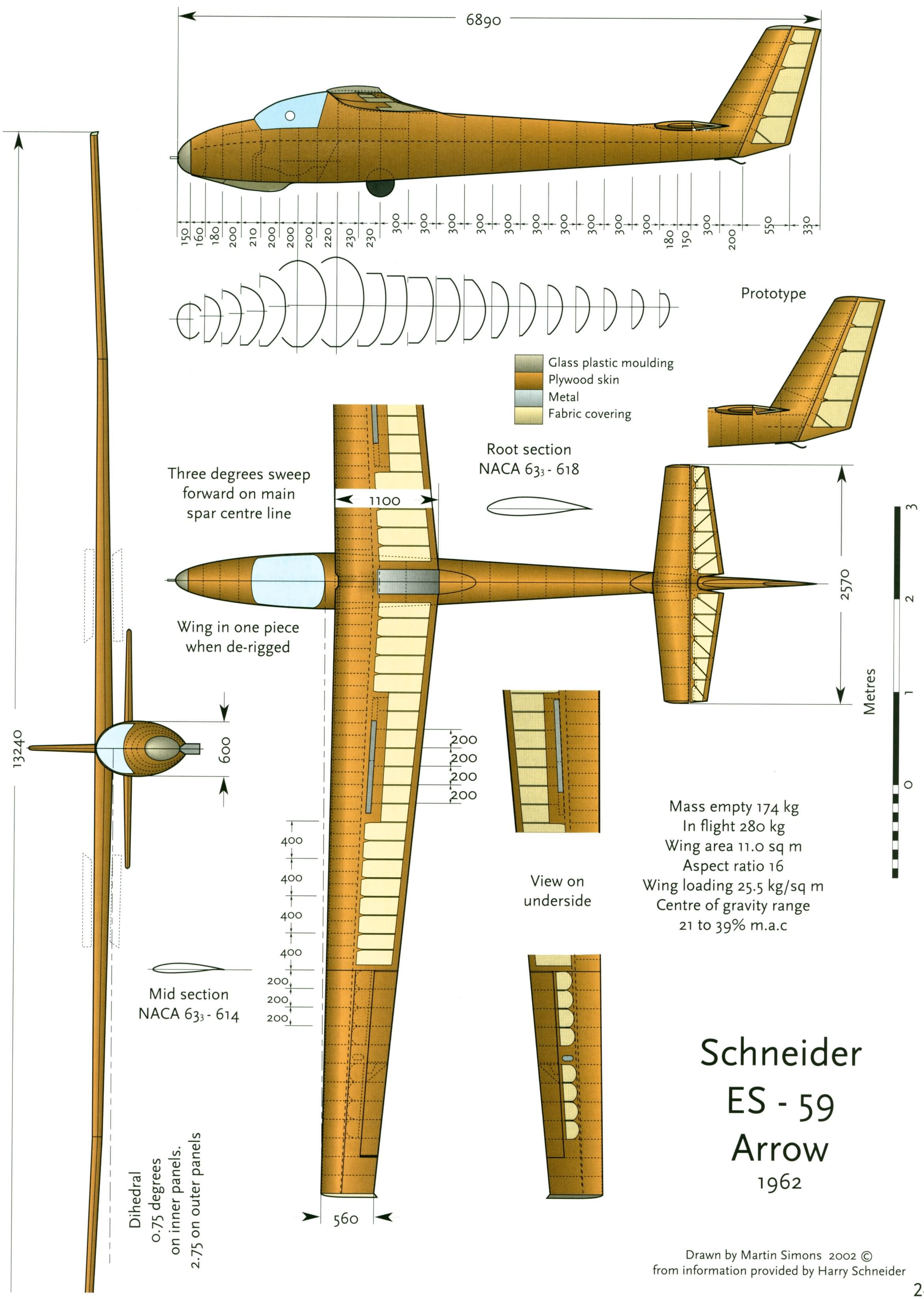
The Siren Company made modifications before beginning production. The wing sweep angle was reduced by 1.5 degrees, the leading edge now swept at a hardly perceptible 0.5 degrees forward. The all moving V - tail unit was replaced by stabilisers with 'ruddervators', the moving surfaces being fabric covered. The external mass balances were no longer required.

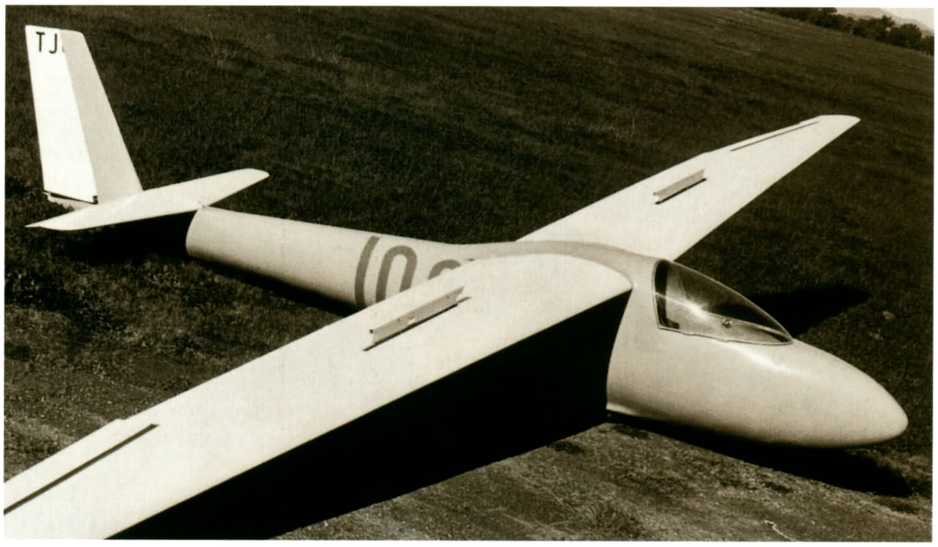
Francois Henry, who had flown a Breguet 901 to 6th place in the Open Class in 1963, won the Standard Class at South Cerney in 1965, with Lacheny 7th, results which justified the effort that had been put into the C - 30. For many pilots, however, the Edelweiss was too extreme and specialised. The performance was undoubtedly excellent but it could hardly be considered truly to belong to the Standard Class. It was never in the running for the OSTIV prize and despite winning the World Championships, it never became very popular outside France. Fifty-three were built. A larger span version, Edelweiss 4, was designed and built but did not go beyond the prototype stage.

Schneider ES - 59 Arrow

Edmund Schneider Senior handed the management of the Company he had founded in Grunau in the nineteen twenties, to his older son, Harry, as he himself approached retirement. Established now in workshops on Parafield Airport north of Adelaide, Harry, with some financial support from the Gliding Federation of Australia, designed the ES - 59 Arrow as a follow-on from the earlier Nymph and Kingfisher. Most Australian clubs were small and not very well off financially, so the sailplane had to be inexpensive but the performance should be as good as possible. The wing, using the NACA 63 series profiles, was slightly swept forward for reasons of balance. To avoid the cost and weight of heavy root end fittings, it was built in one piece. To make this a practical proposition for road journeys by trailer, the span was limited to 13.24 metres (43.4 ft). As had been done with the Schneider Nymph of 1955, the trailer had high level cradles to carry the wing above the roof of the towing car. This was not always satisfactory. Going round a tight corner found the wing tip well out to one side of the car, and it could get damaged by hitting something. The structure was orthodox in wood, with small glass plastic fairings and wing tips.

First flights were early in 1962. The performance was considered very good for the small span. Schneider was in the slightly odd position of competing with himself, building the Ka - 6 under licence while offering the Arrow at a lower price but with a somewhat lower performance.


6890
150 160 180 200 210 200 200 200 220 230 230 300 300 300 300 300 300 300 300 300 300 180 150 300 200 550 330
Prototype
Glass plastic moulding
Plywood skin
Metal
Fabric covering
Root section
NACA 63₃ - 618
Three degrees sweep
forward on main
spar centre line
1100
2570
Wing in one piece
when de-rigged
13240
600
200
200
200
200
400
400
400
400
200
200
200
Mid section
NACA 63₃ - 614
View on
underside
Metres
0
1
2
3
Mass empty 174 kg
In flight 280 kg
Wing area 11.0 sq m
Aspect ratio 16
Wing loading 25.5 kg/sq m
Centre of gravity range
21 to 39% m.a.c
Dihedral
0.75 degrees
on inner panels.
2.75 on outer panels
560
Schneider
ES - 59
Arrow
1962
Drawn by Martin Simons 2002 ©
from information provided by Harry Schneider



Above: The Super Arrow, ES 60B, a slightly downgraded version of the ES 60

Left: The ES 60 'Boomerang' was very successful in Australian conditions and set many national records. It was entered for the OSTIV Standard Class design contest in 1965 but was ruled out by a fractional error in the wing span.

The Arrow was, however, considered superior to the Ka - 6 on the really good, strong soaring days in Australia.

The Gliding Federation decided to send a full team of four pilots to the World Championships in Argentina in 1963. Three of them flew borrowed sailplanes while Jack Iggulden flew the Arrow. Iggulden found the lack of wingspan a considerable handicap. The ES 59 was not a World Championship contender but it was a useful, inexpensive club sailplane.

The Arrow flown by Iggulden was sold to a Californian pilot and continued in use there. In Adelaide, Schneider produced seven more, with various minor improvements, while over the same period he built a dozen of the ES Ka - 6.

The ES 60 Boomerang

For Australian conditions, where both lift and sink are on average stronger, and the air rougher, than in Europe, there was a need for a stronger and faster sailplane than the Ka - 6. Harry Schneider heard of F X Wortmann's new wing profiles and got in touch directly with him. The ordinates and wind tunnel test results, together with Wortmann's recommendations, soon arrived. The ES 60 Boomerang was one of the first sailplanes to employ the new profiles from Stuttgart. The prototype was test flown by Harry Schneider on November 28th 1964.

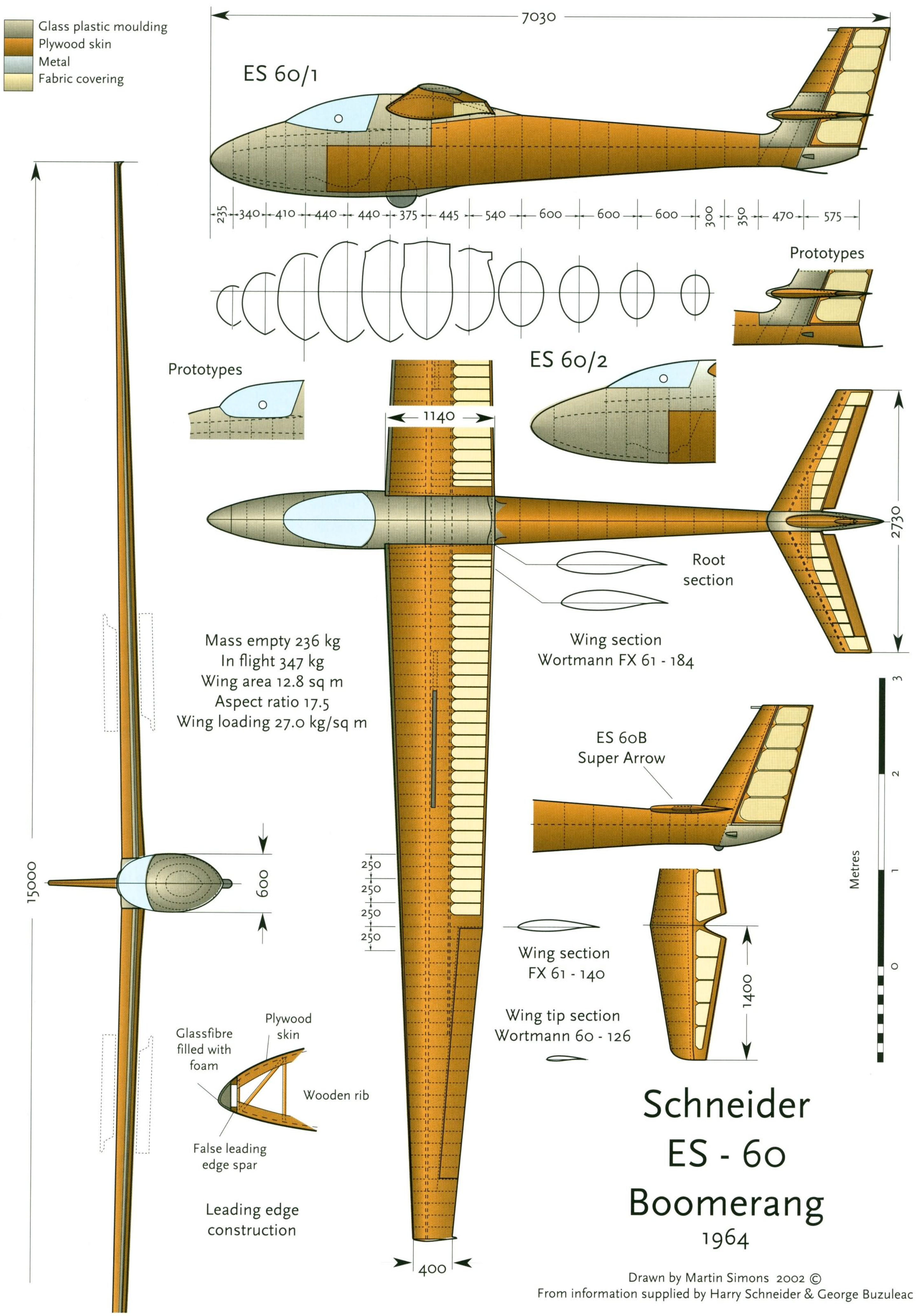
The root wing profile was the FX 61 - 184, 18.4% thick as indicated by the final digits. This was slightly modified over the innermost bays to give greater thickness at the extreme root end, making room for a deeper main spar. The thick profile was progressively reduced to the 14% FX 61 - 140 at the taper break, about 56% of the span. From there the section changed further to the FX 60 - 126 at the tip. Wortmann designed the 60 - 126 profile, more cambered and thinner (12.6%) than the 61 - 140 especially for wing tips. It yielded high maximum lift coefficients with a late stall, reducing the danger of sudden wing dropping without the need for geometric washout. The planform had double taper with almost square tips with a rubbing block of glass-fibre plastic to protect the wing against the gritty surface of most Australian gliding fields.

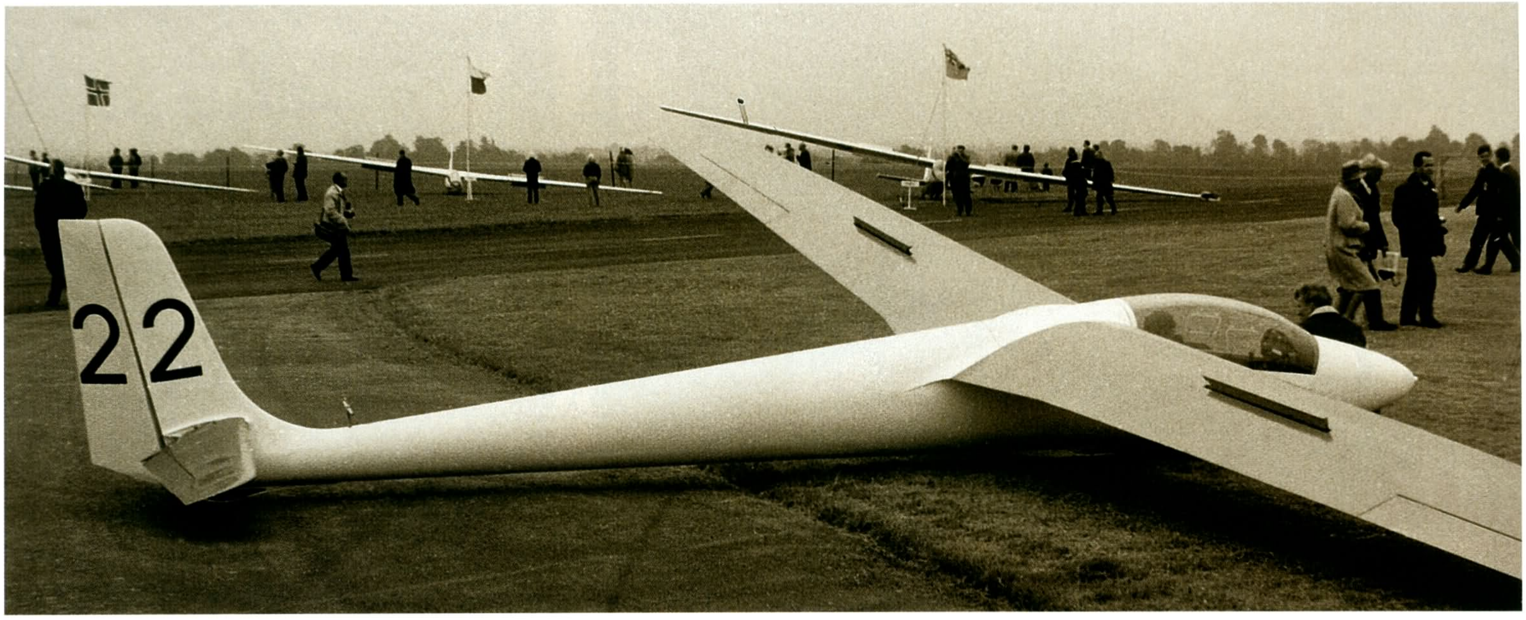
Schneider preferred to use laminated beech for spars, rather then spruce or pine. The laminations were 1.5 mm thick, glued together under pressure. This high strength material, used also in the Schempp-Hirth Austria and SHK, was imported from Germany in bulk. It allowed the spar to be relatively narrow and much less inclined to shrink and crack under the dry and hot conditions of the Australian summer. The ribs, machined to profile, were closely spaced with thick birch plywood skin to the secondary spar. Only the inner rear panels of the wing were fabric covered. The extreme leading edge was a moulded, pre-manufactured fibreglass section, filled with plastic foam, glued and faired to a false leading edge spar member. Large speed limiting dive brakes of the Schempp-Hirth type were fitted. The ailerons were plywood skinned. Taking an idea from the Ka - 6, a simple linkage of the controls caused both ailerons to rise slightly together at extreme rearward positions of the control column, reducing the danger of wing tip stalling at low speeds.

