for training purposes and the second prototype, flown in 1961, had an orthodox tail. Further changes were made to produce the Gobé in the form which entered quantity production in 1963 with an initial plan for 50 to be built.

The wing had a simple rectangular plan, slightly swept forward with the simple pressed alloy ribs aligned at right angles to the spar, rather than being parallel to the centre line. The skins were riveted to the ribs and spar. Ordinary round head rivets were used, without countersinking. There were no struts. The ailerons were slotted and hinged on external brackets. The vertical tail surfaces had a distinctive forward raked appearance with an aerodynamically balanced rudder.

The fuselage, with a single wheel slightly ahead of the laden centre of gravity, had a substantial internal frame to carry the landing loads. Behind the wing there was a metal skinned turtle deck back to the tail, and the belly was also metal skinned, but the sides were covered with fabric carried on light stringers to improve the shape.

The instructor's seat was higher than that of the pupil so there was a clear view directly ahead, through the canopy. This was carefully shaped to avoid distortions, and the nose was allowed to remain pointed to avoid expensive pressing of three-dimensionally curved skins.

In all respects the Gobé proved excellent for its purpose and remained in general use. It became a standard basic trainer for Hungarian clubs and strenuous efforts were made to obtain export orders. There was keen competition in Eastern Europe. The Czech LF - 109 Pionyr, an older, strut braced trainer of generally similar dimensions, which had already been produced in hundreds, had flooded the market. For student pilots after their first few solo flights, the single seat R - 27 Kopé was developed. This shared 80% of the same components with the two-seater. The wing was shortened in span and had no sweep forward. The rear fuselage was the same. Like the Gobé, the prototype had a V - tail but this was replaced once the Gobé design itself had been settled. The only other important alterations were to the cockpit and fuselage nose, which nevertheless showed their origin clearly.

The M - 30B 'Fergeteg' (Whirlwind) two seater.

M - 30 Fergeteg

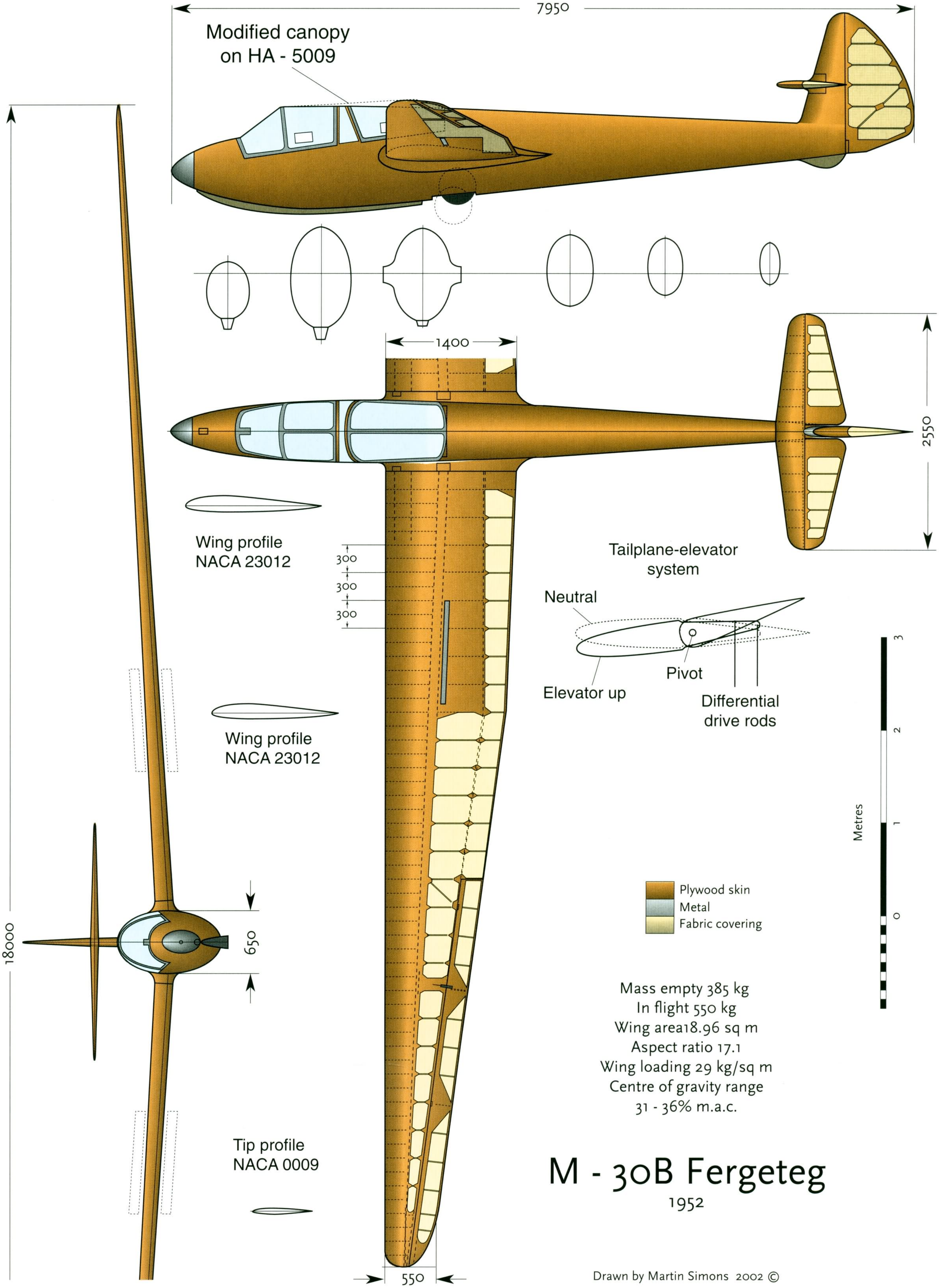
Designer of the Fergeteg (Whirlwind) 18 metre span two-seater was Lajos Beniczky. Work began in Budapest in 1942, but the prototype was not flown until 1950. It was of orthodox wooden construction but had many unusual features, including a semi-retracting wheel. The fuselage was of elliptical cross section. The wing profile over the centre section of the double-tapered wing was NACA 23012, very thin and with small camber, blending to the symmetrical NACA 0009 profile at the tips. The thinness of the wing accounted for the high structure weight. The Fergeteg was noted for its excellent high speed glide. It could be flown solo at a wing loading of 21,9 kg/sq m, which was normal for the period. With two pilots it flew at 29 kg/sq m which was considered high.

Mounting the wing midway down on the fuselage solved the perennial problem of finding room for a second pilot in the rear seat. The wing was slightly swept forward, the leading edge at right angles to the centre line. The main spar was then swept back far enough for the rear cockpit to be clear of obstruction. Inside the fuselage there was a strong steel cross frame to which the wing spars were joined separately by vertical pins. Control linkages to ailerons and brakes connected automatically during rigging.

Schempp-Hirth brakes were used. Ailerons of the Frise type, divided into two, pivoted on external hinges below the wing. On the prototype there were trailing edge flaps extending to the wing root, with coupling to the ailerons. When the flaps were moved fully down 30 degrees the inner segment of the ailerons moved down also through 20 degrees and the outer ailerons drooped 10 degrees. Vice versa, when flaps were up, the ailerons also moved up with them part of the way. Banking then left the flaps fixed while the ailerons moved differentially. On the M - 30 B the flaps were removed altogether and the ailerons much shortened.

The tailplane was very unusual. It was mounted part way up the fin, and was of the all-moving type. However, there was an elevator also, hinged to the moving tailplane. The control linkage was such that movements of the control column fore and aft caused the elevator to move more than the tailplane. Early production models retained this feature but it was abandoned later, to be replaced by a more orthodox elevator - tailplane arrangement mounted on a sub-fin.

The M - 30 was not produced in large numbers but went through several developments, the final version, M - 30 C1 Superfergeteg of 1962, was a single-seater using the same wing but with a fully contoured cockpit canopy and a large dorsal extension to the fin.


7950
Modified canopy
on HA - 5009
1400
2550
18000
650
550
300
300
300
Wing profile
NACA 23012
Wing profile
NACA 23012
Tip profile
NACA 0009
Tailplane-elevator
system
Neutral
Elevator up
Pivot
Differential
drive rods
Metres
0
1
2
3
Plywood skin
Metal
Fabric covering
Mass empty 385 kg
In flight 550 kg
Wing area18.96 sq m
Aspect ratio 17.1
Wing loading 29 kg/sq m
Centre of gravity range
31 - 36% m.a.c.
M - 30B Fergeteg
1952
Drawn by Martin Simons 2002 ©

Above: The Spillo, with its very high aspect ratio, in flight.
Right: The Spillo at Camphill in 1954. The wheeled dolly was used for take off but on the rough Derbyshire fields the small skid undercarriage proved inadequate for landings.

ITALY

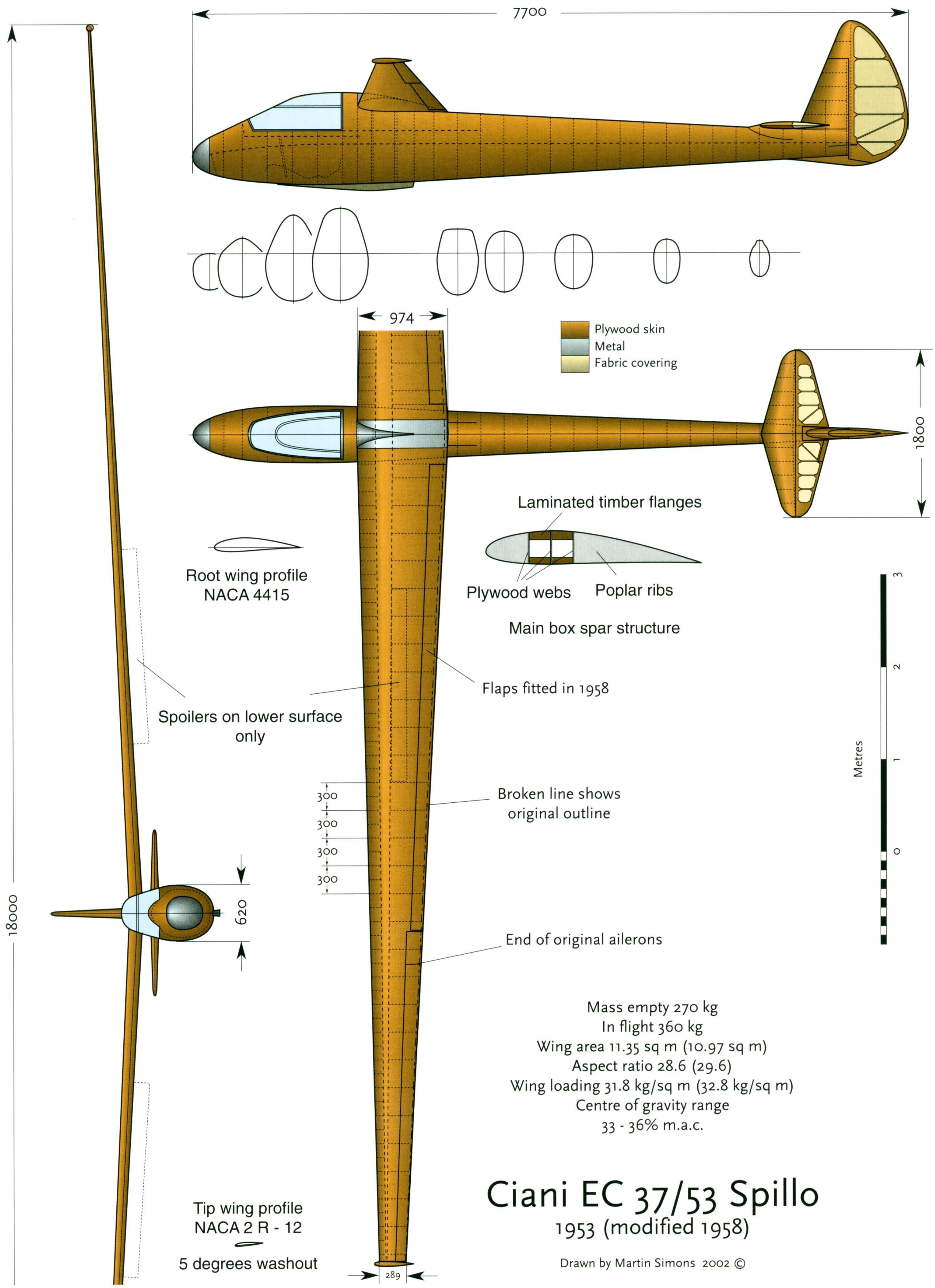
Post war recovery of the Italian soaring movement relied at first on old aircraft that had survived the war years. The large two seat CVV - 6 Canguro originally flown in 1941 remained in service. Fifty two had been built. The pilots A Mantelli and L. Braghini flew a CVV - 6 in the World Championships of 1954 and placed second in the two seat class. The CVV - 7 Pinocchio single-seater developed from the Canguro also proved successful and was entered in the 1952 World Championships in Spain. The CVV (Centro di Volo a Vela del Politecnico di Milano) and the CVT (Centro di Volo a Vela del Polyticnico di Turin) remained prominent in the field of sailplane design.

EC 38 - 53 Spillo

The Spillo, a bold experiment, flew first in 1953 and drew a great deal of attention because of the unusually high aspect ratio of the wing, 29.6, the highest of any wooden sailplane. The designer was Edgardo Ciani, the construction being undertaken by the firm Sezioni Sperimentale di Volo a Vela (SSVV). The main wing section came from the NACA four digit series and was only 15% of the chord in thickness at the root. For such a long, narrow and thin wing the main spar was necessarily quite massive, a double box type with laminated timber flanges and triple plywood vertical webs. The large dive brakes or spoilers were under the wing. There were no flaps at first. The entire wing including the ailerons was skinned with plywood, carefully filled and smoothed to ensure that the wing profile was close to the intended shape. The fuselage was not unusual, a wooden semi monocoque construction of frames and light longerons, with a small sprung skid for landing. The tailplane was quite small.

Such a structure made the Spillo unusually heavy and the wing loading was higher than any contemporary sailplane. Given very good soaring conditions it would have been capable of high cross-country speeds. It was, however, too specialised for general use. Only one was built. In 1958 attempts were made to improve the climbing ability of the Spillo by fitting trailing edge flaps. This entailed a slight increase in weight and a very small increase in wing area, but there was no disguising the fact that the Spillo was too ambitious for the structural materials available.

The Spillo was flown at the 1954 World Championship at Camphill in England, where the bending of the wing during winch launches caused a good deal of excitement, if not consternation The bumps on some parts of the airfield were too much for the small skid. Damage resulted. There were no troubles in the air, except that this was not the weather for the Spillo. Flown by R Brigliadori, it was able to score on only one of the four very poor soaring days. Brigliadori was not alone in this.



Mass empty 270 kg
In flight 360 kg
Wing area 11.35 sq m (10.97 sq m)
Aspect ratio 28.6 (29.6)
Wing loading 31.8 kg/sq m (32.8 kg/sq m)
Centre of gravity range
33 - 36% m.a.c.

Ciani EC 37/53 Spillo

1953 (modified 1958)

Drawn by Martin Simons 2002 ©

POLAND

The IS - 1 Sep is now an exhibit in the Musuem Lotnictwa Polskiego, Krakow. Photo from Anrdjez Glass.

The rebuilding of the Polish sailplane design and construction industry after 1945 was centered at Bielsko Biala in the south of the country, about 30 km southwest of Krakow. Here the Instytut Szybownictwa (IS, Soaring Institute) was set up and staffed by a dozen or so engineers and pilots. Their first task was to produce four types of glider, a primary trainer, a training sailplane, a medium performance sailplane for general club use and a high performance sailplane of international competition standard. The primary glider, IS - 3 ABC, was straightforward and several hundred were soon built. One of the old Salamandra type had survived and was used as the basis for an improved version which entered production as the Salamandra 48. The Polish-designed Komar had been built under licence in Yugoslavia and although all the original plans had been destroyed, a set was provided from Budapest and production began again.

It was usual in Poland to fit battery driven navigation lights to sailplanes, to permit night flying. The appropriate lights were, red at the port, or left, wing tip, green on the starboard tip, and white near the top of the rudder. These were found on many Polish sailplanes though they were not, as a rule, installed on exported aircraft. How much night flying was done in Poland is not clear, but there always was some interest in duration flights extending into or through the dark hours.

Cloud flying and even storm flying was permitted. Although probably not sufficient protection against a full lightning strike, internal electrical bonding of all metal parts, control rods and wires etc., was usual and there were static discharge 'wicks' at the tips of wings, tailplanes and fins.

The undercarriage on many Polish sailplanes of this period was a laminated ash skid cushioned with a long pneumatic tube, rather than separate skid rubbers. The canvas side fairings for the skid were laced with cord, rendering access to the tube for repairs or pumping up easier. As elsewhere, there was a two wheeled 'drop off' dolly which required some care on take off. Releasing it too soon caused it to bounce up and strike the fuselage or tailplane, doing damage. Dropping too late would damage the dolly or bury it in the earth.

IS - 1 Sep

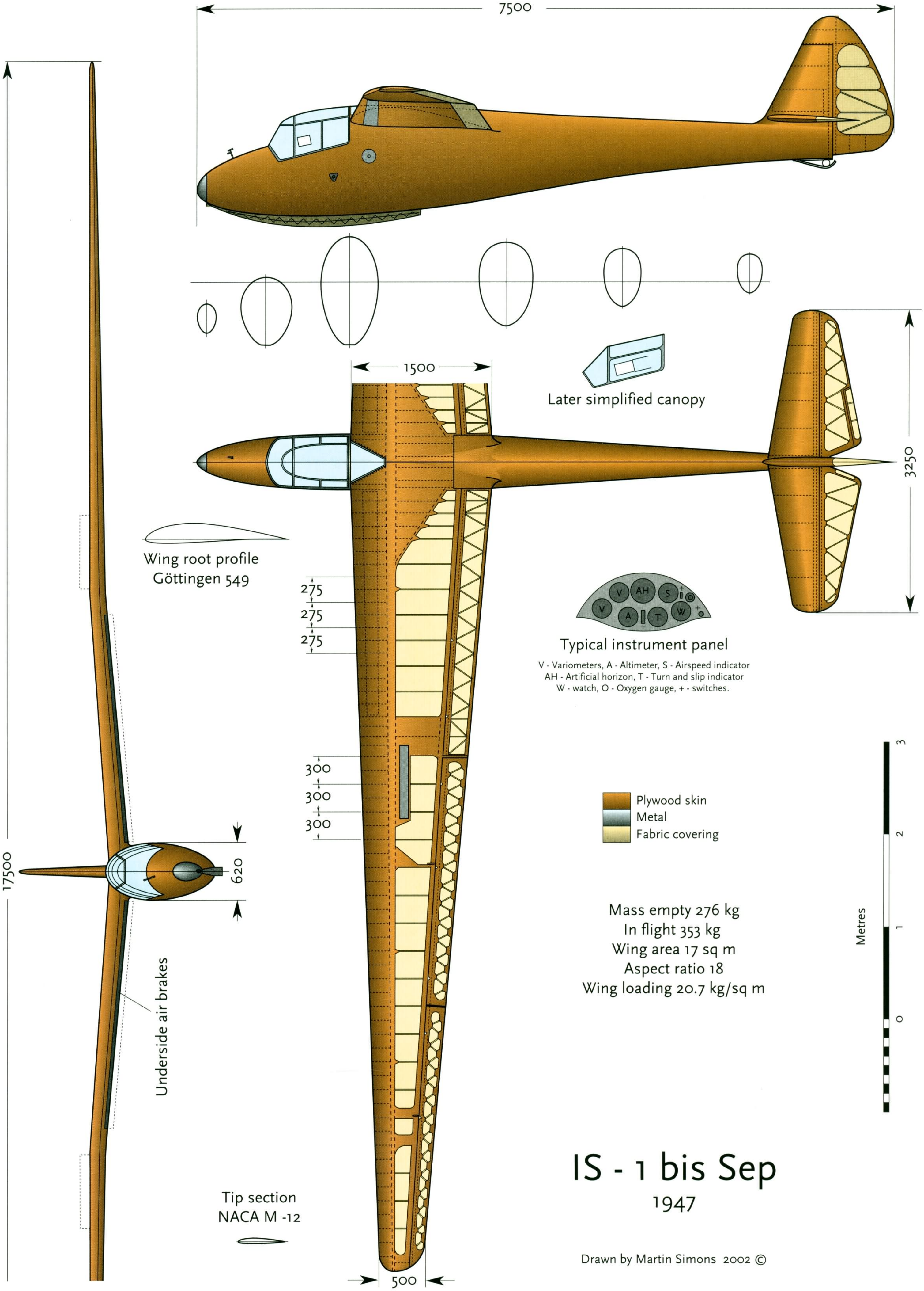
The high performance IS - 1 Sep (Vulture), of wooden construction, was drafted and stressed by the engineers Wladyslaw Nowakowski and Jozef Niespal. It was decided to keep the wing span under eighteen metres, and the flying weight expected was about 315 kg. A gull wing with straight taper was adopted. There were flaps which could be lowered by 15 degrees for soaring and 30 - 40 degrees for landing. The ailerons, in two sections, moved with the flaps by one third of the flap angle. There were air brakes under the leading edge of the wing, a system which had proved successful on the Orlik of 1939. Opening the brakes produced a loud moaning noise which earned the Sep the nickname of 'Howler'. They were redesigned later. There were spoilers on the upper surface too. The tail and the fuselage, of elliptical cross section, were orthodox. The Sep was provided with a normal tow release in the nose, and a bungee hook. On either side of the fuselage about level with the pilot's elbows, there were additional tow hooks for a Y ended towline, allowing considerably higher winch launches than the nose hook. With this location of the tow attachment point, the loads on the tailplane during a winch launch were much reduced.

The prototype Sep was completed early in 1947 and the first flight was in June. It nearly ended in disaster because the ailerons were connected the wrong way round. The sailplane was in the air before this was discovered but the pilot, Piotr Mynarski, realised what was wrong, released the tow and was able to get the glider down safely.

Further tests were satisfactory and the Sep was taken to an international meeting held by the Swiss Aeroclub at Samedan in the High Alps, in July. This became a dress rehearsal for the World Championships which were held there the following year. In the informal competition the Sep, flown by Adam Zientek, achieved eighth place. He won a speed task on one day.

Following advice from the test pilots, various modifications were made including the new airbrakes, increasing the dihedral and the aileron movement. The cockpit was made more compact. Entering production, the mass, empty, had risen now to 276 kg. In the World Championships of 1948 the Poles registered three Seps and a Mucha, but the team was withdrawn from the competition before it began, presumably for political reasons.

Seps took the first three places in the Polish nationals that year and were used to break many National records. Irena Kempowna set


7500
1500
Later simplified canopy
3250
Wing root profile
Göttingen 549
275
275
275
Typical instrument panel
V - Variometers, A - Altimeter, S - Airspeed indicator
AH - Artificial horizon, T - Turn and slip indicator
W - watch, O - Oxygen gauge, + - switches.
300
300
300
Plywood skin
Metal
Fabric covering
17500
620
Underside air brakes
Mass empty 276 kg
In flight 353 kg
Wing area 17 sq m
Aspect ratio 18
Wing loading 20.7 kg/sq m
Metres
0
1
2
3
IS - 1 bis Sep
1947
Tip section
NACA M -12
Drawn by Martin Simons 2002 ©
500

the International Feminine Record for speed round a 100 km triangle in 1949. Only six Seps were produced but some were still in use in the early 'sixties. One survives in the Krakow Aviation Museum.

The Mucha series

The second sailplane designed by the ISZ group was the IS - 2 Mucha (Fly). It was intended for club use, replacing the Komar, but had a good enough performance for cross-country flying and simple aerobatics. In the interests of economy, the best quality materials were saved for the main spar and other vital structural members. Timber of slightly lower standard was used for the secondary structure. The outcome was a simple and practical fifteen-metre sailplane which flew in April 1948. Twenty were built. The original airbrakes were not satisfactory and were redesigned, and a wheel was fitted after clubs requested it. The Mucha - ter was developed by 1950 and 114 were built at several factories, including Jezow, the former Grunau, now renamed. Further small improvements followed, the final total produced reaching more than 150.

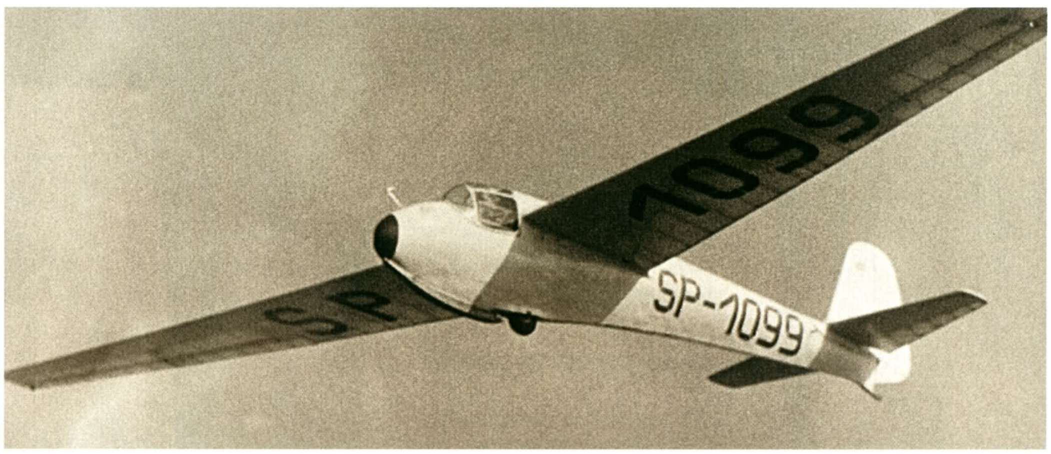
In 1948 the IS was renamed the Szybowcowego Zakladu Dóswiadczalnego (SZD, Sailplane Experimental Institute) but the personnel were retained. Taking opinions from the clubs and their pilots, together with ideas from the original design team, an improved Mucha, the SZD - 12 Mucha 100, flew in 1953.

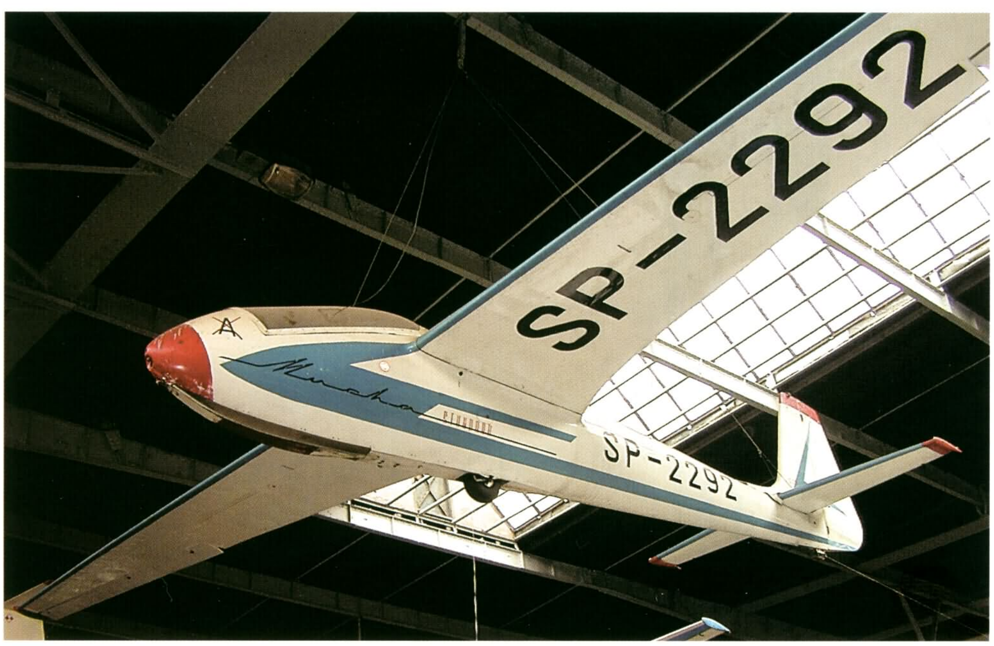
The wing was little changed aerodynamically but the spars, ribs and trailing edges were simplified, the ailerons were made more effective and airbrakes of the Schempp-Hirth type were adopted. The fuselage was improved to increase the comfort of the pilot and to give better all round view. The angle of incidence of the wing was reduced by 2 degrees, so aligning the fuselage better with the airflow at high speeds.

During test flying the ailerons developed severe flutter causing the pilot to bail out. External mass balances under the wing cured this when production started and on the Mucha 100 A of 1958 the external balances were replaced by a metal bar built into the aileron leading edges ahead of the hinges. A retrospective modification applied to many of the sailplanes already built, was to move the wheel back relative to the un-laden centre of gravity, reducing the load on the tail lifting handle during ground handling.

The Mucha 100 proved very popular and more than 350 were built. There were multiple orders from several countries including the USSR, East Germany, Italy, Switzerland, and China. Single examples went to Austria, France, Finland and India. Production was undertaken under licence in China. The Mucha 100 was used as the basis for the Chinese Lie Fang 1 sailplane, which flew in 1958.

The final development of the Mucha came in 1957 when the FAI gliding commission established the Standard Class. The intention was to encourage the development of sailplanes suitable for club use; simple, practical and inexpensive, yet capable of good performance. In some ways the specification was reminiscent of the 1939

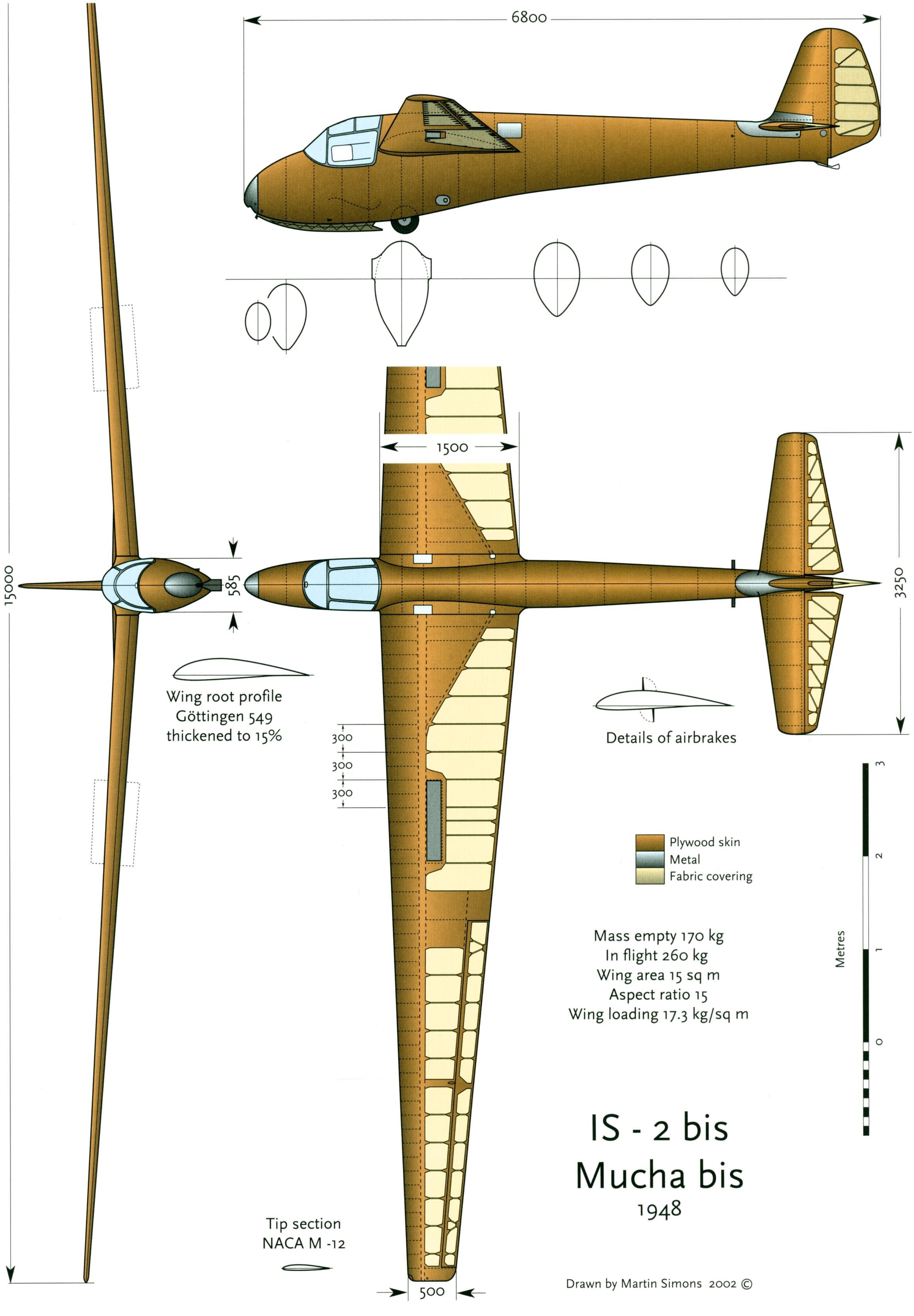




Top: Mucha IS - 2, photo by B Koszewski

Above: SZD 12 Mucha 100, property of the Krakow Museum.

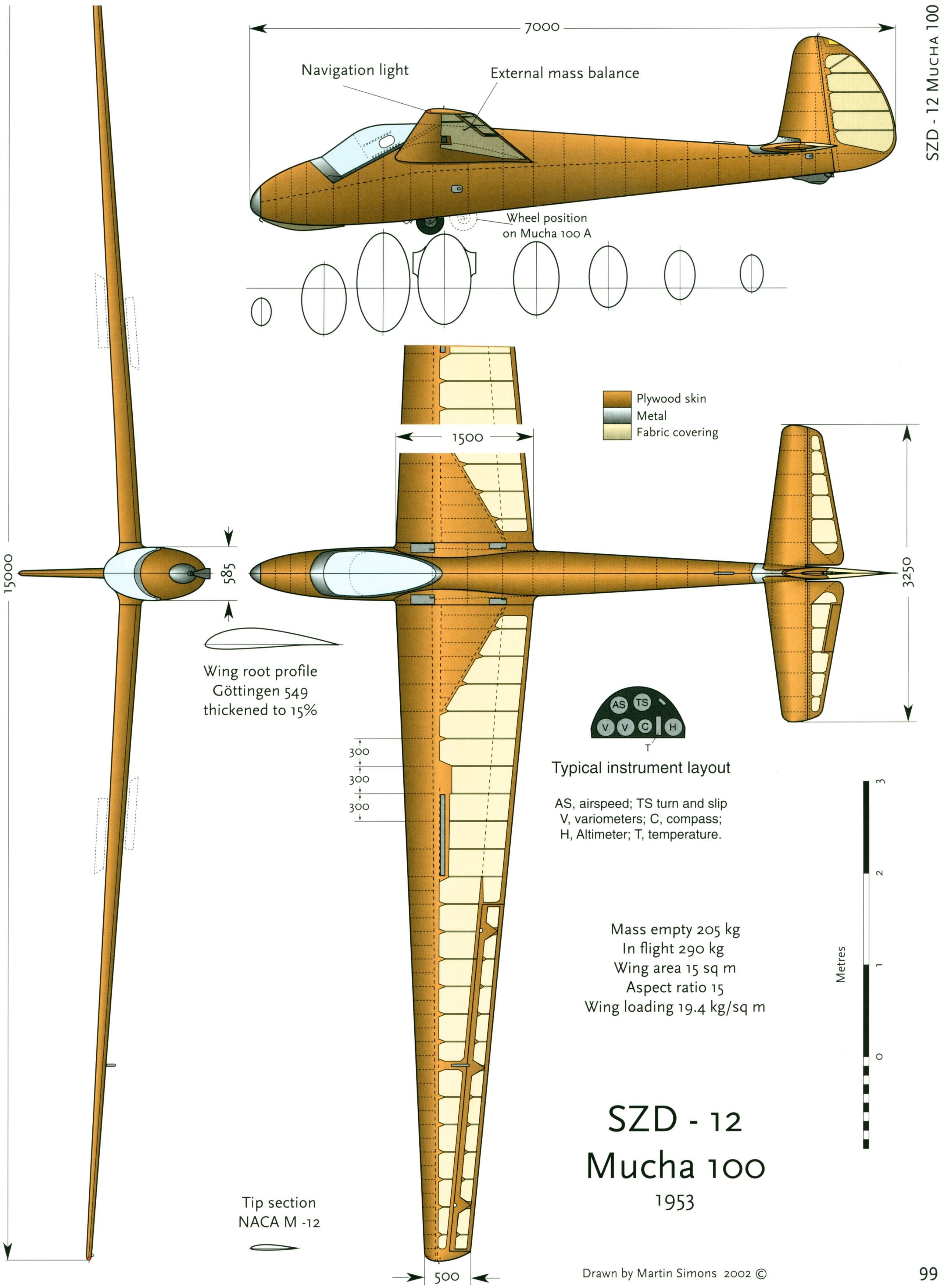
Left: Mucha Standard on display in the Krakow Museum. Photo from Vincenzo Pedrielli

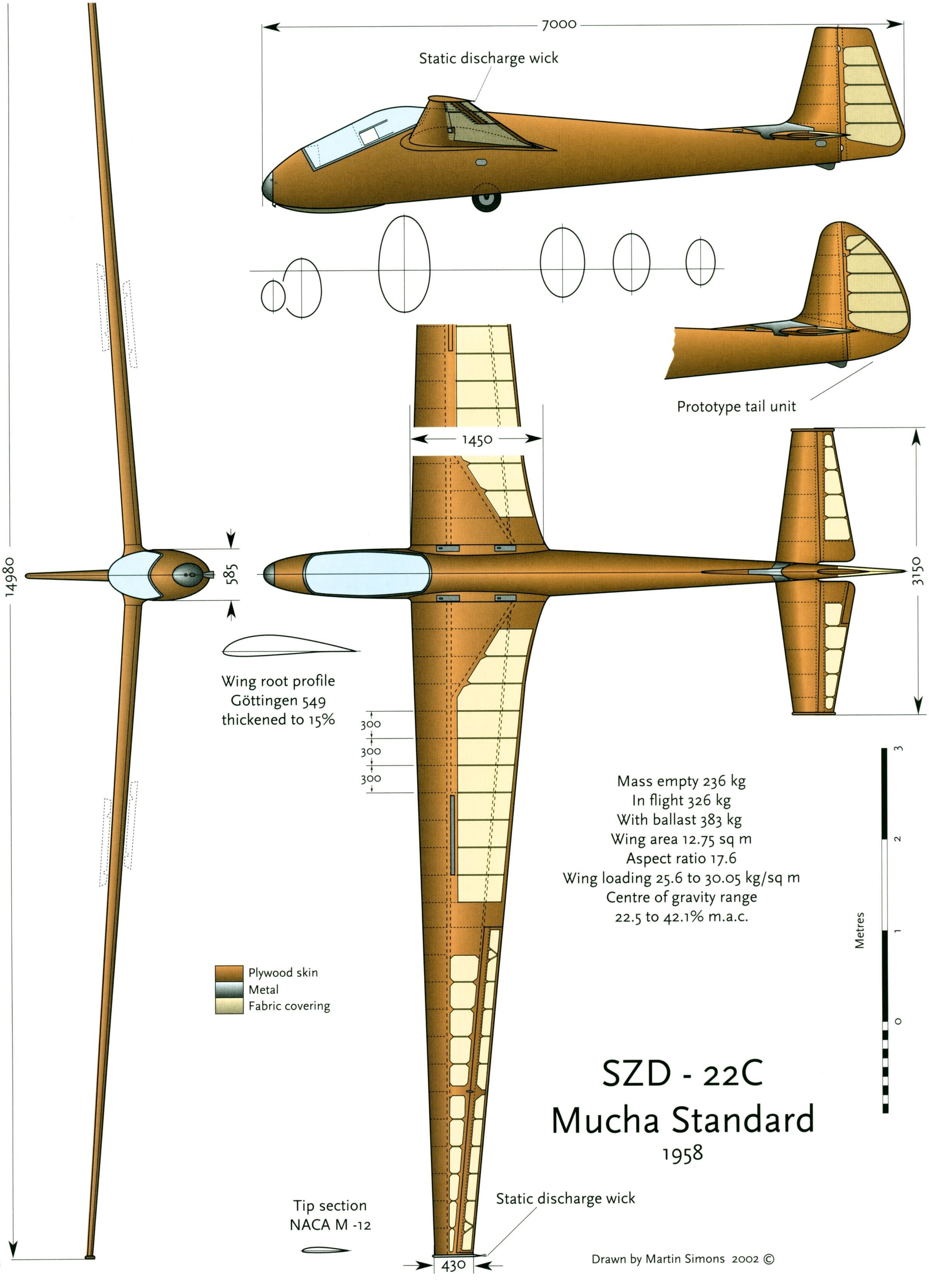


Mass empty 170 kg
In flight 260 kg
Wing area 15 sq m
Aspect ratio 15
Wing loading 17.3 kg/sq m

IS - 2 bis
Mucha bis
1948

Drawn by Martin Simons 2002 ©


SZD - 12 Mucha 100
7000
Navigation light
External mass balance
Wheel position
on Mucha 100 A
Plywood skin
Metal
Fabric covering
1500
3250
15000
585
Wing root profile
Göttingen 549
thickened to 15%
Typical instrument layout
AS
TS
V
V
C
H
T
AS, airspeed; TS turn and slip
V, variometers; C, compass;
H, Altimeter; T, temperature.
300
300
300
Metres
0
1
2
3
Mass empty 205 kg
In flight 290 kg
Wing area 15 sq m
Aspect ratio 15
Wing loading 19.4 kg/sq m
Tip section
NACA M -12
500
SZD - 12
Mucha 100
1953
Drawn by Martin Simons 2002 ©


7000
Static discharge wick
Prototype tail unit
1450
14980
585
3150
Wing root profile
Göttingen 549
thickened to 15%
300
300
300
Mass empty 236 kg
In flight 326 kg
With ballast 383 kg
Wing area 12.75 sq m
Aspect ratio 17.6
Wing loading 25.6 to 30.05 kg/sq m
Centre of gravity range
22.5 to 42.1% m.a.c.
3
2
1
0
Metres
Plywood skin
Metal
Fabric covering
SZD - 22C
Mucha Standard
1958
Tip section
NACA M -12
Static discharge wick
430
Drawn by Martin Simons 2002 ©

Olympic Games Design Competition and, as before, there was a good deal of latitude in the interpretation. The wing span was limited to 15 metres. There must be no complications like flaps or water ballast. Powerful air brakes and a non-retractable landing wheel were required. The materials used must not be rare or costly and the methods of construction not too elaborate. The Organisation Scientifique et Technical du Vol a Voile (OSTIV) announced that there would be a design prize for the sailplane that best satisfied both the spirit and the rules of the specification.

The first occasion when the World Championships would be divided into Open and Standard Class, was the 1958 meeting at Leszno. With all the experience of the earlier Mucha series behind them, the design team of Wladyslaw Nowakowski and Rudolf Grzywaczwy worked quickly. Two prototypes of the SZD - 22 Mucha Standard were completed in time. In one of them Adam Witek became the first Standard Class World Champion. The Mucha Standard was placed second for the design prize, beaten by the Kaiser Ka - 6.

After these important successes, the Mucha Standard was reviewed in detail preparatory to large-scale production. The most obvious external change was replacement of the rounded form of the vertical tail with a more angular, stylish shape but there were many internal alterations in the interests of easier manufacture. Further modifications appeared as production went on, the most popular version being the SZD - 22C. Several hundred were produced with exports to 21 different countries. The Mucha Standard wing was also used again for the SZD - 15 Lis of 1960, another sailplane aimed at the general club market, but which was hardly known outside Poland.