The Boomerang was a very strong aircraft. In rough air, the 'placard' airspeed was 165 km/h (90 kts). Compared with European sailplanes of the time, this was nominally faster by about 10 knots but the strength of the assumed gusts was 20 m/s instead of the lower figures used in Europe.

The fuselage was conventional, a plywood skinned semi monocoque with a moulded glass-fibre nose cone. The cockpit was large enough for a two metre tall pilot with a slightly reclined seat. There was a wheel, conforming to the Standard Class rules.

The fin was swept back, which gave it a slightly longer effective moment arm. The horizontal tail, mounted part way up the fin to


Glass plastic moulding
Plywood skin
Metal
Fabric covering
7030
ES 60/1
235
340
410
440
440
375
445
540
600
600
600
300
350
470
575
Prototypes
Prototypes
ES 60/2
1140
2730
Root section
Wing section
Wortmann FX 61 - 184
Mass empty 236 kg
In flight 347 kg
Wing area 12.8 sq m
Aspect ratio 17.5
Wing loading 27.0 kg/sq m
ES 60B
Super Arrow
15000
600
250
250
250
250
Metres
0
1
2
3
Wing section
FX 61 - 140
Wing tip section
Wortmann 60 - 126
1400
Plywood skin
Glassfibre filled with foam
Wooden rib
False leading edge spar
Leading edge construction
400
Schneider
ES - 60
Boomerang
1964
Drawn by Martin Simons 2002 ©
From information supplied by Harry Schneider & George Buzuleac



Above: The Dart 17 flown by the Canadian pilot, David Webb, at South Cerney in 1965.

Left: The Dart wing under construction.

give ample ground clearance, was of the 'all moving' type and strongly swept back. As with the fin, the sweep was intended to increase the moment arm. On the prototype there was no balance or trim tab. Trimming for holding various airspeeds in flight was by a simple spring.

The Gliding Federation of Australia decided in 1965 to send a team to the World Championships at South Cerney in England. Malcolm Jinks and Bob Rowe flew Boomerangs in the Standard Class. The Australians were not used to European conditions of poor visibility and had not practiced pair flying. Far too often they found themselves alone, scratching low down, with little idea of where they were. Only one of the team had ever flown in the northern hemisphere. One pilot became seriously confused by the fact that the sun was in the south in the middle of the day. Disoriented by 180 degrees, he saw the coast ahead before realising his error. They all finished well down the final results table but learned a great deal.

When it came to the OSTIV design competition, Harry Schneider was chagrined to find that the Boomerang produced for inspection and test flying was a fraction over the stipulated 15 metres wing span. He took a coarse file to the wing tips and the matter was soon righted but the design judges ruled the ES 60 out.

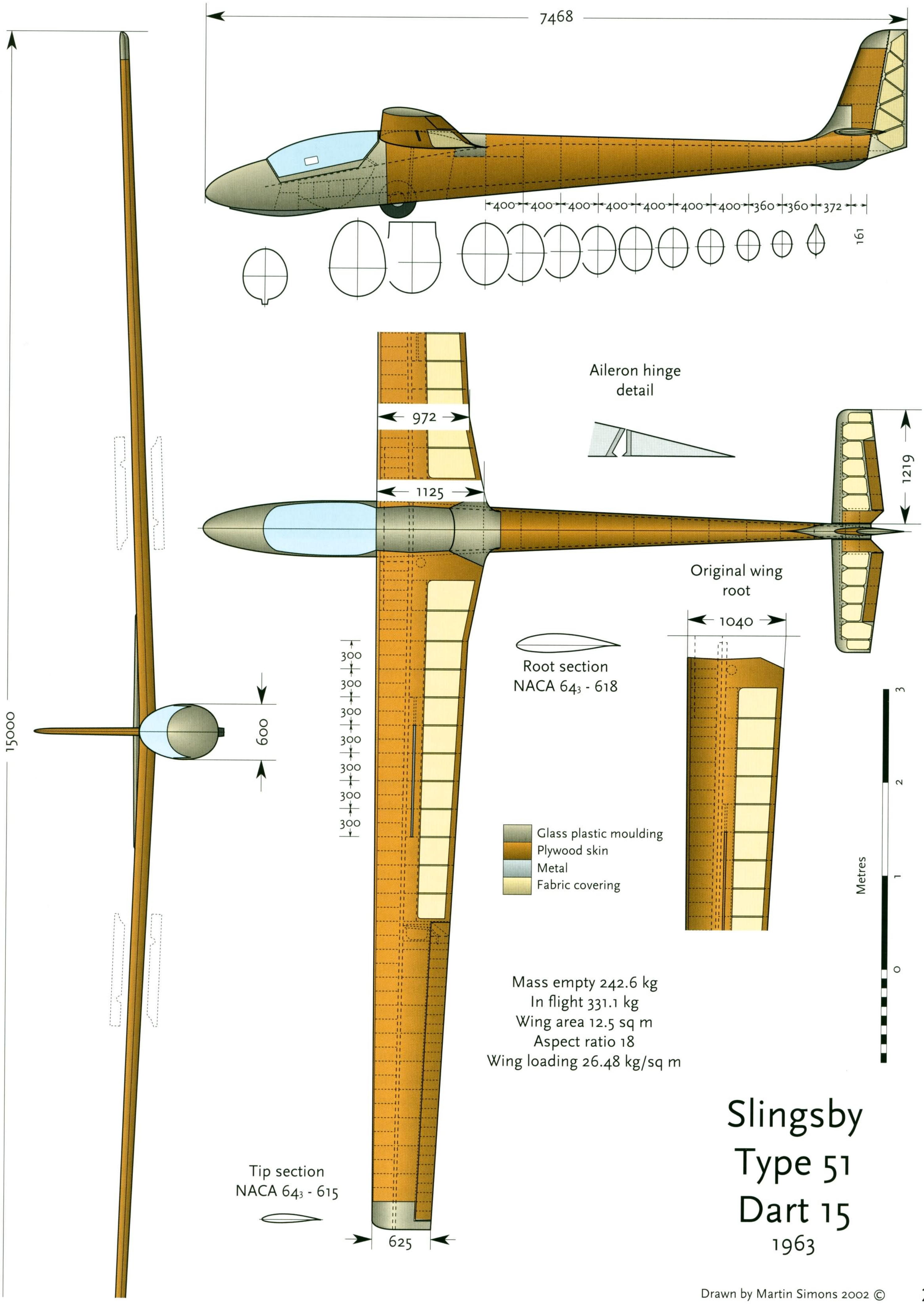
On return to Australia Schneider started production of the ES 60A. Most people did not like the all moving tailplane. An anti-balance tab was introduced. The tail skid was repositioned and the main wheel made to project further from the belly, with a small fairing, to give a better ground angle for take off and landing. The entire nose section was skinned with glass plastic and the cockpit canopy was redesigned. Some further small changes, a slightly lower fin, electrically bonded control surfaces and an improved wheel brake were incorporated. The first batch of half a dozen were completed and sold by November 1965.

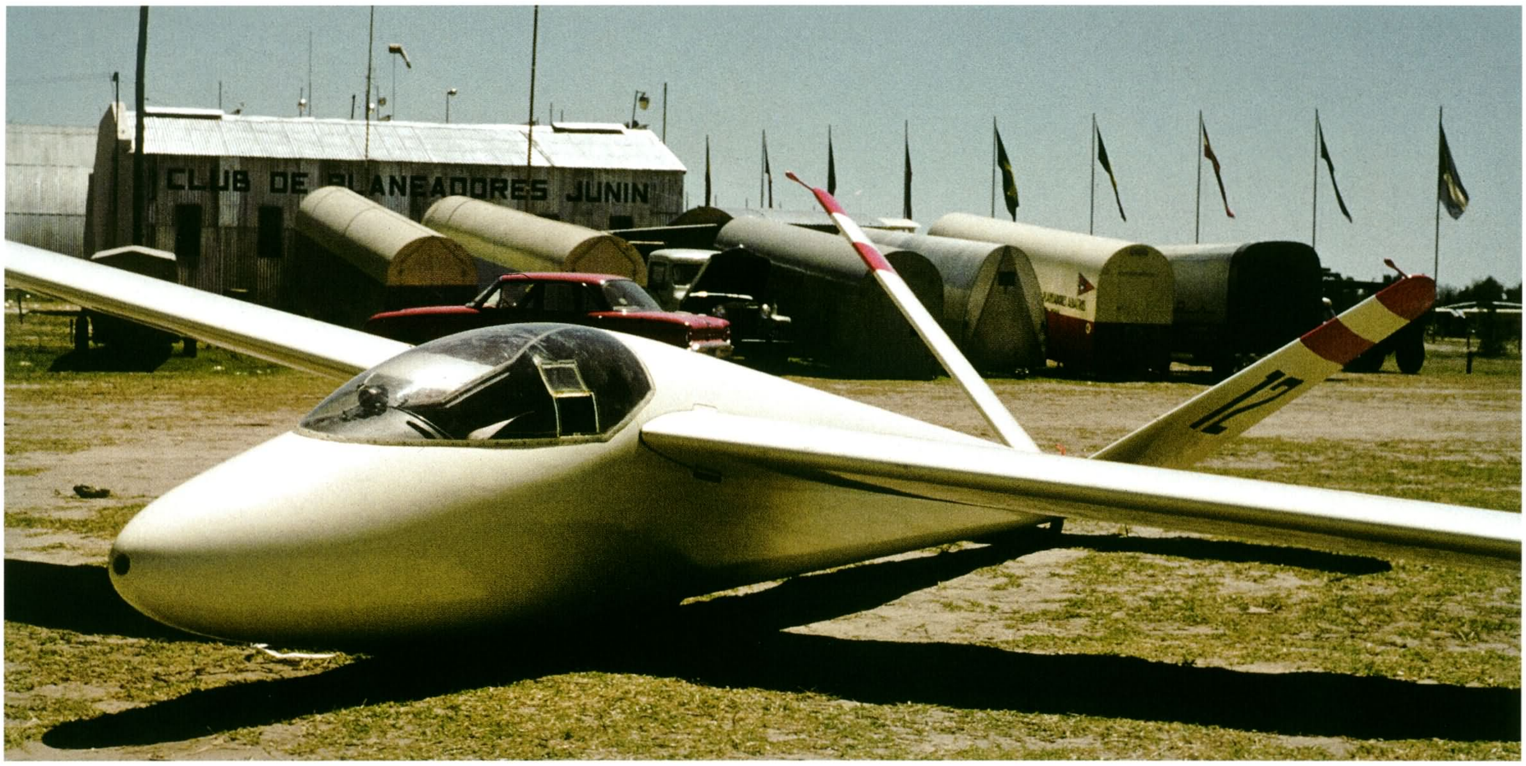
The ES 60 did exceptionally well during the National Championships in 1966 and 67, beating imported 15 metre sailplanes such as the Schempp-Hirth SH 1. Many Australian national records were broken with the ES - 60. The best glide was measured at 30:1. A few more small modifications were introduced and the ES 60 Mark 2 appeared in 1966. A further batch of fifteen was produced, the last in 1968, a total of twenty three including the prototypes. One was exported to the USA, where it remained in service for twenty years or more.

In 1969 Harry Schneider, recognising the need for an early solo sailplane with performance good enough for club and local competitions and badge flights, introduced the ES 60B, called the Super Arrow or, sometimes, Sparrow. This was identical to the Boomerang except that the tail unit was redesigned with a fixed stabiliser and hinged elevator mounted on the fuselage ahead of the raked fin. A wheel replaced the tail skid. The Sparrow was somewhat easier to fly than the Boomerang, with more positive feel to the elevator control and only a slightly poorer performance. Eight were produced before production of the ES 60 ended in 1970.

Slingsby Type 51 Dart

By 1963 the Skylark series had reached the limit of its development. It was time for Slingsby to produce something new. The Company had given little attention to the Standard Class. It was resolved to make a serious attempt to take the OSTIV award in 1965. To determine the main features of the new sailplane, advantage was taken of the latest developments in electronic computing. The well-known pi-


7468
400 400 400 400 400 400 400 360 360 372
161
972
1125
Aileron hinge detail
1219
Original wing root
1040
Root section
NACA 64₃ - 618
15000
600
300 300 300 300 300 300 300
Glass plastic moulding
Plywood skin
Metal
Fabric covering
Metres
0 1 2 3
Mass empty 242.6 kg
In flight 331.1 kg
Wing area 12.5 sq m
Aspect ratio 18
Wing loading 26.48 kg/sq m
Tip section
NACA 64₃ - 615
625
Slingsby
Type 51
Dart 15
1963



lot and writer on the statistical aspects of soaring, Anthony Edwards of Cambridge University, devised a program and the results were passed to Slingsby's designers. Wind tunnel tests were carried out under the supervision of Frank Irving at Imperial College in London. After this the detailed engineering and construction began.

The new wing reverted to the two piece layout, slightly swept forward. The aspect ratio was high but the taper ratio, 0.6, was much more conservative than many contemporary sailplanes, the wing much closer to a rectangular plan than usual. The NACA 64 series profiles were designed for 40% laminar flow. The Dart root section was 20% thick, tapering rapidly to 18% and thence linearly to 15% at the tips. The use of Gaboon plywood, which had proved quite successful on the Skylarks, was abandoned now in favour of birch, but thicker than necessary for the stresses expected. It was thought that this, with standard rib spacing, would retain its form sufficiently to prevent disturbance to the boundary layer. As was becoming normal practice, the plywood was not bent round the nose radius but glued to a false leading edge, with a machined and spindled spruce member for the actual wing nose. A substantial spruce main spar was required, placed far enough back in the wing to avoid making a hump or wave in the skin forward of the 40% chord point.

The fuselage was of oval cross section with the wing mounted high. The front portion and other fairings were glass-plastic mouldings. By running the control rods and cables along the sides instead of under the seat, the vertical height was much reduced, as with the Foka. The seat was reclined but at a much more moderate angle than sailplanes such as the Edelweiss. The undercarriage was a large wheel with a small forward skid. The fin was raked back for the sake of appearance. The tailplane was all moving with anti-balance tabs. For the first time, Slingsbys used glass-fibre reinforced plastic for a stress bearing component. The tailplane leading edge ahead of the spar was skinned with GRP.

The prototype was flying before the end of 1963 and aroused much interest among likely buyers. The sailplane was pleasant to fly, good looking, and handled very well. Production plans were made with early deliveries expected by March 1964. The prototype was, however, a good deal heavier than expected. Despite themselves, the designers had produced a sailplane with a wing loading approaching that of some of the so-called 'lead sleds', excellent in Texas or Argentina but not so successful in Britain and Europe. The computer work done in the beginning depended on various assumptions about the mass, which had not been justified. Apart from this, the performance at low airspeeds, for soaring, was less than hoped. The cause was traced to flow separation at the wing root.

The main spar was re-designed, 20 kg lighter, with light alloy reinforcements bonded to veneers, a system first used for the Yugoslavian Orao of 1948 and adopted more recently also for the Elliott Olympia 460 series. The wing root was modified by reversing the taper of the innermost three rib bays. This smoothed the flow and also added a little wing area, although at the cost of some further departure from the ideal elliptical plan. It also allowed the root profile to be nominally thinner, 18 instead of 20%, without increasing the actual depth of the wing.

At the 1965 World Championships at South Cerney, Gloucestershire, the Dart 15 was awarded the OSTIV prize, which was highly pleasing to the Slingsby Company. That this was also a very good competition sailplane in its class was shown by George Burton's fourth position in the final results, among a galaxy of Edelweiss',

Left: The Standard Austria entered by the Austrian team at the World Championships, Junin, Argentina, 1963. Harro Wodl placed fifth and Johann Fritz (in No. 12 shown here) eighth in the class.
© Royal Air Force Museum Hedon, Charles E Brown
Above: A St Austria flying over England
Right: In Australia the SH - 1 broke several national Records.

Fokas and Std Elfes, but with a Ka - 6 CR flown by the American Wally Scott close behind. It seemed that the right sort of compromise had been struck after all.

Nevertheless, it was decided to offer the Dart as an Open Class sailplane. The span was extended and Nick Goodhart flew the Dart 17 at South Cerney to 7th place. Subsequently the wheel was made retractable, and, with this, the wing incidence could safely be reduced by five degrees for better alignment of the fuselage with the airflow at high speeds. The Dart 15 and the 17R remained in production until 1967, by which time thirty of the Standard Class version had been built, four from kits assembled in New Zealand. Forty-four of the Dart 17R were built, two of these in New Zealand.

Standard Austria

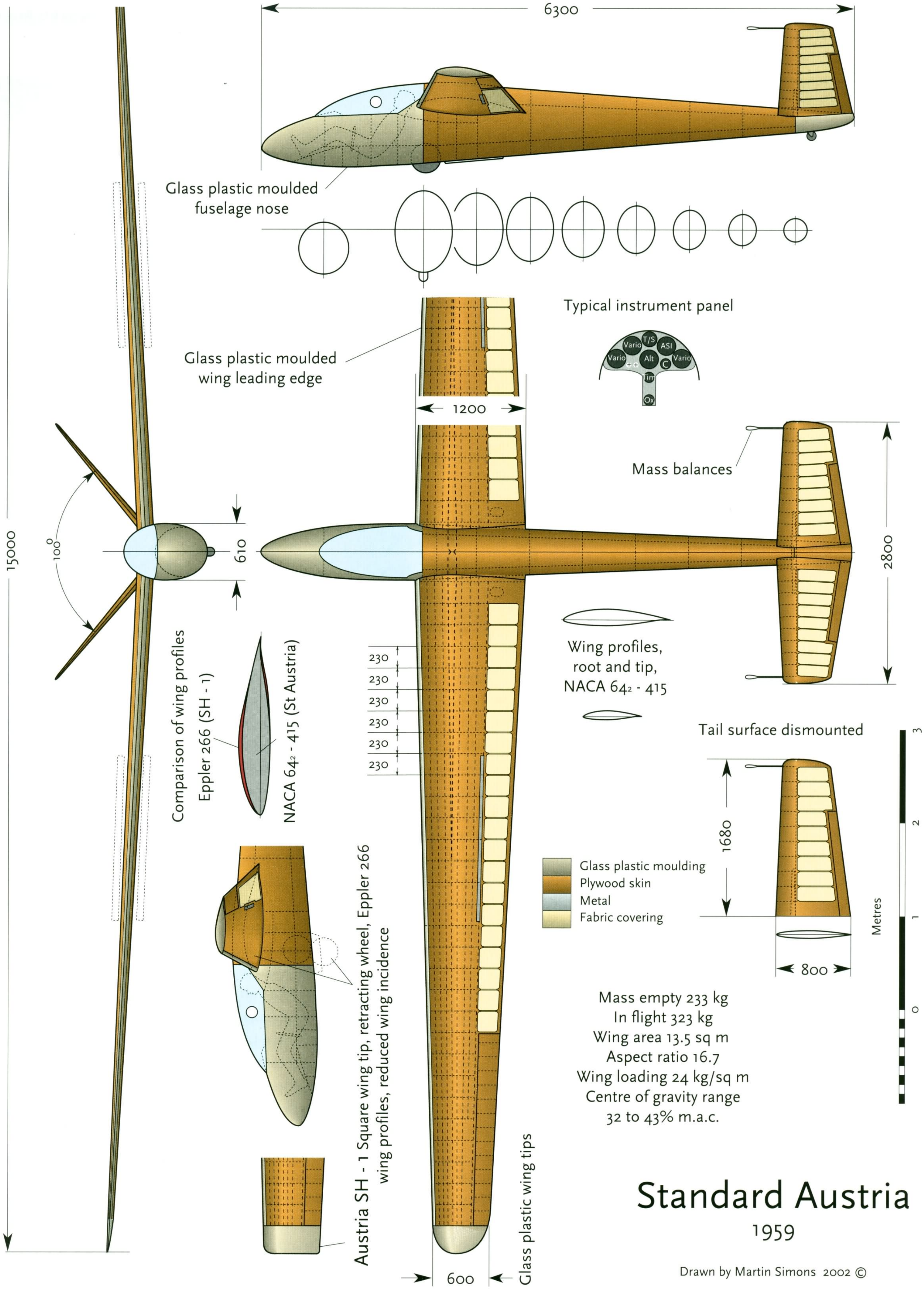
The Standard Austria was one of the most important sailplanes of its period, not so much for its contest record (which was very good) but because it demonstrated what wooden structures for sailplanes could achieve in accuracy and stability for a laminar flow profile. It also led directly to the development of the SHK sailplane which was for a some years recognised as the best wooden 'production' sailplane anyone could buy.

The original design of the Austria was carried out by Rudiger Kunz at the request of the Austrian Aero Club. Kunz recognised the limitations of the traditional type of wooden structure with numerous ribs and a single main spar. Plywood skins were usually laid section by section with scarfed joint made one at a time, panel by panel. Invariably there were waves and ripples in the skin, becoming more prominent as the wood and glues shrank over time. For the Austria Kunz developed a new type of structure.

The wing profile was designed for 40% laminar flow at 0.4 coefficient of lift. The main spar, laminated from 0.5 mm beech veneers rather than spruce or pine, was tapered rapidly to zero 2.4 metres from the root. Wing ribs were cut accurately in metal jigs from 3 mm five-plywood, with numerous lightening holes. These were assembled on a large, rigid metal jig. Eighteen stringers, nine on each wing surface, notched into the ribs, ran from root to tip, correctly trimmed, aligned and checked with templates.

The plywood skins of 2.5 mm plywood were scarfed together in one piece to cover a whole wing surface. They were coated on both sides with epoxy resin and, on the outer side, a layer of glass cloth, to seal the wood against changes of moisture content. The complete plywood skin was then laid on the wing and glued. Air brakes and controls were built into the wing before the second skin was laid. Only after the glue had hardened was the metal jig withdrawn. This produced an excellent, strong and stiff wing, which stood up well for years to changes of humidity and temperature.

The fuselage was of oval cross section, the rear part being a 2.5 mm plywood cone over cross frames. The front end of the fuselage was a glass-plastic shell laid up in a female mould. To conform to Standard Class rules, a single wheel was provided ahead of the centre of gravity with no front skid. The seating position was moderate-

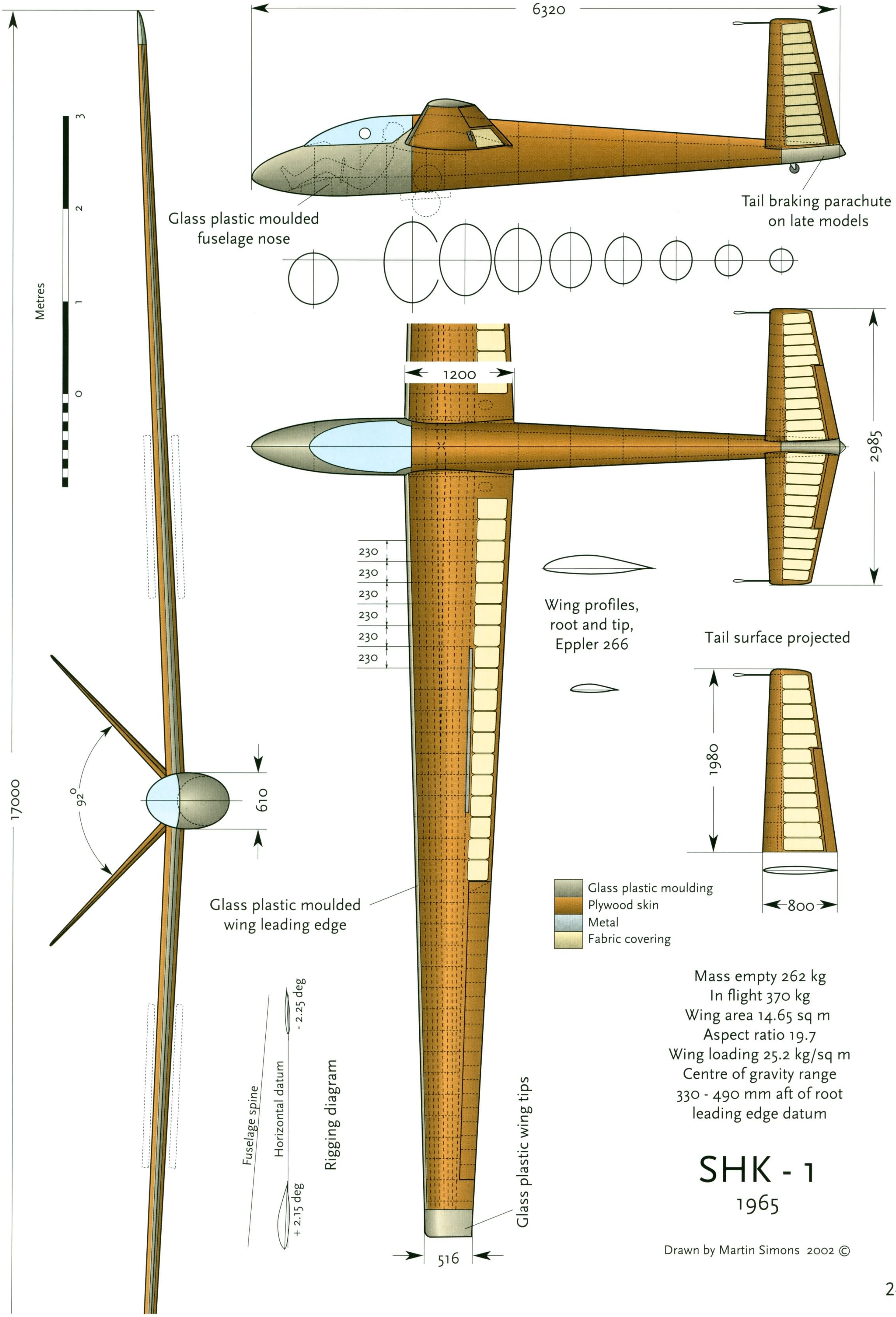


Mass empty 233 kg
In flight 323 kg
Wing area 13.5 sq m
Aspect ratio 16.7
Wing loading 24 kg/sq m
Centre of gravity range
32 to 43% m.a.c.

Standard Austria

1959

Drawn by Martin Simons 2002 ©



Mass empty 262 kg
In flight 370 kg
Wing area 14.65 sq m
Aspect ratio 19.7
Wing loading 25.2 kg/sq m
Centre of gravity range
330 - 490 mm aft of root
leading edge datum

SHK - 1

1965

ly reclined, with a blown transparent canopy. The general form of the fuselage was reminiscent of the HKS - 3 and the cockpit was roomy enough for large pilots. Rudder pedals and headrest were adjustable in flight. The all-moving fabric-covered V - tail on the prototype was swept back, but this was changed on all subsequent aircraft to an un-swept layout. There were anti-balance tabs to provide some feel on the control column. The tail cone was glass-plastic, easily removed for inspection of the ingenious V - tail controls.

The prototype was built in the workshops of the Austrian Aero Club in Vienna. First flight was in July 1959.

At the 1960 World Championships the prototype Standard Austria won the OSTIV Design prize. Fourteen were built in Vienna, mostly for Austrian buyers but one went to Switzerland and one to South Africa. The Aero Club realised that they did not have the capacity for large scale production and made an agreement with the Schempp-Hirth Company at Göppingen in Germany for the Austria to be built there under licence.

Production of the Austria S (S for Schempp) began in 1962 and thirty were built, almost all for the export market. With her Austria, Ann Burns set the Feminine World Record of 103 km/h for the 500 km triangle in 1963. In the USA Ben Greene broke the World Goal flight record with 733 km in 1963, but held it for only three weeks. (Al Parker set the new figure at 788 km with his Sisu.)

Production was then moved to the Schempp-Hirth works at Kirchheim. For the Austria SH series a new wing profile, the E 266 designed by Richard Eppler[48] was adopted.

A criticism of the Standard Austria was that the fuselage belly was close to the ground and liable to damage on rough surfaces. After five of the Standard Class SH were completed in 1964, a new version, the Austria SH - 1, was introduced. This had a retracting wheel, which took it out of the Standard Class. With the wheel up there was less drag and with the wheel down the belly was further off the ground. There was an additional gain. With the sailplane in a more nose up attitude on the ground, the wing incidence could be reduced to align the fuselage better with the airflow at high speeds.

Thirty two of the SH - 1 were completed before production ceased in 1965. Most went for export, one finding its way to Australia where it broke the National Distance Record in 1967 with a flight of 736 km by Stuart Cox.

Schempp - Hirth SHK - 1

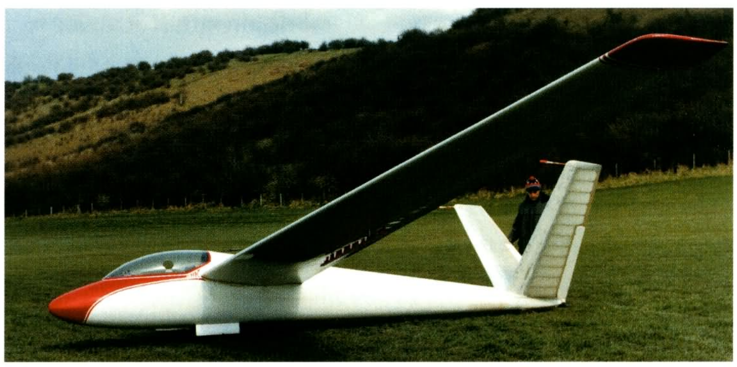
In 1964 the Standard Austria S and the SH - 1 were in production at Schempp-Hirth. After Wolf Hirth's death in 1959 Martin Schempp, the survivor of the partnership that had been formed in 1935, was head of the Company. Knowing that the success of the Austria could not continue indefinitely he looked for a designer who could improve it and give it a new lease of life. The person he found was Klaus Holighaus, the junior of the four members of Akaflieg Darmstadt who had developed the outstanding Darmstadt D - 36 glass-fibre reinforced plastic sailplane. This had recently made its first flights. Holighaus took on the task of upgrading the SH - 1.

48 - See the notes under Uribel, above

The span was increased to 17 metres, the ailerons enlarged in proportion. The Eppler wing profile was used with the same methods of wing construction. The accuracy of the surface and finish was of the same high standard as the Austria. This was held to be as good as a wooden structure was likely to achieve. To prove the general concept, in the first instance an ordinary SH - 1 was taken out of the production line at Kirchheim and fitted with the new, longer wings. The fuselage, cockpit, undercarriage and general structure remained the same. The tail unit was enlarged. Early flights went well but at the rearmost centre of gravity location, Holighaus, flying from the airfield at Hahnweide, entered a spin and could not recover. He announced by radio his intention to bail out and prepared to do so, jettisoning the canopy. Fortunately, when he was half out of the cockpit the aircraft came out of the spin by itself and he was able to land safely. Martin Schempp later found the canopy among the trees not far from the edge of the aerodrome.

With a new, much enlarged tail unit, the surfaces set at 92 degrees instead of 100 as on the Austria, a longer fuselage and improved cockpit, the SHK gave no further trouble. It quickly established itself as outstanding for cross-country and competition flying. The best glide ratio was about 38 : 1 It was probably the best wooden sailplane available in its time and certainly the best available from regular factory production. Rolf Kuntz took third place in the Open Class at South Cerney in 1965 and there were many other contest successes. But by 1968 the writing appeared rather clearly on the wall. The World Championships that year were at Lezsno in Poland. George Burton, the leading British pilot, had chosen to fly an SHK in preference to a Slingsby Dart or the Slingsby - built HP - 14C. He placed 7th. Every one of the six sailplane above him on the final list, was built from glass-fibre-reinforced plastic.

The SHK remained in production from May 1965 till December 1968. Fifty-nine were built altogether. Schempp-Hirth, and Klaus Holighaus, were moving on.



Above: SHK at Sky Sailing Airport in the USA.
Below: The SHK, an impressive, large and very successful development of the Standard Austria, seen here at Dunstable.

PART 3
Glass ships

New materials

As shown in the preceding part of this book, extraordinary ingenuity was applied to the use of traditional materials, wood and light metal alloys, to achieve a good enough surface on wings to take advantage of laminar flow wing profiles. Almost every conceivable technique was used at some time. These had varying degrees of success. Some techniques were apparently simple, relatively inexpensive and effective, as was the case with Slingsby's Skylarks, the Kaiser Ka - 6 and the Schreder HP series. Others were complicated, difficult in production, sometimes overly heavy and very costly.