IS - 5 Kaczka

The Bielsko team resolved in 1948 to investigate some unorthodox sailplane layouts, the first of which was the IS - 5 Kaczka (Duck) or 'Canard'. This was entirely a research aircraft and was modified and re-modified many times. On the first low hop in March 1949 the test pilot, Mynarski, found it impossible to reduce the airspeed for landing. The foreplane was re-rigged and ballast added in the nose. It was then possible to fly the glider and aerotows were done, but it proved dangerous to get into the slipstream from the tug, since directional control was immediately lost. Control in pitch was very sensitive and the sensation in turbulent air distinctly unpleasant for the pilot. It was described as like driving a truck over a series of potholes.

Work was abandoned for seven years because of pressure of other projects, but in 1959 the Kaczka was flown again. There were about five distinct versions, rudders and ailerons being changed, increased elevator and rudder areas, and even a centre of gravity made variable in flight by means of a threaded rod carrying a weight. The weight could be screwed forward or back as the pilot chose. The

A rare photograph of the experimental IS - 5 Kazka

leading edge of the foreplane was fitted with a slot, and so on. Mynarski eventually accumulated about 35 hours flying time in the canard, with 117 launches. There was little progress and the glider was eventually lost in a hangar fire at Lodz in 1961.

(IS - 6X) SZD - 6X Nietoperz

The SZD - 6X Nietoperz (Bat) was intended to provide experience with tailless aircraft and was never expected to enter production. The combination of sweep forward over the inner panels of the wing with sweepback towards the tips, was adopted because it allowed the vertical stabiliser and rudder, mounted at the rear of the nacelle, to operate on a relatively long moment arm. The sweepback was necessary to allow the wing tips, with washout, to provide stability in pitch. The basic layout having been decided, various changes to the control and stabilising surfaces were made to discover what effects each alteration had. The trailing edge control surfaces were in three portions which could be geared in different ways. The outermost sections, fabricated in metal, formed the ailerons, which acted also as airbrakes by opening in clamshell fashion. As brakes they proved ineffective at high airspeeds but could be used for the landing approach.

The aircraft, built of wood, was tested in three main configurations:

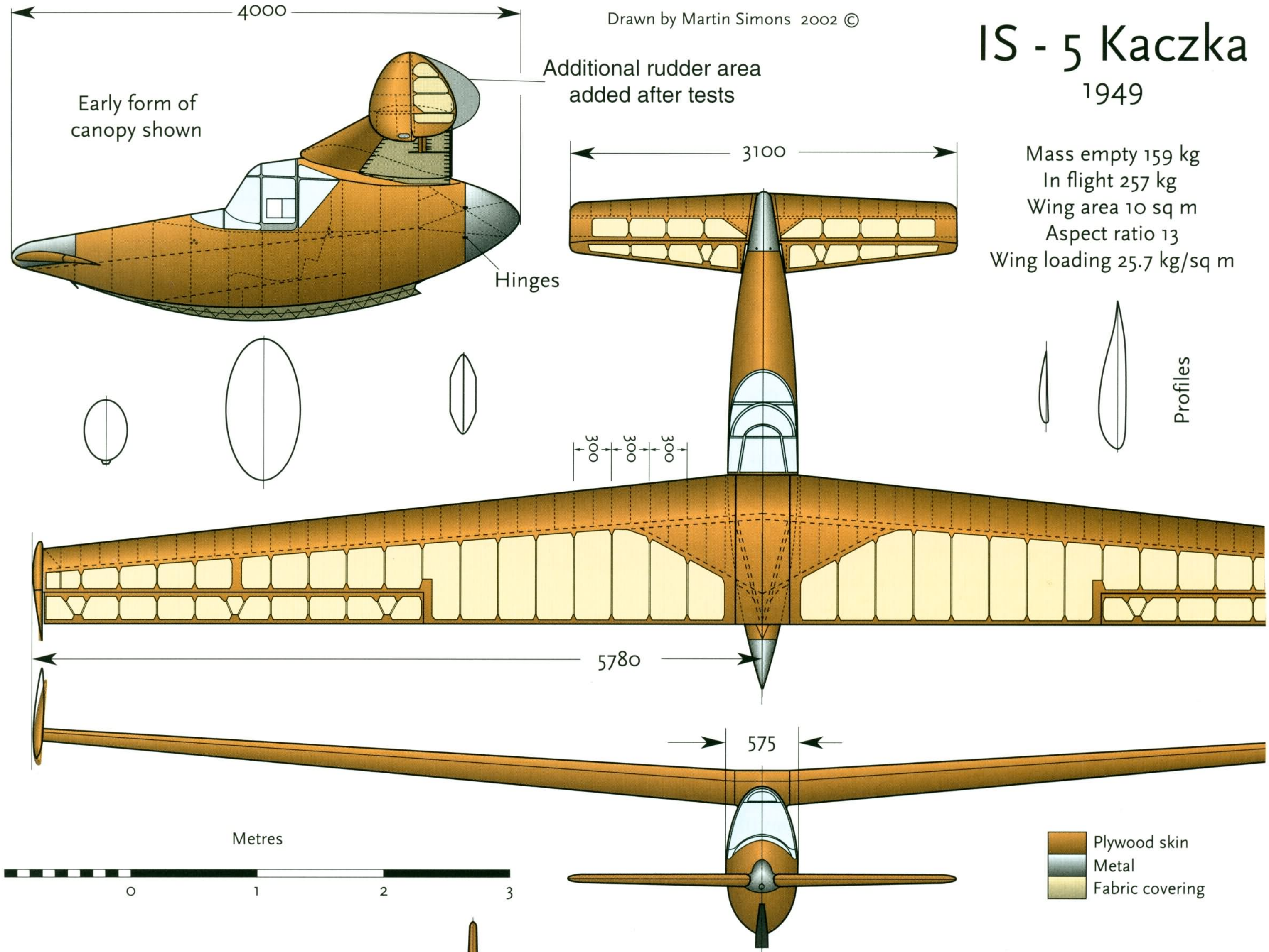
1) With elevons but no independent elevator. Early difficulties with take off were overcome and towed flights to 2000 metres were made successfully. The glider proved quite stable in pitch and could be flown on tow with hands off the stick. The position relative to the tug could be adjusted by the pilot moving forward or back in the seat without touching the controls. Lateral stability was not good but acceptable. Simple aerobatics were possible.
2) The rudder was locked in neutral. Lateral control was barely adequate.

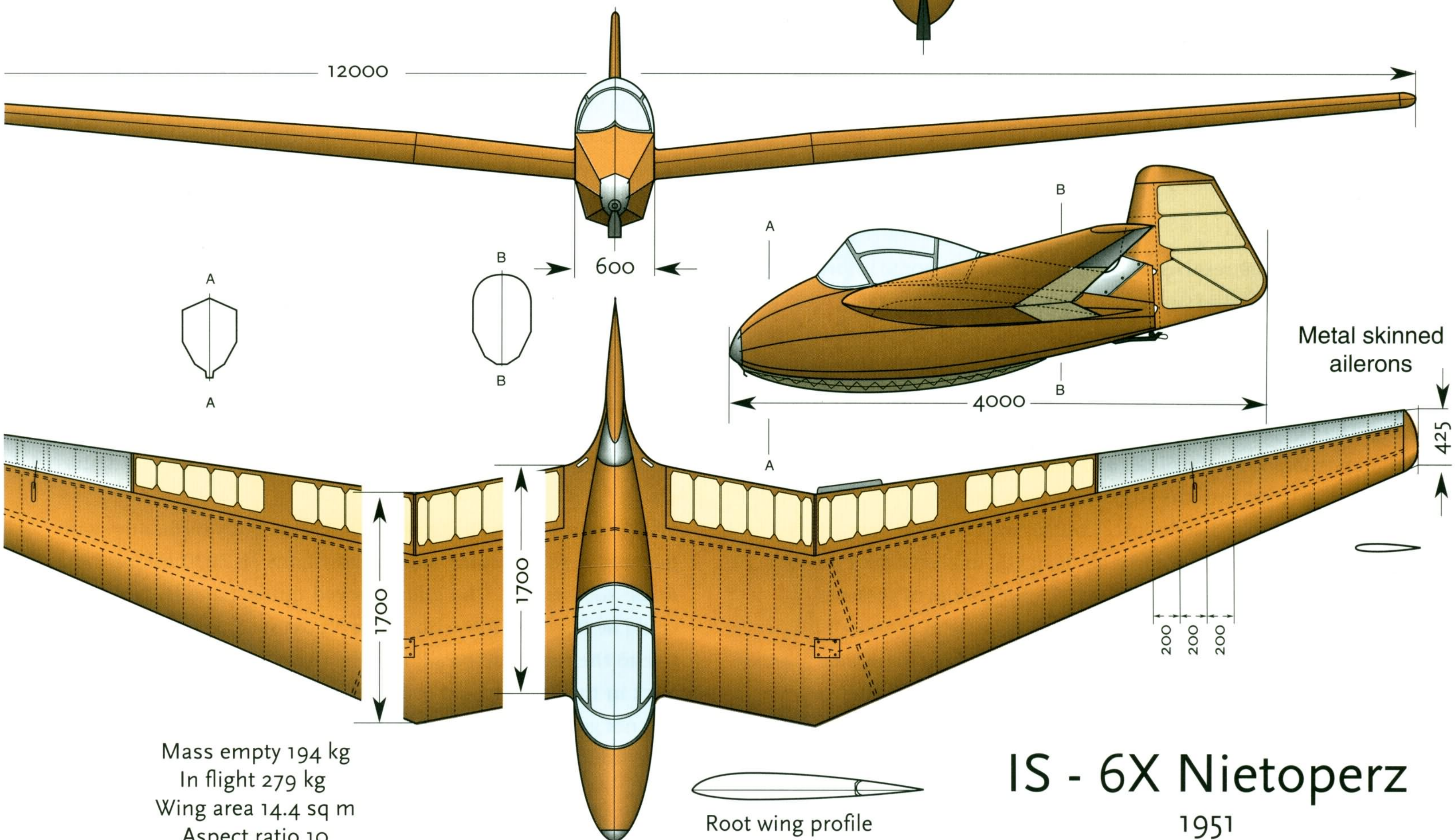
Drawn by Martin Simons 2002 ©

IS - 5 Kaczka

1949

Mass empty 159 kg
In flight 257 kg
Wing area 10 sq m
Aspect ratio 13
Wing loading 25.7 kg/sq m



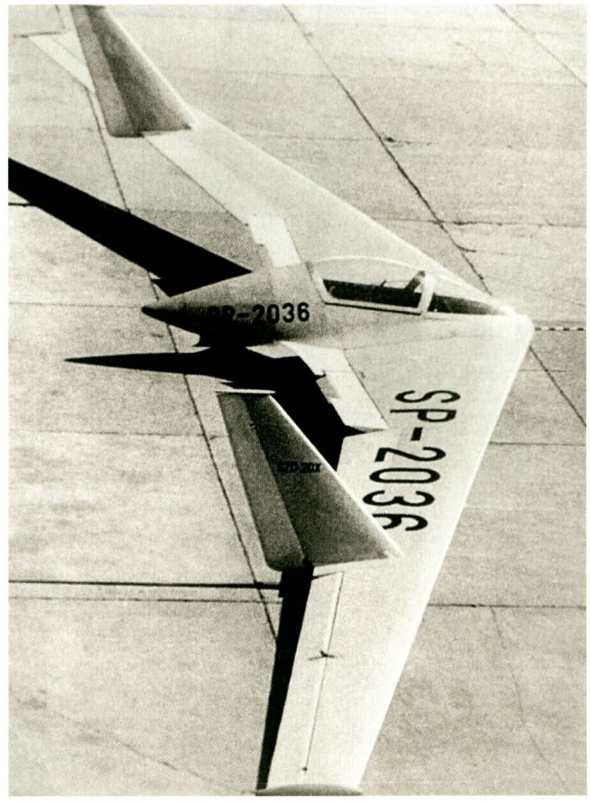


IS - 6X Nietoperz

1951

Mass empty 194 kg
In flight 279 kg
Wing area 14.4 sq m
Aspect ratio 10
Wing loading 18.7 kg/sq m

Above: The IS - 6X Nietoperz



Left: The SZD - 20X Wampir of 1950 o 51, an unsuccessful attempt to equal or surpass the performance of orthodox sailplanes

3) The rudder was removed altogether. Lacking corrective action against adverse yaw, applying the ailerons produced a nose down pitch and roll in the opposite sense to that intended, followed by a steepening spiral dive.

The tests were enough to persuade most pilots not to fly the Nietoperz, but Adam Zientek persisted with it for some time before it was finally grounded. It was transferred to the Museum in Krakow.

SZD - 20X Wampir

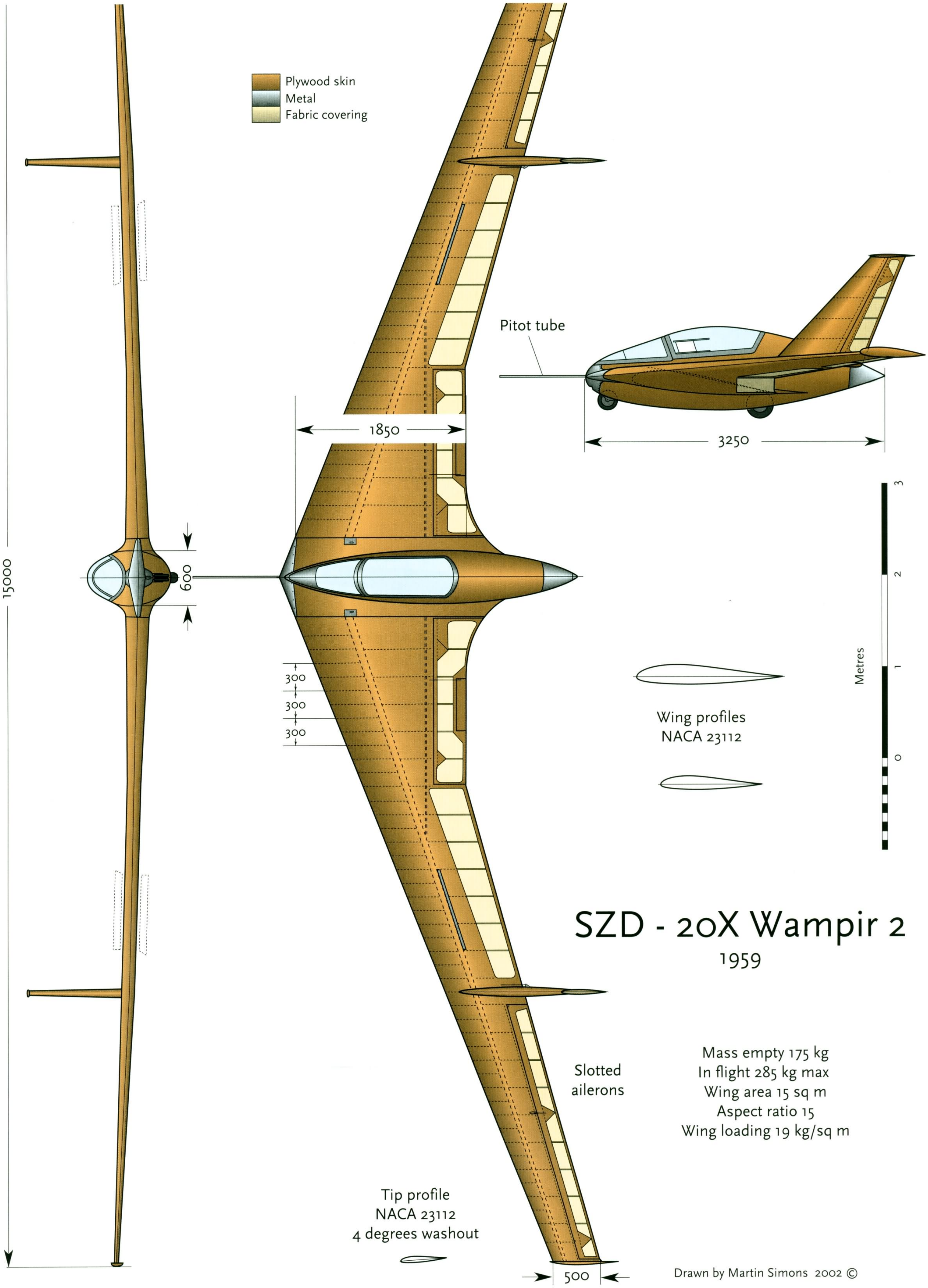
It was thought that enough had been learned from the Nietoperz to enable a tailless sailplane to be built that would have flight characteristics and handling not much more difficult than an orthodox type. The design of an SZD - 13X Wampir 1 began in 1955, with wind tunnel model tests to confirm the major features, but this project was shelved for three years because of other work. When revived the SZD - 20X Wampir 2 resulted. It was intended to have a wing similar in general dimensions to that of the Mucha, to enable performance comparisons to be made on a fair basis. The wooden wing was swept back and built with the necessary washout (negative twist). Two large vertical, swept-back fins with rudders were mounted on the wing more than half way to the tips. The ailerons, mass balanced, were mounted entirely outboard of the fins, the elevators were inboard to avoid mutual interference between the control surfaces in their different positions. A mechanism was provided enabling the pilot to couple or uncouple the elevator and the ailerons to give an elevon effect, for flight trials. Airbrakes were of duralumin. The pilot was housed in a carefully streamlined nacelle, a steel tube frame with a light plywood shell and moulded transparent canopy.

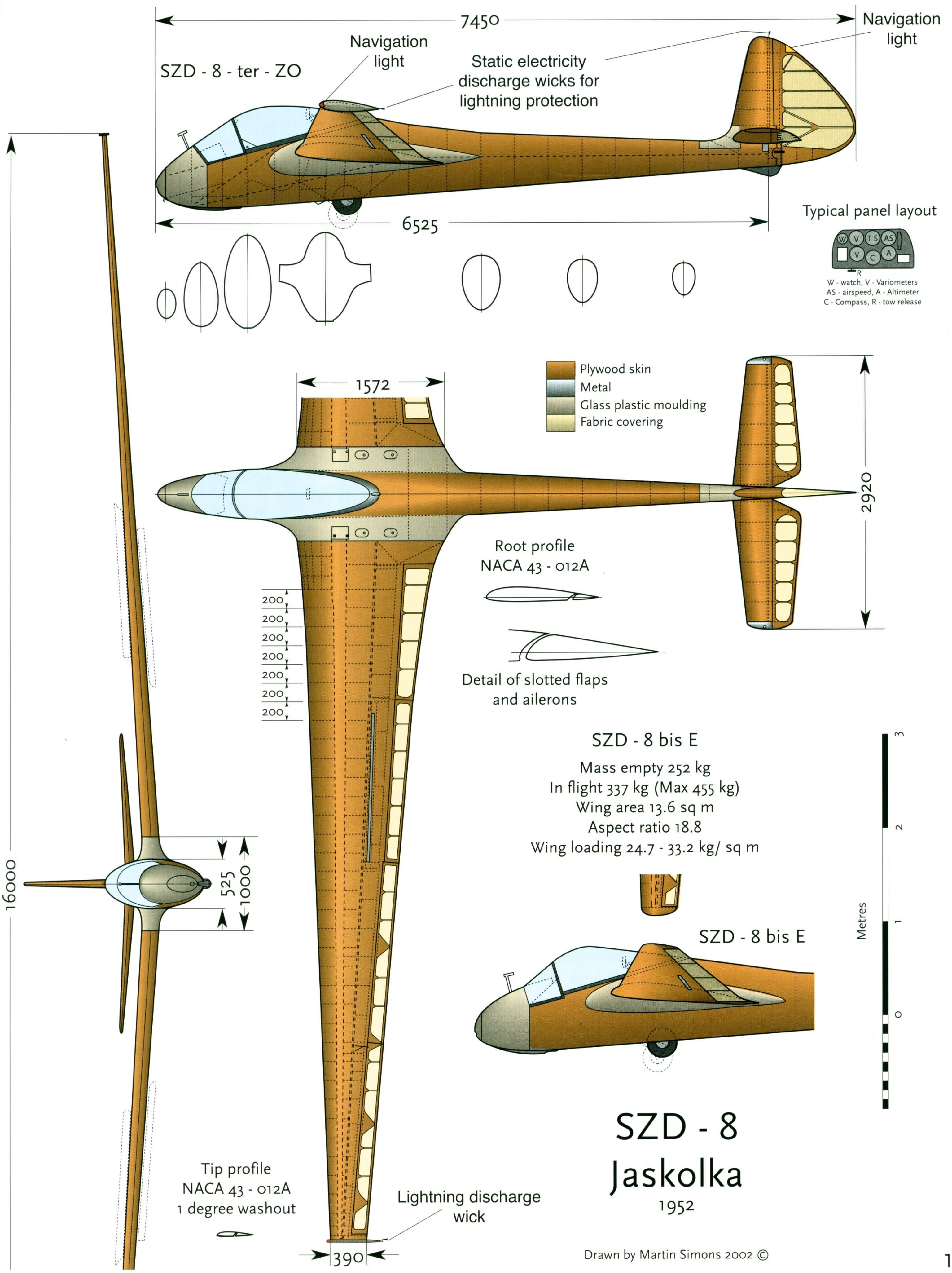
Adam Zientek carried out the test flights in September 1959. Taking off from anything but a very smooth surface was difficult. The wing tips were very near the ground and in the early stages of a launch, lacking enough airspeed for control, a wing tip going down would cause an immediate ground loop. Operations on grass airfields were impossible. On aerotow, entry to the slipstream caused loss of control. The airbrakes caused strong pitching tendencies when landing and needed care. The first stalling test produced a spin. The Wampir would not recover until the pilot, Adam Zientek, moved himself as far forward as possible in the seat to shift the centre of gravity forward.

Finally, during a test at moderately fast gliding speed, serious flutter developed and a bale out became necessary. The Wampir project was abandoned.

SZD - 8 Jaskolka

The Jaskolka (Swallow) was designed during 1950 - 51 by a team led by Tadeus Kostia. It was intended to be a high performance sailplane capable of cloud flying and simple aerobatics. It was basically of wooden construction but for the first time in Poland, large use was made of moulded glass-fibre-reinforced plastics (GRP) for the complex curved parts, especially the large wing root fairings and the nose cone. The wing was straight tapered but the roots widened and deepened considerably to join the fuselage where the fairings also gave the pilot some useful extra elbow room and storage space. The NACA 5 digit series wing profiles were used. The flaps and ailerons were slotted. The airbrakes were further back on the wing than usual but of adequate area. Streamlined tip bodies


Plywood skin
Metal
Fabric covering
15000
600
1850
300
300
300
500
Pitot tube
3250
Metres
0
1
2
3
Wing profiles
NACA 23112
Tip profile
NACA 23112
4 degrees washout
Slotted
ailerons
SZD - 20X Wampir 2
1959
Mass empty 175 kg
In flight 285 kg max
Wing area 15 sq m
Aspect ratio 15
Wing loading 19 kg/sq m
Drawn by Martin Simons 2002 ©


7450
SZD - 8 - ter - ZO
Navigation light
Static electricity discharge wicks for lightning protection
Navigation light
6525
Typical panel layout
W - watch, V - Variometers
AS - airspeed, A - Altimeter
C - Compass, R - tow release
1572
Plywood skin
Metal
Glass plastic moulding
Fabric covering
2920
Root profile
NACA 43 - 012A
Detail of slotted flaps and ailerons
200
200
200
200
200
200
200
SZD - 8 bis E
Mass empty 252 kg
In flight 337 kg (Max 455 kg)
Wing area 13.6 sq m
Aspect ratio 18.8
Wing loading 24.7 - 33.2 kg/ sq m
16000
525
1000
SZD - 8 bis E
Metres
0
1
2
3
Tip profile
NACA 43 - 012A
1 degree washout
Lightning discharge wick
390
SZD - 8
Jaskolka
1952
Drawn by Martin Simons 2002 ©

The later versions of the Jaskolka, SZD - 8 - ter ZO, had a smooth shape for the nose and front cockpit canopy. The canopy slid back on rails to allow access to the cockpit.

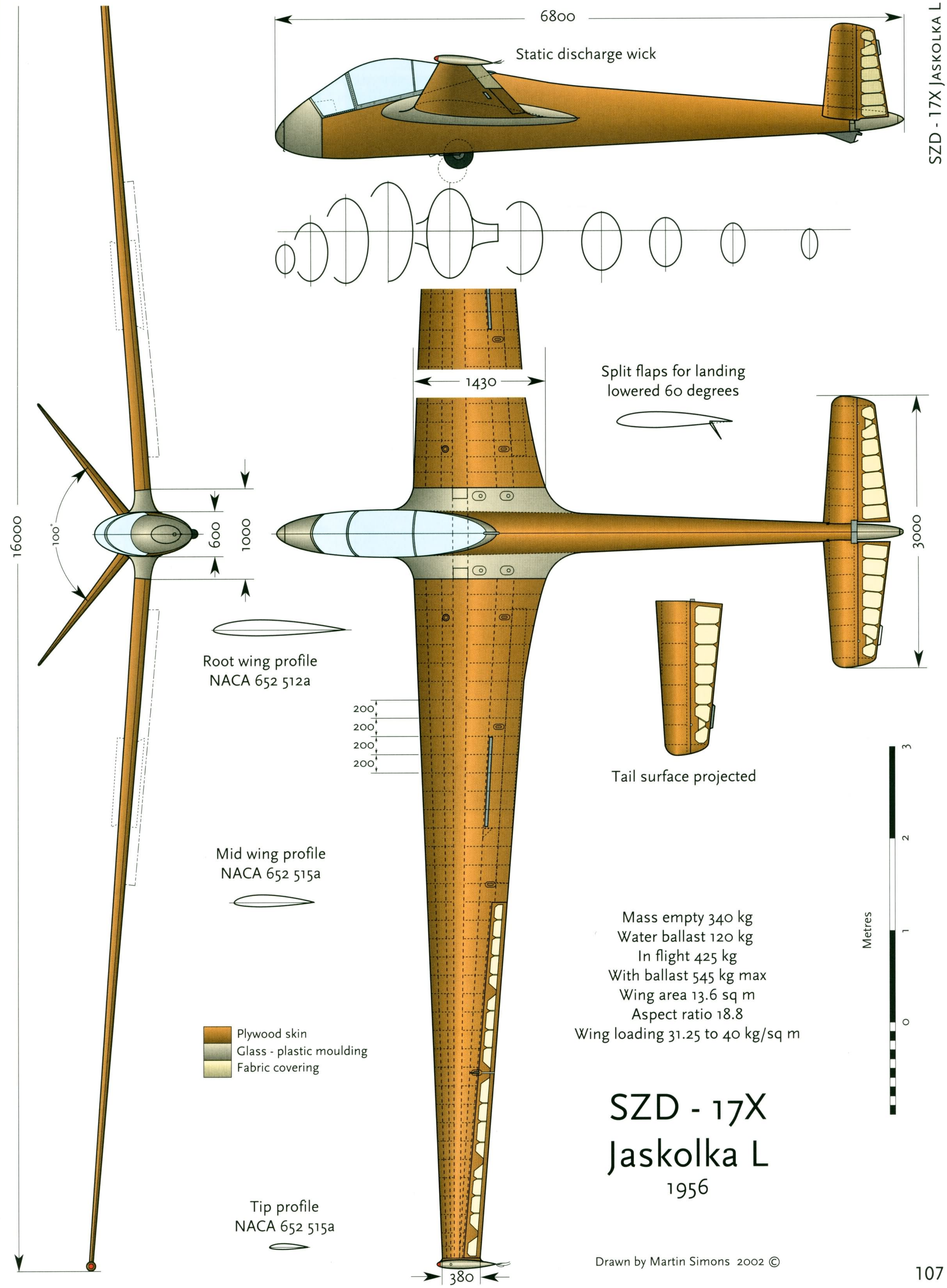
Above: The Jaskolka - 8 - bis W was fitted with water ballast tanks, here being filled before a contest flight. Left: The V tailed SZD - 17X Jaskolka L in the museum at Krakow. Photo V Pedrielli

were mainly for protection of the ailerons from contact with the ground if a wing went down during take off. The vertical tail was orthodox but the tailplane had a slight dihedral angle, to keep it clear of the ground. For transport it folded up against the fin. The fuselage, plywood skinned except for the glass-plastic areas, was of approximately oval cross section. The cockpit canopy, unusually for a sailplane, slid back on light rails. The wheel was semi retractable.

First flights were in September 1951 with Adam Zientek in the cockpit. He found many minor defects caused by the complexity of the control systems and the various linkages. The sailplane also seemed to be unusually noisy. Much more alarming, the prototype was nearly lost when it went into an irrecoverable flat spin. Zientek (as he had in the Wampir) shifted forward as far as possible in the seat and was able to pull out. Thorough mathematical analysis of the spin was carried out, and very extensive testing was done (not all by Zientek). Development went ahead, with a lengthened fuselage and enlarged tail. The source of the noise was traced to the shape of the canopy, which was redesigned.

The second prototype flew without difficulties in December 1951. Performance trials showed that the Jaskolka was superior to the Mucha. Production of what was now termed the SZD - 8 -bis Jaskolka began with 30 aircraft and further orders came in. The SZD - 8 - bis E model followed. The SZD - 8- bis W had provision for 95 litres of water ballast to be carried in wing tanks. As production and demand continued more improvements were made, the most obvious to the external eye being the improved front cockpit canopy introduced with the SZD - 8- ter ZO model, which was the final production version.

The Jaskolka broke many World Records, for example the 100 and 200 km triangle speed tasks, a goal and return feminine record flight of 565 km by Pela Majeswka, and others. At the 1956 World Championships in France, a Jaskolka flown by Gorzelak placed third in the Open Class. In 1958 at Leszno Edward Makula, flying a Jaskolka, placed fifth in the Open Class and there were ten other pilots flying Jaskolkas. Many of the SZD - 8 were exported, the total produced exceeding 150.


SZD - 17X Jaskolka L
6800
Static discharge wick
1430
Split flaps for landing
lowered 60 degrees
3000
16000
100°
600
1000
Root wing profile
NACA 652 512a
200
200
200
200
Tail surface projected
Mid wing profile
NACA 652 515a
Mass empty 340 kg
Water ballast 120 kg
In flight 425 kg
With ballast 545 kg max
Wing area 13.6 sq m
Aspect ratio 18.8
Wing loading 31.25 to 40 kg/sq m
Metres
0
1
2
3
Plywood skin
Glass - plastic moulding
Fabric covering
SZD - 17X
Jaskolka L
1956
Tip profile
NACA 652 515a
Drawn by Martin Simons 2002 ©
380

Above: Bocian SZD - 9 bis C, photo from the Museum Lotnikctwa Polskiego, Krakow.
Left: Bocian on winch launch in Queensland, Australia.

Jaskolka variants that never reached production status were many. A Rudlicki tail (V-tail) version was built in 1951, the SZD - 14X.[24] During spinning tests the torsion loads on the fuselage were so great that the tail was nearly torn off. The pilot, Adam Dziurzyinski, prepared to bail out but finding he could just retain control he stayed with the sailplane and managed to land safely. The tail unit was rotated through 45 degrees and was attached only by one longeron and a small piece of ply skin.

The V - tail idea was reintroduced later when the last version of all the Jaskolkas was developed, the SZD - 17X Jaskolka L. The L here stood for Laminar. The capacity of the ballast tanks was much increased, the undercarriage was made fully retractable. Four were built but by this time, in the minds of the SZD team, an entirely new Open Class sailplane was beginning to take shape.

SZD - 9 Bocian

The decision to produce a new high performance two-seater was taken early in 1950. The SZD - 9 was to have a good cross-country performance and to be capable of cloud flying, blind flying training and high altitude soaring. The pilots were to sit in tandem, the rear seat being on the centre of gravity allowing the sailplane to be flown solo from the front cockpit. The wing was mounted at a high mid position on the fuselage, with sweep forward to allow the main load-carrying structure to be located behind the rear seat. The span was 18 metres and the NACA 5 digit profiles were chosen, 18% of the chord in thickness at the root, tapering to 12% at the tips. The structure was all-wooden, the wing being skinned with plywood back to the rear spar. The ailerons were slotted and divided into two sections. Air brakes of the Schempp-Hirth type were adopted, located at the 50% chord point.

The fuselage, of elliptical section, was deep and the rear seat slightly higher than the front one, allowing some view ahead for the second pilot. In the prototypes and for early production the canopy was built up in sections but later was replaced by bubble mouldings. There was a large wheel and a small front skid. The tail plane was mounted on a sub fin with a dorsal extension.

Adam Zientek flew the prototype in March 1952. As often with a prototype there were many defects, some serious and others less so. Ground handling was difficult because of the forward location of the wheel, and it was too easy to rig the tailplane with the elevator disconnected. The rudder was judged inadequate. All the stick loads and the forces required to open and close the brakes were too high. The necessary changes led to a new prototype being built by June 1952. Performance measurements suggested that the rigging angle of the wing should be changed to align the fuselage better with the airflow.

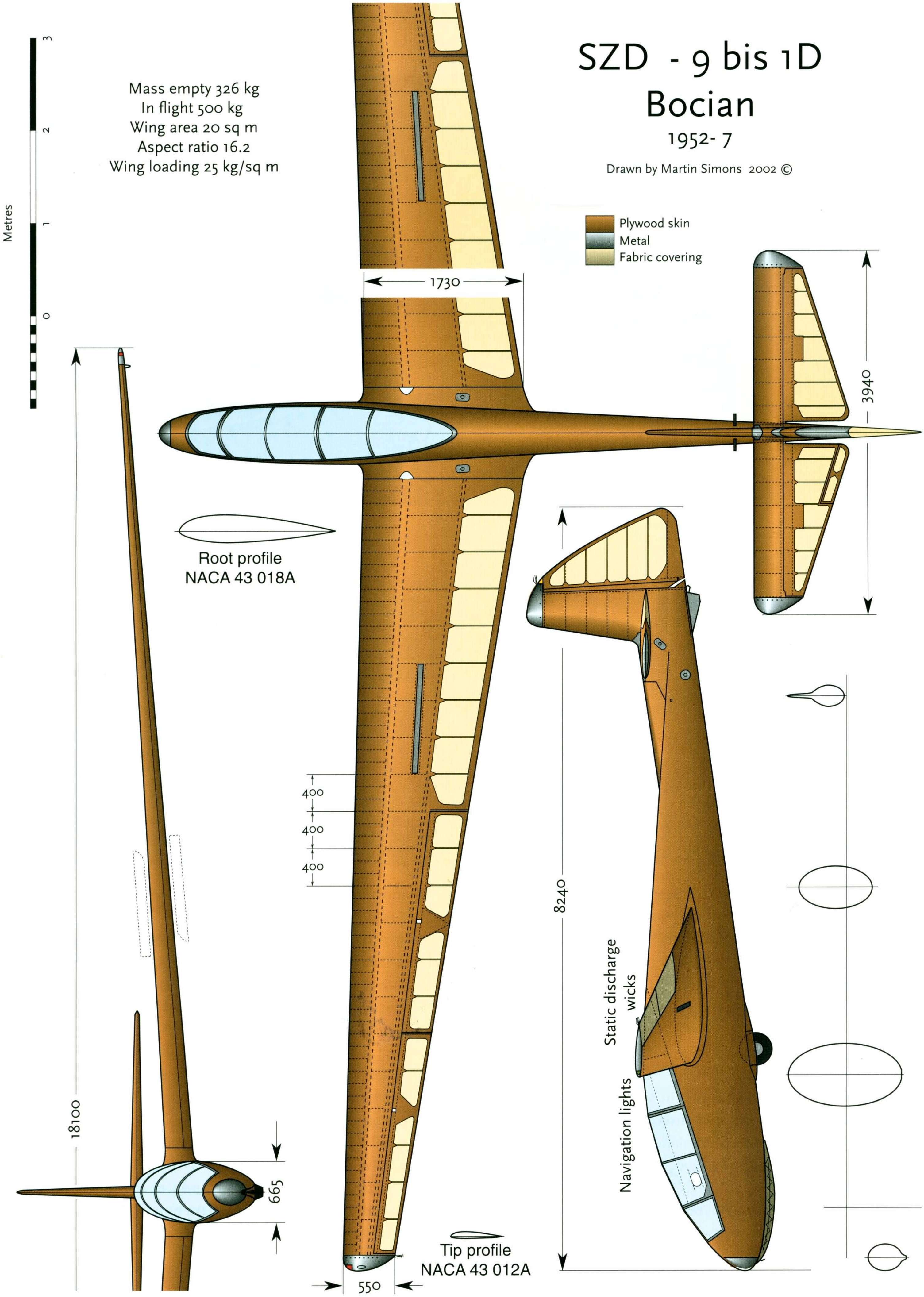
24 - In Poland the V - tail is termed a Rudlicki tail. It was originally flight tested in 1931 by the Polish engineer J Rudlicki in 1931 and proved successful. The original idea was mooted in 1910 by the Germans Hopfenwieser and Höfinger, but they never reached the flight test stage.

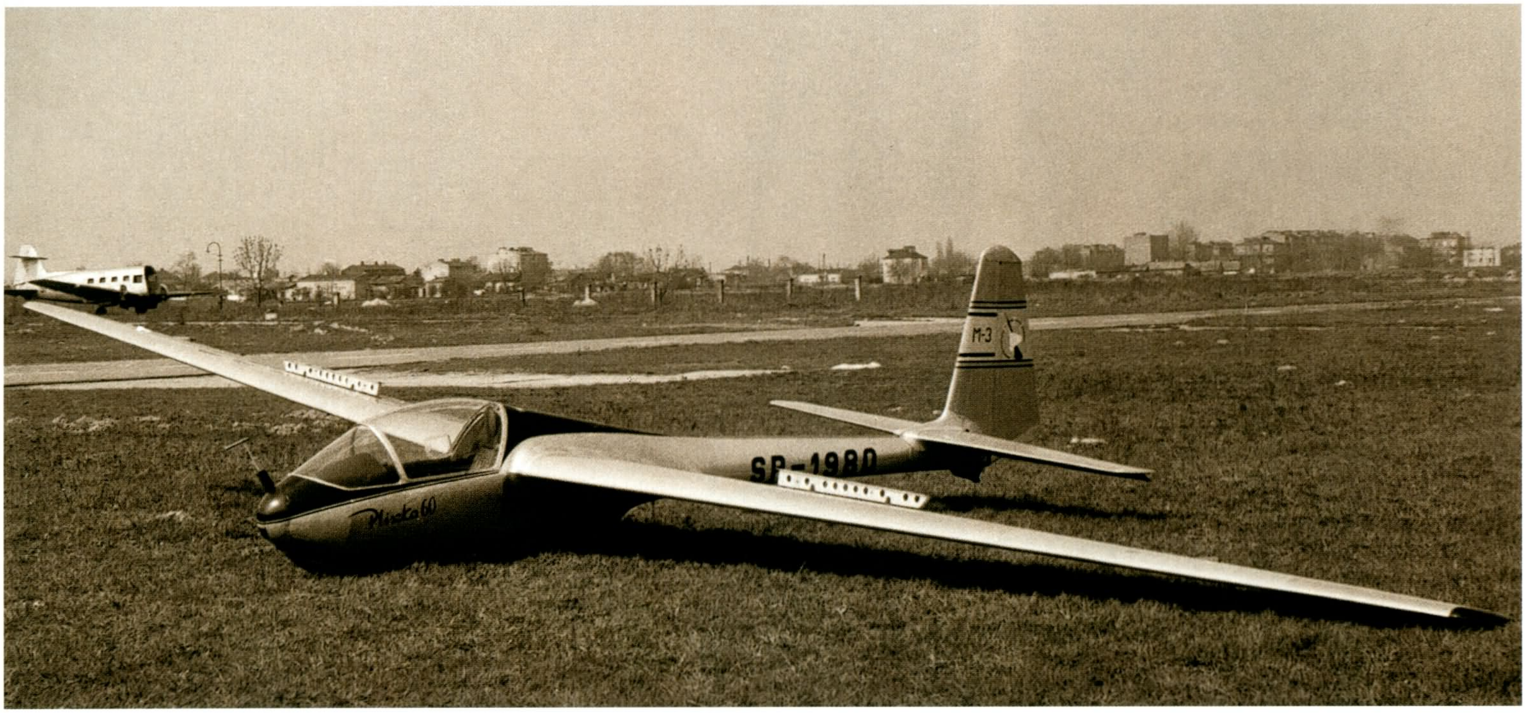
SZD - 9 bis 1D
Bocian

1952- 7

Drawn by Martin Simons 2002 ©

Mass empty 326 kg
In flight 500 kg
Wing area 20 sq m
Aspect ratio 16.2
Wing loading 25 kg/sq m





Above and right: The second prototype of the M - 3 Pliszka of 1959. Despite promising performance, the type did not enter production.

After some further work the first limited production was undertaken at Jesow (ex Grunau) from March 1953. After a thorough testing during the Polish national Championships, the SZD - 9 - bis 1C, or Bocian C, entered production. The final version, the Bocian D, flew in 1958 and was exported in large numbers. A total of 645 were built and many remained in service in 2002. There were experiments with several versions which did not go into production, including one with pulsejet propulsion.

The Bocian established many two seat World Records, including a goal and return of 543 km, a speed of 61.7 km/h for the 300 km triangle and the feminine goal and return of 400 km by Pela Majewska. At St Yan in 1956 the Polish team of Nowotarski and Sandauer took 6th place in the Bocian.

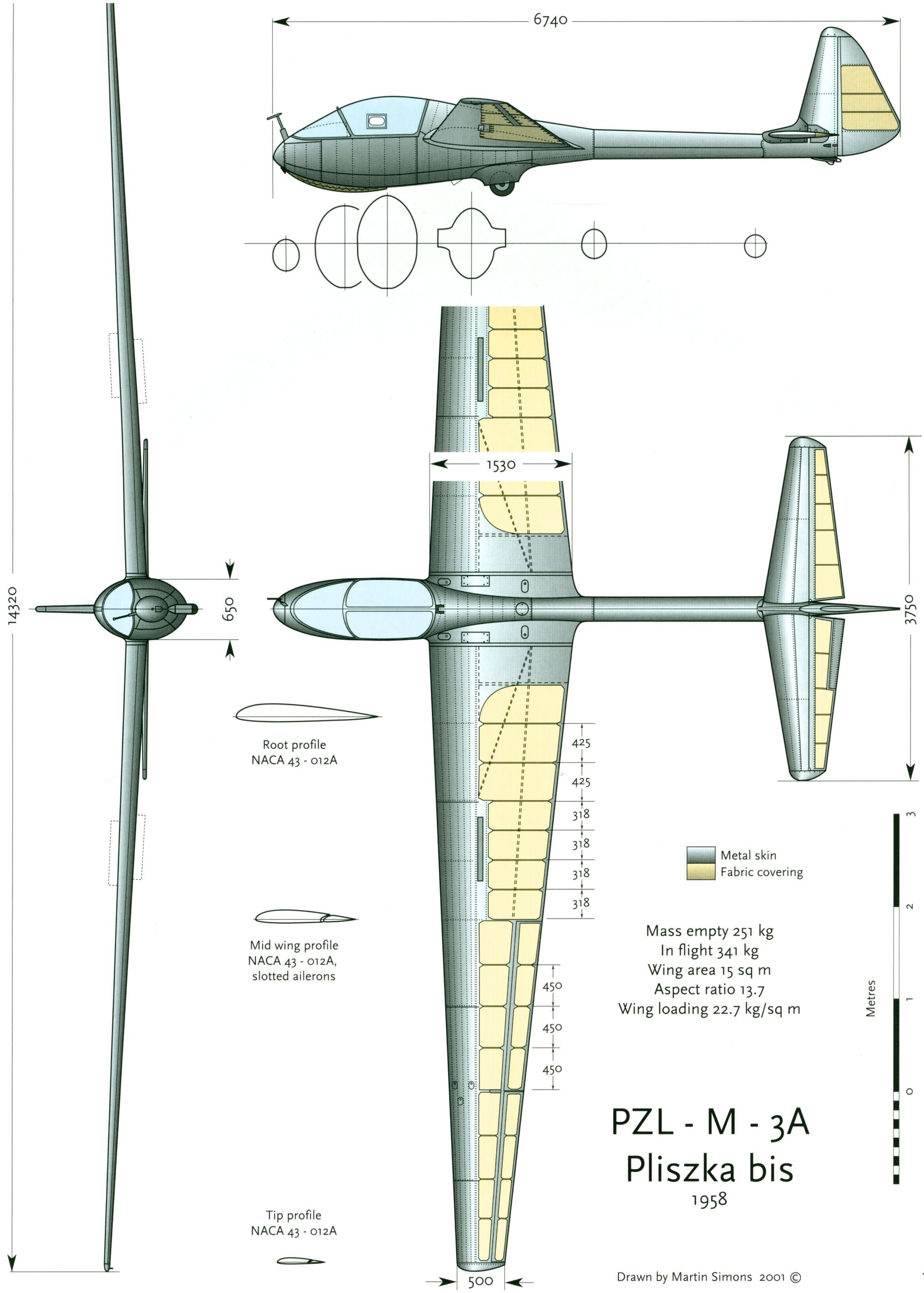
PZL M - 3 Pliszka

A new, young design team at the factory in Mielek, the WSK (Wytwórnie Sprzetu Komunikacyjngoe, Transport Equipment Works), decided in 1956 that an all metal sailplane would have many advantages, and began work on the Mielek 1, Pliszka (Wagtail). The more experienced SZD group encouraged them.

In pre-war times the Polish Aircraft Industry became widely known by the initials PZL. (Panstwowych Zakladów Lotniczych, State Aviation Factory). This name had been replaced by WSK, but in 1957 the old PZL title was reinstated.

Other work delayed construction of the WSK/PZL Pliszka project and it was 1959 before the prototype flew. Initial results were encouraging, the sailplane handled well and its performance exceeded that of the Mucha 100. The group attributed this to the accuracy of the wing profile, because of the metal skin. Following suggestions from the test pilots, a second prototype was built but the performance was less good, partly because the workmanship was somewhat poorer. In other respects the results were still satisfactory so a third prototype, the M - 3A Pliszka - bis was built for testing in 1961. To allow a full range of aerobatics, the structure was strengthened, increasing the mass by 25kg.

A decision by the government planners to concentrate glider manufacture in Bielsko caused the Pliszka project to be abandoned and no further development took place.



Mass empty 251 kg
In flight 341 kg
Wing area 15 sq m
Aspect ratio 13.7
Wing loading 22.7 kg/sq m

PZL - M - 3A Pliszka bis

1958

Drawn by Martin Simons 2001 ©

The Fi - 1 was designed and flown in Sweden. Wing and tail were based on the DFS Meise, but some interesting methods were used in constructing the fuselage.

Sweden

In 1936 glider pilot Rudolf Abelin joined a canoe building company in Båastad. He had worked at De Havillands in England. He introduced the idea of using moulded veneers to construct the hulls. Before long the company's range of products was expanded to include sailplanes and gliders. It moved to Halmstad and changed its name to AB Flygindustrie. German sailplane types were built under licence.

Flygindustrie Fi - 1

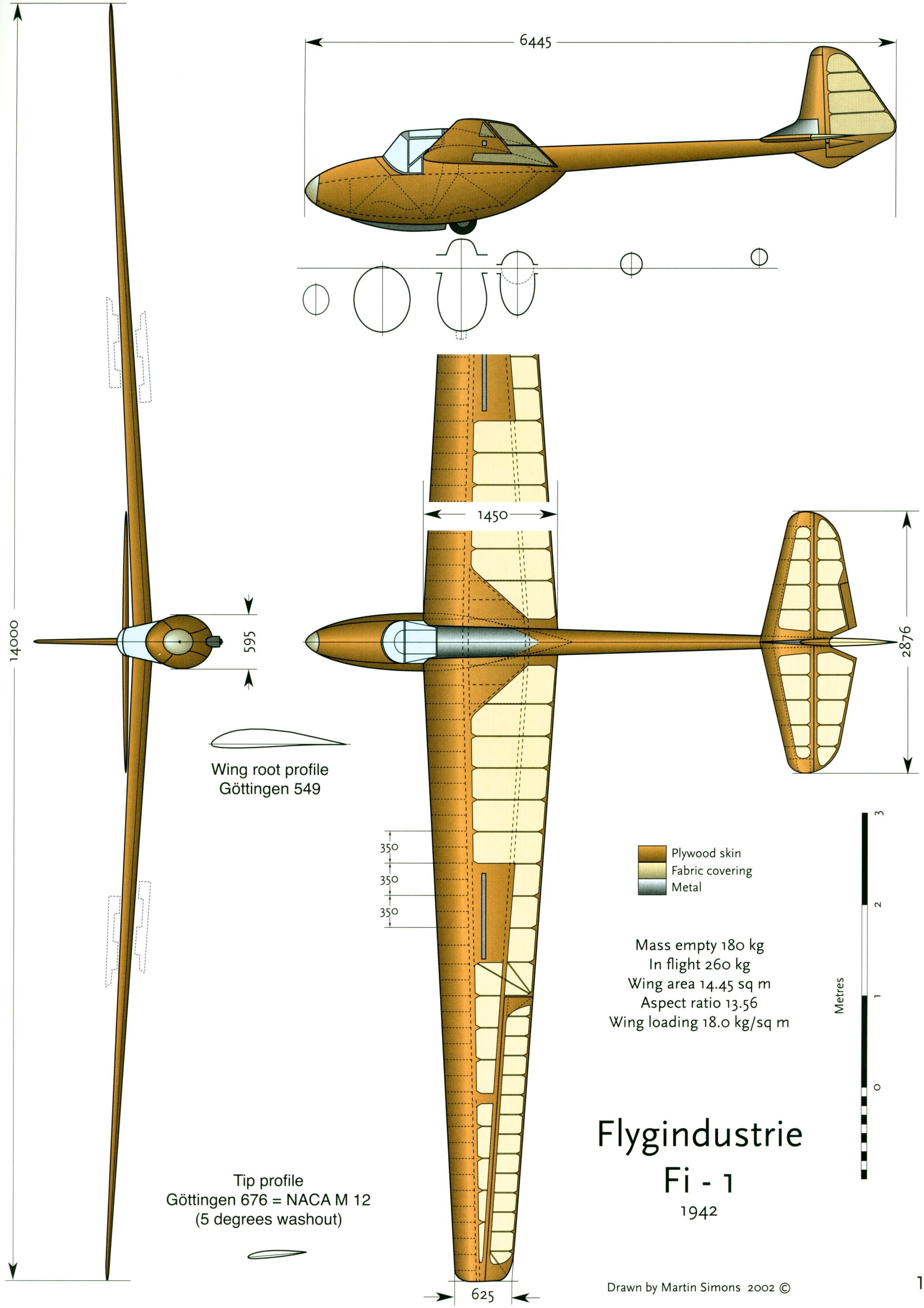
The Fi - 1 strictly falls outside the dates of this book, but is included to show that there was at least the beginnings of an indigenous sailplane design industry in Sweden, which has produced many outstanding pilots and World Champions. The Fi - 1 also incorporated some innovative ideas which deserved further development.

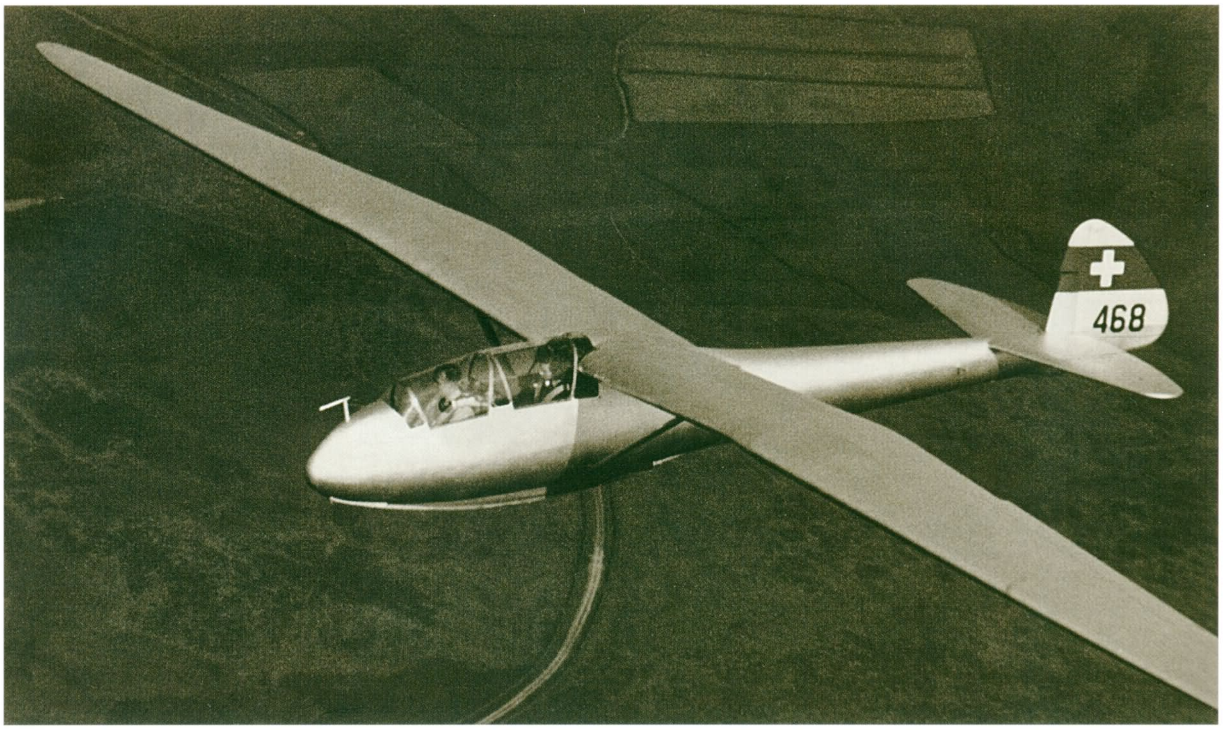
The Fi - 1 was originally intended to be an improvement on the Grunau Baby for early solo pilots, but it grew into something a good deal better. The wing was based closely on that of the German Meise (Olympia), but the span was reduced to 14 metres. The tail unit also was similar to the Meise.

The fuselage was original and incorporated some interesting structural methods, inherited from the canoe factory. The front pod housing the pilot and controls was a steel tube framework with a light moulded wooden shell to give it a well-streamlined and smooth form. Multiple strips of veneer were laid up in criss-cross fashion with glue over a male form. A vacuum bag pressed the shell onto the form and all was baked in an autoclave for two hours. The rear fuselage was a circular sectioned wooden tube, produced by wrapping layers of Finnish birch plywood round a mandrel and baking under pressure for at least a full day. The nose cone also was moulded over a male form, but in this case from rayon fabric impregnated with resin glue.

In flight the Fi - 1 was pleasing and suitable for aerobatics. The cockpit canopy was not well shaped at first and caused some flow turbulence, which affected the tail, but the shape was improved without great difficulty. The sailplane did not fulfil its intended function since it was too advanced for Grunau Baby pilots. Only seven were built. One went to the Polyteknisk Flyvegruppe in Copenhagen in 1949. The students there made some improvements and pilot K. A. Rasmussen flew it at the 1950 World Championships, held at Orebro. He placed 18th out of 29, which, in a sailplane intended for training, was a remarkably good result. The same sailplane was used for the first Gold C distance flight made in Denmark.

Another was exported to Iceland in 1945. It was flown for some years then languished in its trailer. It was brought back to Sweden and restored for the Alleberg Sailplane Museum.


6445
1450
2876
14000
595
350
350
350
625
Wing root profile
Göttingen 549
Tip profile
Göttingen 676 = NACA M 12
(5 degrees washout)
Plywood skin
Fabric covering
Metal
Mass empty 180 kg
In flight 260 kg
Wing area 14.45 sq m
Aspect ratio 13.56
Wing loading 18.0 kg/sq m
Metres
0
1
2
3
Flygindustrie
Fi - 1
1942
Drawn by Martin Simons 2002 ©



Above: The S - 25 with pilot, Hans Wurth, in England, 1947. Right: The S -25 was hired in 1947 for several months by the Derbyshire & Lancashire Gliding Club. It is shown above Camphill. Photo G Thompson

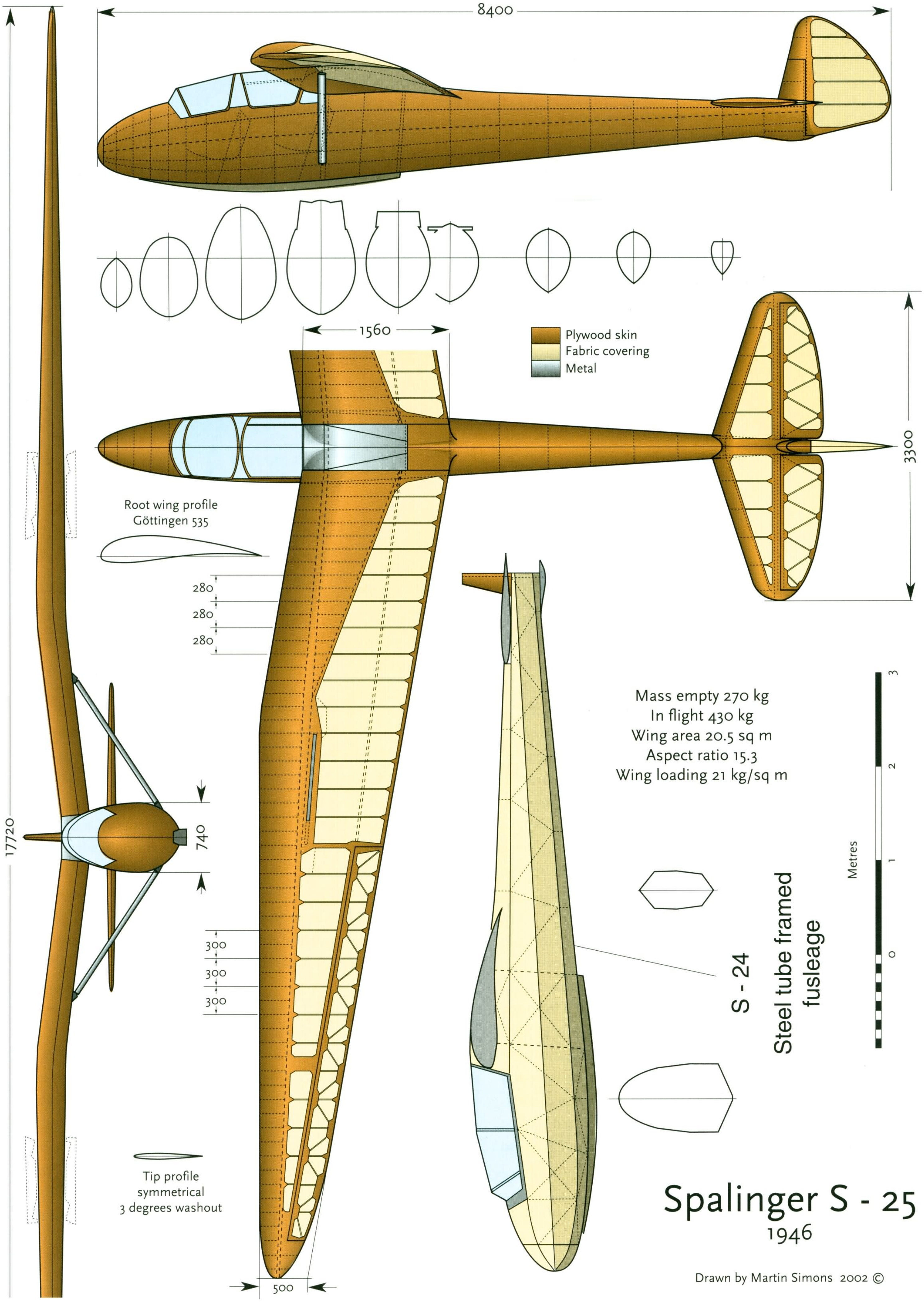
Right: The Spalinger 25 was Jacob Spalinger's last sailplane design. One was flown in England at the 1947 National Championships.

SWITZERLAND

1947 was a Renaissance year for Swiss soaring. Sigbert Maurer in spring broke a whole series of National records. In June a group, with two brand new Swiss sailplanes, flew as guests in the first British post war Nationals and made a great impression. A research group began to publish Alpine soaring maps based on pilot's experience in differing weather conditions, showing known good thermal areas, safe landing places in the mountains and warning of hazards. At the end of July the International Engadine Week at Samedan was arranged. "It will be recorded in the history of engineless flight and will impress itself indelibly on the memories of pilots and spectators alike," it was claimed. This came true. Teams arrived from France, Poland, Czechoslovakia, Egypt, Britain and Sweden to sample alpine soaring conditions. It was agreed that the 1948 World Championships, the first to be held since 1937, would be at Samedan.

Spalinger S - 25

Jacob Spalinger had a long series of successful sailplane designs to his credit and began work on a new two-seater, the S - 25, in 1942. It was at first thought of as the S - 21 III but as work went on it became obvious it needed a new designation. In the prevailing conditions of shortages and restrictions, the firm AG Wynau could not complete the prototype until June 1946. It was a gull winged wooden two-seater with seats in tandem. The solution to the problem of the rear pilot's view was similar to that used by Shenstone and Czerwinski for their Harbinger, and Castello for the CM - 7. The strut braced wing was swept forward over the centre section with the leading edge of the outer panels straight, creating an elbow. Spalinger had used a similar but less extreme plan for the S - 21of 1937. To avoid the complication of curving timber in two planes for the sweep forward and the gull dihedral, Spalinger continued the main spar straight to the root, with a diagonal member to take the torsional loads and the single strut to carry the bend-



Spalinger S - 25

1946

Drawn by Martin Simons 2002 ©

The WLM 1 was fast, strong and built like a watch. It competed in the 1948 World Championships at Samedan.

ing moment. This allowed the spar to be much lighter since the bending loads at the root were nil. The wing structure was orthodox, with plywood skinning over the front third ahead of the spar. The plywood grain was laid diagonally to improve torsional stiffness. The name of the wing profile was not recorded but measurements taken from the construction plans show it was the familiar Göttingen 535.

The fuselage was a plywood skinned semi monocoque of the usual kind and the tail unit was inherited almost unaltered from the previous Spalinger designs.

The S - 25 was one of the two sailplanes taken to England in 1947. The pilots were Hans Würth and K Haberstich, the latter having supervised the construction of the aircraft. While there they broke the Swiss national two-seater distance record with a flight from the contest site at Bramcote in the Midlands to the East Coast in Norfolk, 210 km. After the competition the Derbyshire and Lancashire Gliding club hired the Spalinger with a view to buying it. It was aero-towed to Camphill and was operated there for several months while members made their assessment.[26] The club decided against buying it and in November the S - 25 was aero-towed back to Switzerland in stages by Ann Douglas and Lorne Welch.[27]

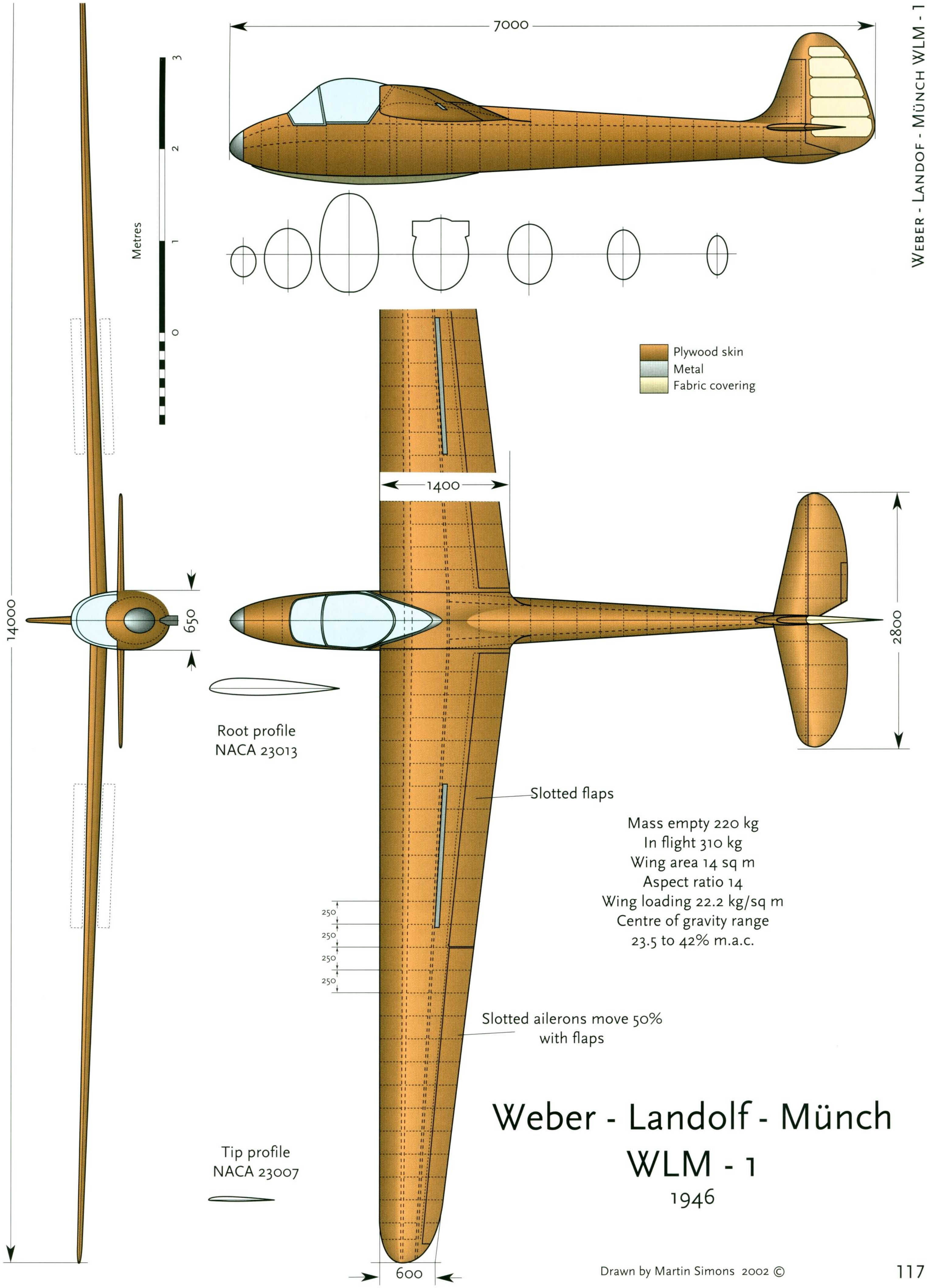
26 - The author, under instruction, made his first ever soaring flight in the S - 25 during this period.

27 - They married some years later.

In Brazil Swiss sailplanes already had a high reputation, since the Flamingo single-seater had been designed and built there by Hans Widmer and Kurt Hendrich who were of Swiss origin and had good contacts with their home country. With the help of Hendrich, and agreement with Spalinger, the S - 25A was completed in 1954 and bought by the Aeroclub de Bauru. The 25A model had a wheel and modified cockpit canopies to give the pilots more headroom. The Brazilian S - 25 thereafter had a very successful career, placing third in the Brazilian national Championships in 1955. It survives in good condition. Spalinger also produced a version of the S - 25 with a steel tube fuselage, fabric covered. This is sometimes called the S - 24 in Switzerland, but apparently flew after the all-wooden original.

WLM - 1

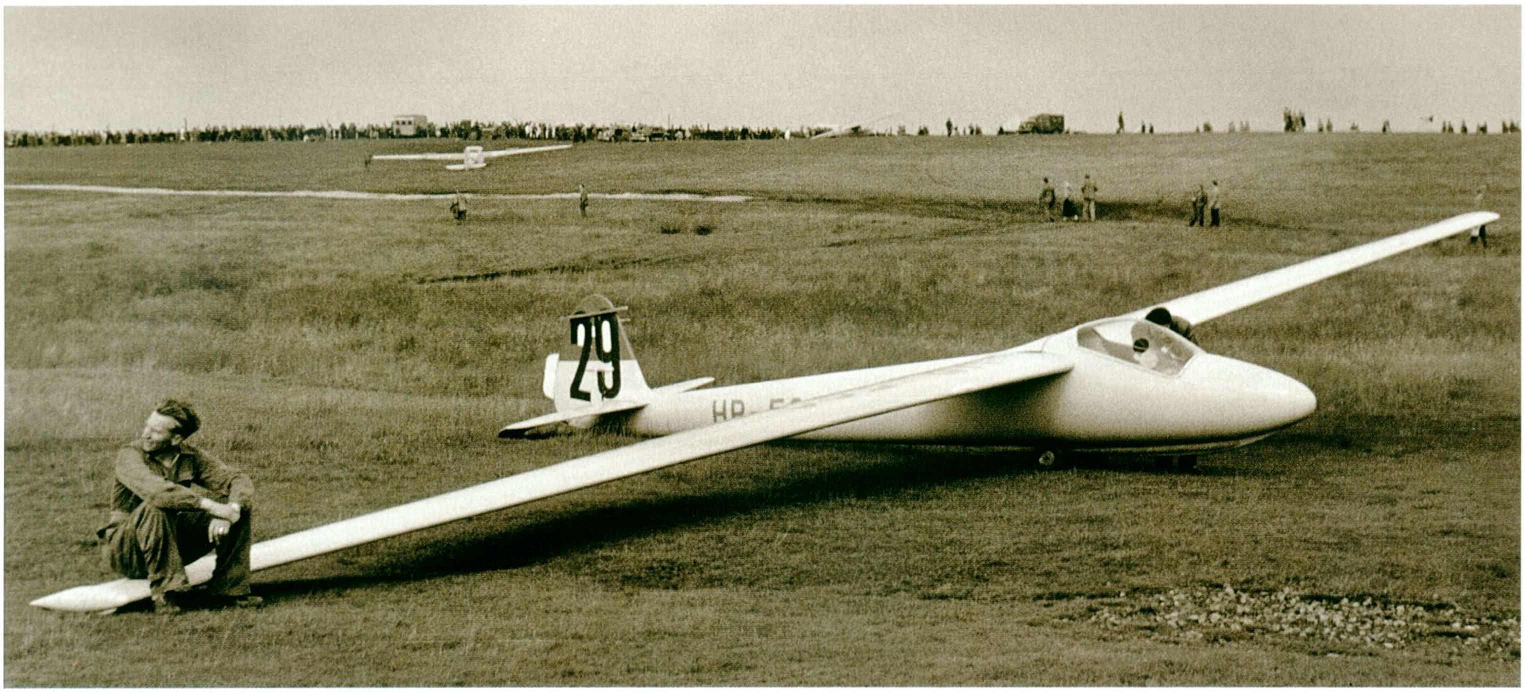
The WLM - 1, which first flew in 1946, was designed from the first as a very fast and strong sailplane. It was capable of a full range of aerobatics excepting only flick rolls. There was a particular interest in it from the Swiss government who expected to use it in training military pilots. The cockpit was laid out deliberately to resemble that of a fighter and with a raised canopy the all-round view was excellent. The WLM - 1 was also expected to be successful in soaring competitions in good weather, especially as the emphasis was shifting to racing and closed circuit task flying.



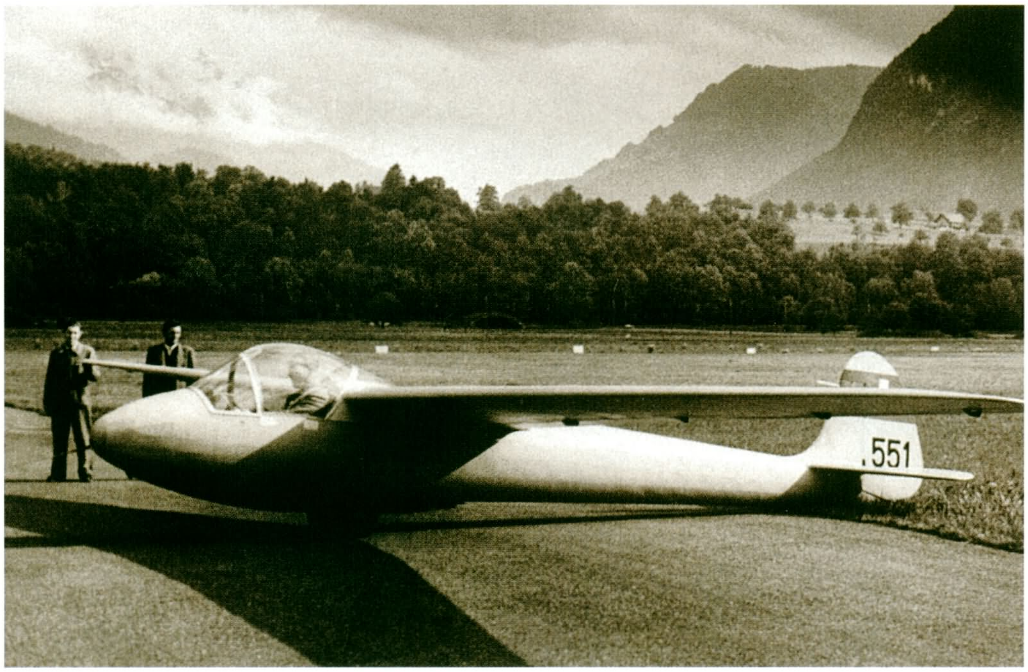
Mass empty 220 kg
In flight 310 kg
Wing area 14 sq m
Aspect ratio 14
Wing loading 22.2 kg/sq m
Centre of gravity range
23.5 to 42% m.a.c.

Weber - Landolf - Münch
WLM - 1
1946

Drawn by Martin Simons 2002 ©



Left: The cockpit was designed to resemble a fighter cockpit. Swiss Air Force pilots learned aerobatics in the WLM - 1.



Top: The large and heavy WLM 2 withdrew from the competition at Camphill in 1954.

Bellow: The WLM - 1 with take off dolly.

The wing employed the 5 digit NACA profile 23013, only 13% of the chord in thickness at the root, tapering to the very thin 23007 (7%) at the tip. Slotted flaps were expected to improve the rate of sink at low flight speeds. For landing the flaps could go down to 40 degrees, when soaring they would be 10 degrees down and for fast glides were set at neutral. The 23013 section is so slightly cambered that there would be no gain in reflexing the flaps. The ailerons, also slotted, were coupled to move down half as much as the flaps. The wing and control surfaces were entirely skinned with plywood. The airbrakes were positioned somewhat further aft than usual, but were large to ensure they were sufficiently effective.

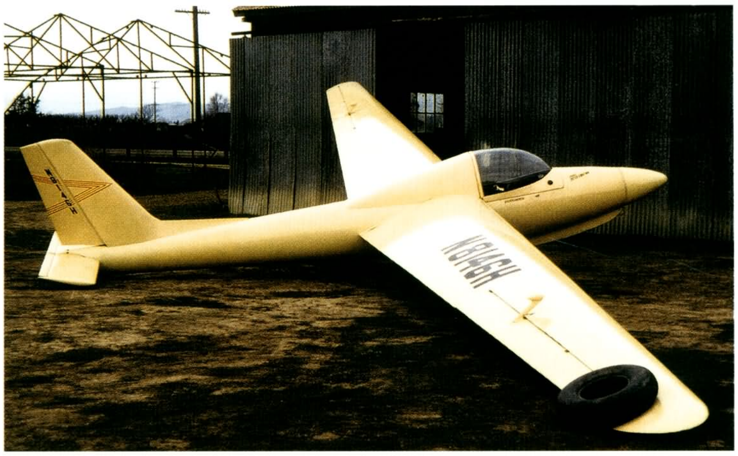
The fuselage was the normal semi-monocoque type skinned with plywood and the horizontal tail was also ply skinned throughout. There was no wheel but the usual kind of rubber-sprung skid.

Three of the WLM - 1 were entered in the 1948 World Championships at Samedan, two flown by very experienced Swiss pilots, the third by H Temmes from Finland who, probably, had not flown in mountains much before. Visiting pilots were astonished by the WLM's ability to fly extremely fast without fluttering. They were less impressed when it was seen to have difficulties in weak lift, coming slowly down as the 18 metre Weihe, Air 100 and the small, light Moswey sailplanes climbed. The weather did not suit the aircraft and final results showed its limitations.

For the 1954 World Championships the WLM - 2, which was larger, appeared. It was described by one technical expert as complex and heavy, but the pre-formed plywood skins were an indication of things to come.

Left: The Penetrator after reconstruction of the cockpit canopy and undercarriage

Below: The Penetrator in its original form



USA

While the chief designers and manufacturers of sailplanes in the USA after 1939 were the Schweizers, whose factory was in Elmira, New York State, there was always a very strong tradition of home building. The Schweizers themselves produced kits as well as complete sailplanes. There were many other distinguished engineers who produced plans, construction guides and advice. While any commercial company involved in aircraft production was forced to consider the likely market for a new sailplane, the private person, given sufficient time and energy, could think in terms of building only one of a kind. Enterprising individuals who set out to attempt something new made many of the most important advances.

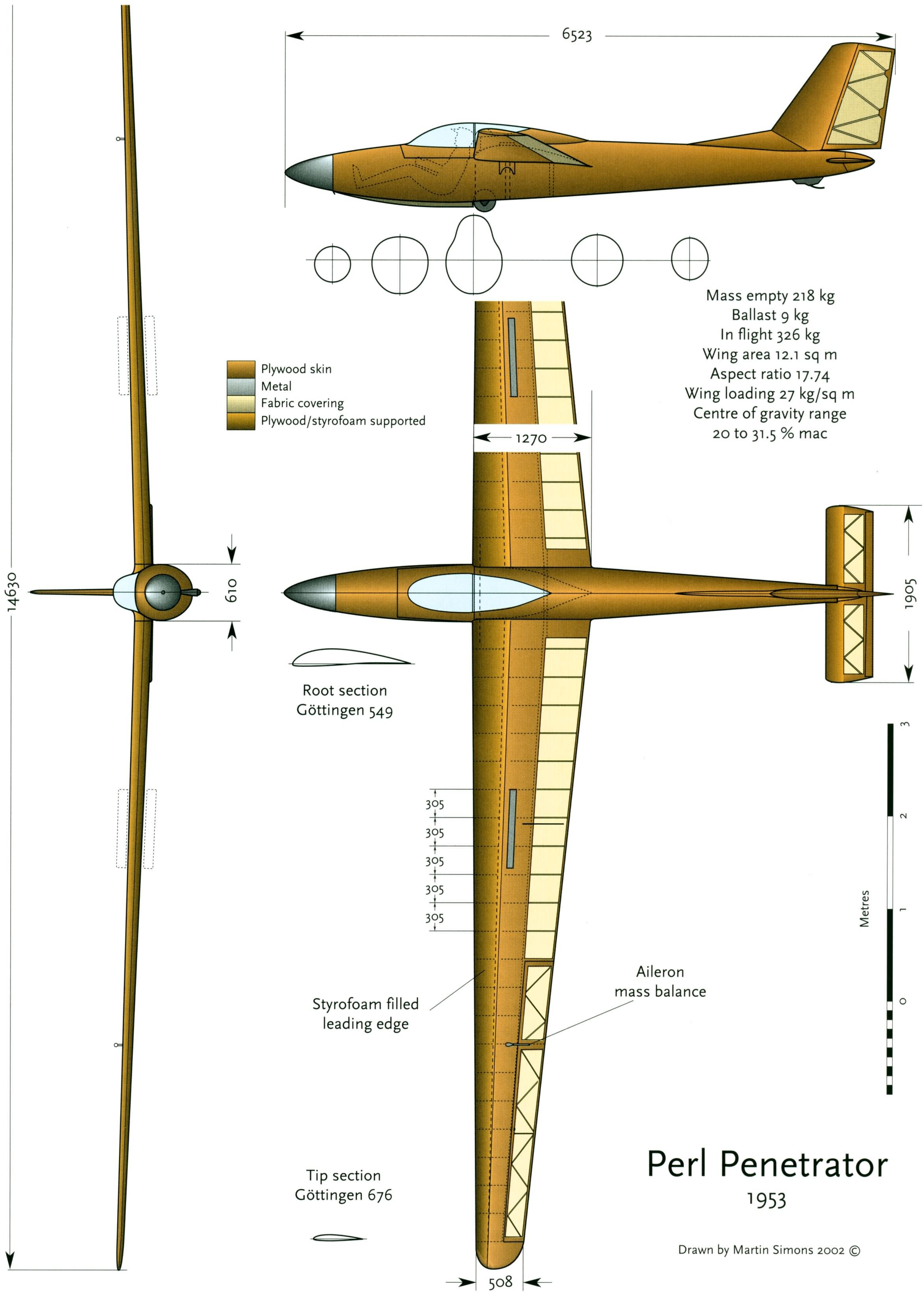
Perl PG - 130 Penetrator

Harry Perl was an engineer who had been much involved in flight testing military gliders during the Second World War. In post war times Perl worked with Ted Nelson on the design and construction of the Nelson Hummingbird, one of the first successful self-launching sailplanes. Perl then turned his attention to a single seat self-launching sailplane which might be regarded as a smaller version of the Hummingbird. The intention was to build it in metal, but a sudden rise in the cost of aircraft alloys, caused by the Korean War, led him to make it in wood after all. There was difficulty in finding a suitable engine. The project went ahead as a sailplane with the intention to fit an engine later. As the name implies, it was not intended to be a slow-flying floater. It was a fast cross-country sailplane to take advantage of the strong thermals commonly found in the western and southern USA, rather then the feebler convection experienced in the north and east.

The Penetrator was completed in 1953 and won a design award at the 1954 US National Soaring Championships. The span was 14.63 metres (48 ft). There was no very great aerodynamic innovation, with aerofoil sections identical to those of contemporary European types. The wing was mounted at shoulder height on the round-sectioned fuselage, which had a long tapering nose. It was expected that when the motor was installed, the pilot's seat would have to be moved forward to achieve correct balance. The cockpit canopy was of tear drop shape. A deep, sprung skid was provided with a drop-off wheeled dolly for take off. The tailplane was of the all-moving kind with a counterbalance tab to give the pilot some feel on the control column, and the fin was stylishly raked back.

The most important feature of the Penetrator was that the plywood wing skins were supported internally by Styrofoam plastic. On wooden sailplanes, however accurately built they may be, there is always some shrinkage of glue and wood after completion. This creates waves and humps on the wing. When the Penetrator wing was being constructed, after all the nose ribs had been glued to the front of the main spar, blocks of Styrofoam were cut to fit between them and glued in place. The plastic was cut and sanded down exactly to the level of the rib outlines. After this an inflated rubber bag was used to press the plywood skin down onto the smooth surface of the foam while the glue hardened. The result was a very smooth wing surface which did retain its form accurately.

Behind the second spar, the wing was covered with fabric. The ailerons were mass balanced with rather large external arms and lead weights on the upper side.



Mass empty 218 kg
Ballast 9 kg
In flight 326 kg
Wing area 12.1 sq m
Aspect ratio 17.74
Wing loading 27 kg/sq m
Centre of gravity range
20 to 31.5 % mac

Perl Penetrator

1953

Drawn by Martin Simons 2002 ©

After early trials, Perl redesigned the undercarriage, removing the excessively large skid and fitting a wheel. The cockpit canopy was also reshaped to a more streamlined form.

The Penetrator , as expected, was heavy and fast, a very good cross-country sailplane in good weather. Perl was not, however, a very keen contest pilot and preferred to use his sailplane for his own sport flying. Only one was built and the engine was never fitted. It continued in use as a sailplane until the nineteen seventies. Perl himself died in 1983 and the Penetrator was presented to the National Soaring Museum at Harris Hill, Elmira.

Top: BG - 12a at Harris Hill, NY, 1995
Below: BG - 12a fuselage. This aircraft , VH - GHJ, was built in Australia and still flies in Queensland. (The sailplane in the background is a Slingsby T - 53.)

Briegleb BG - 12

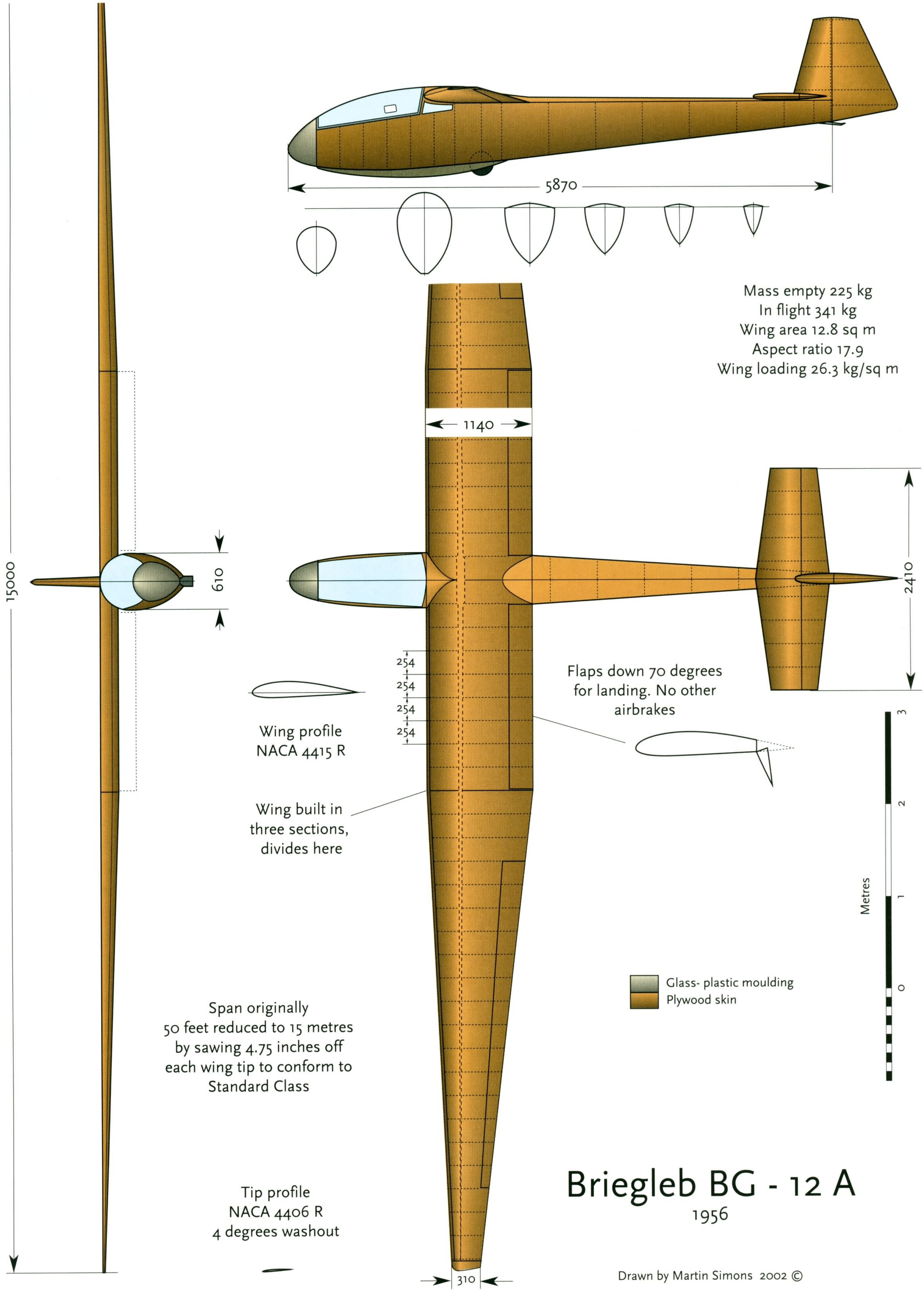
In 1953 William G Briegleb recognised the need for a sailplane capable of being built by amateurs, but with a performance good enough for cross-country speed and contest flying. He had years of previous experience in sailplane design, having already produced the BG - 6 and BG - 7 in 1939 and 40 respectively. The BG - 12 was, Briegleb wrote, "the next step up from model aircraft building."[28] To build it required the minimum of tools and equipment, cheap materials and only a moderate degree of woodworking skill.