The aerodynamicists continued to work, devising newer profiles requiring ever more accuracy. It became more and more important for the wings to keep their perfect form under the wide variety of conditions met by a sailplane in normal operations. A wing that was nearly perfect when the sailplane left the finishing shop, would often look very different after a season in service. It might have been baked in hot sun and wind, covered in dust, soaked by rain, frozen, heated and cooled again, several times in a single day. It would be flexed up and down and twisted many times during every flight. This would go on in succeeding days, weeks and months.

If the wing itself was nearly perfect, the rest of the sailplane should be brought to the same standard. A fuselage and tail unit considered adequate for a wood and fabric aircraft, if attached to a very good wing contributes a greater proportion of the total drag. Perfection of shape and surface were required throughout. Skids, wheels, leaking airbrakes, small gaps at control hinges, cockpit canopies that did not fit perfectly or had clumsy hinges, projecting pitot tubes and mass balance weights, control horns sticking out into the airflow, everything required attention.

The need for a new material and a new way of building sailplanes, became more and more pressing. Foamed plastics of various types were introduced as the filling for a sandwich skin, or sometimes to fill an entire wing nose as with the Perl Penetrator. The idea of making sailplanes entirely from plastics had occurred to many people before any one attempted actually to do it. The English sailplane designer, Roy Scott, wrote a five part series of articles in the magazine, Sailplane and Glider, in 1944. As he pointed out, plastics were already in use at that time for some small components. Fabric and wood veneers were commonly impregnated with phenolic resins. Light shells could be made from wood veneers soaked in glue and pressed into female moulds. Scott mentioned several likely cold- and thermo-setting plastics, discussed how these might be made structurally useful by various reinforcing materials, including paper, wood and fabric fibres. He outlined some possible moulding techniques.

In England after the two-seater design competition of 1947 had been won by the Kendal K - 1, a trial wing was moulded. The material chosen was an asbestos fibre reinforced resin, which proved to deteriorate over time. The project was abandoned.[49]

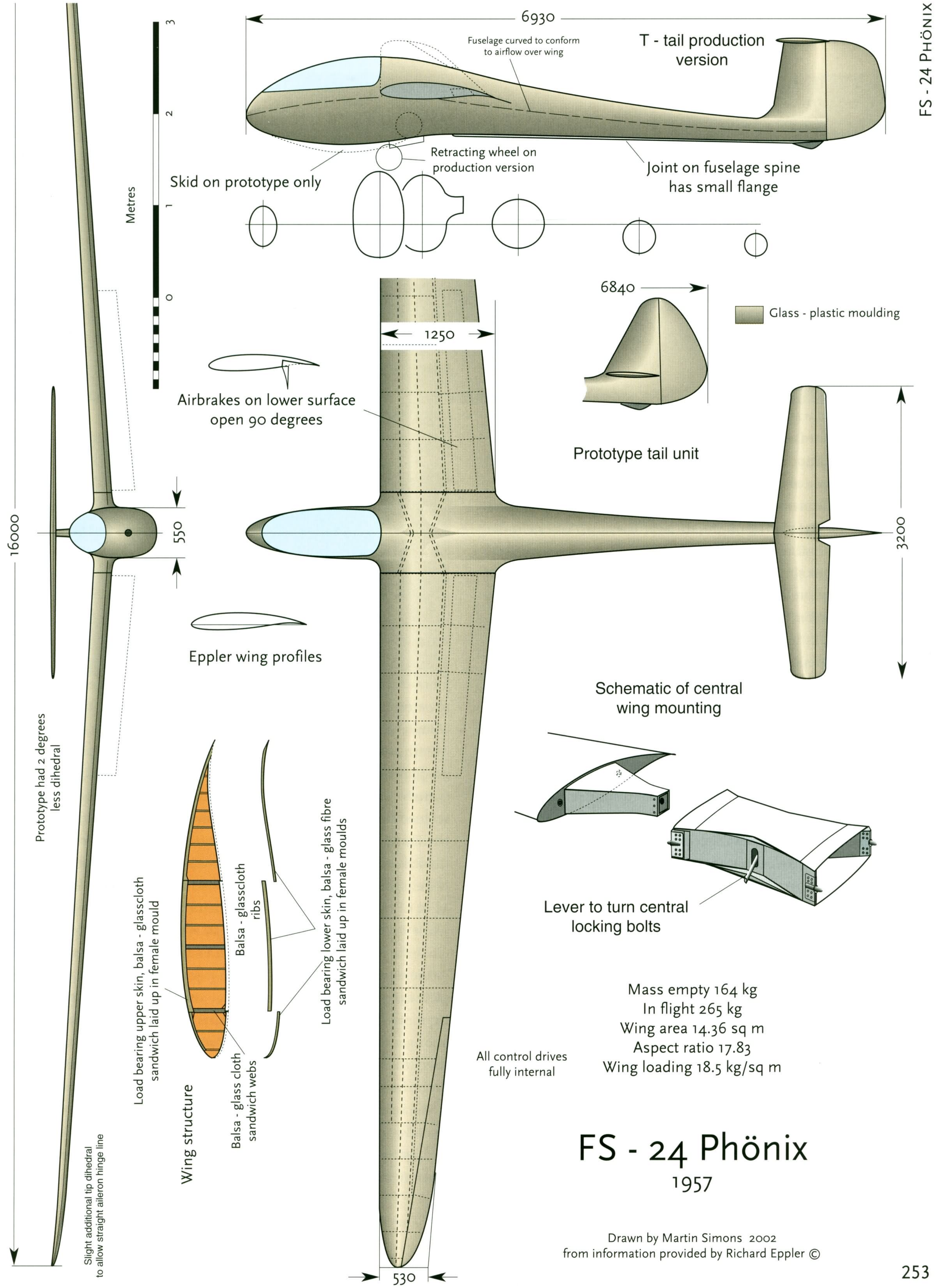
In the early 'fifties, glass-fibre incorporated into polyester resins came into widespread use in the automobile industry and elsewhere. Sailplane designers were quick to see the advantages of this material for many, three-dimensionally curved, components such as nose cones, fairings, wing tips, seats, etc. Sailplanes such as the Slingsby Skylark 2 and the SZD Jaskolka incorporated quite large mouldings. Within a few years these became normal items. The orientation of the reinforcing fibres was often random, the fibrous reinforcement being felt-like mats of chopped, short strands of glass. Woven cloth could be used where it was necessary to give greater strength to the finished product. Glass rovings were rarely used except sometimes to add local stiffness round the edges of a product.

As a rule, the glass-reinforced polyester parts were not treated as load bearing structures. They were often required to resist varying air pressures and had to be firmly fixed in place, but were not used for the main strength components such as spars and stressed skins. In 1957, this changed.

New problems

The adoption of Glass-reinforced plastic (GRP) structures brought its own difficulties. Much had to be learned. The material was very strong in tension and compression but it was highly elastic. Most of the early GRP prototype sailplanes, and even some that went into production, suffered from flutter. Fortunately this was rarely of catastrophic nature. Glancing briefly some years ahead, the Akaflieg Braunschweig carried out a careful study of wing-aileron flutter on their 22 metre span SB - 9 sailplane and published the results in

49 - See further notes under 'Short Nimbus' and 'Harbinger' in Part 1 above.



FS - 24 Phönix

1957

Drawn by Martin Simons 2002
from information provided by Richard Eppler ©

1972. These included spectacular film of the wing fluttering in two distinct modes, depending on the airspeed.[50]

Under certain conditions, such as flying at sub-stratospheric heights in very cold air, and icing, damage to the wing skins was possible. Balsa was not the best material for the filling of sandwich skins. It would shrink enough for the edges of the planks to become faintly visible on the outer surface of the wing. Moisture could get into it. New plastic foam fillings were introduced before long.

Above: The Phönix prototype in 1957, a rare photograph supplied by Richard Eppler

Left: The Phönix cockpit.

Right: The T - tail Phönix

Below: A very early stage in construction of the fuselage shells, shown here by Herman Nägele

New techniques had to be devised for repairs. Temperature and humidity control was necessary for some of the resins to cure properly, which meant that ordinary gliding club workshops had to be heated, air conditioned or even abandoned. Some workers in the factories developed allergic reactions to epoxy resins.

Longer term, some of the gel coats used in the moulding process deteriorated slowly, crazing on the surface. The small cracks in the gel coat could grow inwards and might eventually damage the glass-fibres. Sometimes the crazing would become apparent under the paint of registration letters or numbers. Stripping and refinishing was necessary. Different gel coats were adopted after this.

To begin with, little or nothing was known about the fatigue characteristics of GRP epoxy resin structures. For the time being, German authorities placed a fatigue life limit of 3000 hours on all non-wooden sailplanes.[51] Research was eventually done on complete wings and other components, showing that this limit could be safely extended. Indeed, when failures occurred, it was usually metal parts that began to crack, not the glass. Australia, where flying hours tended to run ahead of the rest of the world, played an important role in these studies. Results from extended tests at the Royal Melbourne Institute of Technology were published by OSTIV in 1991.[52]

In the early 'sixties, all this was far in the future.

FS - 24 Phönix

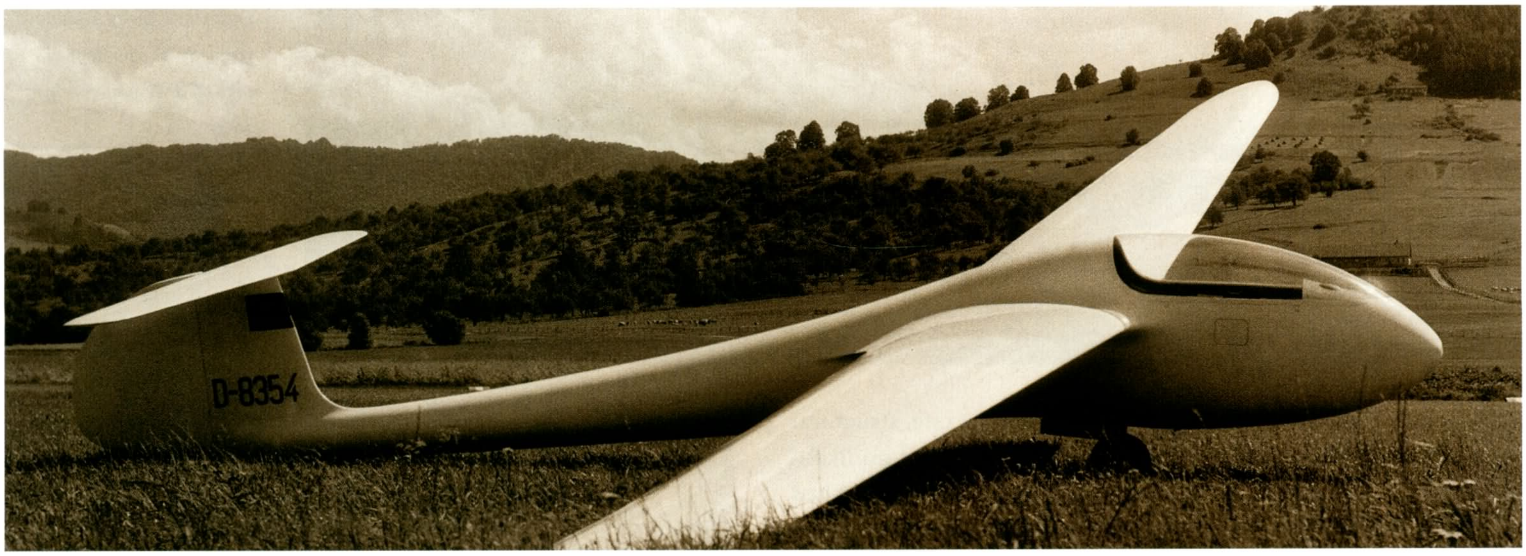
Hermann Nägele was 29 years old and Richard Eppler 30 when in 1954 they approached the German government in search of a financial help with a new sailplane project. Both were aeromodellers, Nägele having published several model plans and Eppler held, since 1940, the record 13 m 33 sec for duration of a tailless indoor model. Nagele had built a full scale light aeroplane and flown it, illegally and secretly, during the post-war period. Now aviation in Germany was freed from the restrictions. His idea was to construct a new sailplane by laying skins of paper impregnated with glue over balsa wood. Needing help with aerodynamics he approached Eppler with this suggestion in 1951. They did some preliminary studies. Nägele was working full time as a civil engineer and Eppler, while tutoring at Stuttgart Technical University, was also working for his PhD in mathematical aerodynamics. Neither of the young men could give the necessary time or money to carry their ambitious project to completion unless they found financial support.

Both were alumni of Stuttgart Tech, but since they had already graduated they were not strictly members of the Akaflieg Stuttgart (which was for undergraduate students). However, their plans seemed promising and a special 'Industrial Development' (Industrie Entwicklung) division of the Akaflieg was set up for them. This made it easier for some limited government funds to be granted. Nägele gave up his job to devote all his time to the FS - 24, Phönix. Most of the general design and construction was his responsibility while Eppler carried out the necessary stress calculations. He applied the results of his PhD research to develop the aerofoil section.

The idea of using GRP with balsa wood sandwich skins for a complete sailplane was born after Eppler attended a conference on plastic materials in Stuttgart. GRP skins would be both lighter and stronger than paper. They made many specimen pieces and tested them in the University laboratories. Nägele too became convinced of the benefits. The sailplane design was completely changed.

The actual work of construction was done initially in a workshop rented at reduced rates from Wolf Hirth, who allowed two of his craftsmen to help. Hirth was hoping to produce the new sailplane when it had been proved. The two pioneers had no examples to copy, no-one else had more experience of GRP aircraft structures than they did. They had to think and re-think every step as they progressed.

50 - OSTIV Publication XII, Congress at Vrsac, 1972. See also Technical Soaring, Vol XVIII, No 3, pp 69 - 72 and references cited there.
51 - This included metal sailplanes.
52 - Technical Soaring, Vol 15, No. 4, October 1991.



Nägele began. It was necessary to construct large and highly accurate female moulds for the wings, which were to be built from the outside inwards. Separate moulds were needed for the upper and lower skins. A separating agent was first required to prevent the resins sticking the finished product to the forms. The outer layers of glasscloth, impregnated with polyester resin,[53] was to be laid in the mould, followed by the balsa wood and then the inner glasscloth skin. Internal ribs, webs and stiffeners were added to the upper wing skins, still in the moulds, with the required brackets and controls, after which the lower skin was added in three sections, front, central and rear.

The fuselage was laid up with balsa and glass cloth on an inner built-up form or 'plug'. The balsa filling was laid on first, after the separating agent. Any necessary strengtheners, such as around the cockpit rim, were made from plywood and added at this stage. The outer glass skin was then laid on, and after curing the shell was separated into two parts, to be skinned inside with more glass, and the two half shells joined with overlapping glass cloth layers. A good deal of careful surfacing and finishing was needed. The team developed a fine sense of touch, running their fingertips over the surface to detect low and high spots needing treatment. A young woman who sometimes visited the workshop remarked that these fellows didn't seek girl friends because they preferred petting their sailplane.

The cockpit canopy was blown inside a female form taken from the finished fuselage, to ensure a perfect fit.

In 1956 Eppler left the University and took a post with the Bölkow Aircraft Company. Rudi Lindner, then aged 25, joined the firm later in the same year. He, too, was a famous aeromodeller, having twice won the World Championship for free-flight A - 2 model sailplanes. He had since become a very good sailplane pilot. Interested in the Phönix he joined the group, made many valuable suggestions and took on the work of making the many small metal parts that were required.

In 1957 financial and personal difficulties arose for Nägele and he too, was offered a post working for Bölkow. This allowed the Phönix to be completed by November of the same year, not, after all, in the Hirth workshop but at Bölkow.

The sailplane that emerged at last was unlike anything seen before, aerodynamically perfect, and, it proved, structurally, more than strong enough. The wing was of quite generous area with a very moderate aspect ratio by sailplane standards. The structural weight was also low, so the wing loading too was less than most sailplanes of the period. Eppler had approached the design with the idea of achieving the best average cross-country speed in moderate soaring weather. Later, he admitted he had been too conservative.

There were ten ribs in each wing. The group came to believe these were not really necessary. There was no main spar, the loads being borne mainly by the thick upper and lower sandwich skins, with three stiffening vertical webs. To gather and transfer the stresses from wing to wing and to the fuselage, a rather massive bridge structure was needed, with locking bolts to be inserted. No one at this time had worked out ways of fabricating glass-plastic spars from unidirectional rovings. The air brakes, or flaps, were under the wing, requiring quite heavy forces to lower them. A wheel control was provided to make this easier, but it took a few seconds to get them down so landings had to be carefully planned. The fuselage was shaped to conform as far as possible to the curved airflow over and under the wing. The original tail unit was conventional. There was a landing skid but no wheel, only a small 'drop off' dolly was provided for take off.