The span was 15.24 metres but Briegleb pointed out, after the new Standard Class specification was issued, that by removing a small amount of each wing tip, the BG 12 would meet the 15 metre requirement without appreciable loss of performance. The wing profiles were chosen from the NACA 4 digit series, which did not require perfectly accurate surfaces in order for them to work well.

Rather than the complicated brakes used in most European sailplanes of the period, simple trailing edge flaps were provided, to be lowered to 70 degrees when required for landing. These were not intended to limit the airspeed or to be forced down at high airspeeds. The wing was built in three parts, avoiding the need for heavy and expensive main spar fittings in the centre. The spar was a simple laminated member, which could be laid up on a straight, flat bench. The wing ribs were routed from Douglas fir plywood in much the same way as balsa ribs are cut for model aircraft. The whole wing, including ailerons and flaps, was skinned with 3.2 mm (1/8th inch) thick Douglas fir plywood. This, being less dense than the usual aircraft birch ply, formed a smooth profile without excessive weight. To avoid having to bend the thick material round the wing nose, a wooden leading edge spar, shaped to the profile section, was provided. The lower wing skins were joined up and cut to size, then laid on the bench. The spar and ribs were glued in place on this. The leading edge nosepiece was then glued to the lower skin and the ribs. The upper skin was glued first to the leading edge, then gradually pressed down onto the ribs and spar, stapled in place till the glue cured.

The fuselage was also built very simply with a series of nearly triangular routed plywood cross frames and Douglas fir ply skinning. The tail unit followed the same general methods.

28 - OSTIV Publication V, 1958.



Briegleb BG - 12 A

1956

Drawn by Martin Simons 2002 ©

Cherokee at Mount Kearsage in 1978. In this case the constructor used a blown bubble canopy.

All plywood surfaces were normally protected with a layer of lightweight glass cloth laid with resin, rubbed down and painted.

The prototype XBG - 12A wing was flown in 1956, at first on an old fuselage from a BG 6. Various alterations were made as a result of test flying. An adjustment of the angle of incidence was made to align the fuselage better with the airflow at high speeds. There was some strengthening of the wing centre section because the fuselage was heavier than expected. The final estimates of performance after flight-testing indicated a best glide ratio about 33:1, which may have been optimistic.

Kits were produced and distributed from 1957 on. Briegleb claimed that the BG 12 could be completed in 600 hours. Except when the builders were very experienced and had everything well prepared with all materials to hand, the average was a good deal longer.

The BG 12B was developed later, the wing now being in two sections with an 18% thick wing root section. The BG 12C, 15 metres span with airbrakes as required by the Standard Class specification, followed. The specification called for the brakes to be capable of operation at high diving speeds and they were expected to limit the airspeed to the designed maximum figure. Plain flaps of the kind fitted to the BG 12A did not meet these requirements because they could not be fully extended when the glider was flying fast. Apart from the high stresses involved, the pilot did not have the physical strength to deploy flaps under such conditions.

A total of more than 250 sets of plans and kits for the various marks of BG - 12, were sold, though not all were completed. One unusual aircraft was built by the club at Waikerie in South Australia. A BG 12A wing had been completed when the club discovered that the Edmund Schneider Company in Adelaide had a spare fuselage for an uncompleted new sailplane, the design having been abandoned. With some necessary adjustments the BG 12 wing was fitted to the Schneider fuselage. The resulting sailplane, registered in 1959, flew very successfully for years.

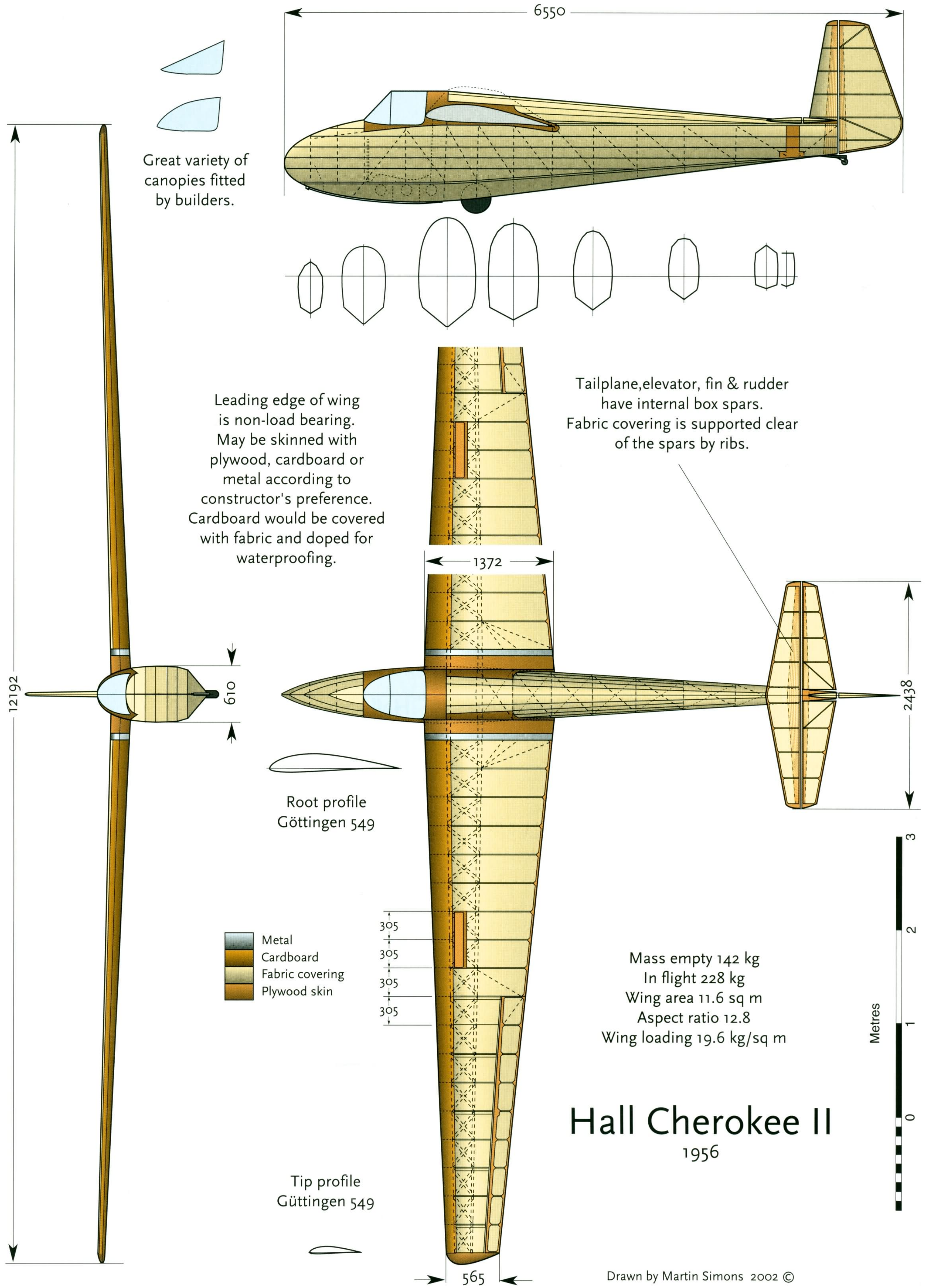
Further development led to the BG 12 BD and BG12-16 of 1969 which had a more refined fuselage incorporating some glass plastic moulded parts, and an all-moving tailplane of metal construction. Kits for 58 of these were sold before production ended.

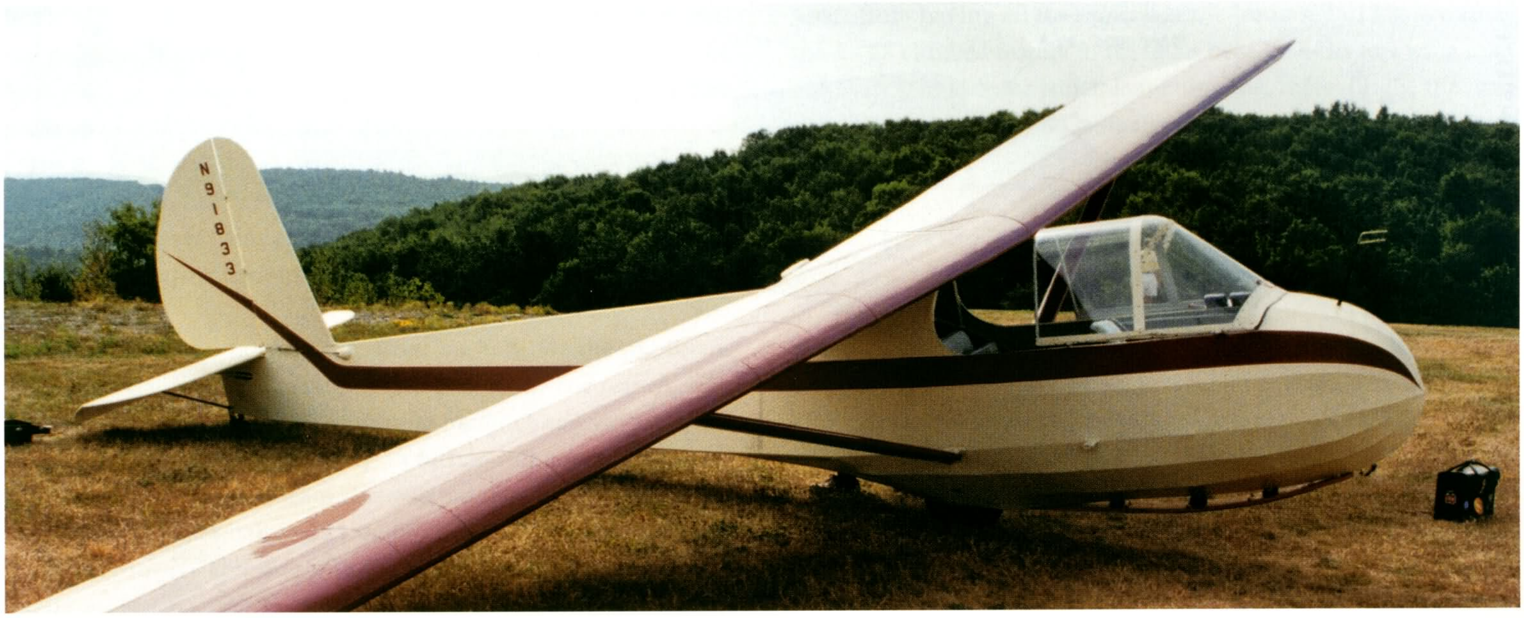
Hall Cherokee II

Stan Hall intended the Cherokee to be constructed by amateurs who had no previous experience of aircraft woodwork, little space to work in, and no facilities for fabricating elaborate metal fittings. A great deal of ingenuity went into the design. Where there was a choice between simplicity in the work and engineering or aerodynamic sophistication, Hall chose simplicity. There was a multiplicity of separate pieces to make but each operation was very simple in itself, requiring no great skill.

The Cherokee was of small span and aerodynamically simple, the object being to provide a safe and strong aircraft for the builder to fly, not a fast competition sailplane. It handled very well in the air, soared readily in weak or strong thermals, and was perfectly capable of good cross-country flights and simple task flying for the early badge flights.

It was normal for wooden sailplanes to have plywood skins to carry the torsional loads in the wing. This required many accurate scarf joints between separate sheets of plywood to form continuous, load-carrying parts of the primary structure. Amateurs found scarf jointing difficult and time consuming. Hall therefore did away with stressed skins. The wing was built around twin spars, cut from solid spruce without difficult tapering or planing, but strengthened where required by gluing reinforcing pieces back and front. The spars were braced against twisting by a very simple system of diago-


6550
Great variety of canopies fitted by builders.
12192
610
Leading edge of wing is non-load bearing. May be skinned with plywood, cardboard or metal according to constructor's preference. Cardboard would be covered with fabric and doped for waterproofing.
1372
Tailplane,elevator, fin & rudder have internal box spars. Fabric covering is supported clear of the spars by ribs.
2438
Root profile
Göttingen 549
Metal
Cardboard
Fabric covering
Plywood skin
305
305
305
305
Mass empty 142 kg
In flight 228 kg
Wing area 11.6 sq m
Aspect ratio 12.8
Wing loading 19.6 kg/sq m
Metres
0
1
2
3
Hall Cherokee II
1956
Tip profile
Güttingen 549
565
Drawn by Martin Simons 2002 ©



nal cross bracing, strips of wood being glued criss-cross fashion on the top and bottom edges of the spars.

The Cherokee ribs were cut by bandsaw from cheap plywood. Full scale 'Ozalid' print patterns were provided with the plans. These were glued to the ply. Two sheets were tacked together so that ribs for left and right wings were produced with one careful cut. The necessary cross braces were added later. A complete set of ribs for a Cherokee could be made in one or two working days.

The wing was covered with fabric. To form a smooth entry for the airflow, the leading edge might be covered with cardboard, damped, bent round and glued to the ribs. If the constructor preferred, cheap aluminium sheet or thin plywood could be used. Since the skin was not required to carry anything more than air loads, the choice of material was not very important providing, in the case of cardboard, it was suitably covered with fabric and doped for waterproofing.

The fuselage was a basic box frame built up like a model aeroplane with four main longerons joined with uprights, diagonals and plywood gussets. Cross frames were placed where necessary to carry wing, tail and the wheel. There was a strong central keel at the front to support the pilot's seat and controls. The box was faired by light stringers which required little or no difficult bending, joining or laminating, and covered with fabric. Plywood, of a cheap variety, was used around the cockpit to provide a strong frame for the transparent canopy, and at the wing root junction to withstand handling. Aluminium strips were used to close the joint between wing and fuselage.

The Cherokee proved very popular and 250 sets of plans were sold worldwide before Stan Hall took them off the market. How many of the type were actually completed is not known. Some of the plans may never have been used. On the other hand, some enthusiasts certainly built more than one Cherokee from a single set of plans.

There were some later developments. The Cherokee RM was designed and built by Terry Miller and John Ree, with a greater wing span and low drag profiles. Several more were built from plans supplied by the designers. There was also a powered version, the Flaglor Cherokee, which had two go-kart motors mounted on under wing pylons. It flew in 1964.

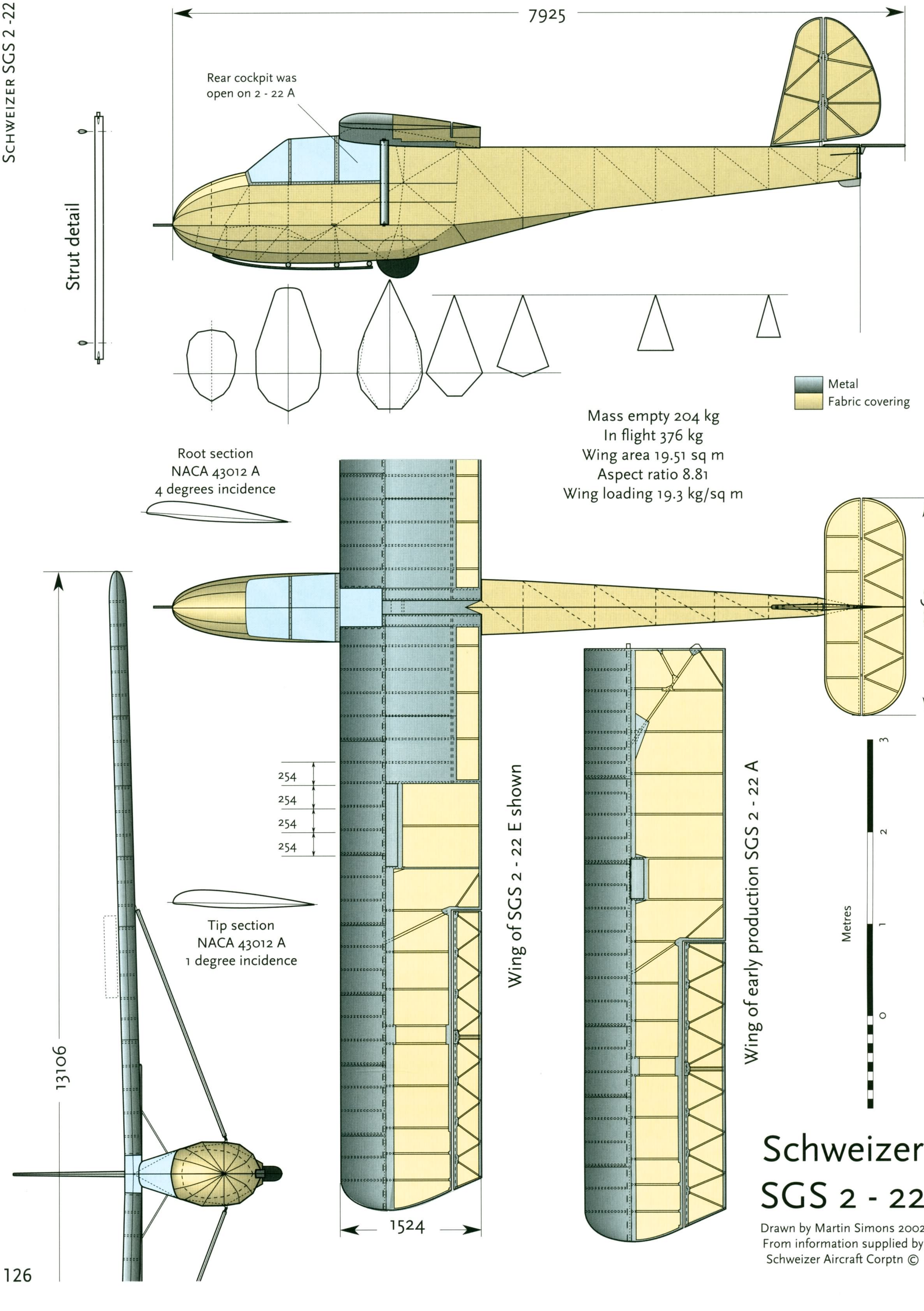
The Schweizer SGS 2 - 22. Note in this very early model, there was no transparent enclosure for the instructor

Left: The SGS 2 - 22 with other famous Schweizer products, the SGS 1 - 19, SGS 2 - 8 (TG - 2) and SGS 2 - 12 (TG - 3)

Schweizer SGS 2 - 22

The three Schweizer brothers, Ernest, Paul and William, were convinced that the future of sailplanes was in all-metal construction. They had great success with their SGS 2 - 8, 29 better known as the TG - 2. It had broken soaring records in 1940 and then was adopted and manufactured in quantity for military training. It had a welded steel tube fuselage, fabric covered, with aluminium alloy wings. They had built the SGS 2 - 12 (TG - 3) with wooden wings only because they were officially instructed to do so during the wartime of shortage of aircraft alloys.

Post war, they hoped for a rapid growth in the soaring movement and believed there was an urgent need for some robust two-seat trainers. The TG - 2 had never really been intended for this role. It was a sailplane for performance and the rear pilot was not in a good position to act as instructor. The TG - 3 was better in this respect



Schweizer SGS 2 - 22

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but it had always been a military glider and had a very limited soaring performance. Something entirely new was required and Ernie Schweizer, the oldest of the three, began on the design in 1945. The prototype flew in early February 1946.

The 2 - 22 had a high wing with strut bracing, the steel tube, fabric covered fuselage having a triangular cross section aft of the wing. The tail unit was also fabricated in light steel tubing. The wing was all light alloy, sheet covered ahead of the spar and fabric covered behind.

The seats were in tandem, the front cockpit, for the pupil, enclosed by a transparent windscreen and sidepieces. The rear cockpit, under the leading edge of the wing, was not enclosed at all. The instructor could thus lean slightly to either side and see directly ahead. The view upward from this position was obstructed by the wing. The instructor had to get into place before the pupil, clambering in over the cockpit side with the help of the step provided. The pupil could then climb in and close the cockpit canopy.

All the preliminary test flights went well except that the 2 - 22 seemed incapable of spinning, even when ballast was added to the tail to move the centre of gravity well beyond the normal aft limits. Yet to demonstrate that recovery from a spin was possible, was part of the FAA requirements before type approval could be granted. The rudder stops were repositioned allowing the sailplane to be forced into a spin, and then recovery was demonstrable. After this the rudder stops were put back to their original position. The Schweizers felt it safer to teach student pilots first in a sailplane which would not spin. They could be transferred later, perhaps to one of the old ex-military aircraft, for this part of their training.

The Schweizer SGS 1 - 21, one of only two built.

Apart from having all the characteristics required of a safe trainer, the 2 - 22 climbed readily in thermals because of its low wing loading. It was suitable for winch launching but, increasingly, the practice in the USA was for all launches to be by aerotow. The 2 - 22 was well suited to this.

Production began in May 1946. Sales were not at first very rapid. Despite their limitations, ex-military sailplanes were available at a third of the cost of the 2 - 22. Not till 1957 did the total production of the 2 - 22 exceed fifty.

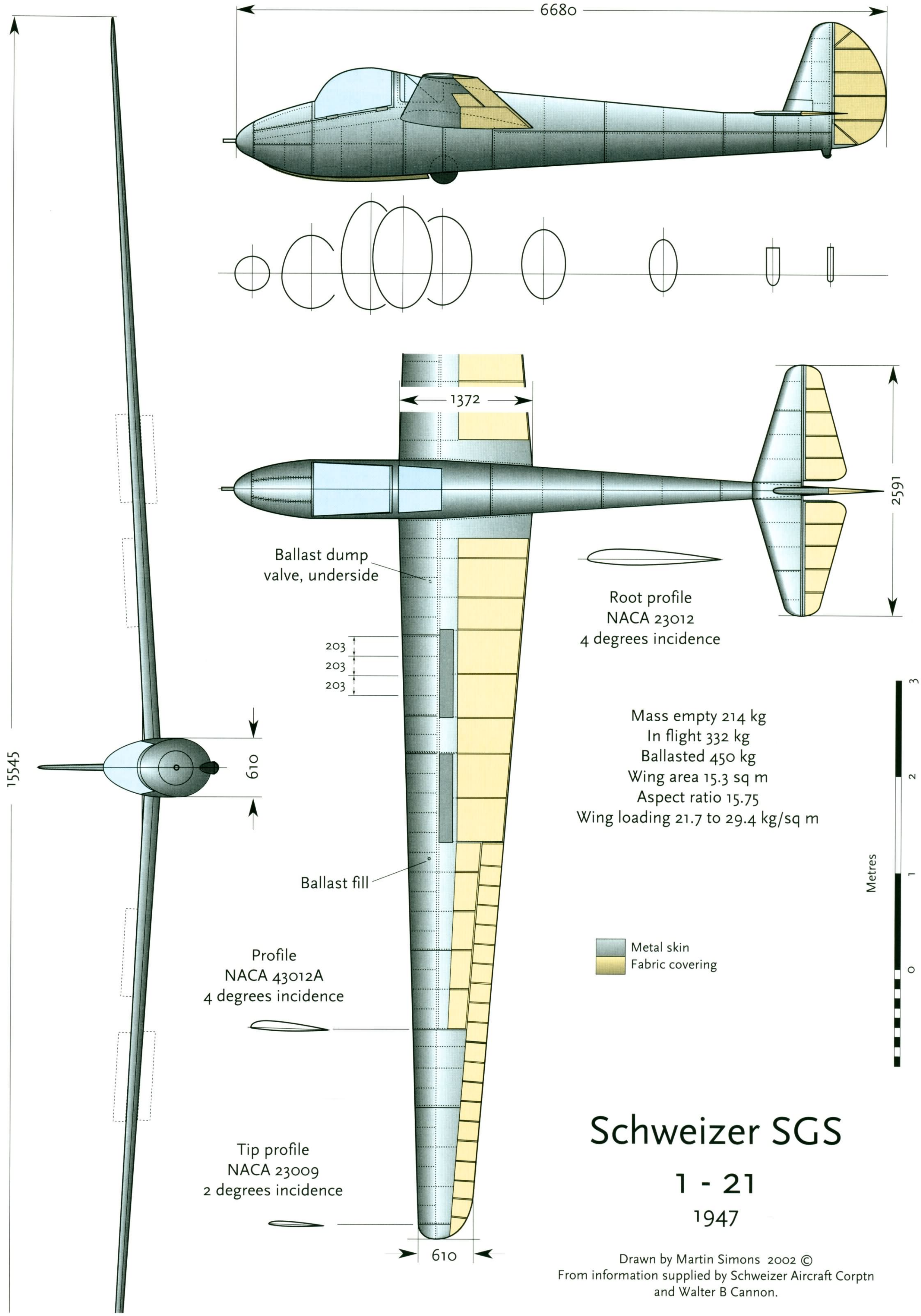
The 2 - 22A, which was designed in response to a requirement of the Air Force Academy, had improvements including a fully enclosed rear cockpit with a side door for access. The 2 -22C, for the civilian clubs, had ailerons of narrower chord to reduce the stick forces, and kits were offered. Seventy-five plus twenty-two kits were sold and thirty were delivered to the Indonesian Air Force.

Further changes, including a new, moulded canopy and increased area of transparency for the instructor, improving the view upwards, resulted in the 2 - 22E of 1963. Of this eighty-seven were built with twenty-two kits, before production ceased in 1967. The replacement was the SGS 2 - 33.

Schweizer SGS 1 - 21

The SGS 1 - 21, despite the number, did not fly until after the 2 - 22, work on it being postponed while the more urgent need for the two-seater was addressed. The 1 - 21 was the Schweizer's first attempt to produce a high performance single seat sailplane. It was of aluminium alloy with stressed skins except for the fabric-covered areas of wing and tail. The span, 15. 54 m (51 ft), promised a good performance without the high cost of a larger span. The wing profiles were chosen from the NACA 5 digit series because the Company had previous satisfactory experience with these. They had a high maximum lift coefficient and, because the point of maximum camber was well forward, they produced small pitching moments. Only 12% of the chord thick at the root, much thinner than possible with wooden sailplanes, the wing would have low drag at high speeds. The fuselage was of oval cross section, with cross frames at 609 mm (24 inch) spacing, light longerons and alloy skins. There was a wheel and simple front skid. The cockpit was comfortable with a moulded canopy providing an excellent all round view. The nose cone was spun from aluminium.

The main spar was built up from standard L sectioned extrusions for the flanges with alloy sheet webs. The ribs were pressed from sheet over Masonite forms and the skins flush riveted to them and the spars. The main loads from the wings were carried through the fuselage by a large yoke built up from two sheets of 12.5 mm thick alloy spaced apart to accept the wing root fittings, and mounted in the fuselage at an angle to give the required incidence. Ballast tanks were built into the wing to allow 118 kg of water to be carried. This was the first American sailplane to be so equipped, and although not the first in the world, it was well ahead of its time.[30] With ballast, the wing loading was 29.4 kg/sq metre.



Schweizer SGS

1 - 21

1947

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From information supplied by Schweizer Aircraft Corptn
and Walter B Cannon.

One of the two SGS 1 - 21s has been restored in recent times and is shown here at Harris Hill, Elmira, during the 1995 International Vintage Sailplane Meet.

Two 1 - 21s were built, one being ready for Dick Comey to fly in the 1947 US National Championships, held at Wichita Falls in Kansas. Comey won the Championship and broke the US National distance record with a flight of 483 km. It was broken again by the visiting Frenchman Eric Nessler in the Air 100, within a few days, and then again by John Robinson with 535 km in the old RS - 1 Zanonia. (Robinson was the first American pilot to exceed 500 km in soaring flight.)

The second 1 - 21 was completed and sold, but to the Schweizer's great disappointment, no further orders came in. The market was still dominated by the large numbers of ex-military gliders, including the Schweizer's own TG - 2 and 3, and the Laister Kauffman LK - 10. The LK lent itself to extensive modification to improve performance without a very large expenditure of capital. Despite its excellent performance, the price of the 1 - 21 was too high and there was no obvious way to reduce this. The brothers decided it would not be worthwhile to go through the long and costly process of getting official type approval, which would be required if the sailplane was produced in quantity.

The two 1 - 21s that were completed remained in use. Ginny Bennis flew Comey's 1 - 21 to a Feminine distance record of 234 km and it was flown by Stanley Smith in the 1952 World Championships in Spain. The same pilot won the US Nationals with it in 1957, when it was ten years old.

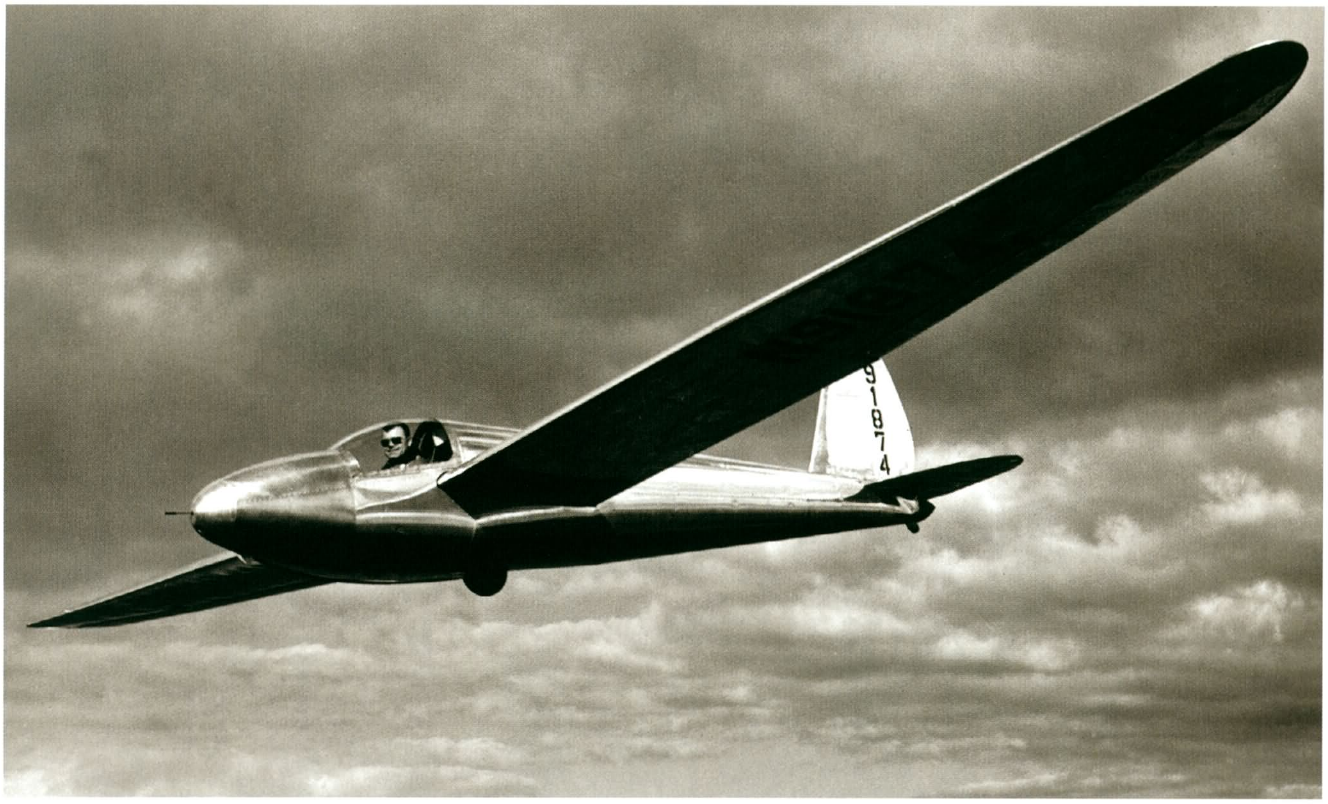
30 - Wolf Hirth's Moazagotl of 1933 had a ballast tank, but it is not known how often, if ever, it was used.

The SGS 1 - 23 series

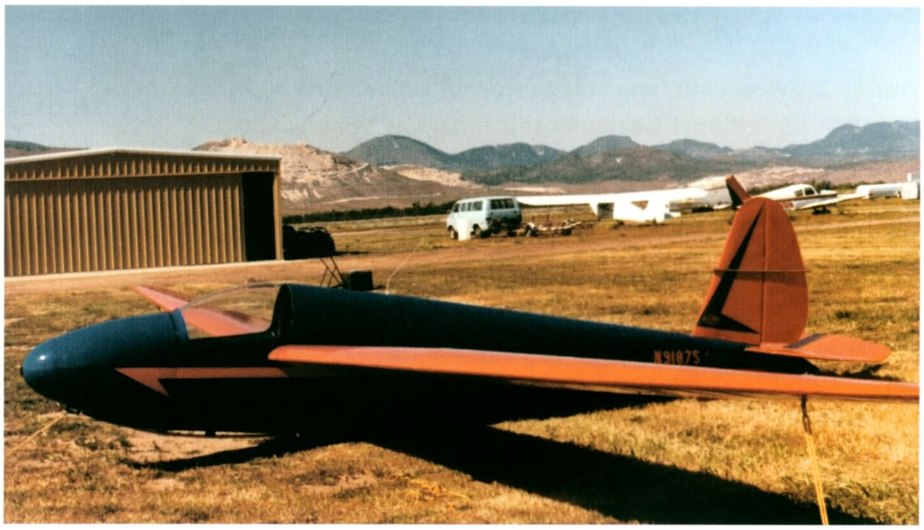
The Schweizer 1 - 23 grew directly from the disappointing experience with the 1 -21. By reducing the span to 13.36m (44 ft) and simplifying the structural design, manufacture would be easier. The wing, using NACA 5 digit profiles but with slightly more camber, required fewer different rib pressings and the main spars were easier to fabricate. There were no ballast tanks. Spoilers on the upper side of the wing were used for landing approach control. The entire aircraft was metal skinned. The skins were mostly overlapped rather than the more costly butt jointing. Early test flights proved the 1 - 23 was pleasant to fly and had a good performance. The best glide ratio seemed about the same as that of the 1 - 21, although the high-speed glide was not so good, especially in the absence of ballast.

The prototype 1 - 23 was demonstrated at the 1948 US Nationals, and attracted favourable attention. The price quoted was about $1000 less than the 1 - 21. Several orders were placed at once but the Schweizers still hesitated, believing that a minimum of ten sales was required to justify further expenditure. By March 1949 only nine orders had been placed. It was nevertheless decided to go ahead and the 1 - 23A went into production.

Bill Ivans in December 1949 set an altitude record of 9205 m (30,200 ft) in the Sierra Wave over Bishop, California, in his 1 - 23. At the 1950 National Championships in Texas, second, third and fourth places went to 1 - 23 pilots and there were several others in the top ten. Bill Coverdale almost broke the World Out and Return record with a flight of 389 km. Any doubts about the 1 - 23A were



Paul Schweizer flying the prototype SGS 1 - 23 in 1948



Below: A 1 - 23 at Tehachapi in Californía. In a sailplane of this type Bill Ivans set a world height record of 9205 metres in 1949

removed by these excellent results. At the year's end, Ivans again broke the height record in the wave with a climb of 9175 m and an absolute figure of 12,823m (42,070ft).

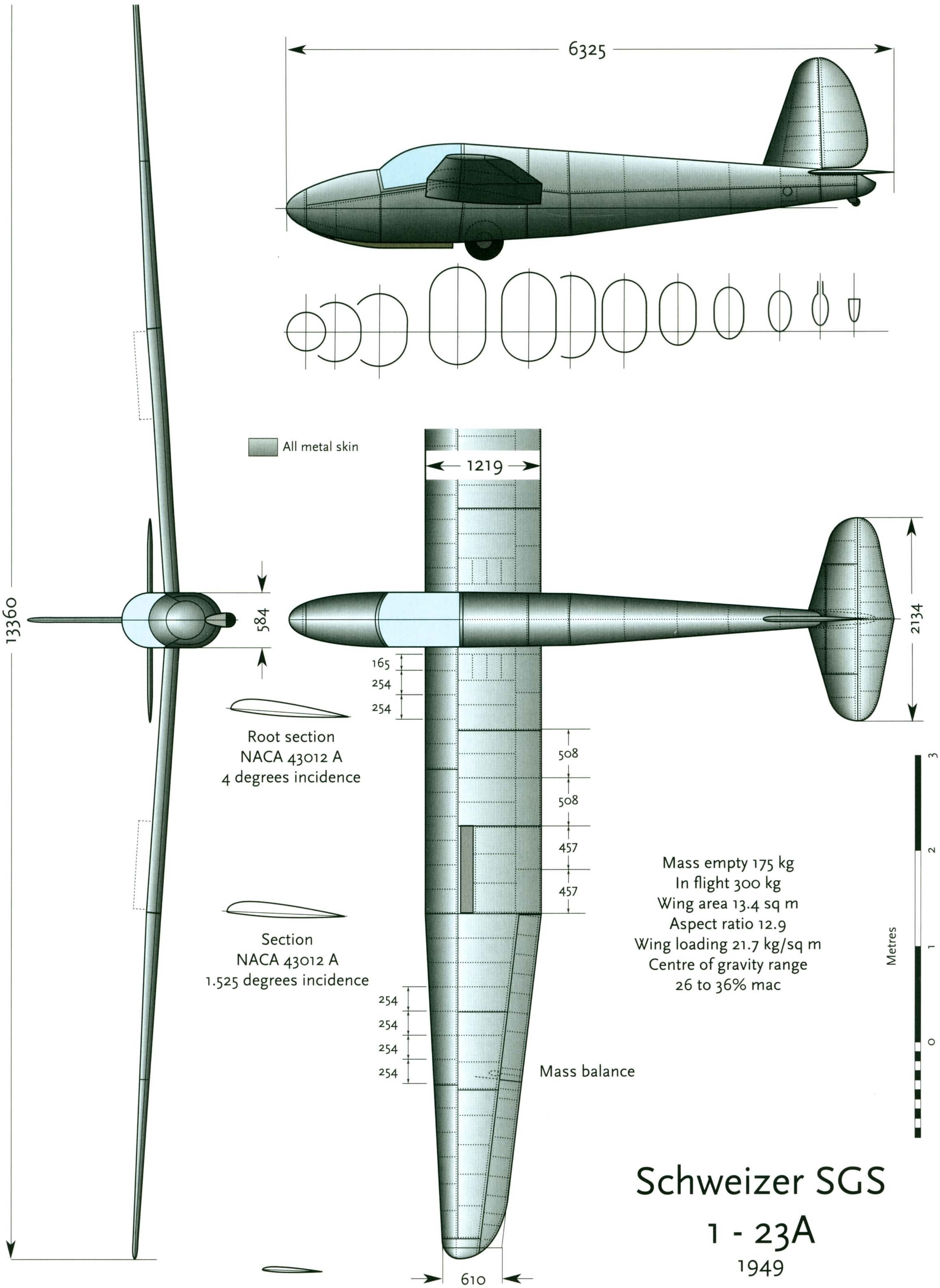
Twenty-one of the 1 - 23 were sold. For the World Championships of 1952 in Spain, a special 1 - 23B was built with the span extended to 15.24 m (50 ft). The performance was improved, as expected. Calculations showed that no strengthening of the structure was required. Nonetheless, a 1 - 23C was built with stronger spars and heavier gauge skins to prevent noisy 'oil canning' in flight.[31] Paul MacCready flew the 1 - 23B and Paul Schweizer himself the 1 - 23C at Madrid. MacCready placed sixth in the final scores.

The 1 - 23D had the same span as the C version but reverted to the lighter spar and wing skins of the B. The ailerons were re-positioned. MacCready won the US Nationals in 1953 with the 1 - 23D and a dozen were built. For the 1954 World Championships the 1 - 23E with a further increase in span to 16 metres and the wheel replaced by a faired skid to save drag, was built for MacCready. Further improvement resulted from greater attention to detail such as butt jointing the skins and flush riveting. In the very poor weather, MacCready finished fourth, which was a very encouraging result.

The 1 - 23F was an experimental aircraft with attention to many details, following the lines pursued by Raspet with the Tiny Mite and Johnson with the RJ - 5. All gaps and leakages were sealed, the skins all flush riveted and smoothed, the wheel faired. Results were encouraging enough for the Schweizers to produce the 1 - 23G of which eight were sold, and the 1 - 23H, which was the first 1 - 23 to have full dive brakes instead of spoilers. The final version was the Standard Class Schweizer 1 - 23H-15. Production ceased entirely in 1969, more than twenty years after the original 1 - 23 had flown.

An interesting development was the 1 - 24 which was built by Howard E Burr, using a standard 1 - 23 fuselage but fitting a new 16.92 m tapered wing. This, named Brigadoon, was very successful and remained in serviceable condition in 2002, as do many other examples of the 1 - 23 series.

31 - Oil canning is the noise made by many metal sailplanes (and other aircraft) when the skin briefly distorts under load and springs back again, like the side of an oil can after squeezing. Apart from the irritating sound, the distortion of the skin does not help the airflow to remain smooth.



Schweizer SGS
1 - 23A
1949

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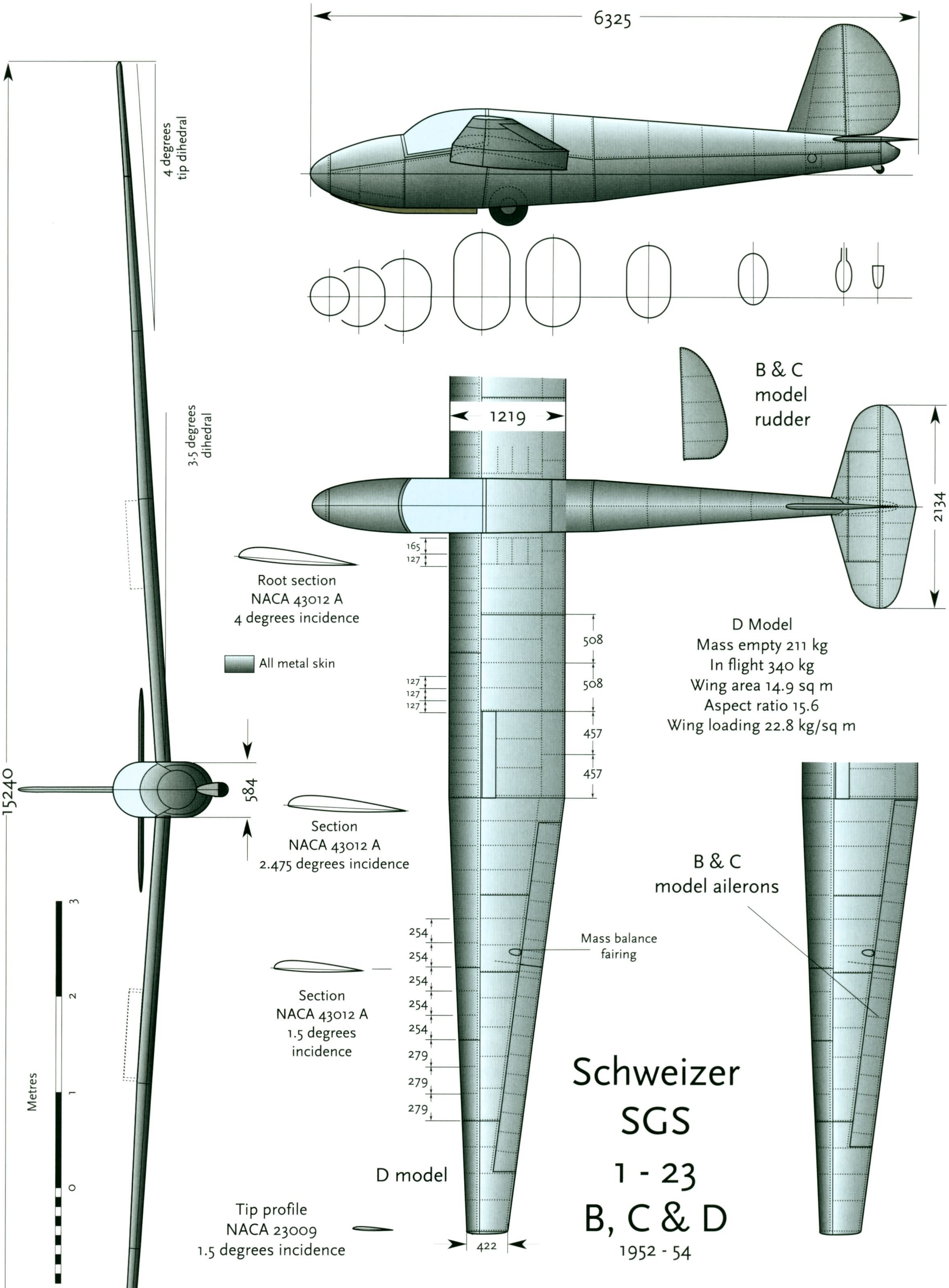

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Left: The SGS 1 - 26 takes a winch launch

Below: The annual 'One Design' competition for the SGS 1 - 26 became very popular. Here at one of the earlier of these events, fifteen of the type are assembled at Harris Hill.

The SGS 1 - 26

The Schweizers in boyhood had been interested in boats and were much impressed by the idea of 'one design' yacht racing. When serious soaring competitions started, the leading pilots and European manufacturers began to invest in large, elaborate and costly sailplanes in order to gain a winning margin. The Olympic Games 'one design' proposal of 1939 - 40 having come to nothing, in 1944 Paul Schweizer argued in the journal, Soaring, for a 'one design' competition, to equalise the chances of all the pilots. The idea was not taken up but ten years later it revived when the Schweizers produced the SGS 1 - 26. Before undertaking the new design, they conducted a wide survey among pilots. The majority, it seemed, would be happy with a small sailplane which could be bought for $1000 in kit form or $1500 complete, and which would be capable of flights up to the Gold C badge standard. To meet these prices was not feasible but the demand for inexpensive sailplanes, even if it meant some sacrifice of performance, was clear.

The 1 - 26, when it emerged, was a small sailplane with a steel tube framed fuselage and light alloy wings. It was offered for sale ready to fly, or part finished, or as a kit for home assembly. In the 1954 US National Championships, flown by Clarence See, the prototype placed eighth in a field of thirty-six, beating many far bigger and more expensive sailplanes with, nominally at least, better performance. Within a few months of starting production in 1955 more than a hundred kits were sold and over twenty complete sailplanes.

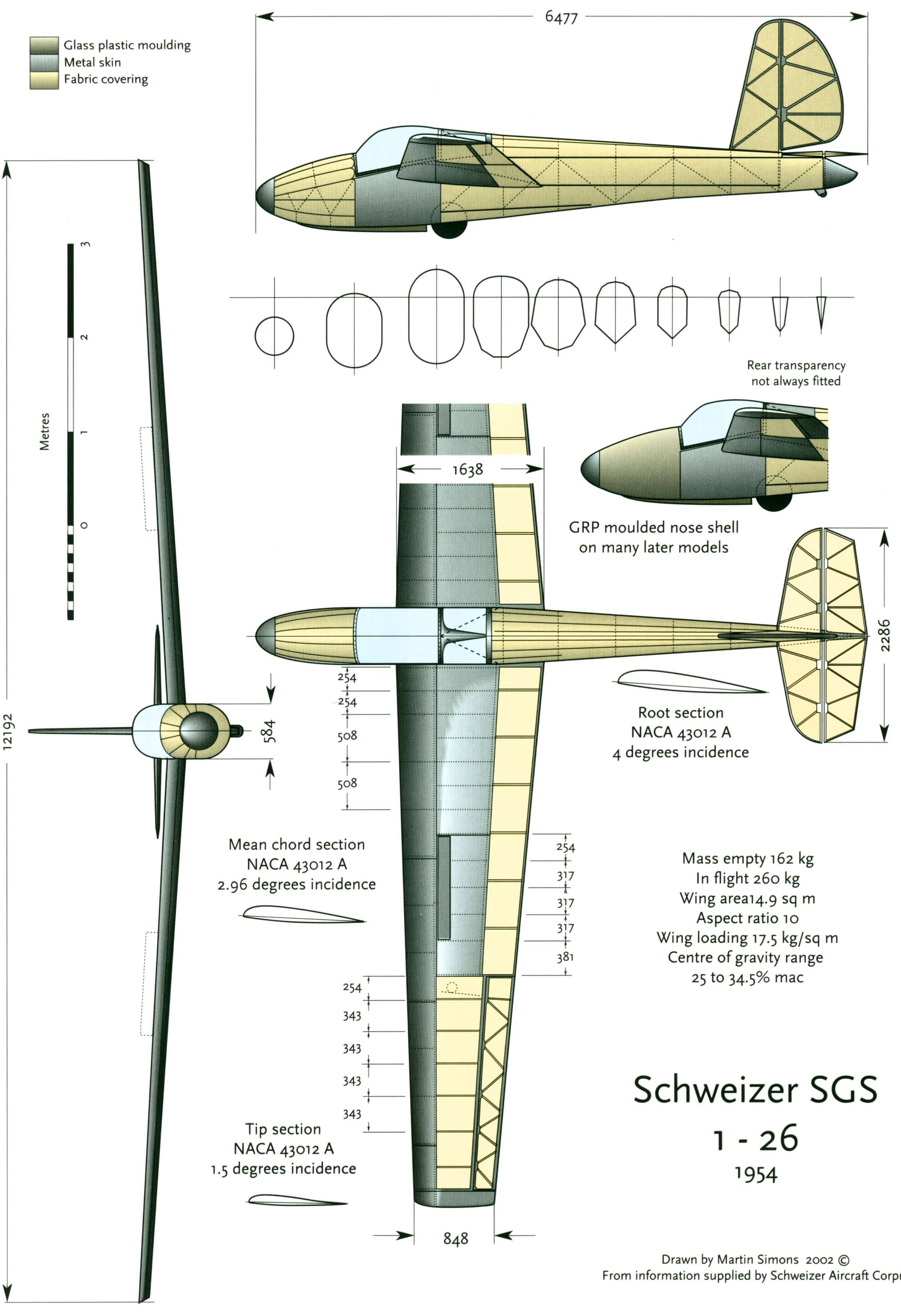
204 kits were sold before the market for these dried up entirely. All but one were completed and flown. Meanwhile sales of complete aircraft expanded, including one bulk export of 30 to the Indonesian airforce. Of the A, B & C models, a total of 410 were sold.

The first of a long series of 1 - 26 Regattas was held at Elmira in 1955, with seven sailplanes. These meetings became regular annual events with larger and larger numbers attending and flying. A National 1 - 26 Association was eventually formed, with regional 'one

design' contests and, from 1965, a regular National 1 - 26 Championships. It had taken ten years for the full 'one design' concept to be realised.

A small difficulty arose. In the interests of maintaining the cheapest possible price, Schweizers, a little at a time, introduced changes to the design. For instance, the 1 -26B model of 1956 had metal skinned wings except for the ailerons. This increased the weight slightly but made the sailplane easier, and hence cheaper, to build. The performance was hardly affected. Next the 1 - 26C appeared with some glass plastic mouldings. The D model came along with dive brakes instead of spoilers, metal skinning on the nose of the fuselage, improved canopy, more leg room in the cockpit. Eventually (but not until long after 1965) the 1 - 26E appeared with the fuselage now a monocoque structure in aluminium alloy, a new, stylish vertical tail and only the control surfaces covered in fabric. There is a difference in flying weight of about 56 kg between these late models and the original 1 - 26A. The wing loading has risen from 17.5 kg/sq m to 21.4. There is a difference in performance favouring the heavier models on all but the weakest soaring days. It is also fair to say that the later 1 - 26 is better sealed, quieter in the air and generally pleasanter to fly. When does it become apparent that the 'one design' is no longer one?

The D and E models, with all metal skins and re-designed tails, continued in production until 1980, bringing the total of all the 1 - 26s to 689.



Schweizer SGS 1 - 26

1954

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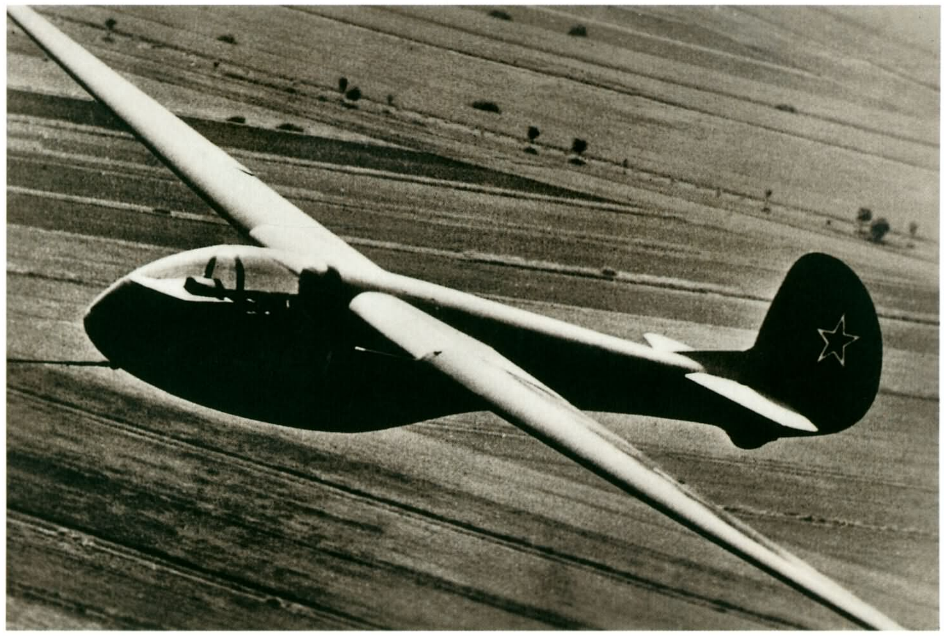
USSR



The Antonov A - 9, a development of the famous distance record breaking sailplane of 1939

Information about soaring in the USSR has always been difficult to find, partly because of the language difficulty but more because there was a great reluctance by the authorities in Moscow to allow publication of any technical information at all during the period of the cold war. It is known that there was official support for glider training as a preparation for military service. Youth groups and sporting clubs were encouraged to build and fly model aircraft, and young people were able to fly gliders. Those who did well would often go on to train as aircrew. Sailplanes such as the Czechoslovakian Pionyr and Blanik two-seaters were imported in large numbers from East European countries and an astonishing number of new sailplane designs were produced in the USSR itself. Apart from a few sketches and photographs, with the bare dimensions, details were generally not released. There were a few exceptions.

Antonov A - 9

O. K. Antonov was one of the most prolific designers of sailplanes in the world. He was active in the early nineteen thirties and is best remembered for the Red Front 7 sailplane with which Olga Klepikova set the world distance record of 749 km in 1939. The record stood for twelve years until broken by Dick Johnson in 1951.

The A - 9 flew in 1948 and is regarded as an improved RF - 7. Both were built in wood and for the most part followed standard practices. The wing was different in plan, with a constant chord centre section, but the fuselage and tail unit seem to have been almost identical to the RF - 7.

The wing profile, described as the ZAGI R - III, was thick with the point of maximum thickness and camber very far forward and a slight reflexing towards the trailing edge. Some members of the American NACA 5 digit profile family would be generally similar. The span was 16.24 metres and the aspect ratio nearly twenty. The structure was heavy and the wing loading high. There was no wheel, but a dolly was used for ground handling and dropped after take off. The cockpit canopy was a plastic moulding in two sections.

The main structural difference between the A - 9 and sailplanes produced in other countries, was that the centre section of the wing was not detachable from the fuselage. The very strong main spar, with multiple laminations and plywood webs, carried through with no break. The main frames of the fuselage were glued directly to it. If carried on a road trailer, the width of three metres might have caused some difficulties. It may be that the usual method of returning sailplanes from cross-country flights was by aerotowing. Arrangements would probably be made with traffic police for a wide load to be carried on the road, if necessary.

The outer wings, carrying the air brakes and mass balanced ailerons, were attached to the centre section with simple fittings and horizontal steel pins, with a light metal strip to close the gap after rigging. There were detailed differences in Soviet engineering practice and instrumentation. The pitot/static tube was evidently mounted on the wing just inboard of the rigging joint. This probably had some advantages in reducing position error in the air speed indicator. Since the centre section was not demountable, there would be no difficulties with making and remaking connections in the instrument lines.

Antonov continued with further developments, There was a 16.5 metre span version of the A - 9, which may have been called the A - 10. The A - 11 which followed was a complete departure from Antonov's previous practices, being all metal with a V - tail, and was followed by the A - 13 aerobatic sailplane, also in metal, and eventually the A - 15.[32]

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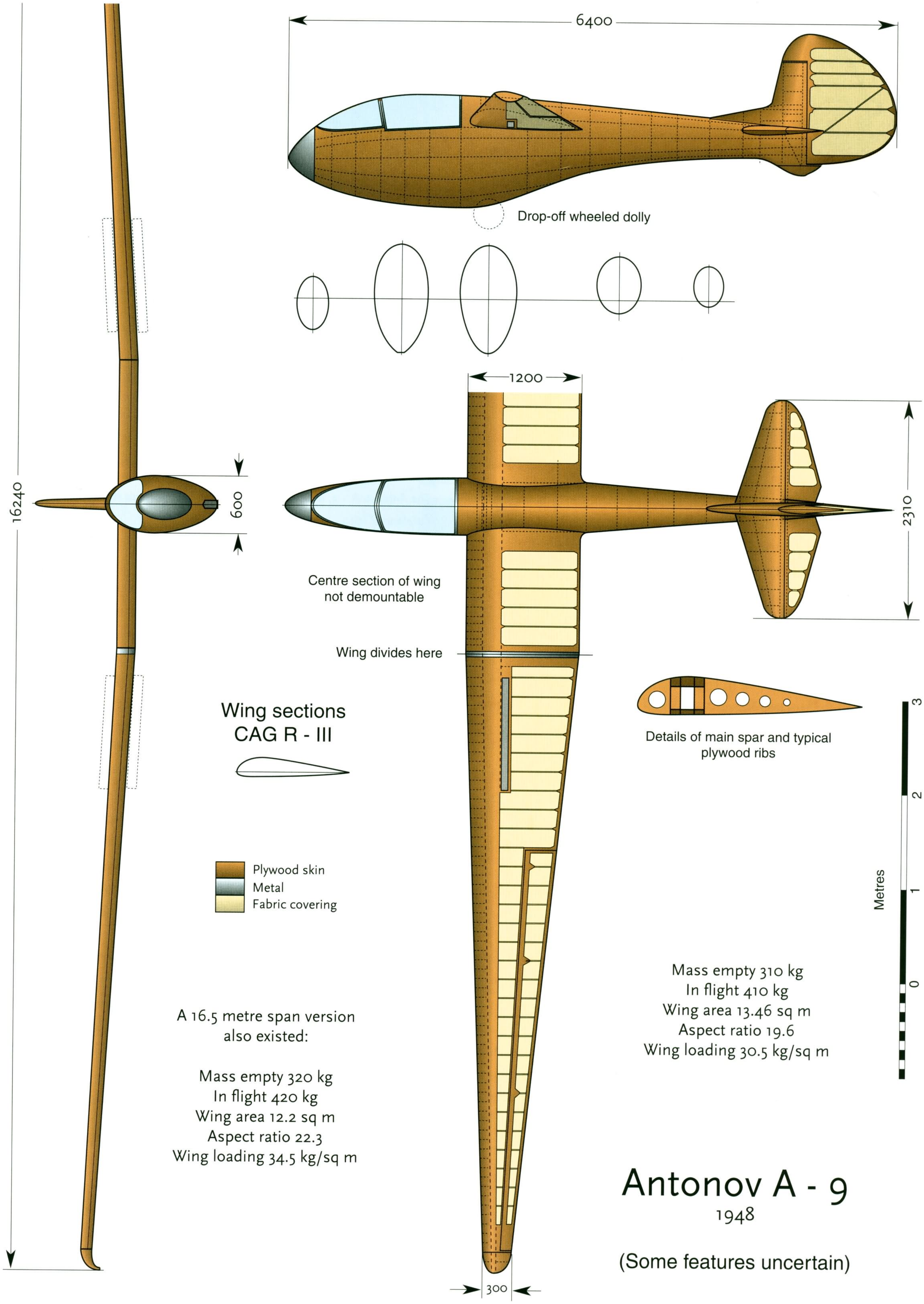
32 - See below



A 16.5 metre span version
also existed:

Mass empty 320 kg
In flight 420 kg
Wing area 12.2 sq m
Aspect ratio 22.3
Wing loading 34.5 kg/sq m

Mass empty 310 kg
In flight 410 kg
Wing area 13.46 sq m
Aspect ratio 19.6
Wing loading 30.5 kg/sq m

Antonov A - 9

1948

(Some features uncertain)

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Above: Kosava, one of the most graceful and efficient of two seaters.

Bellow: Pilots Bozidar Komac (rear seat) and Zvonimir Rain in the Kosava at Camphill. They won the two seat championship.

YUGOSLAVIA

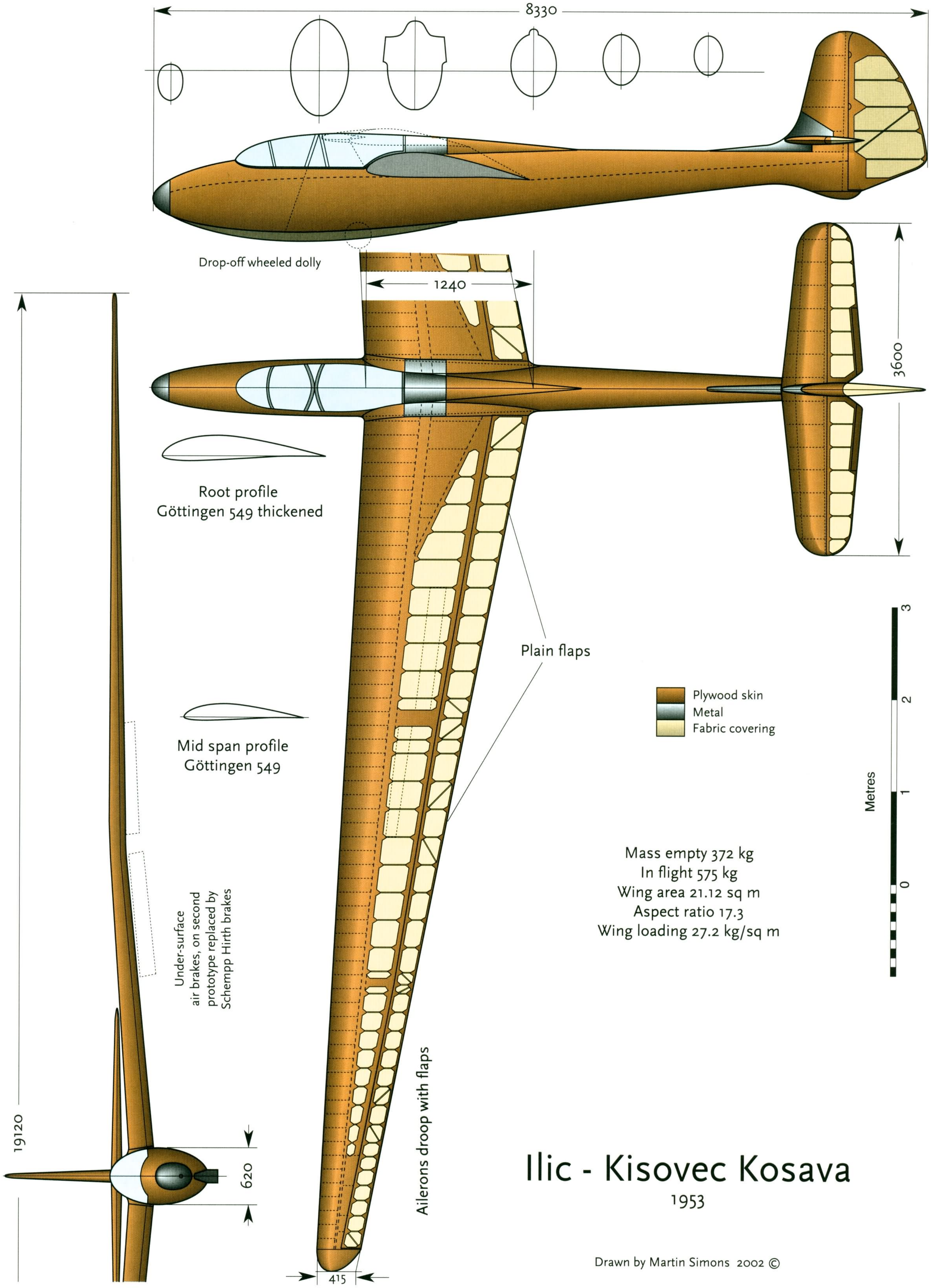
The Yugoslavian Aeronautical Union reported that in 1950 there were 196 aero clubs and 8 major training establishments near the larger cities. There were 33 glider training schools. Aeromodelling, glider training, skydiving[33] and powered flying were treated as parts of a general aeronautical training scheme. Thousands of young people were introduced to aviation in a State-controlled programme. They had to pay little or nothing for their flying. There were more than 200 sailplanes and, before long, more than 10,000 sailplane pilots. All national soaring records had been broken and some of the young pilots were ready for international competition.

In support of this there was a substantial programme of glider and sailplane design and construction. Some German Kranich IIs and Weihes were built but soon replaced by indigenous products. The Triglav fifteen-metre sailplane, which had a shoulder wing with a bubble canopy, entered production, the Udarnik, with a gull wing soon followed. A water sailplane, the Jadran, had been built by a group of students for flying on the Dalmatian coast, where there were few safe landing places but plenty of sea inlets. As a result of all this activity, for a time Yugoslavia became a world leader in soaring and sailplane design.

33 - The first World Championship for parachuting was held at Bled in Yugoslavia in 1951

Kosava

The Kosava (North wind) was commissioned by the Yugoslavian Aeronautical Union from the engineers Milos Ilic and Adryan Kisovec. Built by the Ikarus factory, it was produced in 1953 as a replacement for the Kranich II and proved very successful. Within a few weeks, flown by the young pilot Bozo Komac, it won the national Championship. Komac entered for the first German post-war soaring competition, at Oerlingahusen in 1953, and placed third. The Kosava, flown by Komac and co-pilot Zvonimir Rain, won the World Two-seater Championships at Camphill in 1954 scoring almost twice as many points as the runners up in the Italian Canguro. Rain flew it to second place at St Yan in 1956.



Ilic - Kisovec Kosava

1953

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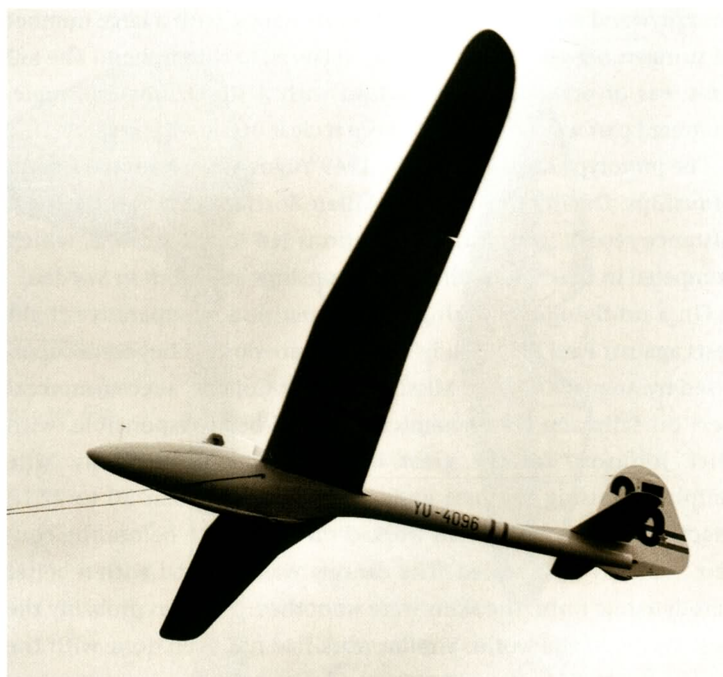
The Kosava was all wood with the normal combination of stressed plywood skins and fabric covering. The wing, mounted at shoulder height on the elliptical-sectioned fuselage, was swept forward to ensure a reasonably good view for the rear pilot in the tandem seats. The large wing span and aspect ratio of 17.3 ensured a good performance, with the widely accepted Göttingen 549 wing profile at the root, tapering to the CAGI 731M at the tips. (Little is known about this profile or its properties.) There were trailing edge flaps and large under-wing air brakes. The ailerons were coupled to the flaps to move part way with them. Since the wing profile was essentially a slow speed section with 4.6% camber, the flaps were mainly intended to be raised, rather than lowered. In high-speed flight this improved the glide and also reduced the negative pitching moment of the wing. With the flaps up by 9 degrees, the wing became effectively auto stable and the tailplane loads nil. The sailplane was stressed for cloud flying.

The fuselage was carefully streamlined with a long transparent cockpit canopy, in sections. There was no wheel but the usual kind of drop-off dolly for take off and ground handling.

There was a further development, the Kosava II, which had a wheel, a straight wing of 18 metres span instead of the gull form, and other detailed changes.



Top: The Orao II c, one of the best sailplane designs of its period. The 'tear drop' cockpit canopy was an unusual feature, giving excellent all round view from the cockpit. The gull wing was someting of a throwback to the 1930s.

Above: The Orao IIC on winch launch with the shoulder type release hook, in the World Championships at Camphill, 1954

Cijan - Obad Orao

The Orao (Eagle) represented a pinnacle of sailplane design when it first flew in 1948. It embodied all the most advanced ideas of the time. The designers were Boris Cijan and Stanko Obad.

The 19 metre wing, with aspect ratio over 20, used the Göttingen 549 profile for most of its length. No one had at this time found a better profile for a sailplane, but the Orao used a modified version slightly reduced in thickness with a very small reflexing of the trailing edge, in the interests of better high-speed glide. The cantilever ratio (i.e., the ratio of root thickness to span) was 53, very high by contemporary standards. The main spar of the central part of the wing, highly stressed in flight, was of light alloy. An early type of metal-to-wood bonding resin was used to attach the outer spar extensions to this and the same process was used to bond the plywood wing skins to the spar flanges. The wooden ribs were riveted to metal brackets on the spar. This kind of composite structure was entirely new in sailplanes.

The wing was slightly swept forward with gull dihedral, there were Fowler flaps and the ailerons were divided into three sections. The innermost section was plain, the second section of the Frise type to counteract adverse drag when banking, and a small section at the extreme tip smoothed the airflow there. Air brakes of the Schempp-Hirth type were fitted. The whole wing was skinned with plywood, the grain set diagonally to improve torsional strength.

The shape of the fuselage was intended to save parasitic drag. The necessary space for the cockpit required a certain minimum cross sectional area ahead of the wing but this was reduced as much as possible. The pilot sat in a slightly reclined position, allowing the fuselage height to be reduced to less than a metre, though pilots at the time did not like this position. There was a little extra elbow-room provided by the wing root fairings. There was no wheel. Aft of the cockpit, the fuselage was contracted to a slender tail boom. This was in order to reduce as far as possible the total surface area of the skin in contact with the airflow.

The tail boom was of a sandwich-skinned type. A double skin of thin plywood was laid over light circular hoops, with a large number of stringers between the two plywood layers, to stiffen them. The tail unit was of orthodox construction with a slight dihedral angle, mounted part way up the fin to keep it clear of the wing wake.

The prototype Orao flew in the 1949 Yugoslavian National Championships. During this meeting Milan Borisek set a new National distance record in it. Minor alterations led to the Orao II, which competed in the 1950 World Championships at Orebro in Sweden.

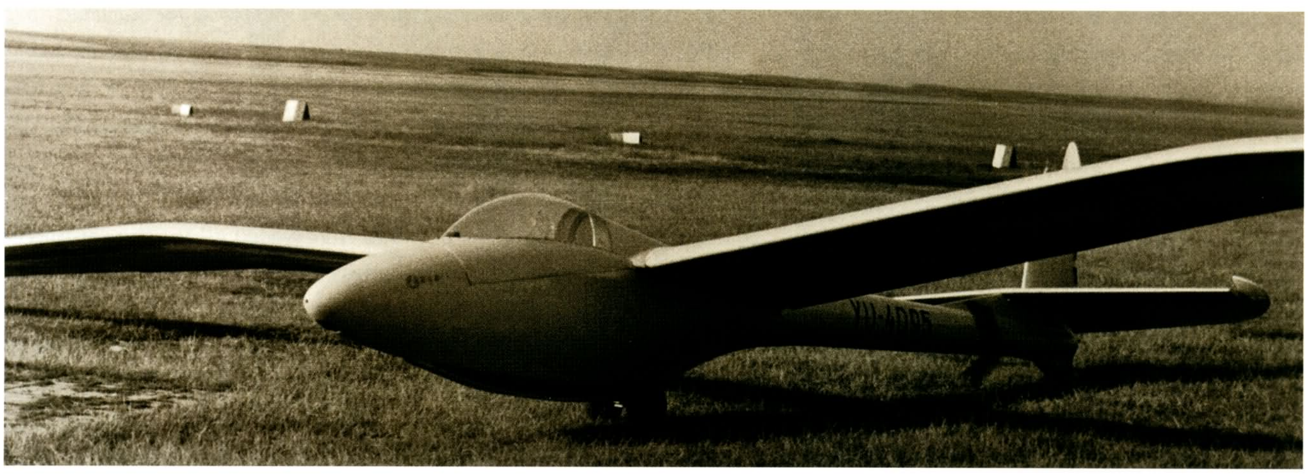
On a no-flying day during the competition, comparative flight tests against Paul MacCready's Weihe were done. They were supervised by August Raspet of Mississippi State College, a recognised expert on sailplane aerodynamics. (He had been responsible, with Dick Johnson, for the great improvements to the Tiny Mite sailplane, raising the best glide ratio from less than 20 to 27:1.) MacCready and Raspet had worked on the Weihe before the contest. All gaps were sealed. The canopy was replaced with a better aerodynamic form, the skins were smoothed. This was probably the best Weihe in the world. Similar work had not been done with the Orao. The ailerons and flaps were unsealed, the surfaces were in need of smoothing and polishing. Even so, Raspet concluded that the Yugoslavian sailplane was the equal of the Weihe at low speeds, and superior in the fast glide. The best glide ratio was 32:1. Borisek had not flown before in any International contest but placed third. First, second and fourth places all went to Weihes, Paul MacCready placing second.

Disaster came a few weeks later. Borisek was engaged in making a documentary film for government propaganda purposes, and as part of this flew the Orao at high speed, low across the airfield. Without warning the tail boom shattered and the sailplane crashed, killing the pilot.

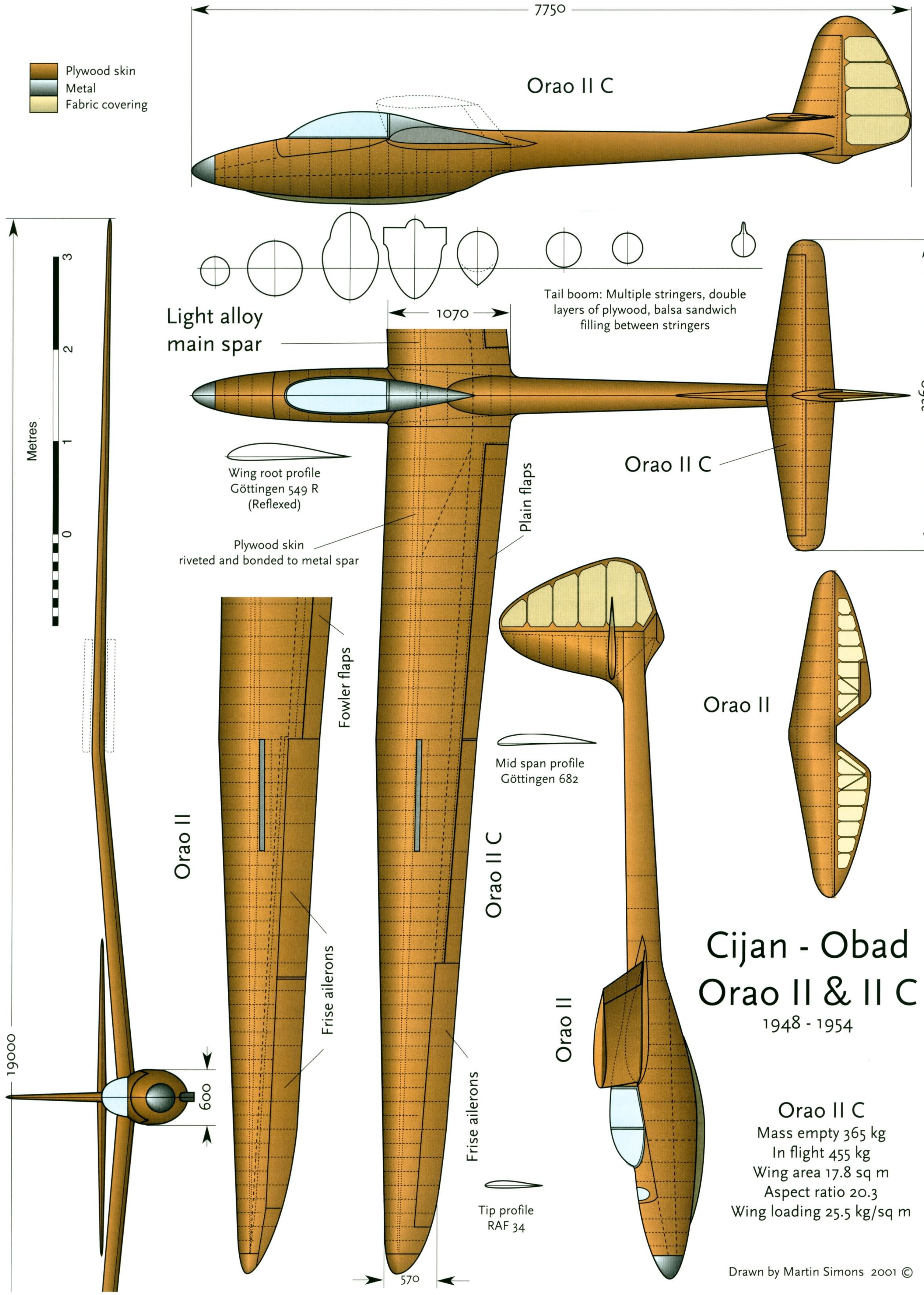
Research suggested that the cause had been tailplane flutter. There followed a complete review of the design, resulting in the development of the Orao IIC, two of which flew in the World Championships of 1954. The wing kept the same plan but the section at the semi span point was changed to the thin Göttingen 682. The Fowler flaps were replaced with simpler, narrow chord plain flaps, which extended beyond the gull bend. The ailerons were simplified.

The fuselage was reshaped to allow the landing loads to be transmitted directly to the main frames. Previously, because of the contraction behind the pilot's seat, the landing loads had been applied ahead of the centre of gravity. A heavy touch down could cause a sharp downward bending of the fuselage and even heavy blows on the tailskid if it hit the ground. This might conceivably have contributed to the eventual failure of the tail boom. The cockpit canopy was also improved, and for winch launching with a Y end to the towline, twin releases were fitted on either side adjacent to the pilot's shoulders. The vertical tail area was increased, with a dorsal fin extension. The horizontal tail was reshaped and skinned with plywood, with the elevator mass balanced. The Orao IIC was tested and best glide ratio of 36.6 : 1 was claimed.

At Camphill, in the poor weather, while the Kosava was winning the two-seat class, the Oraos put up a good performance but not good enough. F Mordej placed 9th, having, like many others, failed to score on the third day. His teammate M Arbatjer missed two days and was nineteenth. He did rather less well at the 1956 World Championships in France.



The designer, Boris Cijan, saved some drag by adopting the 'pod and boom' or 'club' shaped fuselage for the Orao. A 'drop off' dolly was used for ground handling and take off.



Cijan - Obad Orao II & II C

1948 - 1954

Orao II C
Mass empty 365 kg
In flight 455 kg
Wing area 17.8 sq m
Aspect ratio 20.3
Wing loading 25.5 kg/sq m

Drawn by Martin Simons 2001 ©

Part 2

New wings

Figure 1 Pressure variations over a traditional wing profile

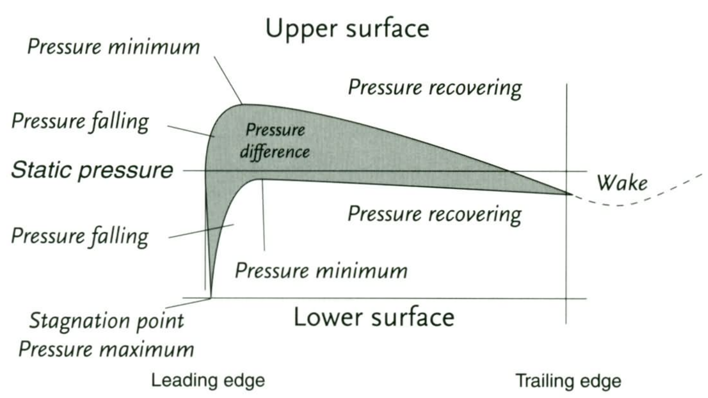
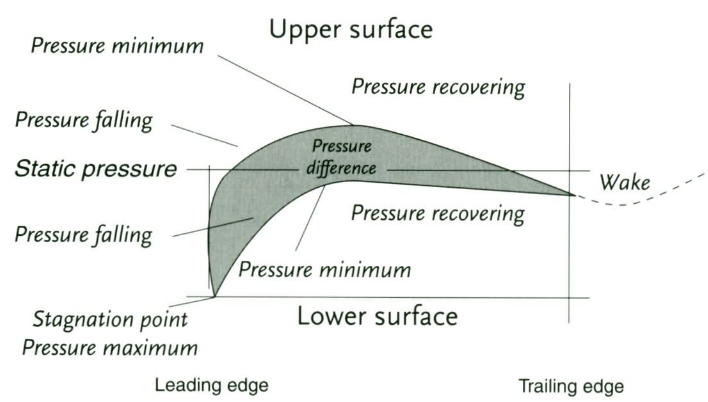


Figure 2 Pressure variations over a laminar wing profile



Laminar Flow

When a wing is yielding lift, meeting the airflow at a positive aerodynamic angle of attack, there is a difference in air pressure between the upper and lower surfaces. Some distance before the wing arrives the pressure is normal or 'static'. As the wing approaches, the air divides to flow above and below. Slightly below the leading edge is a point called the stagnation point. The air pressure at this point is greater than anywhere else on the wing surface. It has the 'static' value plus additional pressure created by the impact of the flow on the wing. As the air moves away from the stagnation point the pressure decreases on both surfaces. After the wing has moved through, dragging some wake with it, the air pressure returns again to the original, undisturbed 'static' value. First there is high stagnation point pressure, followed by a reduction in pressure to some minimum value, followed by recovery to the undisturbed value. The sequence is the same on both upper and lower surfaces but the pressure drop on the under side is less than that above, so there is a difference and lift is generated.[34]

The variation of pressure along the chord of a wing in flight can be measured. A typical result of such measurements for a wing of the traditional Göttingen or NACA 4 digit type is shown in Figure 1. (Lower pressures are shown in the upward direction.) From the stagnation point the pressure falls rapidly, reaches a minimum, then begins to recover. This occurs on both sides of the wing. The lift generated is represented by the shaded area showing the difference in total pressure between lower and upper sides. The recovery to static is not reached perfectly until some distance behind the wing.

When air passes over a smooth surface the flow near to the surface, in what is termed the boundary layer, is at first laminar. The air moves as a number of very thin sheets slipping easily over one another with only slight resistance. After some distance, this laminar flow cannot continue. The boundary layer, which is very thin at first, breaks up and becomes turbulent and thicker. The turbulent boundary layer has a scrubbing effect on the wing, creating additional drag. However, if the surface is very smooth and if the flow is towards a region of lower pressure, as it is on a wing leading edge like that of Figure 1, the laminar boundary layer may persist until

34 - If the wing profile is perfectly symmetrical and at zero angle of attack, the pressure drop on both sides is equal so there is zero lift. Such a wing will yield lift if it is trimmed in flight at a positive angle of attack. A cambered, non-symmetrical, wing profile may also be set at an angle to the airflow at which no lift is created. In this case the total of all the pressures above and below, is zero. For any cambered profile, the aerodynamic no lift angle is the aerodynamic zero.

35 - Jacobs, Eastman N, Preliminary Report on Laminar Flow Airfoils, NACA ACR, June 1939

the point of minimum pressure is reached. After this the transition to turbulence usually occurs.[35]

There are advantages in terms of drag reduction if the laminar boundary layer flow can be made to persist. By careful design of the wing profile the point of minimum pressure, on both surfaces, can be moved aft. This is shown in Figure 2. With carefully made, accurate wind tunnel models very considerable drag reductions can be demonstrated. The theoretical work and the wind tunnel measurements to establish this were carried out systematically in the National Advisory Council for Aeronautics (NACA) laboratories at Langley, Virginia, during the late nineteen thirties and early 'forties of the last century.

From this work at Langley new families of wing profiles, known as the NACA 6-series, were developed. With these sections, the various digits used in their designations have special significance and it is worth knowing their meaning. For example, there is a NACA 64 - 208 profile. The first digit indicates the 6-series family.

The second digit indicates, in tenths, the location on the chord of the minimum pressure point, in this case 4 tenths or 40%. The profile should preserve the laminar boundary layer over the front 40% of the wing, on both sides. To achieve this, the point on the chord where the thickness of the profile is greatest is close to 40%. Traditional profiles would have their thickest point further forward.

The third figure, 2, indicates the designed lift coefficient for this profile, omitting the decimal point. The best results are found at a lift coefficient of 0.2. This is a fairly low lift figure, which would correspond to an aircraft flying at a fairly high cruising speed.

The last two digits, 08, give the percentage thickness, 8% of the chord.

Summarising, the 64 - 208 is a thin section intended to create least drag at a fast cruising speed. With such a thin profile, quite small departures on either side of the designed lift coefficient cause the boundary layer to become turbulent and the drag rises sharply. This might be of no importance for an airliner which spends most of its flying time at a steady speed, but for a sailplane required to fly slowly when soaring and fast when penetrating sinking air, the 64 - 208 profile would probably be unsuccessful.