53 - Polyester for the FS - 24. Epoxy resins came later.

Left: Hans Zacher's photograph of the Kria about to take off at Braunschweig in 1960

Below: The Kria on a winch launch with flaps down.

To satisfy the authorities that the FS - 24 would be safe, structural tests were carried out. These established that there was no likelihood of failure in the air, but all, including Eppler, were astonished at the flexibility of the wing, which deflected three metres at the tips when tested to the nominal maximum permitted loading plus the usual margin.

The Phönix made its first flight, by winch launch with Hermann Nägele at the controls, on November 27th 1957. If one date marks the beginning of a new age in soaring, this was the day. In 1958 he achieved his Gold C 300 km distance flight in the Phönix.

In 1959 the Phönix was taken, with Nägele, to the USA for flight tests and measurements by August Raspet of Mississippi State College. The best glide ratio was found to be 40:1, a remarkable figure with an aspect ratio of less than 18. Raspet wrote a detailed account of the studies and reported to OSTIV in 1960. The Phönix wing profile in some respects exceeded even Eppler's expectations. Raspet wrote "No airfoil has ever before been reported which, according to full scale free flight test data at low Reynolds numbers, had such low drag, such a high maximum lift coefficient and such extensive laminar boundary layer flow. This great success, however, could have been achieved only by mean of the new fiberglass-balsa sandwich construction of the Phönix which provided ultimately smooth and wave free surfaces."[54]

Two further prototypes were built by Bölkow, with improvements. A retracting wheel was added, the skid being removed. The tail was changed to a T tail, the Phönix T then entering production. Eight were completed before production stopped in 1961 when Bölkow required the workshop for other products.

In the German National Championships in 1961 there were five of the Phönix competing, Ernst Günther Haase and Rudi Lindner placing second and third. Haase had not done so well with the Phönix at the World Championships in 1960. Lindner won the German Nationals in 1962, and in 1963 broke the World Distance Record, flying 876 km from Stuttgart to St Nazaire on the French Atlantic coast (along with Karl Fischer and Otto Schauble who were flying their humble Ka-6CRs). On the same day, a Phönix flown by Emil Bucher broke the goal flight record by flying 615 km from the Hornberg to Chartres.

No Phönix ever suffered structural failure in flight, or flutter. The prototype is displayed in the Deutsche Museum in Munich. Most of the other seven were still flying in 2002.

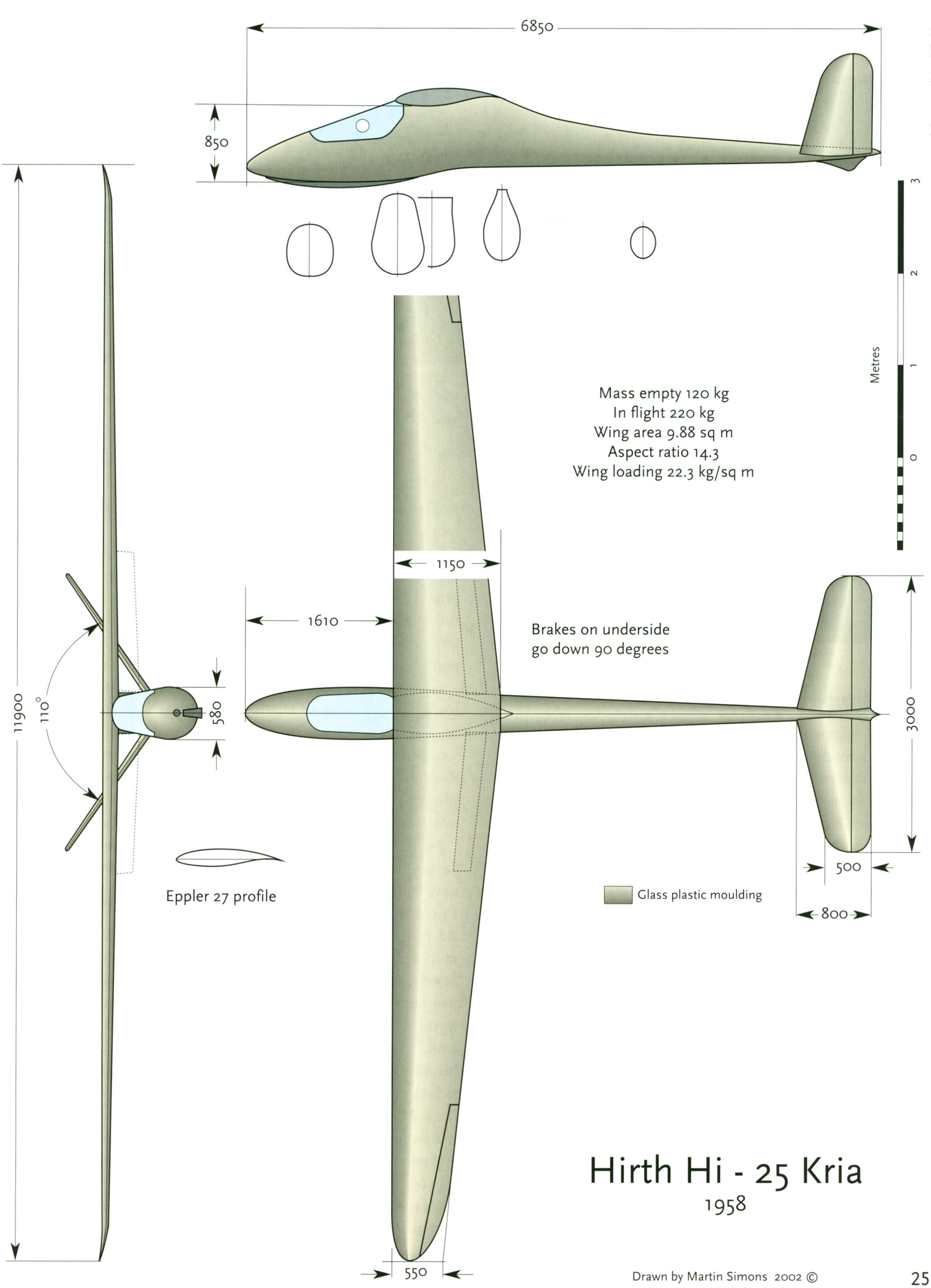
54 - OSTIV Publication VI, Congress at Cologne, 1960

Hirth Hi 25 Kria

Wolf Hirth had been keenly interested in the development of the Phönix and had hoped to manufacture it in his works at Nabern. When it was taken over instead by Bölkow he remained interested and decided to become involved more directly in the new technology. The second GRP sailplane after the Phönix was the Kria (named after an Icelandic Swallow). In many respects it was a miniature version of the Phönix, the most obvious difference apart from size being the V - tail. Like the Phönix, an Eppler profile was used and the air brake-flaps were under the wing. The fuselage was shaped to conform to the airflow, upwash ahead of the wing, downwash behind. The methods of construction and materials were the same as those developed by the Phönix trio. The wing was in one piece with no dihedral except, at the tips, some slight upward curvature was necessary to keep the aileron hinge line straight.

Rudi Lindner made the first flight on 31st December 1958 at Hahnweide. There were no great expectations for the experimental aircraft but the performance was better than would have been expected from any orthodox 12 metre sailplane. The main problem was that only small pilots could get into the tiny cockpit. Those who flew it found the ailerons rather feeble but otherwise it was pleasing to fly.

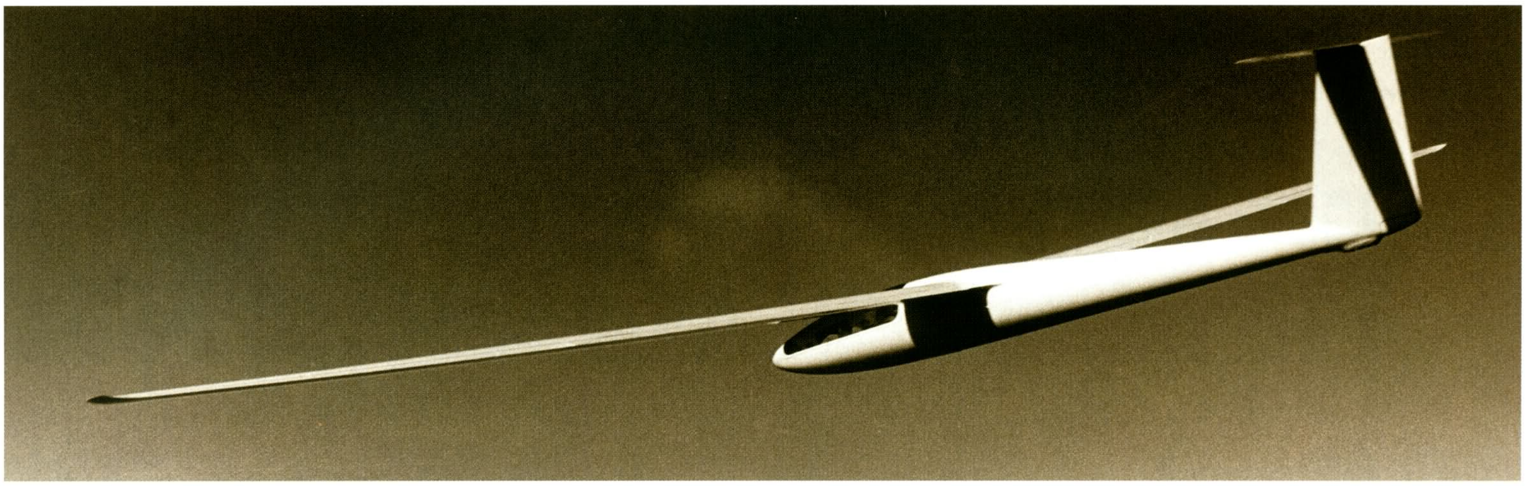
After Hirth's death in 1959 the Kria was given to the Akaflieg Stuttgart and flew for several years at Hahnweide. It was included in some of the OSTIV sailplane evaluation courses for pilots, conducted by Hans Zacher at various centres in Europe. When it was retired from use it was stored at Bezgenriet as part of a collection of old aircraft belonging to Fritz Ulmer. The hangar and all it contained were lost in a fire caused by arsonists in January 2001.

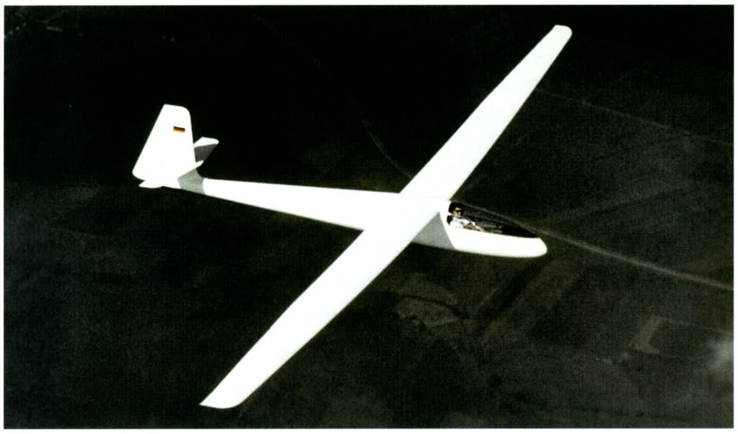


Hirth Hi - 25 Kria

1958

Drawn by Martin Simons 2002 ©





Above: The BS - 1 prototype which was commissioned by Heli Lasch and flown in South Africa
Left: The SB - 6 in flight

SB - 6 Nixope and the BS - 1

The SB - 6 Nixope (Water sprite) was designed and built by the Akaflieg Braunschweig and made its first flight in 2nd February 1961. The leader of the group at Braunschweig was Björn Stender. His father Walter had been an engineer with Dornier and had helped Rudolf Kaiser in Kaiser's early years as a sailplane designer. Björn had been involved with the Akaflieg's SB - 5, a V-tailed wooden sailplane which flew in 1959. At an OSTIV Congress in 1958 he heard of the new developments in glass-plastic structures and visited Nabern to study the Phönix.

The Akaflieg decided to build an experimental GRP sailplane. It was an ambitious design with 18 metres span and a high aspect ratio. The wing profiles, without flaps, came from Richard Eppler. To avoid the difficulties caused by air brakes in the wings, only a ribbon type braking parachute was fitted. The ailerons were quite small. The pilot's position was fully reclining, allowing the fuselage to be of small cross section, with a retracting wheel. There was a long transparent, blown, cockpit canopy, fully contoured with the fuselage. The tail unit was cruciform, with an all-moving horizontal surface.

Construction of the wing did not follow the methods of the Phönix. A large, strong box spar, of balsa and GRP, was constructed first. On this, balsa ribs stiffened with GRP, spaced at 80 mm, were glued and the entire wing then planked with balsawood. After smoothing, the glass was laid over this. The fuselage was built in a similar fashion. Numerous cross frames were set up on a steel jig. Balsa planking 10 mm thick was laid, smoothed and the glass afterwards. The inner framework was then withdrawn.

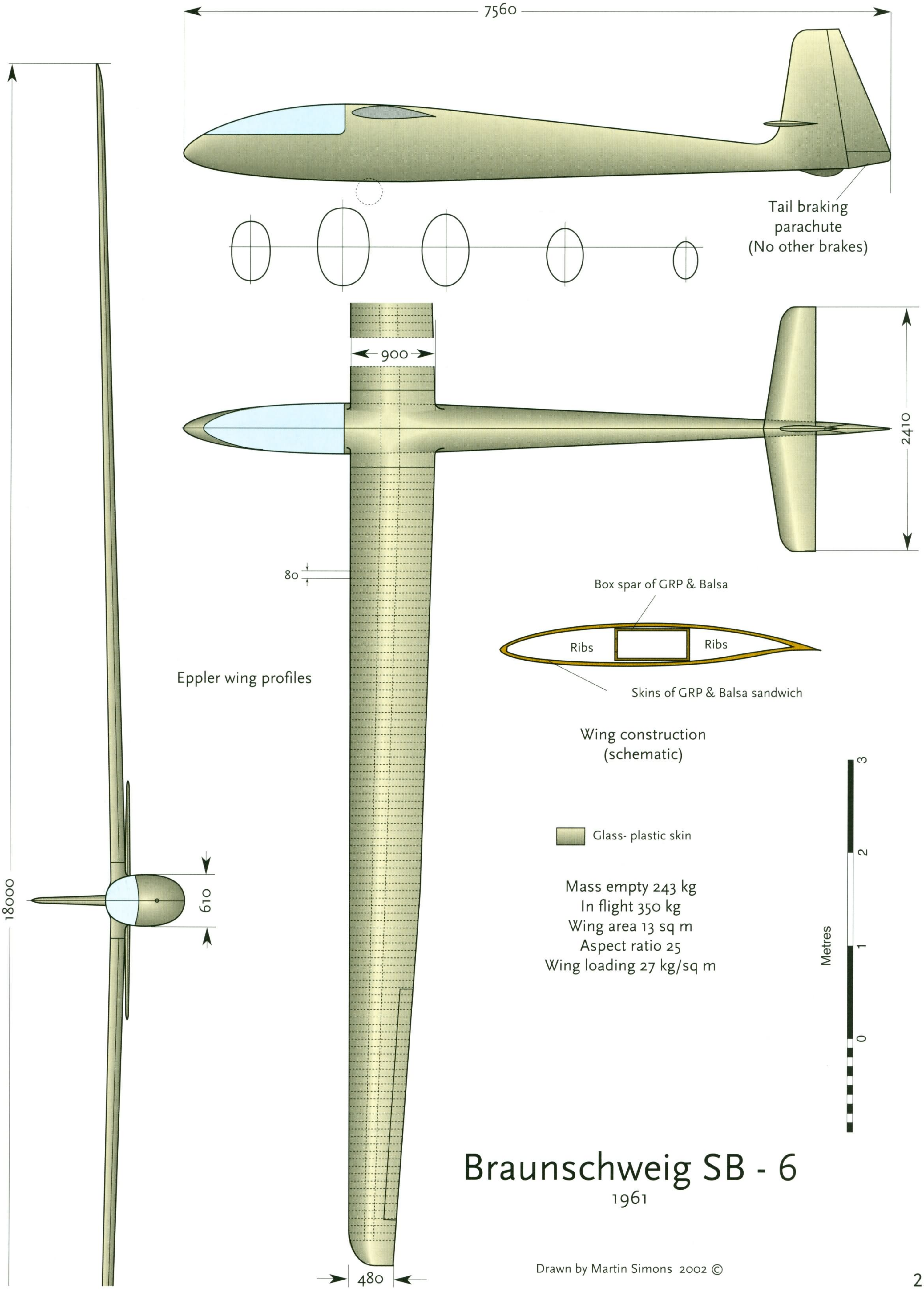
By using this method of construction the labour and cost of making female moulds was avoided, but the amount of work required to produce a smooth and accurate finish was probably in the longer run greater. Some later prototypes were built in much the same way but for long production runs, female moulds were used for all components, wings, fuselages and tail surfaces.