An additional figure is often added, before the dash and usually written as a subscript or in a small size letter. This is an indication of the ability of the profile to operate efficiently if it is not trimmed exactly at the designed or 'ideal' lift coefficient. To give an example of this, the NACA 63_3 - 618 has the minimum pressure point at 30%, an ideal lift coefficient of 0.6, a thickness of 18%. The small figure 3 before the dash indicates that it will still produce laminar flow and low drag at lift coefficients 0.3 on either side of the ideal value. The section is intended to be efficient at all lift coefficient values from 0.3 to 0.9, from moderately fast to slow flight. The boundary layer on a perfectly smooth wing with this profile, should remain laminar on both surfaces over a wide speed range, which is exactly what is required for a sailplane.

Other figures sometimes appear with these profiles but the significance of the main digits is not changed.

Smooth skins

Unfortunately, the thin laminar boundary layer is easily disturbed. Even when it is moving towards the pressure minimum, a small obstruction such as a rivet head, a hump or bump caused by a skin joint, even a fly speck or a blob of paint, can force an early transition to turbulent flow. Test specimens of the profiles were deliberately roughened. Drag figures measured in the wind tunnel after this were just as high as, or higher, than those of traditional profiles. Moreover, even if a special wing was built with very smooth and wave free skin, in service it was difficult or impossible to keep the wing clean enough. For ordinary aeroplanes there seemed little chance of laminar flow for more than a very short distance behind the leading edge of the wing. When the NACA 6 series aerofoils were first developed it seemed to many that they would have little or no application. The first attempt to use these profiles was with the North American P - 51 'Mustang' fighter. The success of this aircraft seemed to prove that the 6 series sections were working although the full improvement hoped for was not achieved.[36]

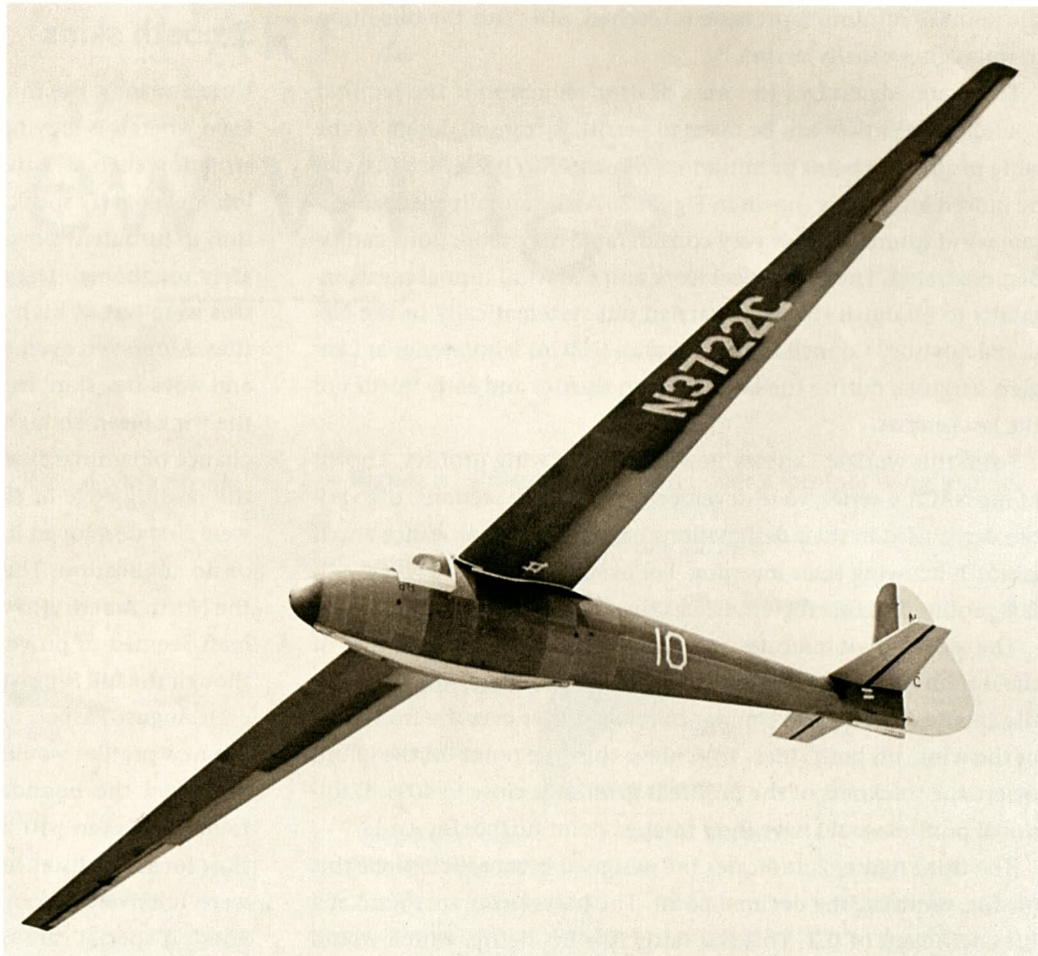
Dr August Raspet, of Mississippi State College, pointed out that the new profiles would find their best application on sailplanes. He measured the boundary layer on sailplane wings in flight and found that even with traditional profiles, there was often laminar flow for some distance behind the leading edge. The wooden skins were relatively smooth, lacking rivet heads, and the finish was good. If special care was taken with a sailplane the full extent of laminar flow might be obtained.

Another result from Langley encouraged this view. In aerodynamic terms sailplanes fly at lower Reynolds numbers than most powered aeroplanes. The Reynolds number is a measure of air density, viscosity and the geometric distance of a flow over a surface. Most of the Langley tests were conducted at Reynolds numbers between 9,000,000 and 3,000,000, (nine and three million) corresponding to the sizes and speeds of commercial and military aircraft. Sailplanes spend most their time at Re values around 1,000,000, perhaps exceeding 3,000,000 only at their maximum flight speeds. Tests were carried out over a range of Re numbers down to 700,000, directly applicable to sailplanes and light aeroplanes. It was concluded, "The extent of the lift-coefficient range over which the NACA 6-series airfoils in the smooth condition have low drag, which corresponds to extensive laminar flow, generally increases as the Reynolds number is lowered... The magnitude of the effect is greatest for the airfoils of greatest thickness, highest design lift coefficient, and farthest rearward position of the minimum pressure."[37]

Wings with low drag at high design lift coefficients are most desirable for soaring. A wide low drag range would still ensure good

36 - It is still a matter of controversy as to how much the good performance of the Mustang was due to the 'laminar' wing profiles. Other factors were also involved, including a cleverly designed engine cooling system which, by heating the air passing through the radiator ducts, gave some additional jet thrust.

37 - NACA Technical report TN 1945 by Loftin & Smith, published in 1949.



Above: At the Madrid Championships in 1952, Dick Johnson makes a point with the officials.

Right: The RJ - 5 during its development.. A glide ratio of 40:1 was achieved after many hours of work

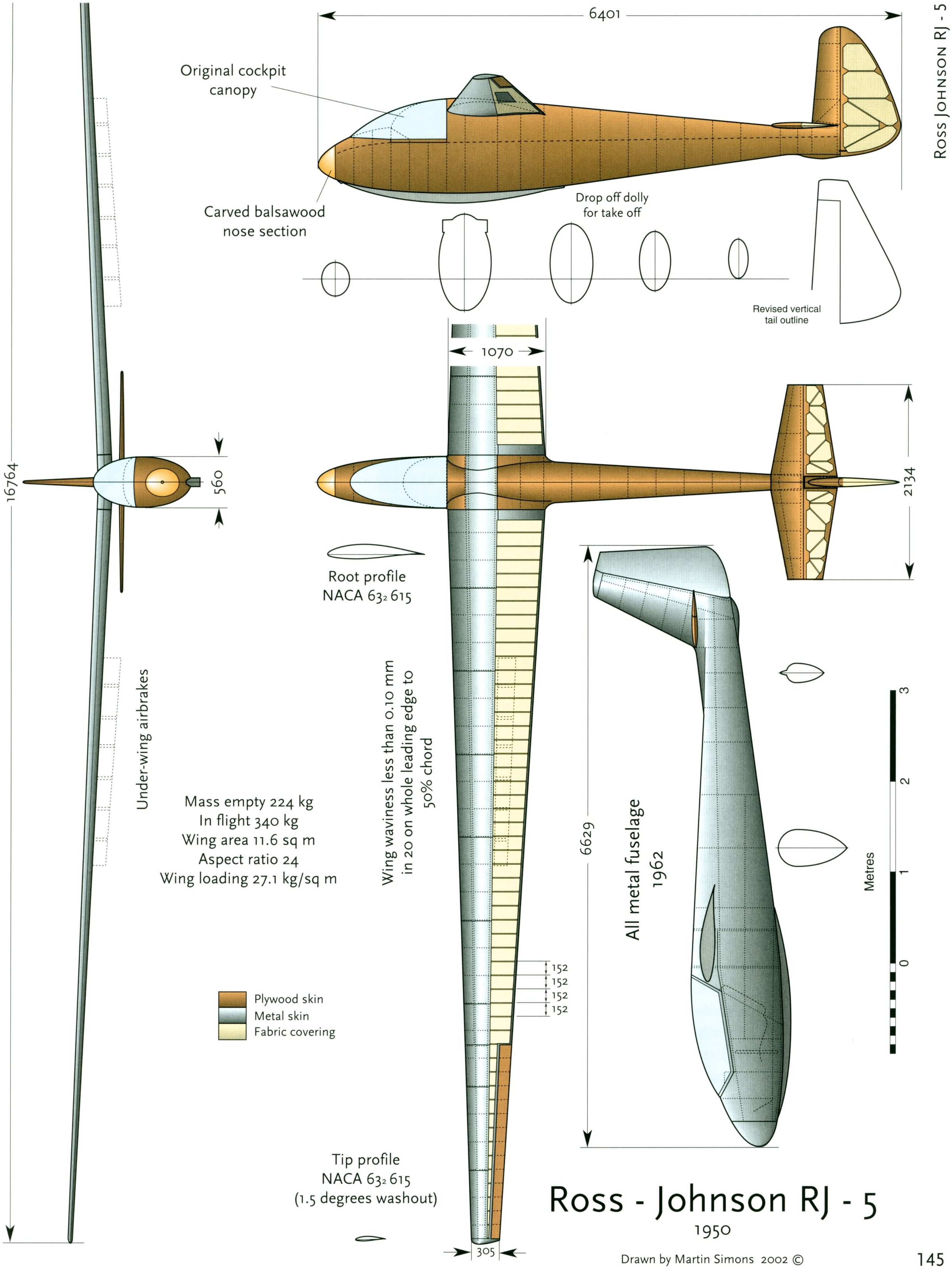
glides at high speeds. A thick profile allows deep wing spars. The fundamental difficulty was that of accuracy and smoothness of the wing surface. If, but only if, that problem could be solved, the stage was set for radical improvements in performance.

In following progress from the time the NACA reports were published, to 1965, the sailplanes described here are arranged in approximate chronological order rather than being grouped by nationality, as was done in Part 1 of this book. There is some justification for this. There was a kind of international community with intercommunication between sailplane engineers throughout the world. A new development or experiment in one place was almost immediately known about everywhere. There was little or no attempt to keep anything secret. Nobody seems to have tried to patent anything, results, both good and bad, were freely published and discussed. If a new approach proved successful it would almost certainly appear for international examination at the next important championship meeting and at the concurrent OSTIV[38] Congress. Everyone watched everyone else on the ground and in the air, everybody learned from everybody. There was first a branching out into all kinds of new realms. There were experiments, new approaches, new materials, new trials, all with the central hope of producing a perfect laminar flow sailplane, accurate, smooth, and practical in service. There were corresponding changes in soaring techniques. Competitions focussed more and more upon speed, on closed circuit racing, timed starts, spectacular high speed finishes. Pilots found themselves flying aircraft with performances they had scarcely dreamed of, attempting tasks that looked impossible until they accomplished them, achieving speeds and distances that astonished themselves. Instruments and radios became more and more sophisticated. Towards the end of the period, one line of development began to dominate.

38 - Organisation Scientifique et Technique Internationale du Vol a Voile.

Ross Johnson RJ - 5

Dick Johnson and Harland Ross decided in 1948 that a new sailplane was needed in the USA. Ross had designed the RS - 1 Zanonia and R - 2 Ibis of pre war times and the R - 3, of which only one was built in the USA (with another in Australia from plans). At that time no American designer had produced a sailplane with a better glide ratio than 30:1 and it was time to move forward. Ross devised the general layout. Dick Lyon, an engineer with the Hughes Aircraft Corporation suggested the aerofoil section, which proved crucial to the success of the aircraft. It was the laminar flow NACA 63_2 - 615, 30% laminar, for an ideal lift coefficient of 0.6, and 15% thick. With the span decided at 55 ft (17.64 m) a metal wing was required. Two duralumin spars were set at 20% and 50% of the chord, with 24ST alloy skin covering them and continuing round the leading edge to form a very strong D box resisting bending and torsion. Flush riveting was essential. Aft of the spar the open frame was covered with fabric. There was a plain trailing edge flap; ailerons were hinged on the upper surface. The air brakes were entirely under the wing, going down to 90 degrees for landing. Hinged at the 50%



Ross - Johnson RJ - 5

1950

Drawn by Martin Simons 2002 ©

chord point they had no pitching moment when lowered and had the advantage that they did not reduce the lift when deployed, as ordinary spoilers and brakes usually did. They were, however, somewhat vulnerable to damage from obstructions on the ground when landing.

The fuselage was very similar to the R - 3, a straightforward semi-monocoque with mahogany plywood skin, and the tail unit also was quite orthodox. Stress calculations for the wing were undertaken by Stan Hall[39] and colleagues at Northrop Aircraft Corporation. Johnson commissioned Ross to build the new sailplane and work began. Meanwhile Johnson attended the engineering school at Mississippi State College (MSC) and took his small sailplane, Tiny Mite, with him for investigation by Raspet at the MSC Engineering Research Station. What he learned from this work became of great value.

The task of completing the RJ - 5 proved too time consuming for Ross. After spending 2,200 hours on it he was forced to leave it to Johnson to finish. It was taken to MSC. Using his experience with the Tiny Mite, Johnson undertook some important redesign. The wing position was raised to leave the upper surface uninterrupted. The angle of incidence was reduced to align the fuselage with the airflow at an airspeed of 130 km/h (80 mph). The ailerons, quite small, were assisted by small drag 'spoilerons', which opened on the down-going wing, when the aileron on that side was raised by more than 12 degrees.

The RJ - 5 flight test results at first were disappointing. The best glide ratio was only fractionally better than 30:1. Detailed analysis suggested various ways of improving on this. The wing skin was measured and found to have waves and humps sometimes of 0.2 ins. (5 mm). The spoilerons and the trailing edge flap gaps were not sealed. The cockpit canopy was a simple part-spherical bubble shape, which caused serious flow separation over the centre of the wing.

Step by step, all these matters were attended to. Flight tests and measurements followed each alteration. The glide ratio was improved first to nearly 33 by filling and smoothing the leading edge and taping over the flap gaps. A new, better-shaped canopy raised the figure to 35. Johnson removed the trailing edge flaps entirely and spent a winter rebuilding all the rear ribs to greater accuracy. The spoilerons were taped in the closed position, which showed that the rate of roll was no worse without them, so they were removed altogether. The glide ratio now exceeded 36:1. The under-wing gaps at the aileron hinges were closed, the leading 50% of the wing was again carefully filled and smoothed, the landing skid was made retractable to lie flush with the fuselage in flight. Nothing was overlooked. The glide ratio at the end of this long programme was better than 40:1, certainly the first sailplane in the world to achieve such a figure.

Between spells of work on the RJ - 5 Johnson took it to the17th US National Championships in 1950, at Grand Prairie, Texas. Between flights he and his crew continued to fill, sand and smooth the wings. Paul Schweizer remarked; "The sailplane did not look very attractive with its different shades of primer and sanded areas, but it did perform well."[40] Johnson won the Championship and set a National Goal Flight Record of 510 km. He won again in 1951, among other things breaking the National Distance Record with a flight of 579 km. In August he broke the World Distance Record by flying from Odessa in Texas to Salina in Kansas, a distance of 861.2 km. The previous record by Olga Klepikova in the USSR was 749 km set in 1939. The news was received round the world with amazement.

Great things were expected of Johnson when he entered for the World Championships in Spain in 1952. Unfortunately the RJ -5 was damaged when landing on rough ground on the first day and missed two contest days while repairs were done. (Stony and small Spanish fields caused difficulties for everyone. Three other competitors wrote their sailplanes off entirely on this day.) On the last competition day, however, he flew the goal race at a speed of 107 km/h, an almost unheard of average for the times.

On returning to the USA, Johnson and the RJ - 5 again won the US Championships. During this meeting he set a new triangular course speed of 88 km/h. He did not enter the 1953 Nationals but in 1954 the RJ - 5 scored so well that Johnson did not need to fly the last day in order to win.

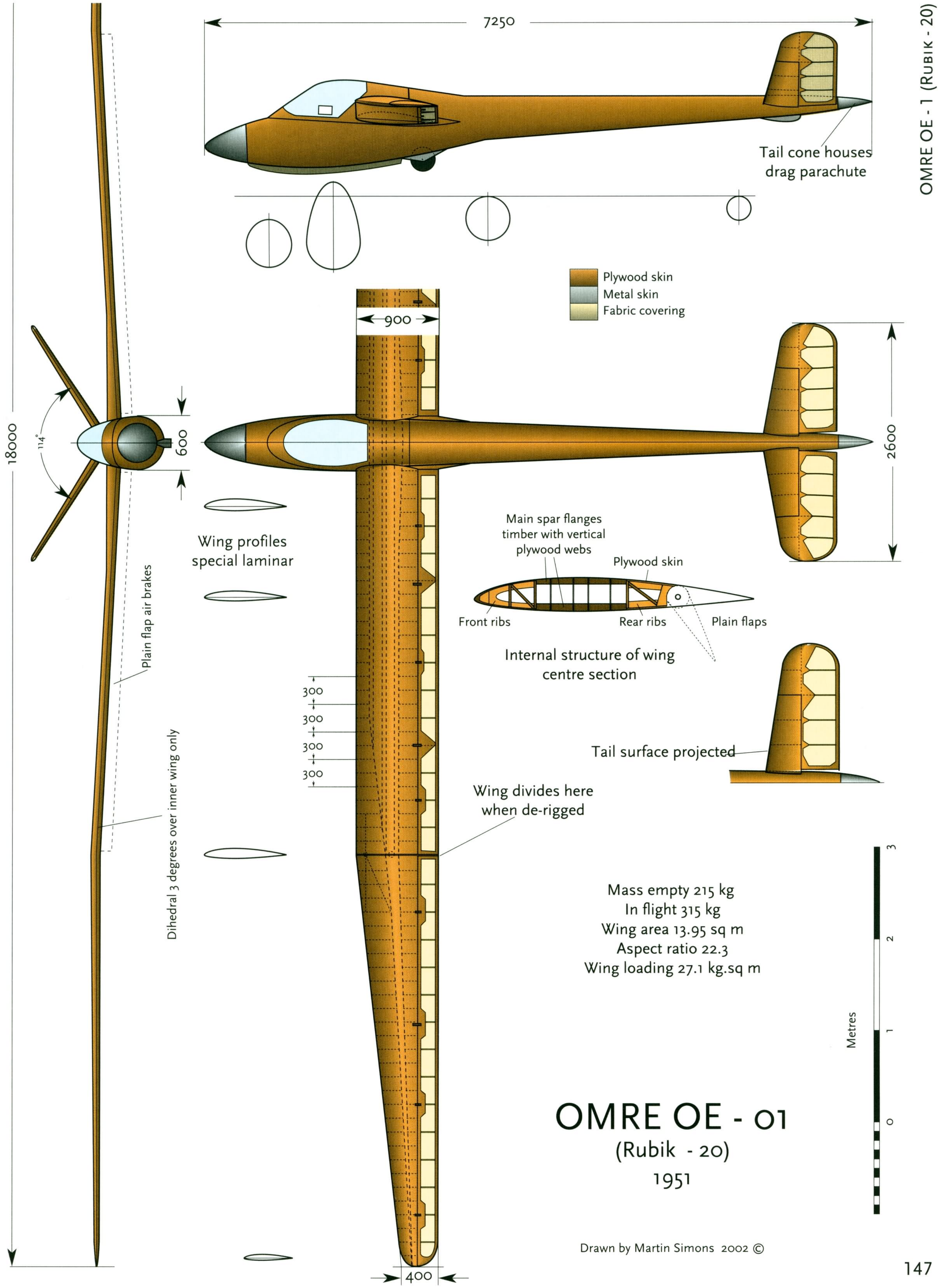
It could not be doubted that the laminar flow wing profiles had made a vast difference. The amount of work necessary to achieve these results, simply to make the wing smooth and maintain it so in service, made an even deeper impression.

OMRE OE - 1 (Rubik - 20)

The OMRE[41] OE - 1 was an ambitious experiment with a laminar flow wing of Hungarian design. It was not intended to fly in competition and incorporated many new features rarely or never seen on sailplanes before. The design group was led by Márton Pap and Erno Rubik. The first flight was in 1951, making it one of the first laminar wing sailplanes to fly after the RJ - 5.

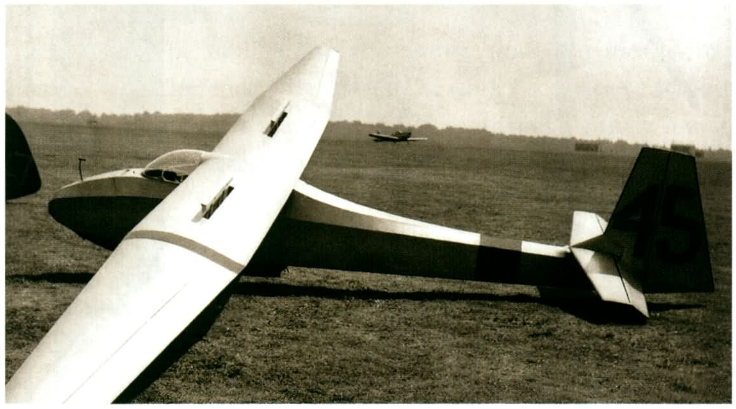
An unusual picture of the pilot in the cockpit of the OMRE OE - 1. For 18 metres span the wing was extremely thin. As the drawing shows, an exceptionally strong main spar was needed

39 - Designer of the Cherokee. See Part 1 above.
40 - Schweizer, P, Wings Like Eagles, p117
41 - Országos Magyar Repülö Egyesület


OMRE OE - 1 (Rubik - 20)
7250
Tail cone houses drag parachute
Plywood skin
Metal skin
Fabric covering
900
18000
114°
600
2600
Wing profiles special laminar
Main spar flanges timber with vertical plywood webs
Plywood skin
Front ribs
Rear ribs
Plain flaps
Internal structure of wing centre section
Plain flap air brakes
300
300
300
300
Tail surface projected
Wing divides here when de-rigged
Dihedral 3 degrees over inner wing only
Mass empty 215 kg
In flight 315 kg
Wing area 13.95 sq m
Aspect ratio 22.3
Wing loading 27.1 kg.sq m
Metres
0
1
2
3
OMRE OE - 01
(Rubik - 20)
1951
400
Drawn by Martin Simons 2002 ©

In the 1954 World Championships the South African pilot, Pat Beatty flew the second Skylark built. In the very difficult weather of this meeting, it competed against much larger sailplanes, some also with 'laminar' wings.

Right: To save costs, the Skylark fuselage was taken almost without change from the earlier 'Prefect' trainer.



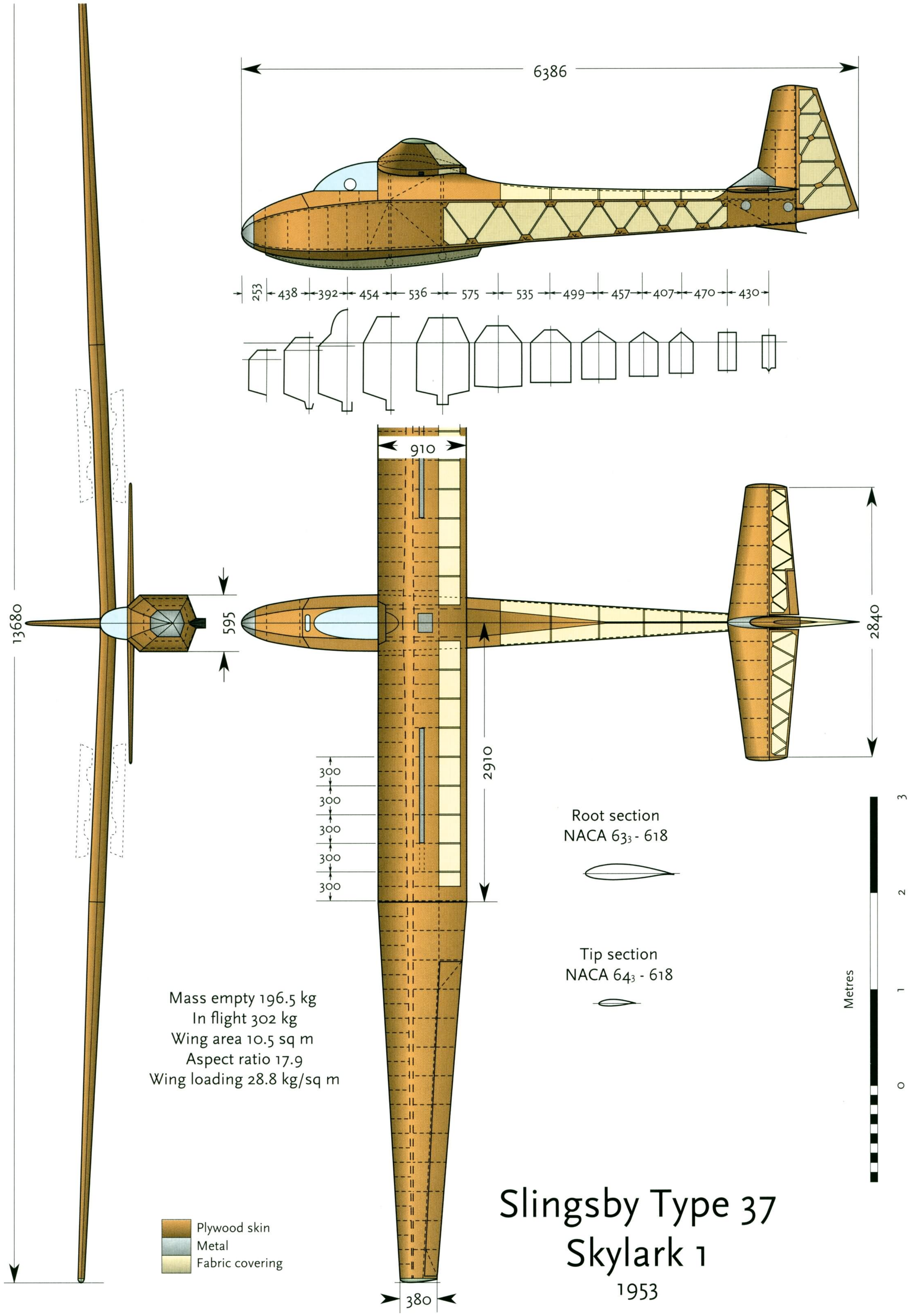
The wing had an unusually high aspect ratio with a thickness of only 12% of the chord, thickened slightly in the centre. An exceptionally strong timber main spar was required, occupying more than a third of the total width available at the root. The spar itself was shaped to conform as closely as possible to the profile, with wing ribs in front and behind. The plywood skin extended over the whole wing except for the flaps and ailerons. To avoid the necessity for very large and heavy wing root fittings, the centre section was built in one piece 9 metres long, with outer panels of 4.5 metres each. There were no air brakes or spoilers on the wing, braking being provided by the flaps and a tail parachute, housed in a detachable cone at the rear end of the fuselage. The wings had a slight 'gull' dihedral form.

Much care was taken to reduce the cross sectional area of the fuselage. The control cables and pushrods were conducted down the sides of the cockpit, protected by guards. The seat was set as low as possible, on the inner skin of the belly. The wheel, not retractable, was well back behind the centre of gravity, so a front skid was necessary. Behind the cockpit the fuselage contracted to a circular tail boom, which carried the V - tail.

How successful the OE - 1 proved is not known. The best glide ratio claimed for it was 32 :1, which was not particularly good for an eighteen-metre sailplane. (The Yugoslavian Orao IIC claimed 36:1 with traditional wing profiles.) The RJ - 5 had not been exceptionally good at first. Probably the OE - 1 would have achieved much better performance if it had been put through thorough process of sealing, smoothing and cleaning up.

Slingsby T - 37 Skylark 1 and T - 41 Skylark 2

Design work on the wing of the Slingsby Type 37 began in 1952, with the intention of producing a small and cheap sailplane with a good performance. The wing, of only 13.68 metres (45 ft) span, would be mounted on a simple box framed fuselage adapted from the earlier T - 30 Prefect training sailplane. Experiments were needed with lateral control. To enable the control surfaces to be changed easily, the wing was designed in three sections to allow the outer panels to be exchanged without having to rebuild the entire wing each time. The aerofoil section proposed was one of the old NACA 4 digit family. However the success of the RJ - 5 suggested to Slingsby's chief designer, John Reussner, that the NACA 6 series profiles might be used as part of the experiment. The 63_3 - 618 was chosen for the centre section, tapering to the 64_3 - 618 at the tips, with a slight modification after testing to retain a flat bottom surface for the ailerons. Calculations indicated that despite the small span a sailplane with this wing, if laminar flow was achieved, would out - perform bigger aircraft with the older profiles, and should be less expensive.

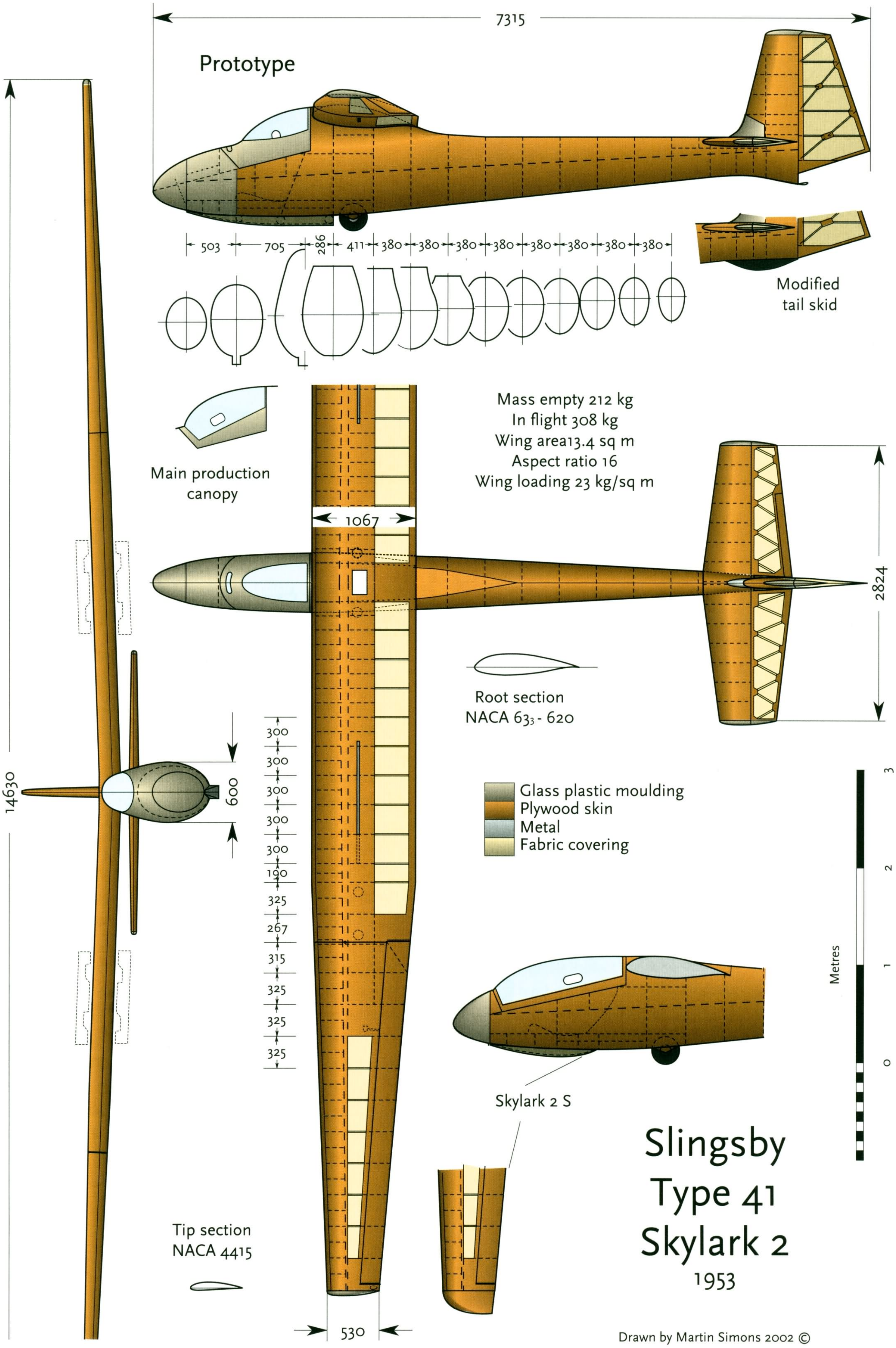


Mass empty 196.5 kg
In flight 302 kg
Wing area 10.5 sq m
Aspect ratio 17.9
Wing loading 28.8 kg/sq m

Slingsby Type 37 Skylark 1

1953

Drawn by Martin Simons 2002 ©


7315
Prototype
503 705 286 411 380 380 380 380 380 380 380 380
Modified tail skid
Main production canopy
Mass empty 212 kg
In flight 308 kg
Wing area13.4 sq m
Aspect ratio 16
Wing loading 23 kg/sq m
1067
2824
14630
Root section
NACA 63₃ - 620
600
300 300 300 300 300 190 325 267 315 325 325 325
Glass plastic moulding
Plywood skin
Metal
Fabric covering
Metres
3 2 1 0
Skylark 2 S
Tip section
NACA 4415
530
Slingsby
Type 41
Skylark 2
1953
Drawn by Martin Simons 2002 ©

Slingsby aircraft till now had been skinned with thin birch plywood. For additional torsional resistance the ply was usually laid with the grain running diagonally. Even if the wing was accurate when it left the factory, the plywood developed waves and ripples as the wood dried and shrank. The performance of a laminar profile would soon degenerate. It would be necessary to fill and smooth the irregularities repeatedly to maintain the performance. If the Type 37 was to be anything more than a 'lark' (as Slingsby himself thought it might be), something new in the way of structures was required.

Slingsby never claimed to be an aerodynamicist but he knew about timber. There was available an African Gaboon plywood of much lower density than the usual aircraft birch. Strength for strength, it was thicker than birch and less prone to shrinkage. It would not be feasible to bend this thicker material round the nose radius of a wing. The extreme leading edge would be an accurately shaped and hollowed out spruce member. The Gaboon ply would be glued to this in separate sections, above and below. If the leading edge rebate joints were well made and properly filled, a smooth wing would result. With a fabric covering and paint finish, it ought to maintain its shape in service.

The Prefect fuselage required only small alteration. The tail unit was as simple as possible, and the first Skylark flew in 1953. The performance was fully up to expectations. It was made available for the well-known pilot, Tony Deane-Drummond, to fly in the British National Championships from July 25th till August 3rd. Deane-Drummond found the performance excellent in good conditions although the wing loading was higher than he liked and using weak thermals was not easy. Despite the short time he had to get used to the aircraft, he placed fifth, which was a good result for such a small sailplane.

The following year, the World Championships were held at Camphill. A second Skylark had been built and was flown in the Championship by the South African Pat Beatty. In the prevailing bad weather he was unable to score on three of the four contest days. He was not the only pilot in this unhappy position.

Top: The Skylark 2 was a complete redesign of the Skylark 1 with new wing of greater span and an improved fuselage. More of the Skylark 2 were built than any previous Slingsby high performance sailplane. Many had canopies altered in service
Above: Skylark 2 with a Skylark 3 behind.

There was obviously room for improvement with the Skylark. In November 1953 the Type 41, Skylark 2 was flown. Although described as a development of the T - 37, the two types had little in common other than the three-piece wing and the use of Gaboon plywood. The wing span was extended to 14.63 m, (48 ft) but the aspect ratio was reduced to keep the wing loading down. A thicker NACA 6 profile was chosen and the wing tips tapered to the old fashioned NACA 4415, to ensure safe stalling character. The fuselage was entirely new. It was streamlined, skinned mostly in Gaboon plywood. There was a wheel with a forward skid.

An important innovation was the use of glass-plastic mouldings for such components as the nose and canopy frame, the wing tips and other small fairings and parts. Polyester rather than epoxy resins were used.

The performance and handling were considered excellent. The best glide ratio was estimated to be 30:1 which was a good deal better than the Olympias widely used in Britain. The Skylark 2 became very popular with clubs and private owners. There were exports, including two kits which were assembled in New Zealand.

In 1958 the Standard Class was introduced at the World Championships in Poland. Philip Wills entered the new class, with a Skylark 2. He was disappointed in his own results but did not blame the aircraft. Production of the Skylark 2 continued until 1961, by which time 63 had been built. This was more than any previous Slingsby high performance sailplane.

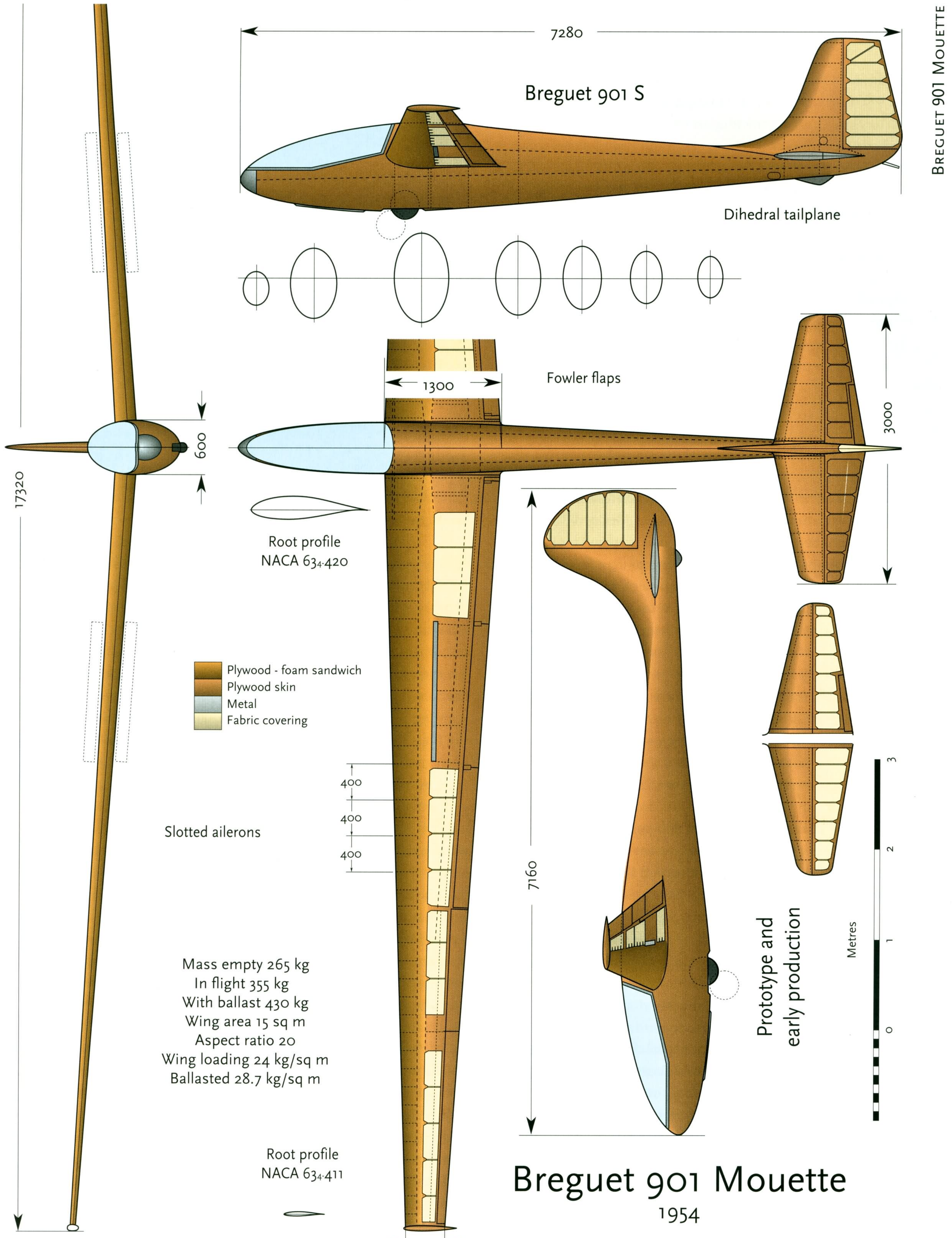
The Skylark 2 lent itself to modification and adaptation. A group at the Bristol Gliding Club led by Dennis Corrick made modifications to their Skylark 2, re-setting the wing incidence to achieve better high speed glide, extending the span to the full 15 metres, fairing the cockpit canopy and wheel and improving many other details including gap sealing. The result was a measurable improvement in performance. This sailplane was still flying in 2006. The author rebuilt a wrecked Skylark 2 in 1966 - 7, and incorporated similar changes, but also reducing the height of the fuselage and reclining the seat. The resulting Skylark 2S was still airworthy in 2005, as are many of the unmodified originals. Developments by Slingsby resulted in the Skylark 3 and 4 (See below).

Top: The graceful fuselage lines and the elaborate external flap hinges of the early versions of the Breguet 901, are displayed here. This was an early production aircraft.
Below: For later production, a simpler fuselage and improved flaps were designed, and the vertical tail enlarged.

Breguet 901 Mouette

Jean Cayla had wanted to be a pilot but his eyesight was too bad to allow this. He discovered soaring soon after he left school. After qualifying as an aircraft engineer he began working for the Breguet Company at Villacoublay. His boss, Georges Ricard, had been in charge of the Breguet 900 project of 1948. In 1952 the Company decided to prepare two sailplanes for the forthcoming World Championships of 1954. Cayla was given the task of designing them. He was allocated a private office for the work and, knowing there was not much time, started at once.

The wing area of 15 sq m and the aspect ratio of 20 determined the span of 17.32 metres. Early in the process of design Cayla was in no doubt that the Br 901 Mouette (Seagull) would use the NACA 6 Series wing profiles. To allow ample depth at the wing root for spars, the profile there was the NACA 63_2 - 420, grading to 63 - 411 at the tips. To maintain accuracy over the vital forward third of the chord, the skins were to be plywood and plastic foam ('Klegecel') sandwich. To allow circling tightly in small thermals, large Fowler flaps were envisaged, with slotted ailerons. To improve the high



Breguet 901 Mouette

1954

Drawn by Martin Simons 2002 ©

speed glide there would be ballast tanks in the wings to take 75 kg of water. The fuselage was a particularly graceful shape, with a fully contoured canopy and a retracting undercarriage which, however, did not disappear entirely into the fuselage and had no doors to seal the wheel well. There were powerful airbrakes in the wings. The Breguet 901 was going to be a much more complicated sailplane than anything seen before.

Detailed work began in March 1953 and continued through the year. There were difficulties and delays with the unfamiliar materials when it came to building. Despite the hold ups, the prototype made its first test flight with Paul Lepanse on 11th March 1954 and the second aircraft on 22nd May. The Championships started on July 21st. With less time to practice than they would have liked, the pilots Gerard Pierre and Guy Rousselet arrived at Camphill. There were four contest days. Pierre did not win any one day but flew consistently and in accumulated points never dropped below second place. By the end his total score was 101 points ahead of Philip Wills in his Slingsby Sky. Rousselet placed seventh, scoring on only three days. Pierre thus became World Champion.

The Breguet 901 had made a great impression. The authorities of the Service de l'Aviation Légere et Sportif (SALS) decided that more of the type should be constructed and Breguet prepared for production of 60 in three batches of twenty. Many changes were made to simplify production and to improve some aspects of the control response. The hinging of the ailerons was re-designed, and the very obtrusive under-wing flap guides were removed. The fuselage lines were simplified and the rudder enlarged. The production sailplane was called Breguet 901 S.

At St Yan in 1956, flying the third prototype, the American pilot Paul MacCready, who had been fourth in 1954, became World Champion. There were five others of the type competing but flying a Br 901 was no guarantee of success. Pierre was 18th.

The Breguet 901 broke six world records, including the 200 km triangle speed by Guy Rousselet at 77 km/h, 677 km to a goal by René Fonteilles, and absolute altitude of 9400m by Jules Landi.

The 901 was expensive and to get the best out of it required a very experienced pilot. The SALS decided to cancel their order after the first batch of twenty had been completed. Ten more were built at intervals to fill special orders and for particular competitions. There were changes of detail on most of these. Including the two prototypes, thirty two were built.

HKS - Series

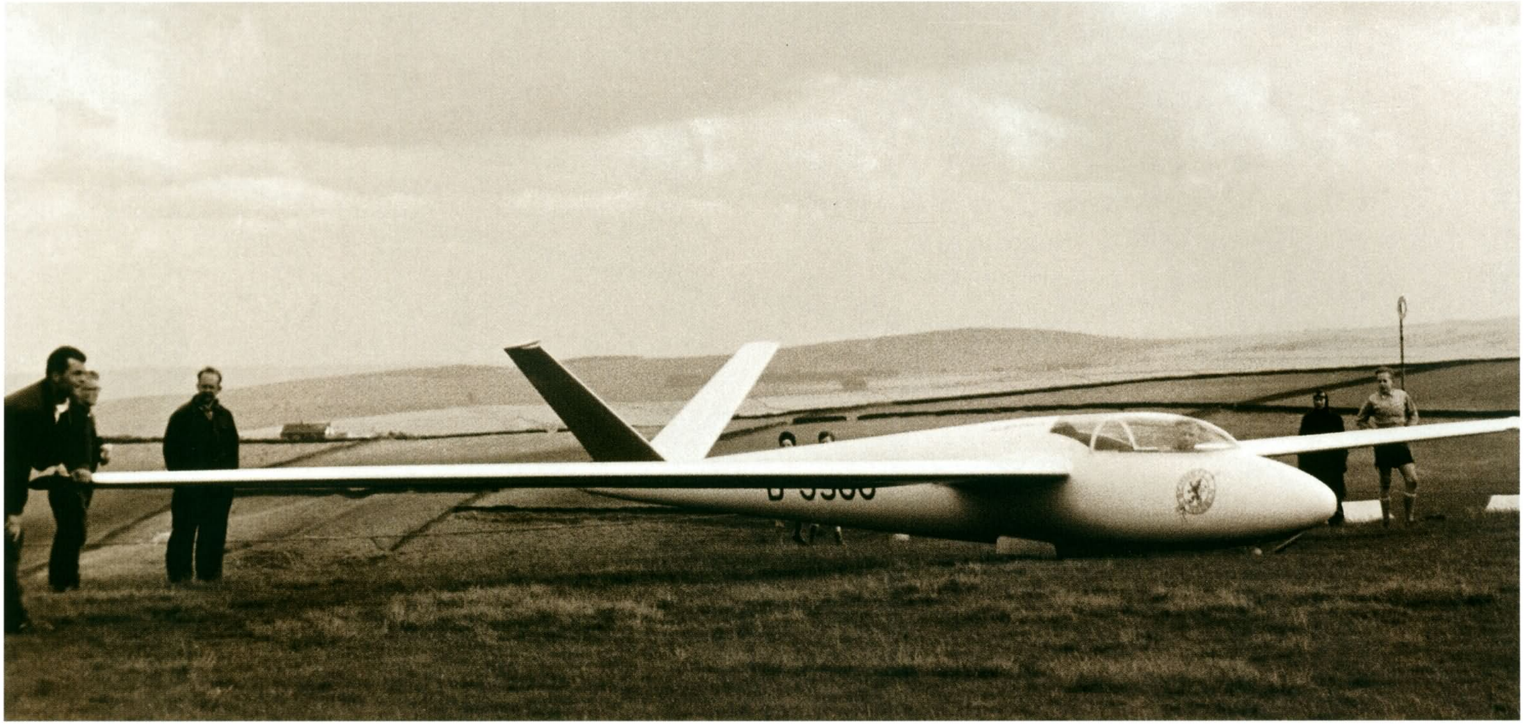
The success of the RJ - 5 and Raspet's work in the USA inspired Ernst Günther Haase, Heinz Kensche and Ferdinand Schmetz to design and build a fast two seat sailplane, the HKS - 1. It took two years. They were determined to bring German sailplane design to the forefront as it had been before 1945.

The main effort was directed to a completely new kind of wing construction. The profile, NACA 65_2 - 715, was an ambitious choice. This section was quite strongly cambered for a lift coefficient of 0.7, to take care of the low speed performance. Laminar flow was expected to extend over the leading 50% of the chord. The RJ - 5 and Slingsby's little Skylark aimed at only 30%. A very high degree of accuracy would be essential. The whole wing must be completely smooth and airtight, with no gaps, leaks or discontinuities. Changing the camber in flight would widen the speed range. Flaps had been used on many earlier sailplanes but had often proved disappointing. The Tiny Mite and the RJ - 5 had both proved better after the flaps had been removed. Hinged surfaces such as ailerons, airbrakes and spoilers could be eliminated only if there was a form of wing warping.

Left: The HKS - 1 flying over Camphill

The main spar was a very substantial double box type with laminated flanges in Baltic pine (Kiefer) and plywood webs. The spars alone weighed 90 kg.

The wing skin was a sandwich of plywood and rigid foamed plastic, which carried across the spar well beyond the critical 50% point in one smooth curve, on both upper and lower sides. The sandwich was made up of an inner layer of 0.6 mm plywood, then a six mm plastic foam layer, and finally an outer skin of 1.5 mm plywood, thinning to 0.8 mm thickness on the outer part of the span. To support the skin, ribs were fitted in front of and behind the spar. The main ribs, spaced 390 mm apart, were framed in wood/plastic sandwich. Between each pair of these, three foam ribs were spaced at 130 mm. There was a false leading edge of pine with a balsa wood packing, accurately shaped and smoothed, to form the leading edge radius. To construct such a skin, the spar having been completed and ribs glued in place, the inner plywood layer was laid, followed by the plastic. Accurate templates and jigs then allowed the whole wing to be smoothed, with long sanding bars, to the exact ordinates minus the thickness of the outer plywood. The final layer of ply-



Right: The HKS 1 preparing for a winch launch at Camphill in 1954. The pilot, flying solo, was Ernst Gunther Haase

wood was wrapped in a continuous sheet round the leading edge from the top of the spar to the underside. Spreading the glue for the final skin was done very carefully to avoid any unevenness which would cause humps and waves. Kensche wrote that the process was not as difficult as the team had expected but it took a great deal of time and care. After completion, measurements using Raspet's technique revealed waviness in some places of plus or minus 0.15 mm, occasionally a little more. A further sixty hours of sanding and smoothing reduced this to 0.05 mm.

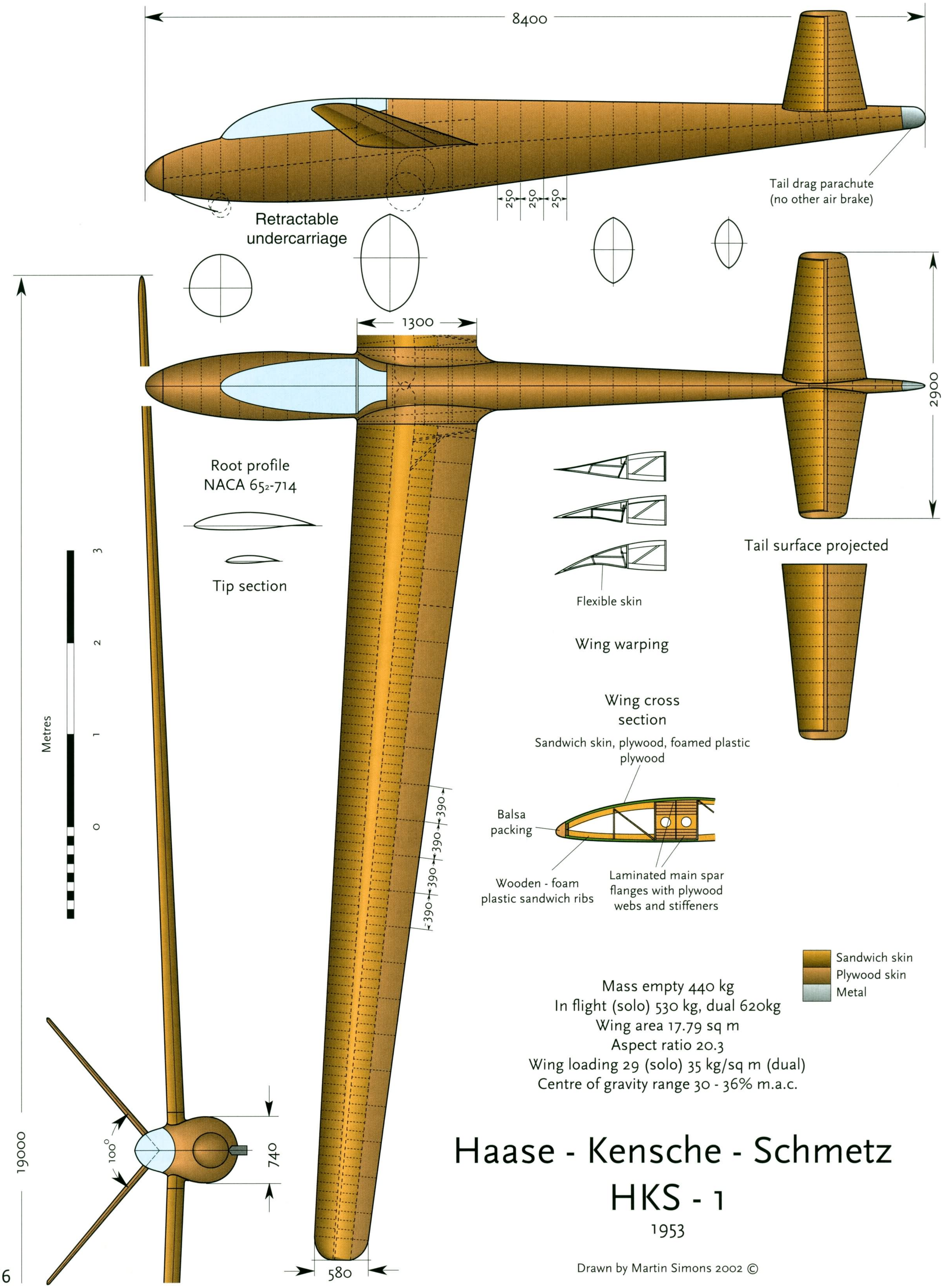
The wing warping mechanism extended across the span from root to tip. The necessary experiments to prove the system were done on a modified Condor IV wing and put through quarter of a million full cycles without any sign of failure. The upper wing skin continued without perceptible joins to the trailing edge, but the inner sandwich stiffening ended at the 70% chord location where there was an auxiliary spar. This allowed the upper skin to flex. Spaced along the auxiliary spar a series of parallelogram linkages were mounted, driven by pushrods from a torque rod. Rotation of the torque rod altered the geometry of the parallelograms and these, pivoted on the ribs, warped the skin. The under skin of the wing in this area was of plywood made flexible by numerous longitudinal saw cuts, not penetrating the outermost veneer. The only discontinuity on the underside was where the flexible skin slid inside the fixed skin just aft of the spar.

The linkages and control drives were adjusted so that application of aileron warped the outer wing in the required sense, with more deflection near the tip. To increase or decrease camber, the whole trailing edge warped up or down. The operating loads for the pilot proved heavy despite assistance from springs. This was considered acceptable in the interests of performance.

The pilots sat in tandem, with extra width to allow the rear pilot's rudder pedals to be alongside the front seat. The wing was swept forward to ensure a good view from the rear cockpit. The fuselage structure was comparatively straightforward. The frames were sandwiches of foam and plywood. To make a good entry for the airflow, balsa was glued over the plywood skin and shaped afterwards to the required contour. (In service this proved too easily marked and dented, so a glass-fibre shell was moulded for the second aircraft) The main wheel was fully retractable but there was also a small nose skid and auxiliary wheel which retracted only partly. The V - tail was constructed in similar fashion to the wing, with sandwich skins for the front part.

Since there were no other airbrakes, a ribbon parachute brake was fitted. The parachute was of the Kostelezky type, a Polish invention. For deployment, the rearmost metal cap of the fuselage opened like a clamshell to become in effect a pilot 'chute to drag the main parachute out of its housing. A cord was attached to the apex of the deployed canopy. This ran through the fuselage to a drum with a handle in the cockpit. This enabled the pilot to wind the cord in, so collapsing the parachute and pulling it back into the housing. The end cap automatically closed. Such air brakes are very satisfactory so long as the parachute does deploy properly when required, and does retract when wound in. If the 'chute does not work correctly, the pilot can be in serious trouble.

The HKS - 1 flew at Dusseldorf in July 1953 and information about it was published widely within a few weeks. It required some adjustments, in particular, the tail came out heavier than expected and it was necessary to add 10 kg of ballast in the nose to bring the balance point forward. The wing loading with two pilots was very high by current standards and it was evident that, in a competition, the HKS


8400
Tail drag parachute
(no other air brake)
250
250
250
Retractable
undercarriage
1300
2900
Root profile
NACA 65_2-714
Tip section
Flexible skin
Wing warping
Tail surface projected
Wing cross
section
Sandwich skin, plywood, foamed plastic
plywood
Balsa
packing
Wooden - foam
plastic sandwich ribs
Laminated main spar
flanges with plywood
webs and stiffeners
390
390
390
390
Metres
0
1
2
3
Sandwich skin
Plywood skin
Metal
Mass empty 440 kg
In flight (solo) 530 kg, dual 620kg
Wing area 17.79 sq m
Aspect ratio 20.3
Wing loading 29 (solo) 35 kg/sq m (dual)
Centre of gravity range 30 - 36% m.a.c.
19000
100°
740
580
Haase - Kensche - Schmetz
HKS - 1
1953
Drawn by Martin Simons 2002 ©

The organisers of the 1954 World Championships had to send urgently for more powerful winches to launch the big new, heavy, sailplanes such as the HKS - 1

would prove difficult because it could not circle tightly in company with other, slower sailplanes. The wing alone scaled 270 kg. This was more than the total weight of the contemporary Scheibe Bergfalke two-seater. With a full crew the take off mass was 620 kg. It was often flown solo. The best glide ratio was measured at 38: 1.

The HKS - 1 soon made its mark in the record books. Flown solo by Kensche, and later by Haase, the German National Record for speed round a 100 km triangle was broken twice.

Haase entered the 1954 World Championships, flying solo, and like everyone else was disappointed by the bad weather. To the organisers the HKS was one of the aircraft that caused a crisis at the outset. The launching winches, adapted from balloon barrage equipment, were inadequate for the new generation of large, heavy sailplanes. A more powerful winch was hurriedly brought from Germany and helped to save the situation. Getting away from the upland site was difficult and many competitors drifted off in weak lift and then found themselves forced down at less than the minimum scoring distance. The Derbyshire fields, where outlandings sometimes had to be done, were small and surrounded by drystone walls. The HKS was damaged, and, although quickly repaired, scored on only two days. Even so, Haase did well enough to finish half way up the final list. He was not the only one who had troubles.

The HKS - 1 remained in service, achieving more record flights. After a season, some small shrinkage of the wing skins occurred, so further work was necessary to restore them. Rolf Kunz flew the HKS - 1 in the 1958 World Championships in Poland. During an overnight retrieve journey by road after a 500 km distance flight almost to the border of the USSR, it was totally destroyed in a road accident.

There was never any question of the HKS - 1 going into production but another one was built and flew in 1955. The HKS - 2 was identical to the HKS - 1 except that the sweep forward of the wings was reduced by 3 degrees, to cure the balance problem, and the front fuselage skin was a glass-plastic moulding. The remains of this aircraft are stored at the Wasserkuppe Museum, but are unlikely ever to be restored to flight..

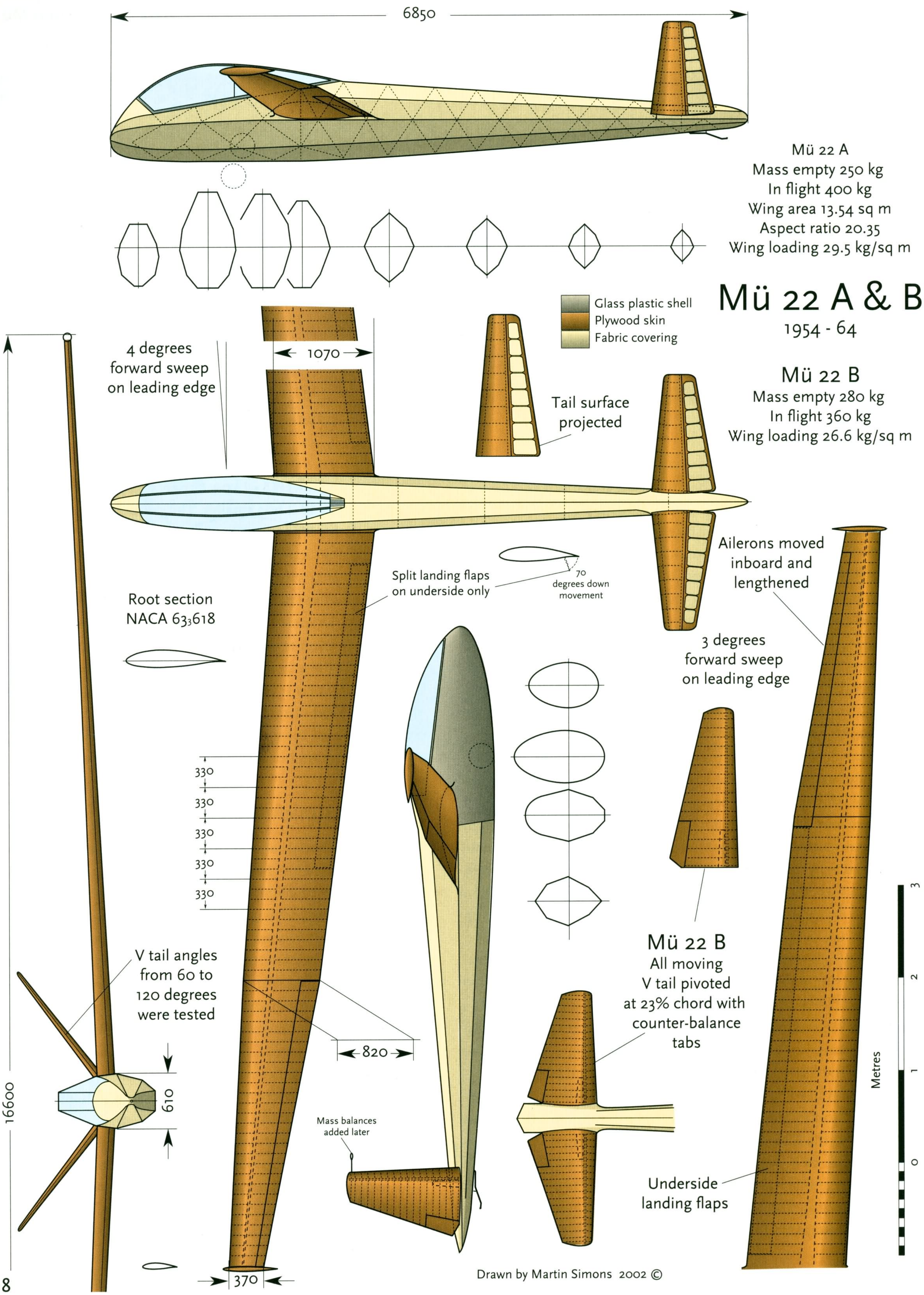
The HKS - 3 was a single-seater of 17.2 metres span. In general design it followed the HKS - 1 very closely except that no wing sweep was necessary and it was smaller. The performance was about the same but with a lower wing loading. There was provision for water ballast up to 50 kg. The landing wheel was moved ahead of the laden centre of gravity, so no front skid or wheel was required. A tail parachute was used for braking as before. There were two important structural differences. The main spar flanges were of light alloy, bonded to a veneer of wood to allow the ribs and skin to be glued to it. The ribs in the warping parts of the wing were made of steel.

In the HKS - 3 Ernst Günther Haase won the 1958 World Championship by a clear margin. During this contest he broke the German national Records for speed round 100, 200, and 300 km triangles. The HKS - 3, intact, is displayed in the Deutsch Museum in Münich.

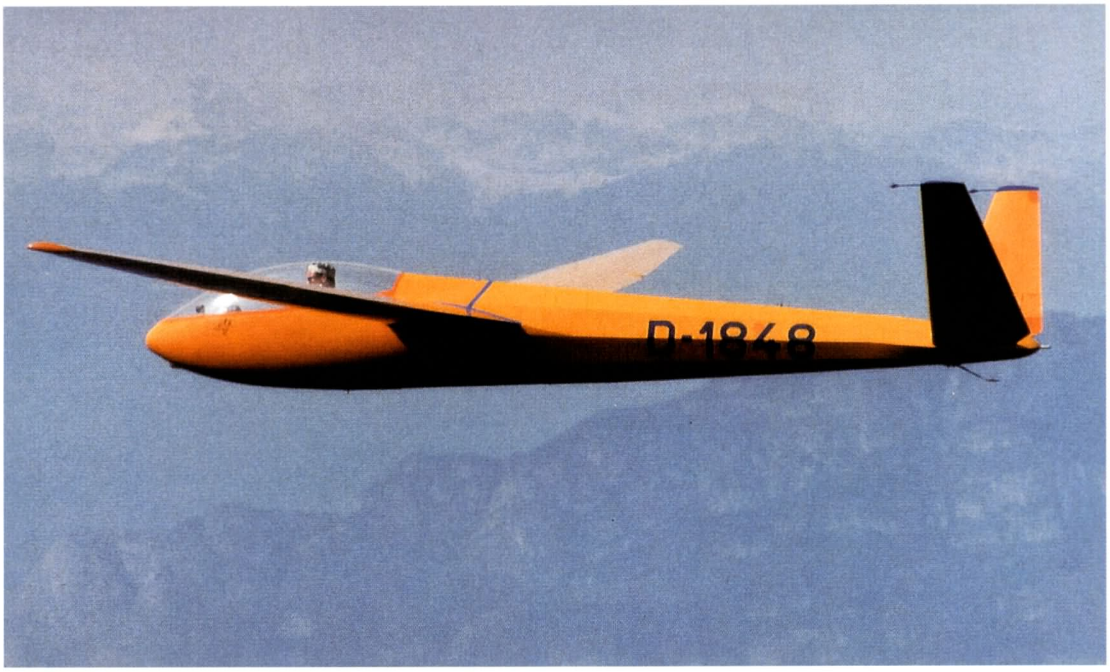
Akaflieg Münich Mü 22

With some financial support from the regional transport ministry, the Akaflieg München began work on their first post-war sailplane in 1953, under leadership of Professor J. Kraus. Their approach to the laminar flow problem was to use traditional methods of construction for the wooden wing, but to space the accurately made ribs much more closely than hitherto, at 110 mm both ahead of and behind the main spar. The profile chosen was calculated to give a favourable pressure gradient over the first 30% of the chord and it was assumed that, if the wing was well made and sufficient trouble taken with smoothing, finishing and maintenance, it would achieve the performance required. To keep the upper wing clear of interruptions, there were no airbrakes. Large split flaps with 70 degree downward movement were fitted.

The fuselage was very much along established 'Münich School' lines, a welded steel tube frame with fabric covering. If the wing did work as well as it should, the extra drag of this very ordinary fuselage would not cause much loss of performance. A V - tail was decided on, with a more orthodox tail unit also to be tried for com-


6850
Mü 22 A
Mass empty 250 kg
In flight 400 kg
Wing area 13.54 sq m
Aspect ratio 20.35
Wing loading 29.5 kg/sq m
Glass plastic shell
Plywood skin
Fabric covering
Mü 22 A & B
1954 - 64
4 degrees forward sweep on leading edge
1070
Tail surface projected
Mü 22 B
Mass empty 280 kg
In flight 360 kg
Wing loading 26.6 kg/sq m
Ailerons moved inboard and lengthened
Split landing flaps on underside only
70 degrees down movement
Root section NACA 63₃618
3 degrees forward sweep on leading edge
330
330
330
330
330
V tail angles from 60 to 120 degrees were tested
820
610
16600
Mü 22 B
All moving V tail pivoted at 23% chord with counter-balance tabs
Mass balances added later
Underside landing flaps
370
Metres
0
1
2
3
Drawn by Martin Simons 2002 ©

Above: *The Mu 22a cockpit. The emblem crow, 'Hans Huckebein' appears on many Münich Akaflieg aircraft.*



Right: *The Mü 22b in flight. The sailplane is still in use*

parative purposes. The students were aware that the V - tail would generate relatively strong torsional loads and stressed the rear fuselage accordingly. The balance calculations showed that, with the light rear fuselage structure and light tail, the wing should be swept forward. The wheel was fully retractable and ahead of the centre of gravity, so no forward skid was needed.

The project went ahead and the first flight was in November 1954. Performance and handling seemed to come up to expectations. For a year the Mü 22 was used mainly for research, with different arrangements of tail and assessments of performance, for the following year. After this it became a sailplane for general use by the students. In 1959, flown by Walther Kunz, it placed second in the Open Class at the German national Championships. Soon afterwards it was destroyed in an accident.

The Mü 22B was a further development with refinements. The wing sweep was reduced to 3 degrees and the ailerons improved. An 'all moving' V - tail with anti-balance tabs was used. The front fuselage was enclosed by a smooth moulded shell of glass-fibre reinforced plastic. In other respects the Mü - 22B was similar to the original 22. During test flying in June 1964, flutter developed without warning and one of the tail surfaces broke off completely. The pilot, Frodo Hadwich, was able to save himself by parachute. The sailplane, without his weight, landed fairly softly and was only slightly damaged. It was repaired. Mass balancing cured the tail flutter. In 2002 it remained in service with the Akaflieg.

Slingsby Type 42 Eagle

The need for a new high performance two-seat sailplane was recognised by the British Gliding Association in 1947. A design competition was announced, entries to be on paper. The Slingsby Company did not submit a design. The winner was the Kendal K - 1.[42] This was a side-by-side seating aircraft with slightly swept forward wing. Construction of a prototype was delayed by years. The design was altered, with the substitution of a laminar wing profile, shortening of the fuselage and a V - tail in place of the original orthodox style. Even more productive of delays was the decision to use an asbestos fibre reinforced plastic material for the wing. Moulds were constructed by the Miles Aircraft Company and a wing was built but at a late stage it was discovered that the proposed plastic was unstable. It seemed excellent at first but degenerated with time and was incapable of use as a structural material. Construction in wood was undertaken by Elliotts of Newbury, in the hope that the K - 1 would be ready to fly in the forthcoming 1954 World Championships. Flight tests showed that the aircraft was dangerous in spins and could not be made safe without further fundamental re-design. The project was eventually abandoned.

Meanwhile Slingsby had produced the Skylark 1 and 2, the latter flying late in 1953. Realising that the K - 1 was unlikely to succeed, the Yorkshire firm began work on the Type 42. The prototype was flown shortly before the World Championships. Anne and Lorne Welch used it to break the National two seat distance record with a 284 km flight. The name came about because Hultons, the publishers of a new children's comic paper, the Eagle, sponsored the entry of the T - 42 to the Internationals.

The Eagle, of 58 ft (17.7 m) span, was of wooden construction except for the use of glass reinforced plastic mouldings for various unstressed parts such as the nose and cockpit canopy frame, small fairings, wing and tail tips. All the plywood skins were of Gaboon plywood with the same kind of leading edge construction as the Skylarks. The wing could be regarded as a larger version of the Skylark 1's with the same NACA profile for the root and centre section but changing to the familiar four digit profile at the tips, as on the Skylark 2. Also like the Skylark the wing was in three parts, the centre

42 - See also the Harbinger and Short Nimbus, above.

The Type 42 Eagle two seater was partly sponsored by Hultons, who produced the Eagle comic paper. In the World Championships at Camphill Ann and Lorne Welch flew the prototype

section carrying the air brakes. To improve the outlook for the second pilot, the wing was swept forward in a slightly complicated manner which, in the long run, did not prove entirely satisfactory. There was a cut out in the leading edge at the root.

The fuselage was a box frame, plywood skinned over the forward part and fabric covered behind the wing except for the ply-covered turtle decking. The tail unit was large and angular.

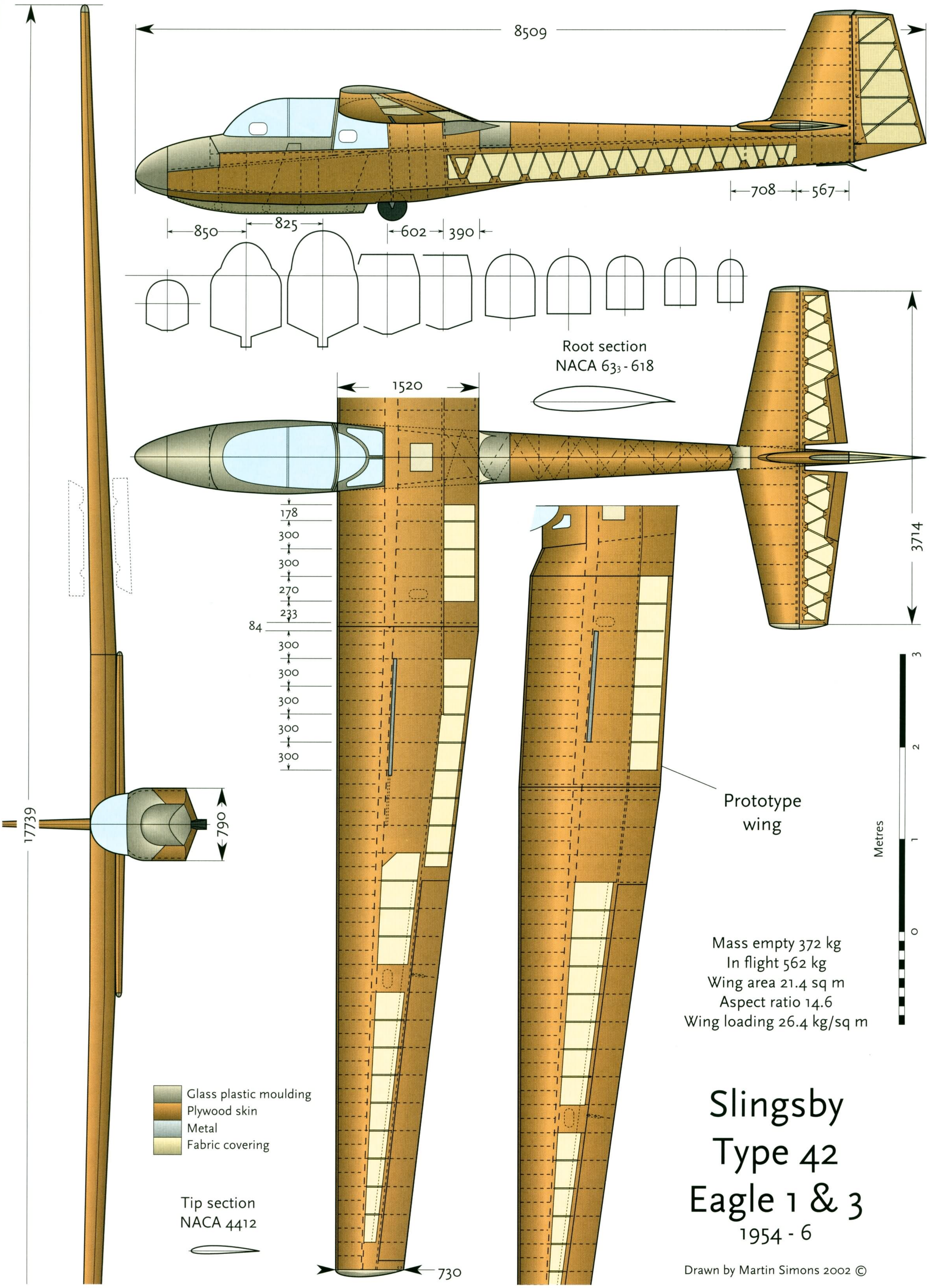
In the Internationals at Camphill the T - 42, like most of the other sailplanes, did not score on one of the four days and slipped down the final score sheet accordingly. Various criticisms from the pilots afterwards indicated that modifications were needed. The T - 42A appeared with a redesigned wing. The leading edge now was straight, at right angles to the centre line from tip to tip. The centre section, which had been very heavy on the prototype, was shortened and the air brakes moved to the outer panels. The rear cockpit, which was uncomfortable, was redesigned. In this form, the T - 42A entered the 1956 World Championships at St Yan in France. It was competing against some very refined sailplanes including the Kosava which had won in 1954, and the Breguet 904, effectively a two seat version of the Breguet 901, and the mighty HKS - 2. Compared to these, as was remarked at the time, the Eagle lacked style with its boxy fuselage, non-retracting wheel and generally rather unexciting appearance. Some dared to refer to it as the 'soapbox' . But, flown by Nick Goodhart and Frank Foster, it astonished the critics by winning the Two-Seat Championship. The Kosava was placed second. Apart from this good result, the Eagle cost about one third as much as the Breguet 904.

Further improvements resulted in the T - 42B, or Eagle 3, which entered production in 1957. The main alterations were an enlargement of the air brakes with a coupling of the elevator trim tabs so that the change of trim on opening the brakes was automatically compensated. The cockpits were further improved by lengthening the nose by 150 mm. A final variation was the so-called Regal Eagle, which had the span extended to 20 metres.

Improvements and simplification of the design, led to the Eagle 3, which had a straight leading edge and the airbrakes moved to the outer section of the three-piece wing.

A total of 17 Eagles were built. There were exports, including two to New Zealand and one to Germany. The 20 metre 'Regal Eagle was used by Wally Kahn and John Williamson to break the British two-seat goal flight record with a 213 km flight into Cornwall from Lasham.

The original prototype Eagle remained in service and in 1955 was flown by Lorne Welch and Frank Irving from Lasham across the English Channel to land in Belgium at Louvain. It was the first Channel crossing by a two-seater and broke the British National two-seat distance record with 402 km. Irving had been confined in the cramped rear seat for the whole flight and after landing could barely stand up for some time. The Eagle 1 came to a sudden end when it collided in cloud with a Slingsby Sky over Lasham in 1958. The pilots escaped by parachute and the Sky was able to land safely with a four metre section of the wing missing.



Mass empty 372 kg
In flight 562 kg
Wing area 21.4 sq m
Aspect ratio 14.6
Wing loading 26.4 kg/sq m

Slingsby Type 42 Eagle 1 & 3

1954 - 6

Left: Rainer Karch with the Zugvogel 1.

Below: The Zugvogel 1 has swept forward wings, distinguishing it from the later Zugvogels 2, 3 & 4.

Kaiser Ka - 5 Scheibe Zugvogel

Rudolf Kaiser's fifth sailplane design was the Zugvogel (Bird of passage) which Egon Scheibe produced and subsequently developed further. Kaiser was fully aware of the developments in the USA of laminar flow wings. It should be possible to get good results with an inexpensive form of construction. Scheibe in any case would not agree to produce a sailplane with anything other than a fabric covered steel-tube-framed fuselage.

Kaiser chose the NACA 63_2 - 616 profile, tapering to 614 in two stages to approximate an elliptical wing plan, with a span of 16 metres. The main spar, of I cross-section, was placed as far back as possible and the wing ribs were more closely spaced than Scheibe had used on the Spatz series. The wing was swept forward to ensure that the pilot's head would be in front of the leading edge. There would be an excellent view. To reduce as far as possible the aerodynamic losses associated with the fabric covered fuselage, the nose was enclosed in a well-shaped moulded plywood shell.

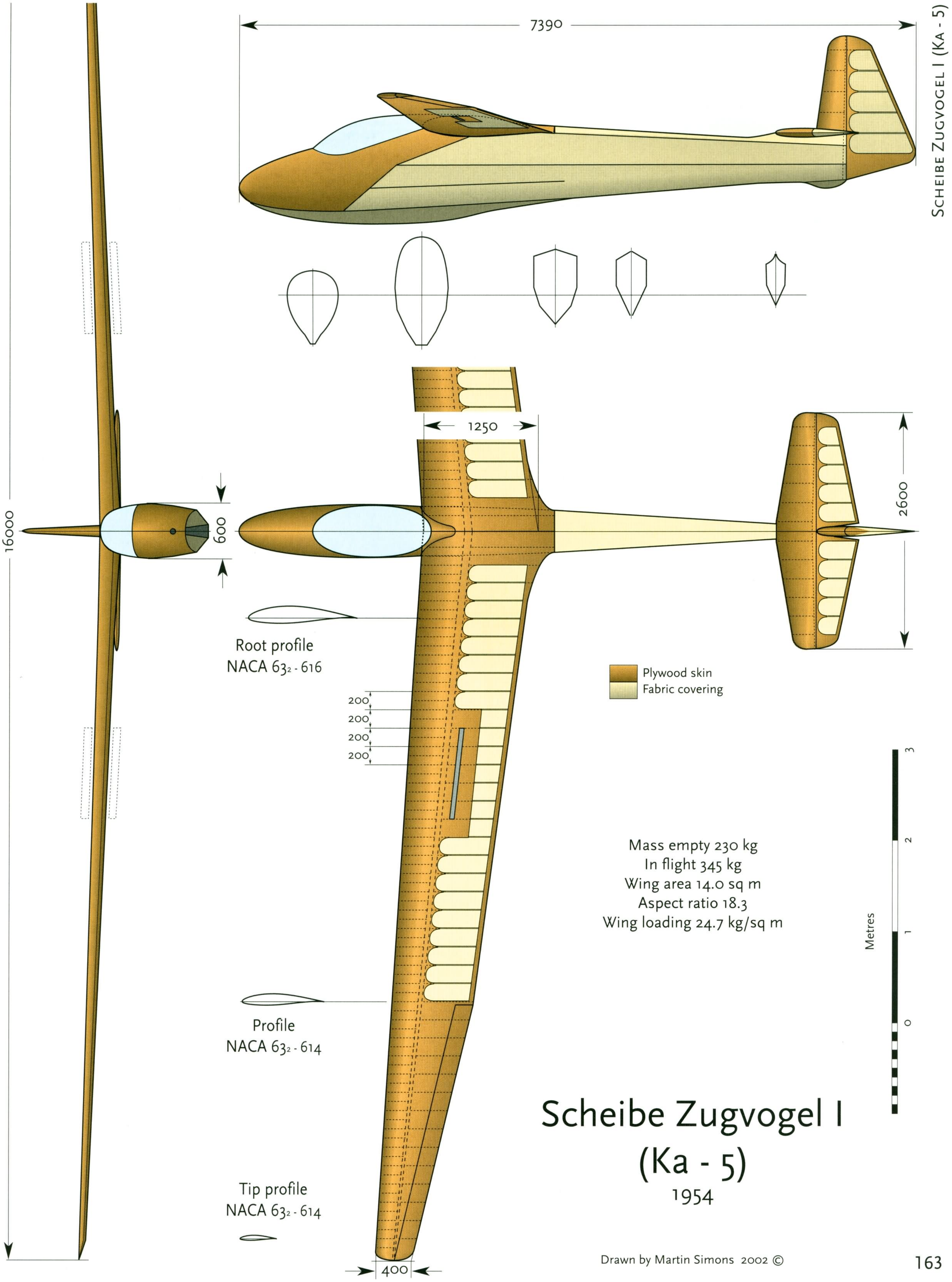
The prototype flew in 1954 and the performance was good. Like other Scheibe sailplanes, the Zugvogel was relatively inexpensive and seemed likely to be popular. Things did not begin very well. The Austrian pilot Alois Hasenkopf took one of the first Zugvogels to the 1954 World Championships in England. During the practice period before the contest began he was seen to enter a cumulo-nimbus cloud near the site and soon afterwards the aircraft broke up, losing a wing. The pilot's parachute did not open fully before he hit the ground. This was not the fault of the sailplane but accidents do not inspire confidence. Hanna Reitsch did much to counteract the reaction by winning the German National Championships in 1955 in a Zugvogel and she entered the 1956 World Championships with the same aircraft. There had been some alterations which she did not entirely like, but she placed 9th in spite of them.

Even so, only seven of the Zugvogel 1 were built. Further development was left to Scheibe as Kaiser departed to work with Alexander Schleicher at Poppenhausen.

Scheibe Zugvogel III

The Zugvogel III, flown in 1957, was developed via the Zugvogel II from Kaiser's original Zugvogel of 1954. The span was increased to 17 metres and the aspect ratio to 20. There was no wing sweep forward. Scheibe's traditional methods of construction, with wooden wing and steel tube framed fuselage, were followed. There was a single wheel instead of the skid. Like Scheibe's other products, the Zugvogel had a good reputation for climbing in weak lift and achieved a good competition record when the weather suited it. Thirty of the III and IIIA model were built.