The SB - 6 was not easy to fly but had a good performance, the best glide claimed as 43:1, although the figures arrived at after testing were somewhat less.

In the German National Championships in 1961, Stender, a relatively inexperienced contest pilot, achieved 6th place. He wrote a thesis on the subject of aeroelasticity. Already one of the problems inherent in GRP structures was making itself apparent.

Before leaving University Stender in 1962 was approached by Heli Lasch, the wealthy South African pilot who diverted from a business trip to Berlin to visit Braunschweig and look at the SB - 6. Lasch was greatly impressed with both the sailplane and Stender. He offered to finance the design and construction of a new sailplane, when Stender had finished his university course. Stender agreed and after graduating moved to Reutlingen where a friend lent him an old house, scheduled for demolition, as a dwelling and workshop. Here he designed and, with three helpers hired for the work, built the BS - 1, which was closely based on the SB - 6. Like the SB - 6, the only air brake was a tail parachute. After test flights in late December 1962, Stender flew the BS - 1 frequently during the coming spring and summer, set a 300 km triangle speed record and won the Regional Championships. Heli Lasch returned to fly and take possession of his aircraft in August 1963 and arranged for it to be shipped to South Africa.

Meanwhile, Stender was building a second BS - 1 for Hans Böttcher. This differed in several ways from the prototype, using plastic



Braunschweig SB - 6

1961

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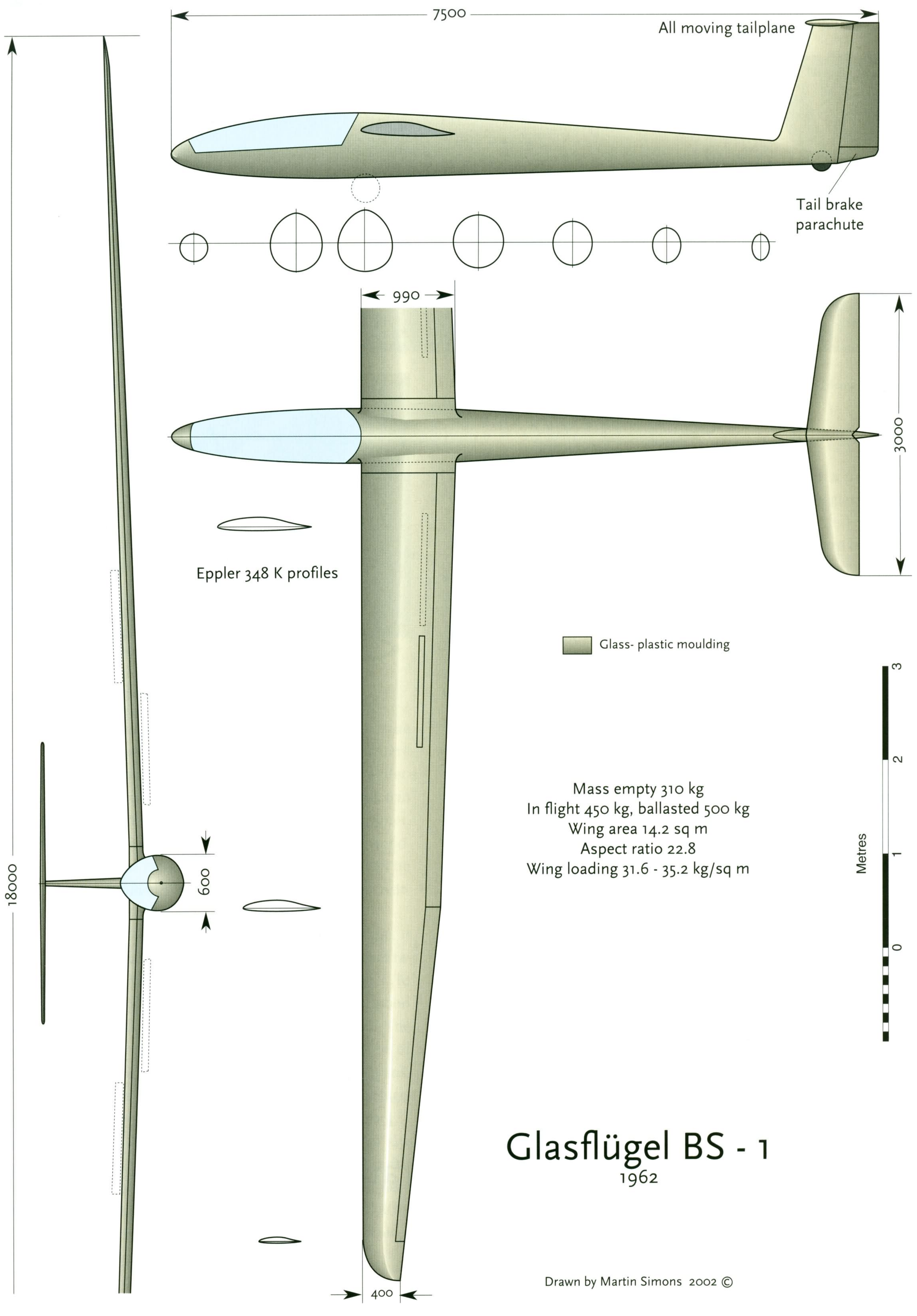
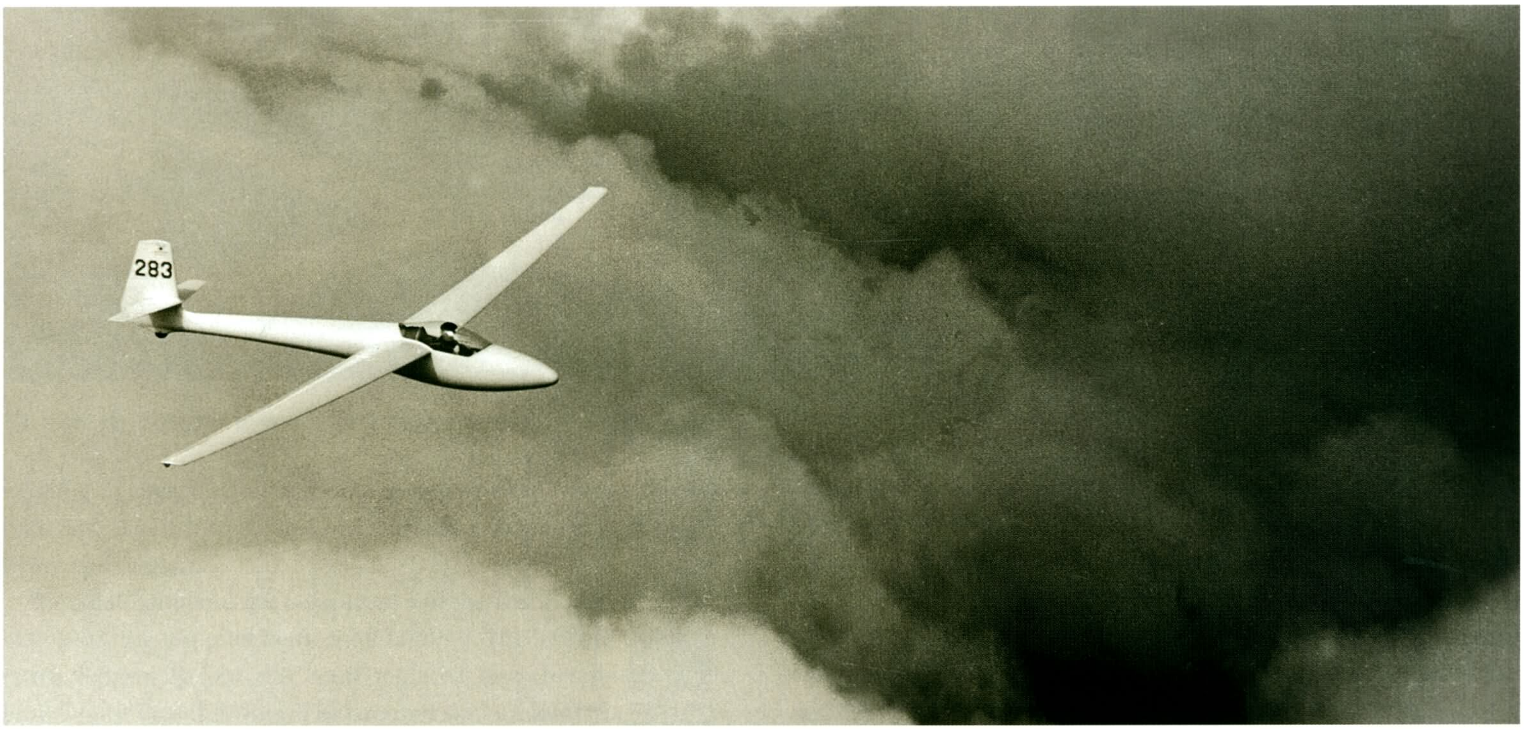

7500
All moving tailplane
Tail brake parachute
990
3000
18000
600
Eppler 348 K profiles
Glass- plastic moulding
Metres
0
1
2
3
Mass empty 310 kg
In flight 450 kg, ballasted 500 kg
Wing area 14.2 sq m
Aspect ratio 22.8
Wing loading 31.6 - 35.2 kg/sq m
Glasflügel BS - 1
1962
400
Drawn by Martin Simons 2002 ©



Wave flying over New South Wales, Australia, in the Libelle H - 301.

foam instead of balsa, and the fuselage was a little greater in cross section. It came out slightly lighter, still with only the tail parachute brake. While Stender was flying it at Hahnweide in October, in turbulent conditions and at an airspeed estimated to exceed 300 km/h, the right wing broke off and the BS - 1 rolled inverted. The tail 'chute was deployed and Stender bailed out by breaking through the canopy, which was not jettisoned. The static line to his parachute was severed and, lacking height to open it manually, he was killed.

Heli Lasch flew the prototype BS - 1 with great success for several years but he also had trouble. In December 1967 he had been flying on a task which he decided to cut short when thunderstorms developed along the intended track. Hurrying to get to a convenient airfield, he took his eyes off the airspeed indicator for too long. When he did glance at it he was startled to see the needle out of sight. He had wrongly put a paper chart on the instrument panel in such a way that it obscured the upper part of the speed dial. He never knew what speed he had actually reached. The wing broke off suddenly, the sailplane gyrated wildly. He jettisoned the canopy and as soon as he undid his harness was ejected from the cockpit, to land safely near the wrecked sailplane.

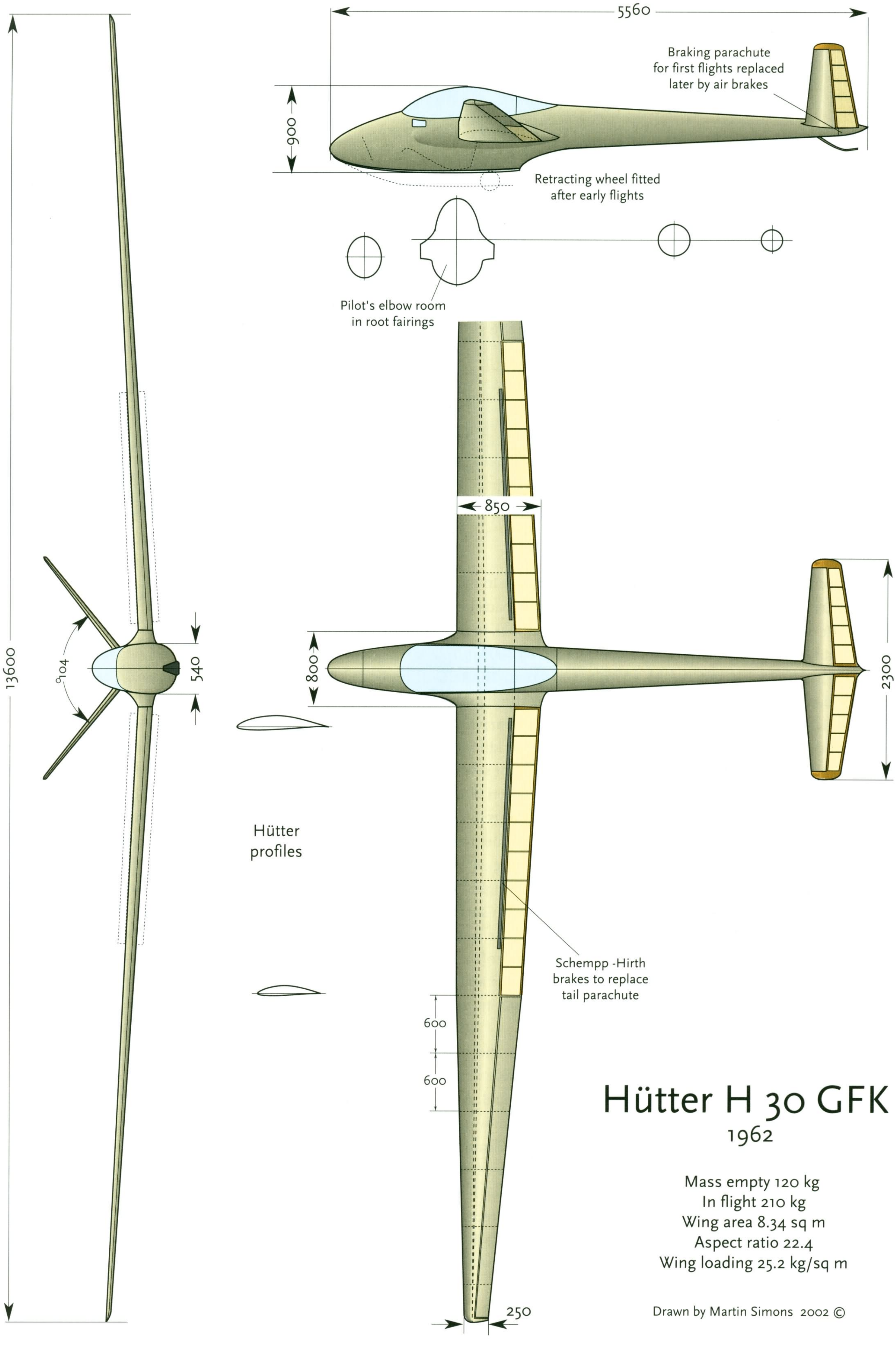
The BS - 1 was reckoned at the time to have been the best sailplane in the world and a group of interested pilots were determined to resurrect the design. It was taken over by Hänle and manufactured by the Glasflügel factory. The aerodynamic form was retained but the structure was completely revised, using techniques and methods worked out for the Glasflügel H - 301 Libelle. It was also equipped with air brakes. After this the Glasflügel BS - 1 was highly successful, winning championships and breaking records, among them the World 300 km triangle speed record of 138 km/h by Alfred Röhm in June 1967. Glasflügel built eighteen of the BS - 1.

Hütter H - 30 and H - 301 Libelle

"What are two glider pilots to do if they are married?" asked Eugen Hänle in an article written late in 1963. Not everyone would answer as he did: "Build a sailplane, of course." The original design of the Hütter 30 was begun in 1948 by Wolfgang Hütter. He and Ulrich, his brother, had worked for Wolf Hirth and were chiefly responsible for the design of the Minimoa and Gövier. They had also designed the small H - 28 sailplane of 1936. The Hütter 30 was intended as a modernised version of the H - 28 with improved wing profiles. It would be built of wood but it was intended to mould the fuselage in laminated poplar veneer and the wing would be a shell structure with plywood and balsa sandwich skins.

Ulrich Hütter meanwhile was working with Hänle, whose chief business was in manufacturing glass reinforced plastic blades for fans, rotors and propellers, and springs using unidirectional glass rovings embedded in resins. The potential for GRP (In German, GFK, Glas-Faser Kunstoff) sailplanes was recognised. Wolfgang saw the value of rovings for the construction of load bearing spars. Plans for the wooden H - 30 were scrapped. Many of the methods that became standard practice for GRP sailplanes spars and fittings, were developed for the H - 30 in this co-operation between the Hütters and Hänle. All the skins were the GRP balsa sandwich type, with balsa webs to stiffen the spar flanges. Part of the trailing edge of the wing, inboard of the ailerons, was fabric covered. The wing profiles were of an old design by Wolfgang Hütter. Only the 'ruddervators' of the V-tail were framed in wood and covered in fabric. There were no airbrakes at first, other than a tail parachute.

Construction of the H - 30 in GFK occupied six years of the Hänles' married life. Perhaps they had little time for anything else,



Hütter H 30 GFK

1962

Mass empty 120 kg
In flight 210 kg
Wing area 8.34 sq m
Aspect ratio 22.4
Wing loading 25.2 kg/sq m

Drawn by Martin Simons 2002 ©

The Hütter 30 - TS, turbine powered originlly but soon converted to a sailplane

working in their kitchen at home to begin with, moving into the hall, and at last into rooms and workshops large enough to take wings and fuselage.

The small sailplane was completed and the first flight was on 5th May 1962, the test pilot being Rudi Lindner. The braking parachute failed repeatedly and was soon replaced by Schempp-Hirth air brakes built into the wing. The original skid undercarriage was replaced with a retracting wheel chiefly because this raised the fuselage and wing tips further off the ground for take off and landing. It was a full year after the first test flights that the H - 30 was considered finished, but the Hänles were delighted with it.

Wolfgang Hütter was not content with the H - 30. Concurrently, as the Hänles were building it, he was working on the H - 30TS, a jet powered version. This had a small BMW gas turbine built into the fuselage behind the cockpit. For this aircraft Hütter designed a new wing of fifteen metres span, with a low drag profile and camber flaps. The spar was reinforced with light alloy bonded with epoxy glue. Heinz Kensche made the first flight with it as a sailplane by aerotow in October 1960, before the Hänles completed the H - 30. The first powered flight followed about a month later. The V-tail was not satisfactory and was replaced by an orthodox cruciform tail unit. Research with the turbine was discontinued before long because of excessive noise and the mass of the motor. The power unit was removed, the intake and jet exit closed up and the H - 30TS became a sailplane.

The Swiss pilot Eugen Aeberli was much interested in the H - 30TS. He visited Wolfgang Hütter with Thomas Bircher and Jürg van Voornfeld of the Zurich Technical University, who had been experimenting with GRP structures for sailplanes. For them Aeberli had constructed moulds for a new GRP fuselage, which had been fitted and flown successfully with the wooden wings of a Ka - 6. They were thinking now of using the H - 30TS wing for this project. The three flew the 30TS and Aeberli took it to Switzerland.

Aeberli returned to Hütter later with the suggestion that a completely new sailplane using the H - 30TS wing should be developed. This was the origin of the H - 301 Libelle (Dragonfly). Apart from replacing the metal in the spar with glass rovings, the wing was the same, using Hütter's profile. The tail also came from the H - 30TS. The fuselage was generally similar in outline, with the same cross sections in the tail boom. It was a GRP shell construction, not the balsa sandwich of the H - 30TS. The wheel was retractable. The seat was only moderately reclined and adjustable. The cockpit canopy was very low and almost completely faired into the fuselage. A tail braking parachute was fitted. Once deployed it could be jettisoned but not retracted. The best glide ratio was about 38: 1.

Hänle constructed the prototype during 1963 - 4, hiring workshop space from the Schempp-Hirth factory in Kirchheim for the wings and Wolf Hirth's at Nabern for the fuselage. Aeberli took delivery in March 1964.

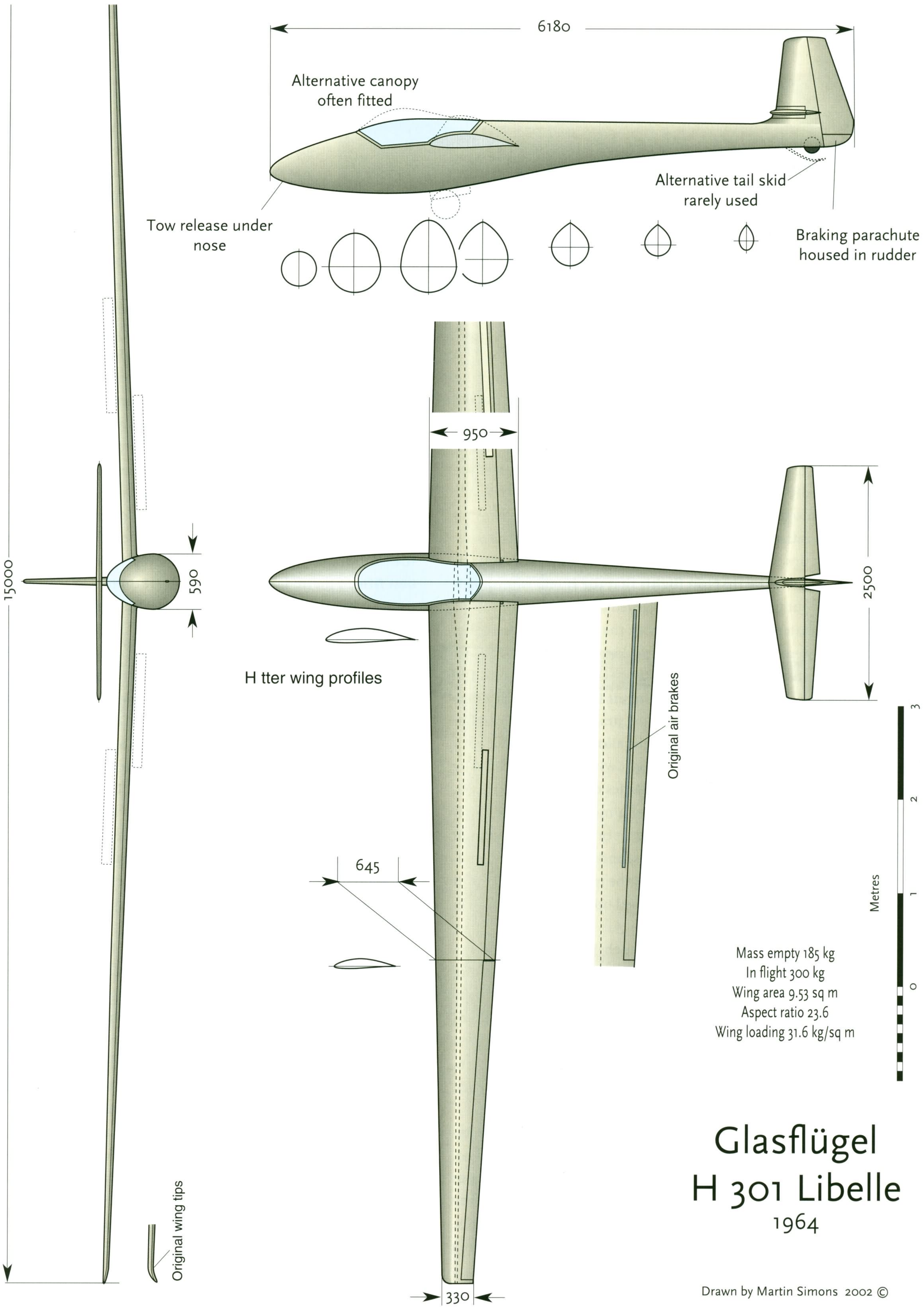
None of the established sailplane manufacturers showed much interest in producing or marketing the Libelle so a new Company, Glasflügel GmbH, was formed with the factory in Schlattstahl. In all, 111 of the H - 301 were completed, many of these being exported to the USA where the type became very popular. Changes made during production included redesign of the air brakes to the more orthodox Schempp-Hirth type, much shorter and opening above and below the wing. A slightly domed canopy was made available as an option and tall pilots preferred this. The Libelle was light on all the controls, responsive and for a time was widely recognised as the best fifteen metre sailplane available. If there was any criticism of its handling, it was that the rudder was insufficiently powerful.

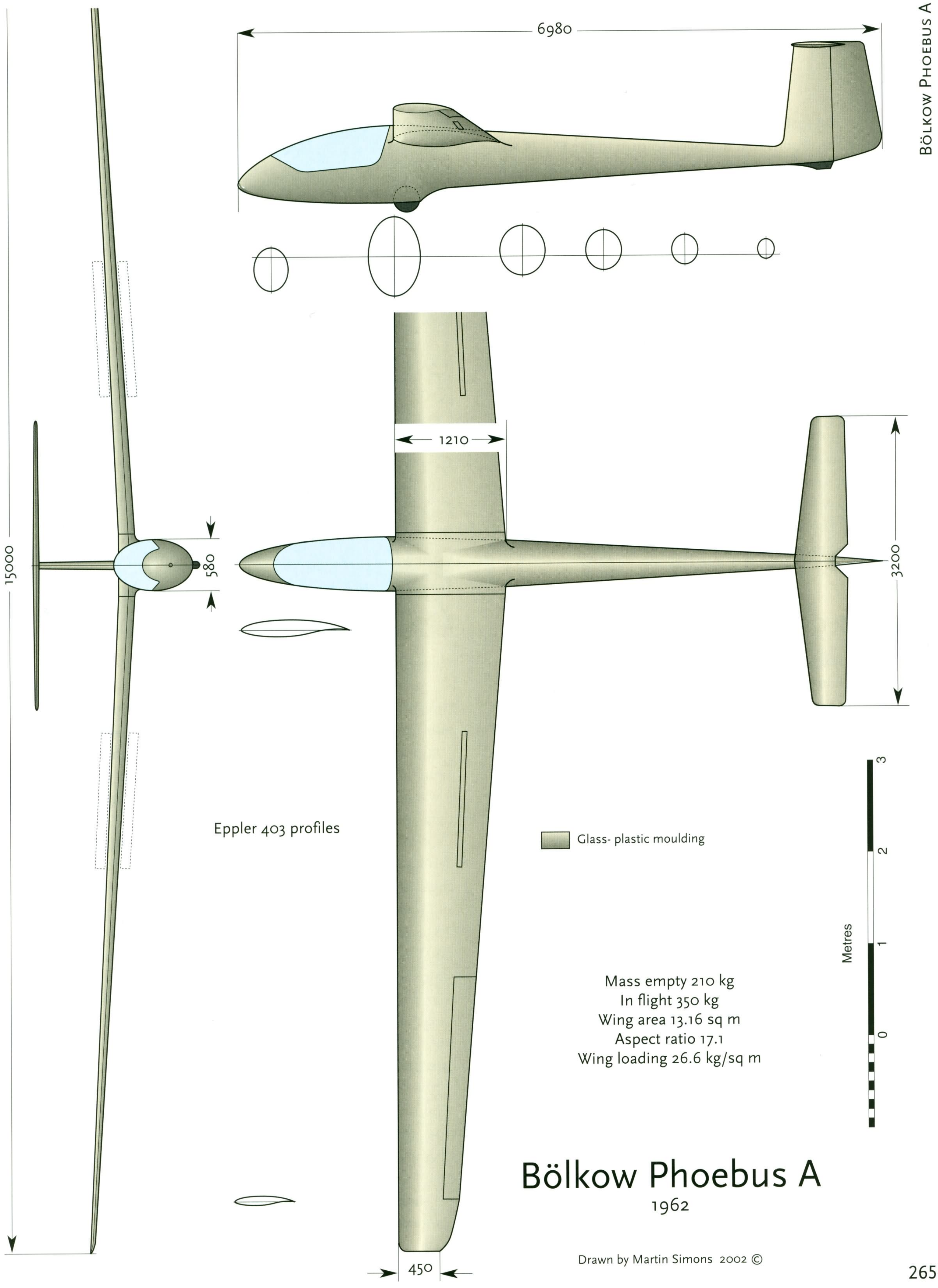
Many record flights were made in the Libelle, including World Record speeds of 138 km/h for the 100 km triangle by H Linke in Germany, and 121 km/h for the 500 km triangle by E Katinsky in the USA. In major competitions it had to fly in the 'Open Class' because it did not comply with the Standard Class rules. It was usually competing with sailplanes of greater span and these, by now, were of equal refinement and better performance.

Several further developments took place. The wings of the Libelle were used by Aeberli's friends in Zurich for the their first HBV Diamant (HBV for Hütter, Bircher, Voornfeld), which was flown in 1964 and led to the development of the Diamant 16.5 and 18. The Standard Class H - 201 Libelle appeared in 1967 and for a time was the most numerous GRP sailplane of any type in the world, with more than 600 examples built.

As new and somewhat better sailplanes began to appear, Will Schumann in the USA set about his H - 301 Libelle to upgrade its performance. The wing profiles were slightly modified at the leading edge, using microballoons and resin with templates. Every other possible source of additional drag was attacked, sealed, smoothed, closed up. The result was an improvement of several points to the best glide. Using papers and templates supplied by Schumann, other owners followed his example.

The original Hütter 30TS was destroyed in a winch launching accident in 1968. But Ursula Hänle did not forget the H - 30GFK, which she continued to fly. In co-operation with Wolfgang Hütter, she produced the 13.6 metre aerobatic H - 101 Salto in 1970. The resemblance to the H - 30 was obvious. Fifty-seven were built by Ursula's new Company, Start+Flug.


6180
Alternative canopy often fitted
Alternative tail skid rarely used
Tow release under nose
Braking parachute housed in rudder
950
15000
590
2500
H tter wing profiles
Original air brakes
645
330
Original wing tips
Metres
0
1
2
3
Mass empty 185 kg
In flight 300 kg
Wing area 9.53 sq m
Aspect ratio 23.6
Wing loading 31.6 kg/sq m
Glasflügel
H 301 Libelle
1964
Drawn by Martin Simons 2002 ©



Mass empty 210 kg
In flight 350 kg
Wing area 13.16 sq m
Aspect ratio 17.1
Wing loading 26.6 kg/sq m

Bölkow Phoebus A

1962

Drawn by Martin Simons 2002 ©

Phoebus

The Phoebus was designed by the Phönix team as a Standard Class sailplane. All the lessons that had been learned in the FS - 24 were applied. Again Eppler devised a suitable wing profile. The importance of high speed performance was now recognised. The wing loading was much higher than that of the Phönix and Schempp-Hirth airbrakes were fitted instead of the underside flaps. The cockpit layout was improved and a T tail was adopted from the beginning with ample vertical tail area and all-moving, mass balanced, elevator. A difference in production was that fuselage shell was built in female moulds, but in lower and upper sections rather than in left and right halves. This had some advantages. The cockpit pan was part of the lower shell, with the lower wing root fairings. The upper part of the shell included the upper wing root fairings and the fin so the only joining needed between the two sections was in the tail boom.

The first flight was in April 1964, by Rudi Lindner, who entered the German national Championships and placed 3rd. At the World Championships in 1965 he came eighth. Manufacture was undertaken by Bölkow in two versions, the A for the Standard Class and from 1967 the Phoebus B, with retracting wheel and the Phoebus C with 17 metres span. 120 of the A and B models were produced and 133 of the C. Production ceased in 1970.

Phoebus flying in the Alps

Darmstadt D - 36 Circe

The Darmstadt D -36 more than any other sailplane illustrates the transformation in design, both aerodynamic and structural, that occurred during the two decades from 1945 till 1965. It began as a project of the Akaflieg Darmstadt after a D 35 two-seater had been abandoned.

Three students were chiefly concerned, Wolf Lemke, Gerhard Waibel and Heiko Friess. A fourth, Klaus Holighaus who was younger, joined the group later. As usual in the Akaflieg, they worked together and consulted all the time, but each concentrated on a particular aspect of the design. The wing was the responsibility of Lemke, the fuselage and tail were Waibel's and Friess devised the air brakes, which, with a flexible wing, were very difficult to arrange successfully. When the work of building began they were helped, as generations of students were, by Heinz Hinz, who was employed by the University to help and advise the students in matters of practical construction. Professor Franz Xavier Wortmann was also involved. He designed for the D - 36 a new wing profile, the FX 61 - 131K, with a profile for the wing tips, FX 60 - 126. (The 'K' in the profile designation indicates flaps.)

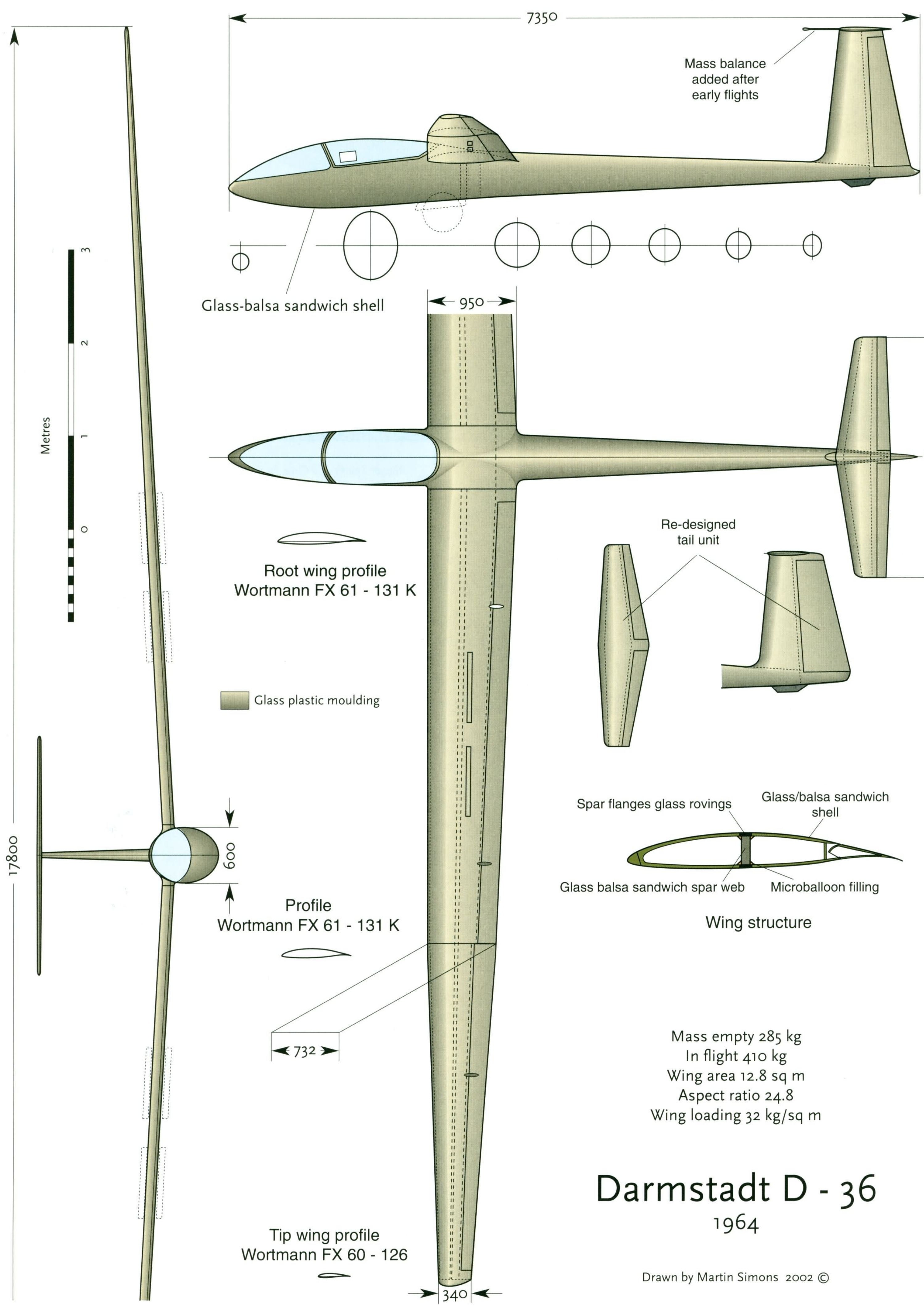
Construction began in 1963. The wings were double tapered to approximate the elliptical plan. The main spar flanges were from unidirectional rovings, with balsa - glass sandwich skins. The fuselage also was a balsa-glass sandwich shell with cross frames of GRP and balsa where necessary to carry concentrated loads and stiffen the structure. The T tail followed the same general pattern. The pilot position was reclined but not extreme. The cockpit canopy was a long, two part moulding, the front section faired and sealed fully to the fuselage, only the rear part removable. The wheel was retractable.

Structural tests were carried out to establish the safety of the structure. As with the Phönix, the flexibility of GRP was impressive. It was apparent that if there were going to be any serious problems they would be in the realms of aeroelasticity.

Concurrently with the construction at Darmstadt, Walter Schneider began construction of his own D - 36, Version 2. It had a parachute brake instead of the Schempp-Hirth brakes of the prototype, and it was somewhat heavier.

The first flight of the D36 V - 1 was by Wolf Lemke at Gelnhausen on March 28th 1964. It was soon found that the horizontal tail, which was slightly swept back, tended to flutter and mass balances were installed. Performance measurements established that the Circe had a best glide ratio of 44:1. Only the SB - 6 and BS - 1 from the Akaflieg Braunschweig, came near to or matched this.

In the D - 36 Gerhard Waibel became German National Champion in the summer of 1964. Rolf Spänig was chosen to fly in the 1965 World Championships and, during his practice flying with the D - 36, made the first 500 km triangle flight ever in Germany. In the World Championships he placed second, beaten by superior tactics, the Polish pilots flying in the Fokas demonstrating that sheer superiority in the glide was not enough by itself. That the D - 36 had the best performance of any sailplane in the Championships was hardly in doubt.


7350
Mass balance added after early flights
Glass-balsa sandwich shell
950
2580
Metres
3
2
1
0
Root wing profile
Wortmann FX 61 - 131 K
Re-designed tail unit
Glass plastic moulding
17800
600
Spar flanges glass rovings
Glass/balsa sandwich shell
Glass balsa sandwich spar web
Microballoon filling
Wing structure
Profile
Wortmann FX 61 - 131 K
732
Mass empty 285 kg
In flight 410 kg
Wing area 12.8 sq m
Aspect ratio 24.8
Wing loading 32 kg/sq m
Darmstadt D - 36
1964
Tip wing profile
Wortmann FX 60 - 126
340
Drawn by Martin Simons 2002 ©

Above: The D - 36 Circe, in its original form

Left: 'Gummiflügel' was the nickname applied to the D - 36. The wings bent much more than this in flight

What impressed observers at least equally, was the extraordinary flexing of the wings. The Germans themselves began to call the D - 36 'Gummiflügel' (rubber wing). There were still many engineers who hesitated and felt that a metal structure, so much stiffer, would be safer.

The tail unit was re-designed by Klaus Holighaus, who removed the sweep back on the tailplane and eliminated the need for mass balancing. After some three years doubts might have been raised again, for the D - 36 V - 1 was lost in 1967 after a failure in flight, the pilot saving himself by parachute. But by this time, many other 'glass ships' were sailing and pilot error was blamed. A lesson that had to be learned, as Heli Lasch discovered, was that traditional methods of judging airspeed were no longer adequate. The new sailplanes picked up speed very quickly, the sound of the airstream was quite small, and, especially with camber changing flaps in different positions, the change of attitude at different airspeeds was quite small or even nil.

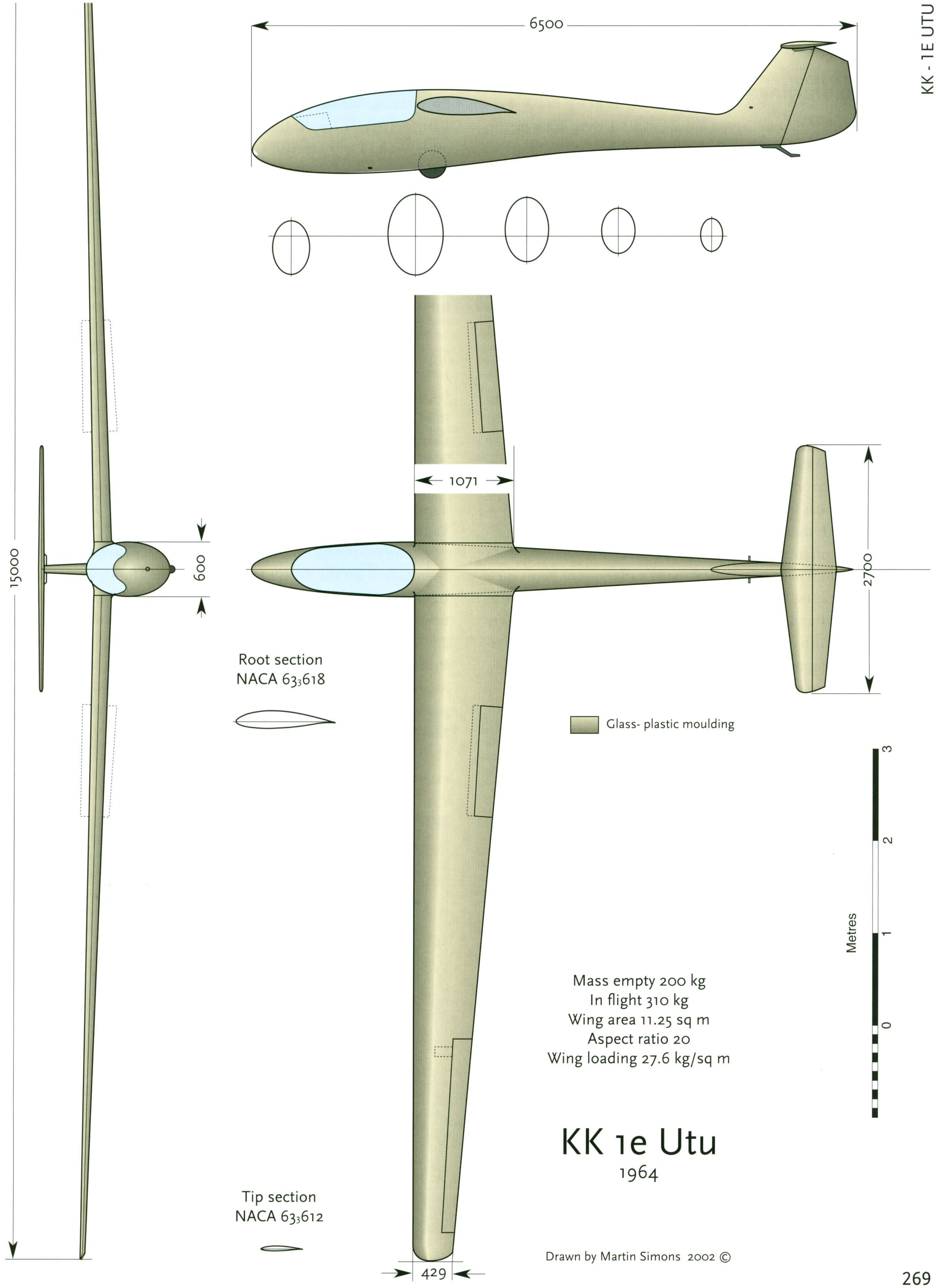
The four young men who had been involved in the design, went on to distinguished careers. In 1985 all four shared the OSTIV Prize for their outstanding contribution to sailplane technology. Also, Heinz Hinz was not forgotten. In 1989, at the age of seventy, he received the Silver medal of the Deutscher Aero Club for his lifetime of service, to the Akaflieg in Darmstadt.

KK - 1E UTU

Germany and Switzerland were not the only countries interested in producing sailplanes in glass-plastic. The Finnish prototype, KK - 1A, flew first in October 1964 after five years of study and research which convinced the designer, Ahto Anttila, that this was where future developments would lead. It was a Standard Class sailplane and was one of the first to use foam plastics rather than balsa wood for stiffening material. Polyester resins were used throughout.

NACA profiles were adopted. The fuselage was shaped to follow the curved flow over the wings to some extent, with a T -tail layout. The wings had a single I sectioned main spar with no ribs. A relatively large thickness of the foam material was used, filling nearly half the internal volume of the wing. The brakes were of the rotating trailing edge type, which avoided many of the problems of leakage and fitting associated with the more usual Schempp-Hirth type. After early testing, various minor improvements were made, further prototypes, the KK - 1B, - C, - D and finally the KK - 1E were built. Production and marketing were undertaken by OY Fibera AB and twenty-two were built before production ended in 1970.

The KK -1 E UTU was produced in Finland to fly in 1964



Mass empty 200 kg
In flight 310 kg
Wing area 11.25 sq m
Aspect ratio 20
Wing loading 27.6 kg/sq m

KK 1e Utu

1964

Drawn by Martin Simons 2002 ©

APPENDICES

About the drawings

The drawings in this work, all on a scale of 1:50, were done by the author using Adobe Illustrator on Apple Macintosh Computers. The Illustrator program allows a draughtsman or artist to use the computer screen as a drawing board and the 'mouse' and keyboard as pen and ruler. Lines of chosen weight, dots and areas of colour shading may be created and placed with great precision. It is not a method of automatically copying information, translating from photographs or other printed matter. Every mark is made deliberately as if with a pen or airbrush. One outstanding advantage is that corrections can be made easily, and copies printed in a very short time for examination and criticism.

Wherever possible original workshop plans, actual measurements and photographs have been used to produce the best possible result. In other cases the drawings are based on previously published sources and where these conflict with one another (which they nearly always do) the author has made whatever adjustments seem best. Doubtless errors remain but it is hoped these will be small.

Little attempt has been made to show items of equipment such as instruments, externally mounted pitot tubes, venturis etc. In practice these were often moved to different locations or changed from season to season. There were a great many variations to items such as cockpit canopies, windscreens, skids and other details, not to mention colours and markings. Model makers and others who are anxious to establish exact details, have no recourse other than careful study and measurements of an actual aircraft.

Colours and markings

The drawings here do not show any paint schemes or markings. It is preferable to examine an actual aircraft to discover them. Coloured photographs, where these exist, are useful. but the photographic process often changes the tones considerably. Nearly all sailplanes of the period dealt with here were painted. A very few had some fabric covered areas in clear dope and varnish, but this was exceptional because the organic fabrics used, cotton or linen, perished rapidly in sunlight if unprotected and had to be replaced at considerable cost.

When GRP came into use, white was almost universal because it reflected light and prevented the underlying resins becoming too hot and softening. When registration letters or numbers were required they too, were in light, reflective colours.

Acknowledgements

This book owes much to the following sailplane designers, constructors, pilots and friends. Some are now deceased. The author thanks them for their assistance in correspondence and conversations, and for their kindness in supplying photographs, drawings and correcting errors.

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The author

The author, Martin Simons, has been involved in gliding for more than fifty years. With the Gold C badge and two diamonds, he has flown about one hundred different types of sailplane, including (at the last count) thirty three of those described in this work.

He is also a keen model sailplane designer, builder and flier.

English by birth he is now based in Adelaide, South Australia, with dual citizenship. His previous books include Slingsby Sailplanes, a standard reference work on the famous British glider manufacturing company, and he collaborated with Paul Schweizer to produce Sailplanes by Schweizer, a companion book about the leading American manufacturer. He also wrote the first volume of the present series, Sailplanes 1920 - 1945. He also wrote Model Aircraft Aerodynamics, the only work of its kind in the English language, and a number of other books and a great many articles, not all of them about aviation.

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Soaring (USA)
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Technika Lotnicza I Astronauticzna (Poland)
Vielles Plumes (France)
Vintage Aircraft (UK)
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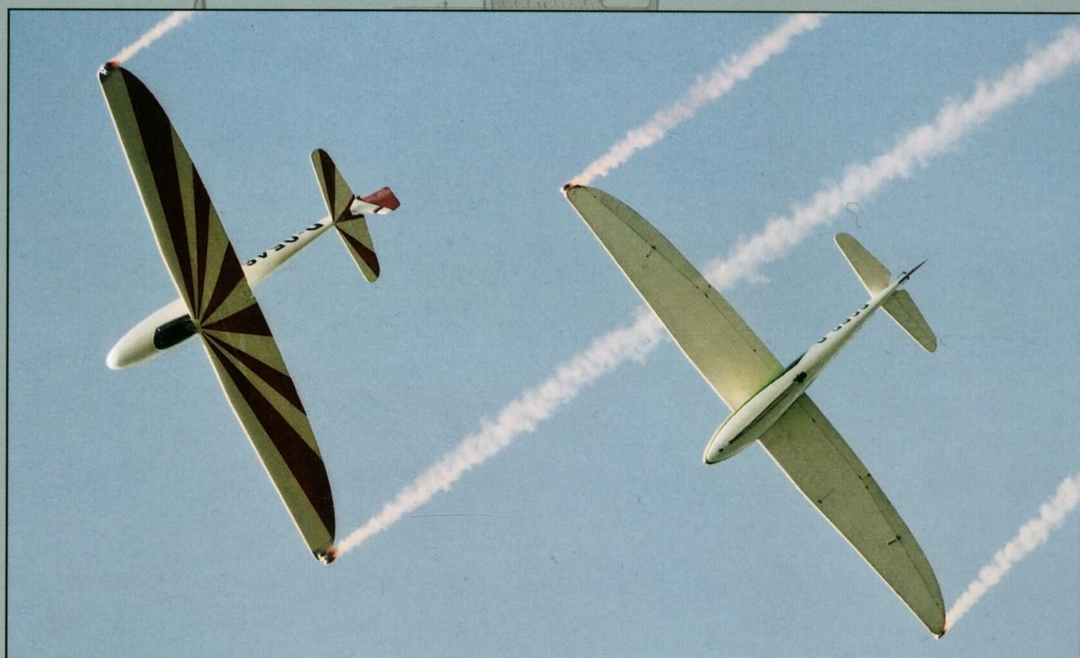
INDEX

This, the second volume of 'Sailplanes' by Martin Simons, describes the extraordinary transformation in soaring that took place from 1945 to 1965. To take advantage of discoveries in low drag aerodynamics it became necessary to develop new structures and methods of construction. Almost every possible combination of materials and techniques was tried with varying success. A great variety of sailplane types appeared. Towards the end of the period, glass-reinforced plastics were achieving great advances in performance.

In parallel, sophisticated electronic instruments and radios were introduced, training methods and piloting techniques changed, records undreamed of before were set, broken and broken again. Competition tasks, formerly simple distance or goal flights, changed to closed circuit races over hundreds of kilometres.

As in Volume 1, the drawings illustrating this work are on a constant scale of 1:50, with cross sections and leading dimensions. Colour shading indicates the materials used. Numerous coloured and black and white photographs are included, many of them rare or previously unpublished. The text contains explanatory material as well as descriptions of the 120 or more sailplanes included.



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