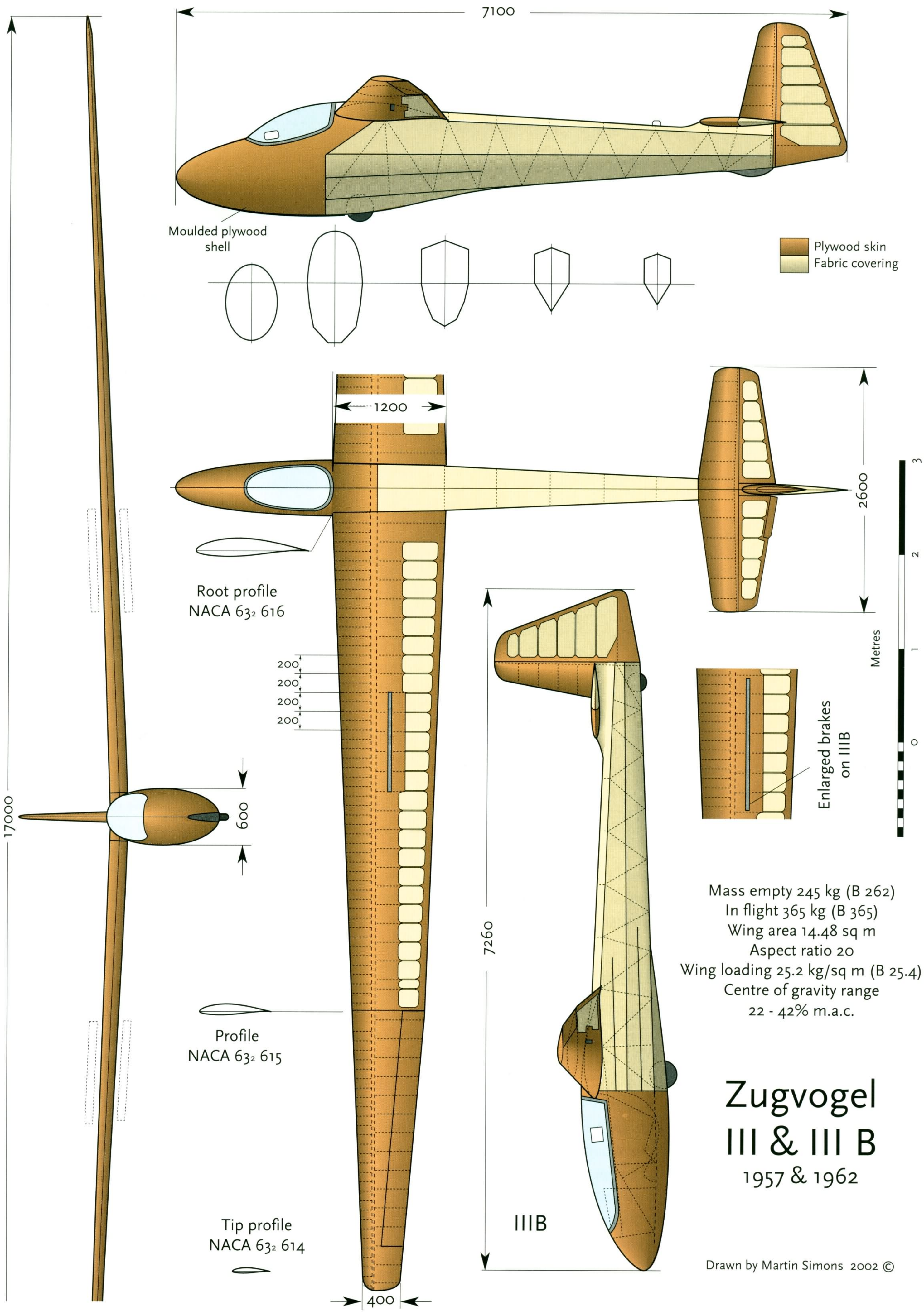
The Zugvogel IIIB of 1963 differed chiefly in having a fully contoured cockpit canopy and reduced fuselage cross section, with a



Scheibe Zugvogel I (Ka - 5)

1954

Drawn by Martin Simons 2002 ©


7100
Moulded plywood shell
Plywood skin
Fabric covering
1200
2600
Root profile
NACA 63_2 616
200
200
200
200
17000
600
Metres
3
2
1
0
Enlarged brakes on IIIB
7260
Mass empty 245 kg (B 262)
In flight 365 kg (B 365)
Wing area 14.48 sq m
Aspect ratio 20
Wing loading 25.2 kg/sq m (B 25.4)
Centre of gravity range
22 - 42% m.a.c.
Profile
NACA 63_2 615
Zugvogel
III & III B
1957 & 1962
IIIB
Tip profile
NACA 63_2 614
Drawn by Martin Simons 2002 ©
400

Zugvogel IIIA, Schwarzhornfalke, now flying in England.

semi-reclined position for the pilot. Of this type 45 were built. It was claimed that if the wings were smoothed and kept in good condition, the best glide of this model could be improved from 36 to 39: 1.

The Zugvogel series led directly to the SF 27 Zugvogel V which became, with the addition of a retracting power unit, the SF 27M, which flew in 1967 - 8 and was one of the first successful self-launching sailplanes.

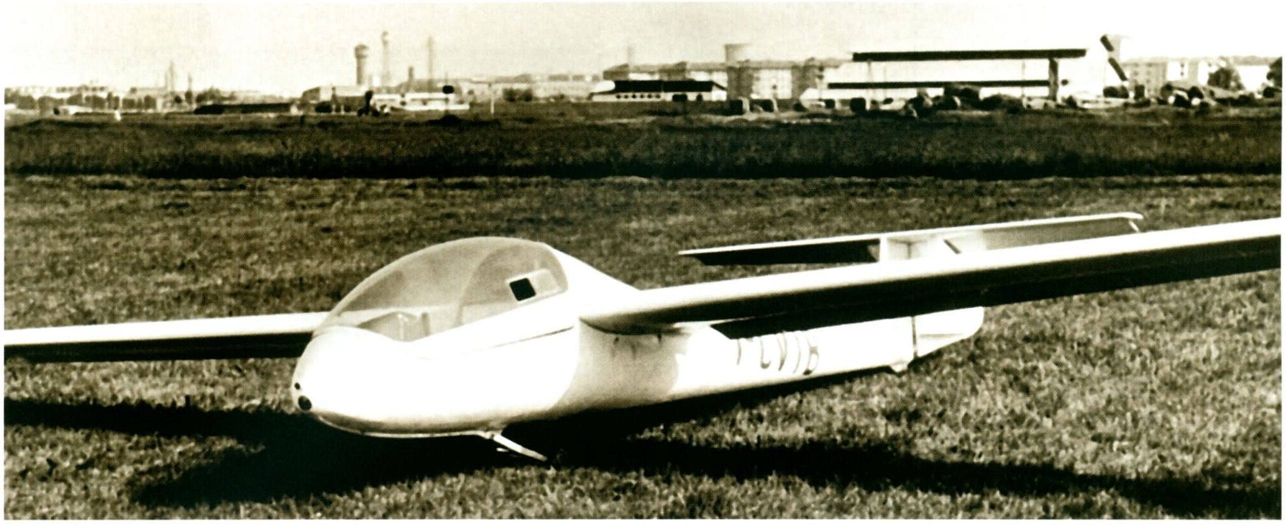
CVT - 2 Veltro

The Centro di Volo a Vela del Politecnico di Torino (Gliding Centre of the Turin Polytechnic) began the design and construction of the CVT - 2 Veltro (Greyhound) in 1953, under the leadership of Alberto Morelli and his brother Pietro. It was a 15 metre span specialised competition sailplane. It was in many respects well ahead of its time and although only one was built, it had considerable influence on other designers. The span was chosen because study of earlier sailplanes indicated that large spans caused such an increase in structural weight that wing loadings became too high. The Veltro when completed had a very moderate wing loading to allow climbing in weak thermals but the high speed glide was improved by careful attention to reducing parasitic drag. The 15 metre span also improved the rate of roll and handling generally.

The wing profiles were from the NACA 6 series aiming for a 40% laminar boundary layer. Special care was taken to obtain an accurate surface, with closely spaced ribs braced to ensure a stable outline. The plywood skins, carried back to the rear spar, were 2 mm thick. Where the skin passed over the spar there was no glue, to prevent shrinkage causing a hump. The extreme leading edge was made from balsa wood to avoid having to bend the plywood round the small radius there. With suitable filling and finishing the balsa proved very satisfactory in service. Camber flaps were fitted to widen the speed range. These were lowered to 60 degrees for landing. There were no other air brakes. The wing was in three sections with ingenious automatic connections for the ailerons when rigging.

The cockpit had a reclined seat. This was one of the most important features, allowing a considerable reduction in the cross sectional area of the fuselage with consequent saving of parasitic drag. Pilots reported that it was very comfortable and there was no adverse effect providing the seat back, parachute and headrest were correctly adjusted. A retracting undercarriage of very unusual type was devised, with twin wheels of small diameter and twin shock absorbers.

So far as the Morellis knew, no previous sailplane had used a T tail layout. This reduced drag because the tailplane was high enough to escape the wing wake. The vertical tail was somewhat less satisfactory, with a very low aspect ratio. Early test flights revealed serious rudder lock in side slips, which was cured by adding a large dorsal fin extension. Later a kind of 'double slotted' rudder was fitted, with good effects on control in the yawing plane.



Above: The Veltro. The reclined seat, T tail and retracting undercarriage with twin small wheels and shock absorber were some of its most remarkable features.

Right: The Strale was an advance on the Veltro.

Test flights began on 9th July 1954 and continued through the rest of that year. Flown by Alberto Morelli, the Veltro made an altitude flight to 7,500 metres in 1956 and broke the Italian national distance record in 1957. It flew in the Italian National Championships in 1957 and 58. In 2002 it was undergoing restoration at the CVT.

CVT - 4 Strale

The Strale (Arrow) was a direct development, by the Morelli brothers, of the CVT - 2 Veltro of 1954. It incorporated all the lessons learned from the earlier venture. The layout and structure were similar but with an extension of the span and airbrakes. There were no flaps. The wing was mounted higher on the fuselage to keep the upper surface clear, and the cockpit was slightly deeper. The airbrakes were of a multiple paddle type; the paddles rotating when deployed to present a series of 'teeth' to the airflow. These proved very effective. The slotted ailerons were skinned with plywood.

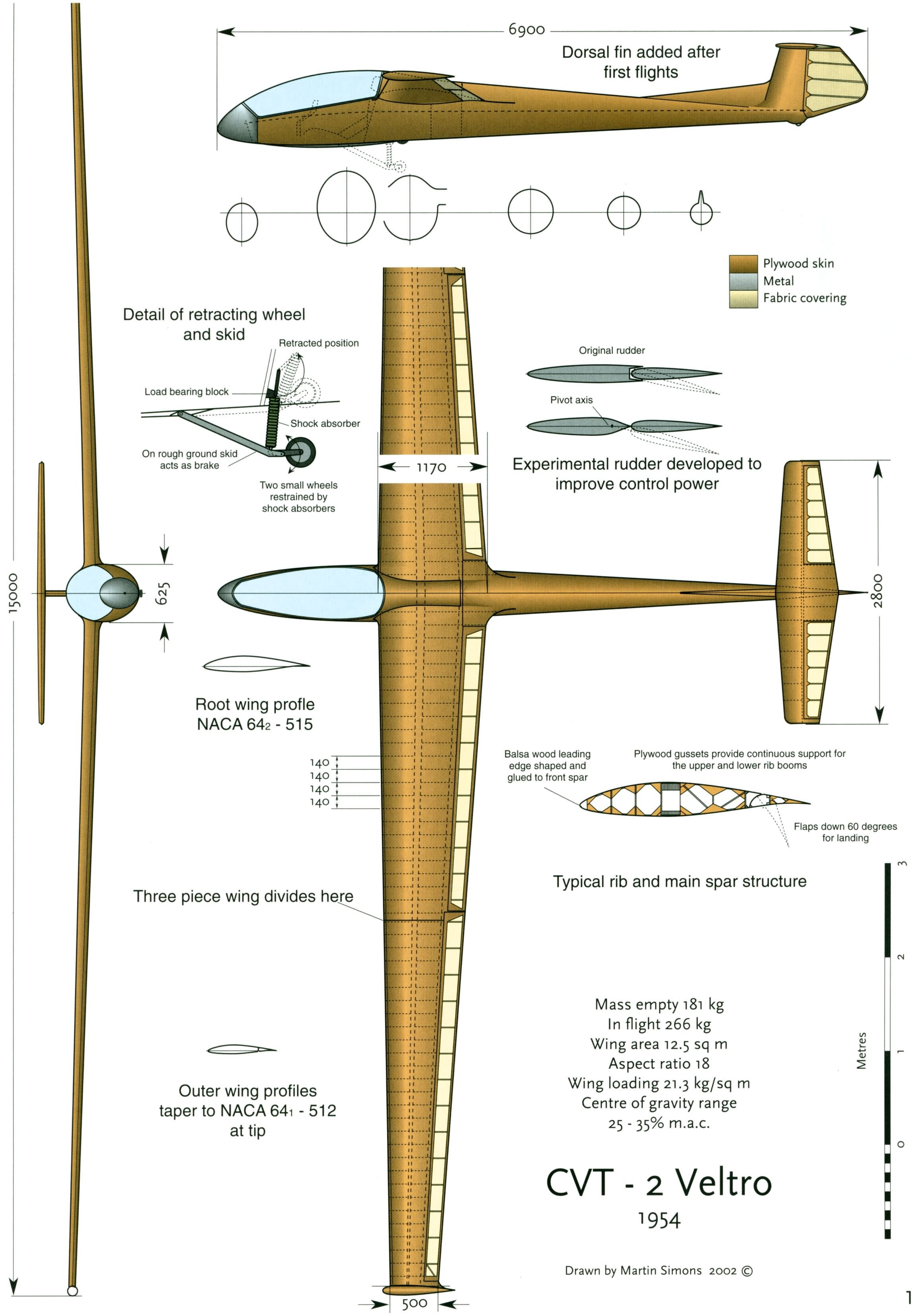
The undercarriage had the same form as the CVT - 2 but was changed to a single wheel instead of twin wheels on the swinging arm, restrained by a single shock absorber. Touch downs on a rough surface compressed the shock absorber, allowing the skid to act as a brake by rubbing on the ground.

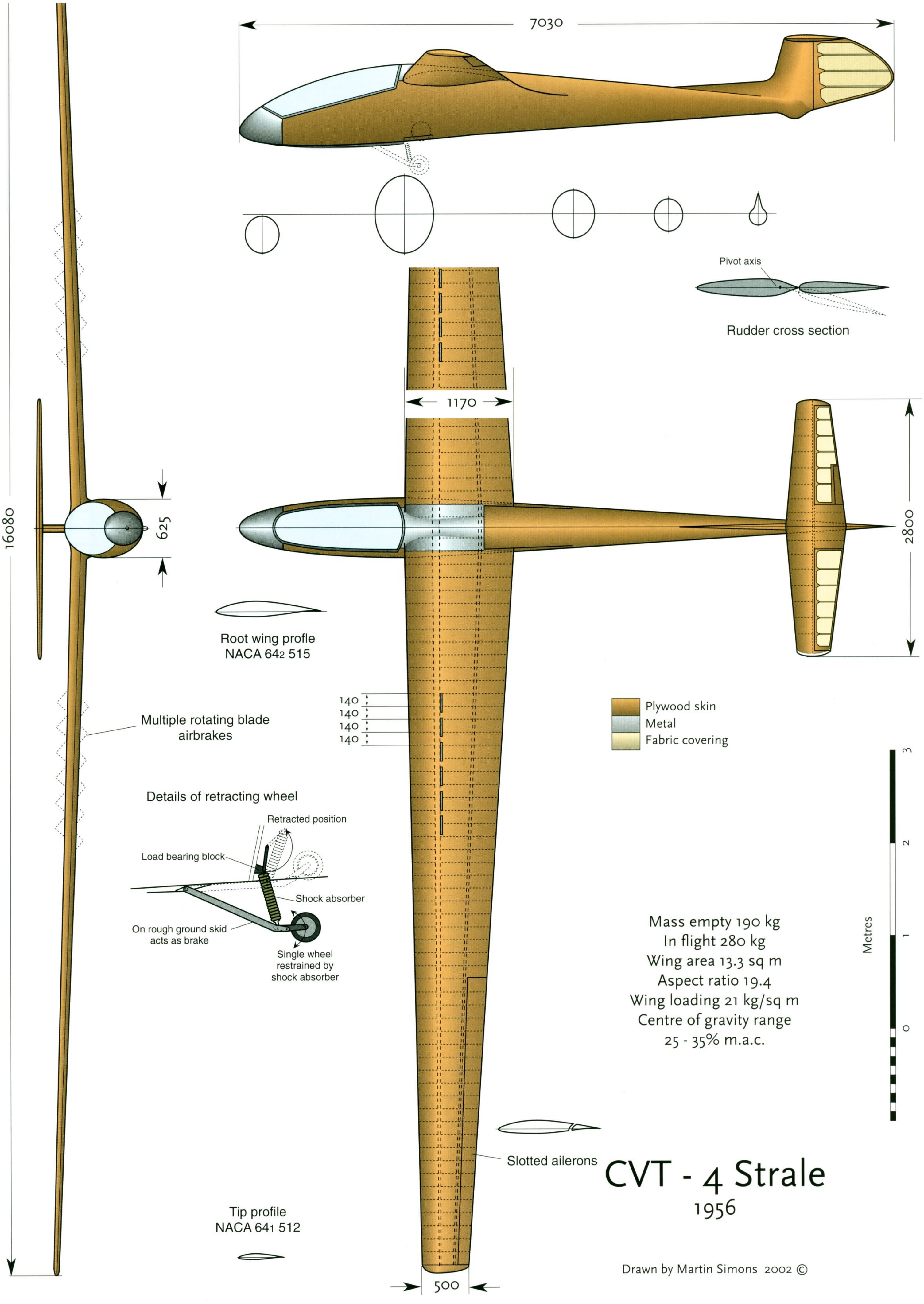
As with the Veltro, only one example of the Strale was constructed and it was regarded as an experimental aircraft.

Kaiser Ka - 6

Rudolf Kaiser designed and built the first Ka - 6 Rhönsegler (Rhön-sailer), with a span of 14 metres, as a private venture. It flew in October 1955. The wing was double tapered with the NACA 63_3 - 618 profile at the root tapering to 614 at the tips. The structure was orthodox but to preserve accuracy the wing ribs in front of the main spar were closely spaced at 125 mm. The fuselage was plywood skinned with elliptical cross section and the tail unit was orthodox. There was no wheel and the pilot's seating position was upright. Performance and handling were very pleasing. A clever arrangement of the control linkages protected the pilot against inadvertent wing tip stalling and spinning. As the stick was pulled back, the ailerons were both slightly raised, the effect being to reduce the angle of attack of the outer wing and delay the stall there.

Alexander Schleicher was quick to see that the Ka - 6 had potential as a club sailplane and agreed with Kaiser to put it into production. To improve the performance, the span was extended slightly to 14.4 metres. 25 of this version were built during 1956 - 7. The Ka - 6B, with a further span extension to 15 metres followed. At this time the FAI Gliding Commission announced the new Standard Class, to be introduced at the 1958 World Championships in Poland. (Part of this decision entailed that two-seaters in future World Championships would have to fly in the so-called Open


6900
Dorsal fin added after first flights
Plywood skin
Metal
Fabric covering
Detail of retracting wheel and skid
Retracted position
Load bearing block
Shock absorber
On rough ground skid acts as brake
Two small wheels restrained by shock absorbers
Original rudder
Pivot axis
Experimental rudder developed to improve control power
1170
2800
15000
625
Root wing profle
NACA 64_2 - 515
140
140
140
140
Balsa wood leading edge shaped and glued to front spar
Plywood gussets provide continuous support for the upper and lower rib booms
Flaps down 60 degrees for landing
Typical rib and main spar structure
Three piece wing divides here
Metres
0
1
2
3
Mass empty 181 kg
In flight 266 kg
Wing area 12.5 sq m
Aspect ratio 18
Wing loading 21.3 kg/sq m
Centre of gravity range
25 - 35% m.a.c.
Outer wing profiles taper to NACA 64_1 - 512 at tip
CVT - 2 Veltro
1954
Drawn by Martin Simons 2002 ©
500


7030
Pivot axis
Rudder cross section
1170
2800
16080
625
Root wing profile
NACA 64_2 515
140
140
140
140
Multiple rotating blade airbrakes
Plywood skin
Metal
Fabric covering
Details of retracting wheel
Retracted position
Load bearing block
Shock absorber
On rough ground skid acts as brake
Single wheel restrained by shock absorber
Mass empty 190 kg
In flight 280 kg
Wing area 13.3 sq m
Aspect ratio 19.4
Wing loading 21 kg/sq m
Centre of gravity range
25 - 35% m.a.c.
Metres
0
1
2
3
Slotted ailerons
CVT - 4 Strale
1956
Tip profile
NACA 64_1 512
Drawn by Martin Simons 2002 ©
500

Right: The Ka 6CR, Kaiser's most famous design, built in hundreds and sold worldwide by Schleicher after earlier versions had great successes.

Below: Ka 6CR

Class, with the solo aircraft.) The Ka - 6 had not been designed with the Standard Class in mind but it could easily be adapted to meet the specification. It was necessary only to add a wheel. The Ka - 6BR (R for Rad, wheel), was prepared.

In the Championships, Heinz Huth placed third in the new class. This was a very good result but what proved more important in the long run was that the Ka - 6BR carried off the OSTIV Design prize. (A small point that might have been overlooked, ignored or possibly unnoticed by the judging panel, was that the linkage of ailerons and elevator was technically outside the strict limits of the specification.) Schleicher was not short of orders after this but it is doubtful if he or anyone realised what was going to happen in the next few years.

In 1960 Huth won the World Championships in a Ka - 6 BR. With the Ka - 6 CR Kaiser introduced some minor improvements to the wing root - fuselage junction and strengthened the main spar. Production of this version went ahead rapidly.

In June 1963 three pilots flying on the same day broke the World distance record. Otto Schäuble and Karl Betzler were flying Ka - 6CRs. The other was Rudi Lindner in a Phönix - the first all glass-reinforced-plastic sailplane.[43] They flew from two separate airfields near Stuttgart to the French coast at St Nazaire, a distance of 876 km. For much of the time they were separated but conversed on the radio. Toward the end of the day they saw each other and flew as a team for about the last 200 km.

In 1963 Huth won the German Nationals in his Ka - 6, and in 1963 at Junin in Argentina he became again World Champion in the Standard Class, the only pilot at that time who had ever won the Championships twice in succession. The Ka - 6 he flew in Argentina was modified in several respects but this success did nothing to diminish the reputation of the aircraft. In 1965 Wally Scott in the USA broke the World goal flight record in his Ka - 6CR.

Production of the Ka - 6 continued without break until 1965, by which time well over 700 had been produced. Edmund Schneider Pty in Australia produced the Ka - 6 under licence as the ES Ka - 6.

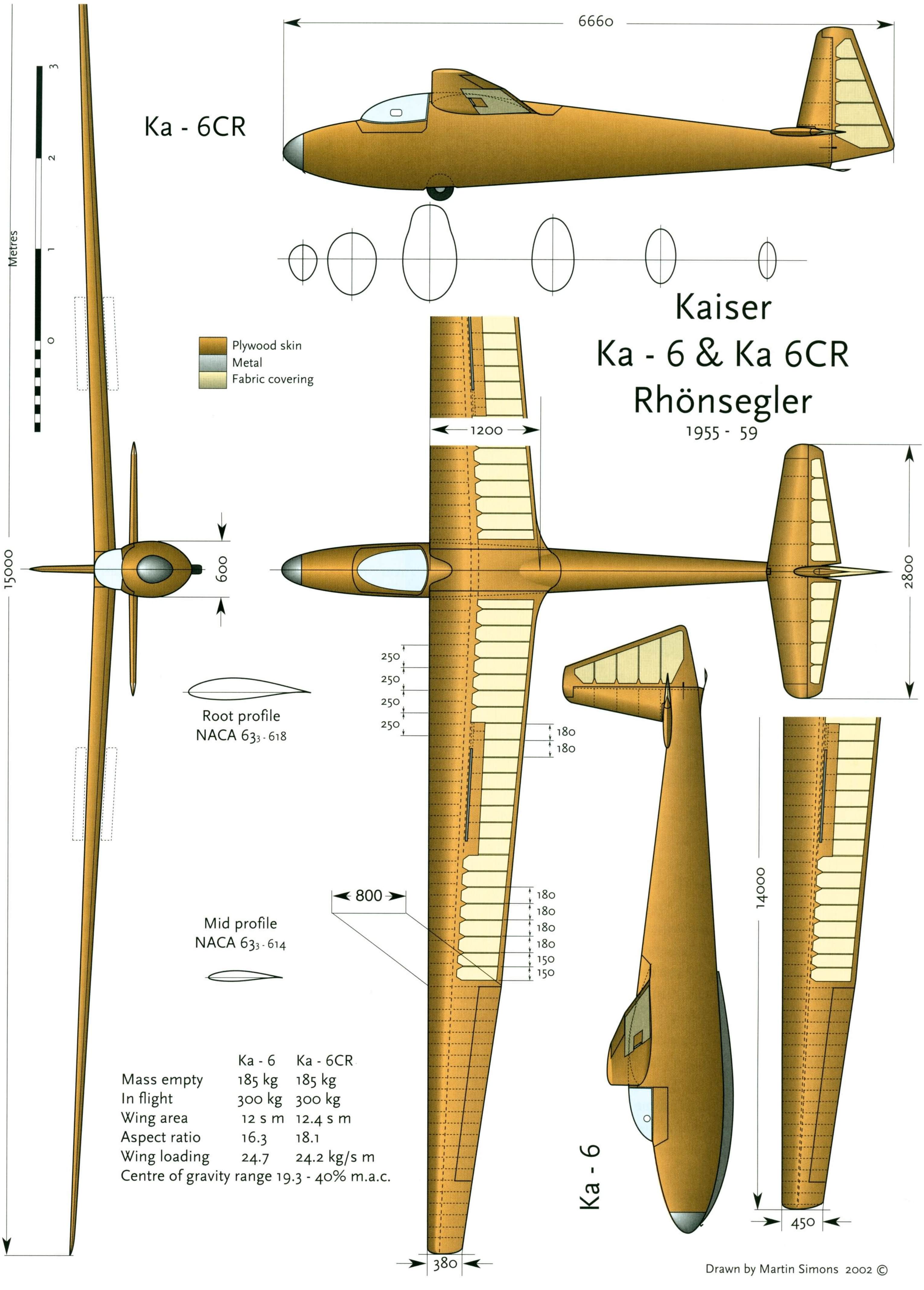
The performance of the Ka - 6B, without the wheel, was measured with a best glide ratio of 31.5: 1. The CR was slightly less, 29 :1. These figures were not especially startling compared with some more specialised sailplanes built from expensive materials with sandwich skins and, in some cases, constant problems of maintenance. But the Ka - 6 brought to ordinary pilots performances far superior to anything they had been able to afford previously. The type was flown by club and private groups all over the world, in every day sport flying, for badge flights up to and beyond Gold C, and in competitions at the highest level. Since the days of the Grunau Baby, nothing of this kind had been known before.

The OSTIV prize could not be awarded to the same aircraft twice. In coming years there were, necessarily, other winners. But it is fair to say that if the Ka - 6 had been eligible it would have won time

43 - See below

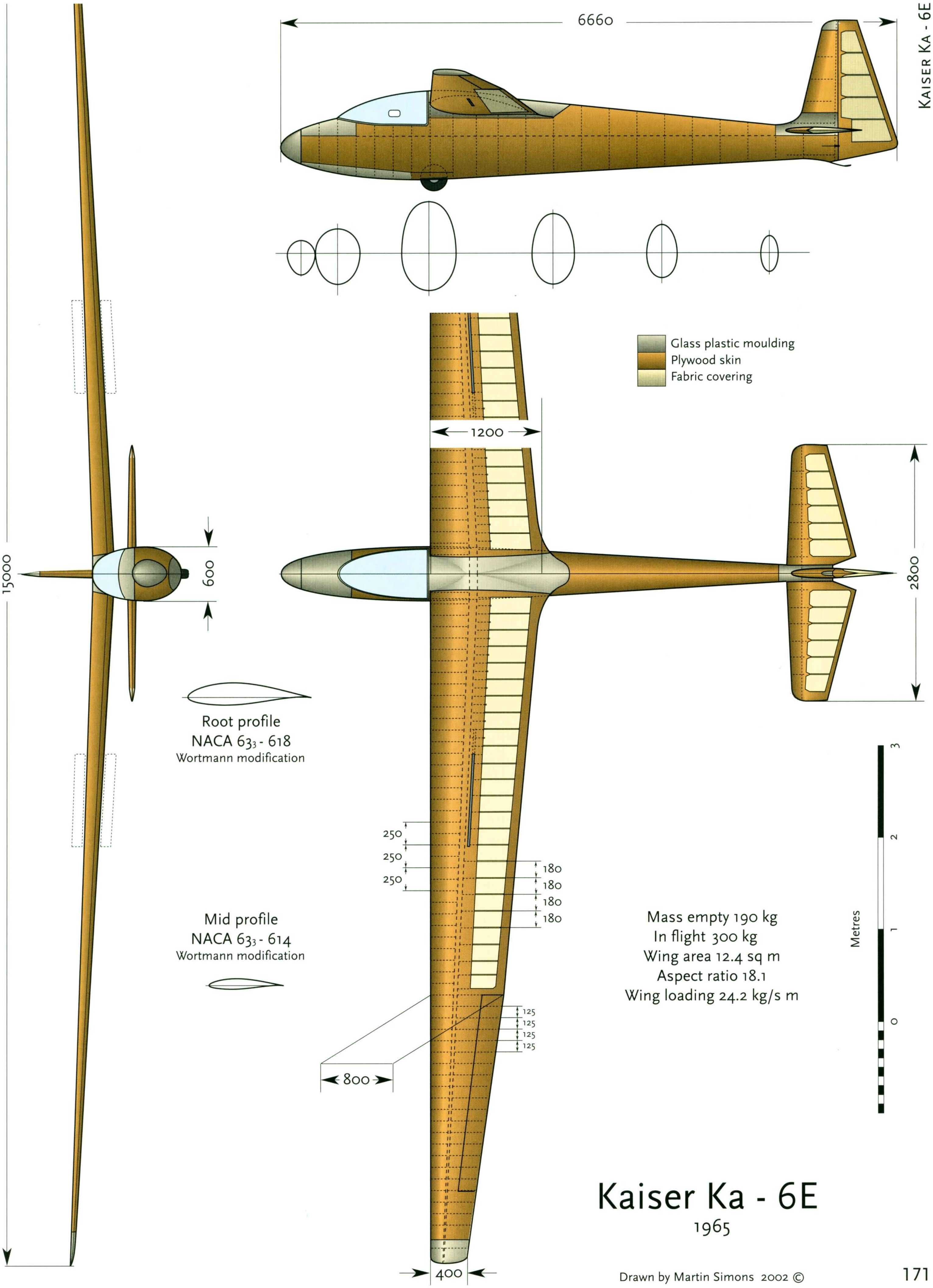
Kaiser Ka - 6 & Ka 6CR Rhönsegler

1955 - 59



	Ka - 6	Ka - 6CR
Mass empty	185 kg	185 kg
In flight	300 kg	300 kg
Wing area	12 s m	12.4 s m
Aspect ratio	16.3	18.1
Wing loading	24.7	24.2 kg/s m

Centre of gravity range 19.3 - 40% m.a.c.



Kaiser Ka - 6E

1965

Drawn by Martin Simons 2002 ©

The Ka 6E, with refined fuselage and cockpit and an all-moving tailplane, was the final version of the Ka 6. This was at Lasham in 1992.

and again. It handled well, was practical in operations, robust, easily repaired, and its performance was good enough to break world records. This could not be said of some of the later OSTIV winners.

Schleicher Kaiser Ka - 6E

To improve on the Ka - 6CR did not prove easy for Rudolf Kaiser. Fifteen of a version with an all-moving tailplane, the Ka - 6PE (Pendulum Elevator) were built. This line of development led to the Ka - 10 of 1963, which had Wortmann FX 40 and 30 profiles with the recommended closer rib spacing and 2.5 mm thick plywood skinning back to 65% of the chord to achieve a smooth wing surface. The fuselage was also refined, the pilot's seat reclined moderately and the cockpit made much more comfortable than the original Ka - 6. The glide ratio was improved to 32: 1 but the Ka - 10 was considerably heavier than the Ka - 6 - CR and the early Wortmann profiles combined with the additional wing loading did not yield the expected low speed performance. Only twelve of the Ka - 10 were built.

Kaiser and Schleicher decided there were better prospects in a new version of the Ka - 6. This became the Ka - 6E. The wing profiles were the same NACA 63 sections as had been so successful on the CR, but Wortmann had shown that a very small modification to the leading edge yielded a measurable improvement at low flying speeds. A small increase in the extent of the plywood skinning on the wing was necessary. The fuselage and pendulum tailplane were taken more or less unchanged from the Ka - 10.

The Ka - 6E flew first early in 1965. The best glide ratio was claimed now to be 34: 1 In weak thermals, although somewhat heavier, it seemed well able to climb with the CR. At high speeds it was better. It was flown by the two-times World Champion, Heinz Huth, at South Cerney in 1965. This time he was unable to repeat his extraordinary success, placing fourteenth. Like many others, he failed to make any score on the first, difficult day of the contest.

The Ka - 6E was particularly pleasing to fly, comfortable and viceless. It became very popular with pilots. Nearly 400 were built between 1965 and 1972, at which time Schleicher decided to replace it with the all glass-plastic ASW 15.

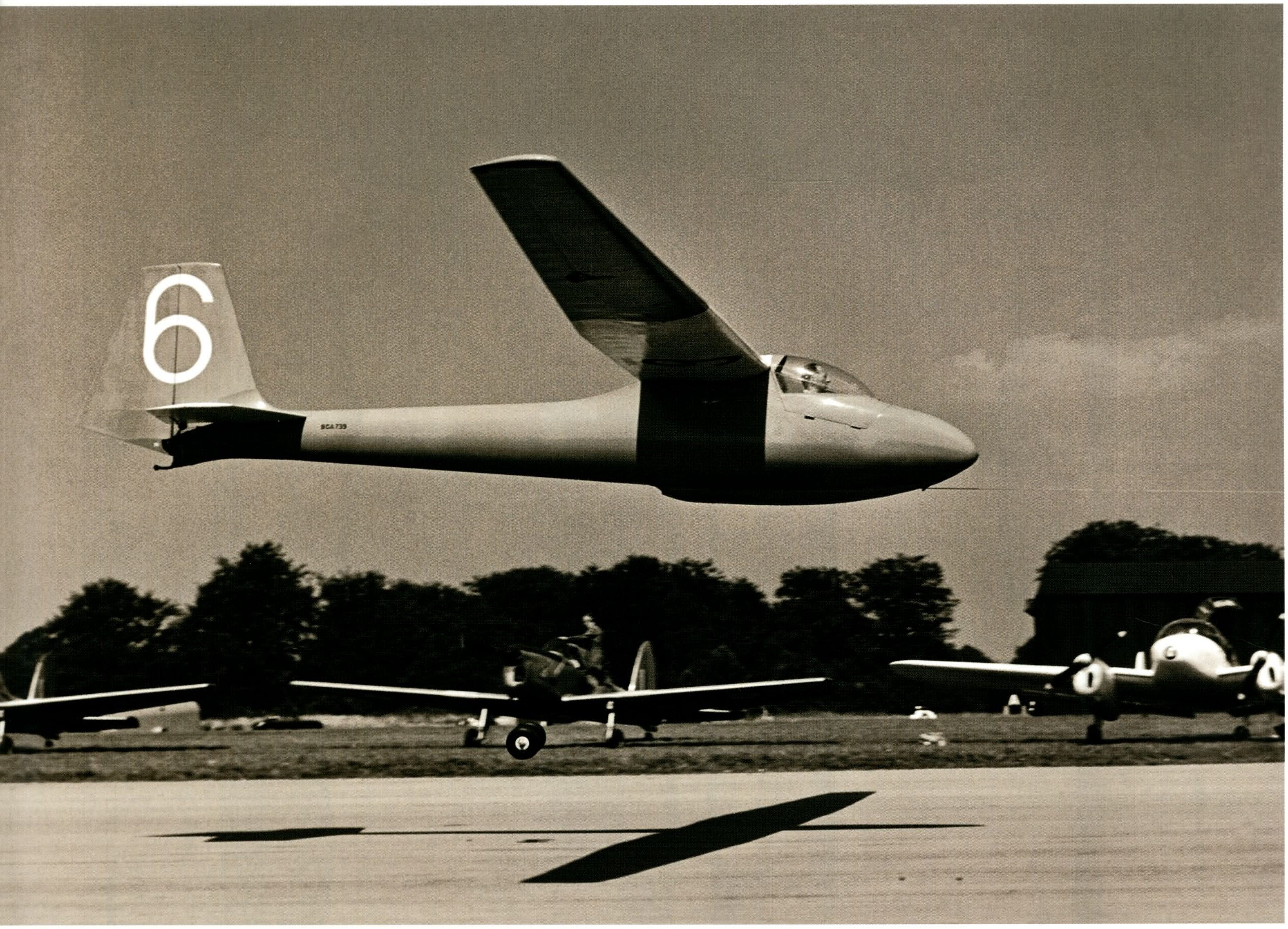
Slingsby Type 43 Skylark 3

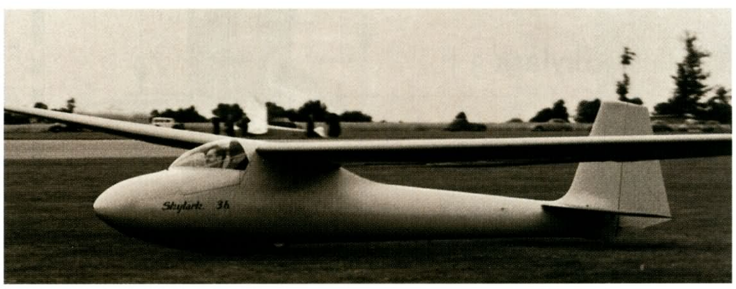
The T - 41 Skylark 2 had proved very successful but, as Slingsby was heard to say more than once, "There is no substitute for span." The leading competition pilots in Britain encouraged him to develop a larger version of the Skylark 2 and although this was not quite as easy to do as they supposed, it was quite feasible. The same kind of development had produced the T - 34 Sky from the T - 25 Gull 4.

The wing was extended to slightly over 18 metres, with the same aerofoil sections as the T - 41. The centre section, with appropriate strengthening, was the same length but with enlarged air brakes. The outer wing panels were considerably longer. The ailerons on the Skylark 2 had to be connected manually when attaching the outer wings. On the Skylark 3 they connected automatically when rigging. The fuselage and the cockpit remained almost unchanged but the tail unit was increased in area. The same material, Gaboon plywood, was used for skinning. The main disadvantage of the new wing was the weight of the centre section. With the fuselage upright, two strong men could just manage to lift the centre section into place on the rather high fuselage neck. To have a crew of four was much better. (Sailplanes of comparable span with two piece wings were usually worse in this respect.)

A best glide ratio of 36:1 was claimed but flight tests later produced a figure closer to 32:1. It was nothing unusual for designers' estimates to be optimistic. The Skylark 3 was relatively inexpensive, it was stable and straightforward to fly, and as experience was soon to show, it performed very well in competitions against much more expensive and complicated 'Open Class' aircraft.

There were seven different versions of the Skylark 3, the most popular being the 3B, which had the cockpit and seat moved forward to achieve a better balance, and the 3F which had aileron ser-





Top: The Skylark 3 was flown by Nick Goodhart in the 1957 British National Championships with a 'drop off' dolly to save the drag of a wheel.
Above: A natural development, the Skylark 3b had a landing wheel.

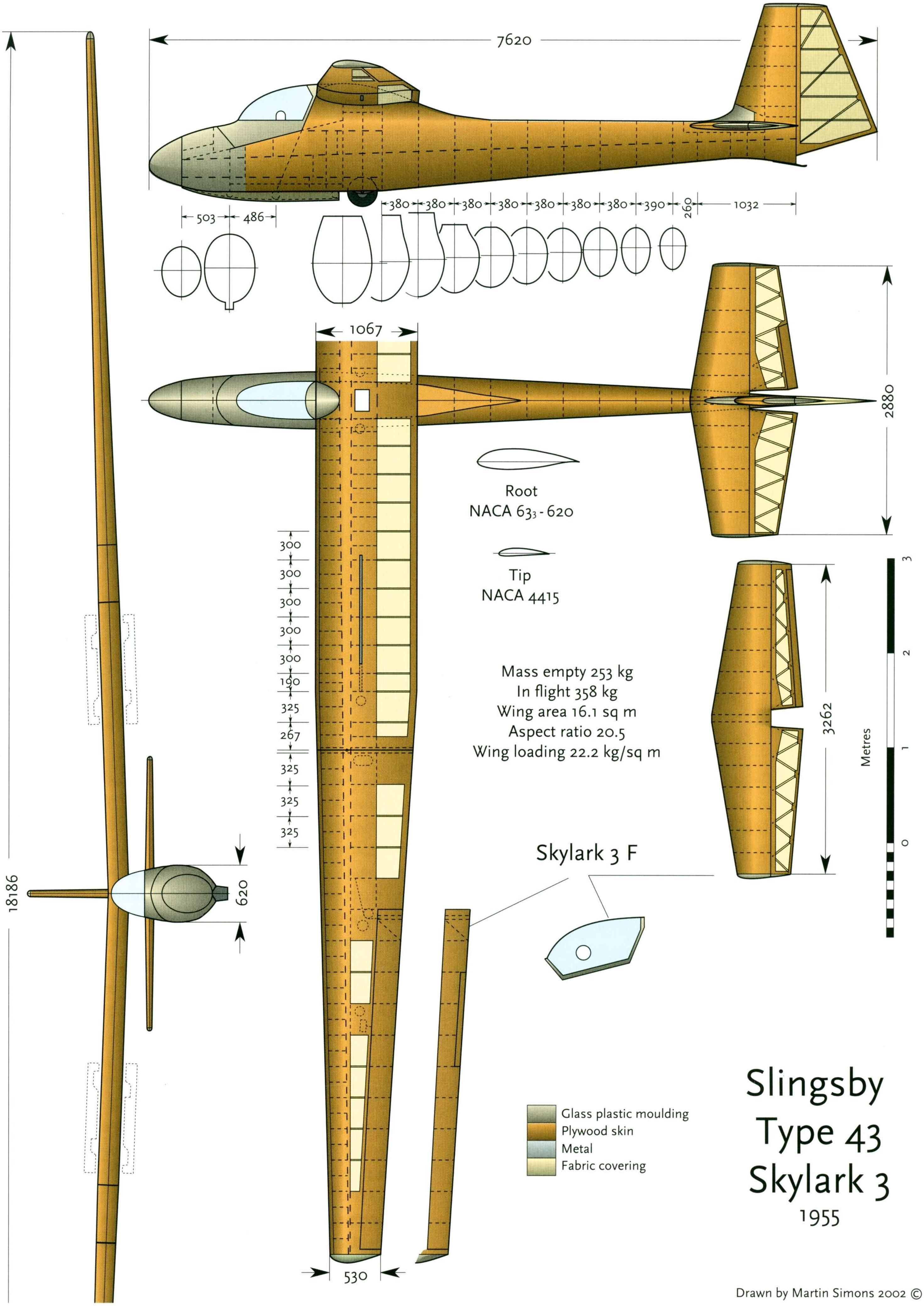
vo tabs and a redesigned tailplane and elevator with narrower chord to reduce stick loads.

There were six Skylark 3s in the World Championships in 1956, Geoffrey Stephenson placing sixth. The Skylark 3 broke most of the British National Records and was used by Anne Burns to break the World Feminine Records for altitude, goal and return, 200 and 300 km triangle speed records. In June 1957 Tony Goodhart soared from Lasham across the English Channel to St Didier near Arras, and his brother made the first 500 km distance flight in Britain the following year. In New Zealand Dick Georgeson broke the World height gain record, climbing 10,200 metres after release from tow. In 1960 at Cologne in Germany, Rudolf Hossinger won the World Championships in a Skylark 3.

The Skylark 3 was Slingsby's most successful high performance sailplane both in terms of competition successes and number built. The total reached 65 before production ceased. The T - 50 Skylark 4 replaced it after 1961.

Slingsby Type 50 Skylark 4

The Skylark 4 was in most respects a Skylark 3 with a new fuselage. To prevent the wing tips at high airspeeds presenting to the airflow at negative aerodynamic angles of attack, the tip profile was changed to a 6% cambered form instead of the 4% camber of the earlier type. This allowed the wing to be built without washout yet it should still show safe stalling characteristics. There was an im-



Slingsby Type 43 Skylark 3

1955

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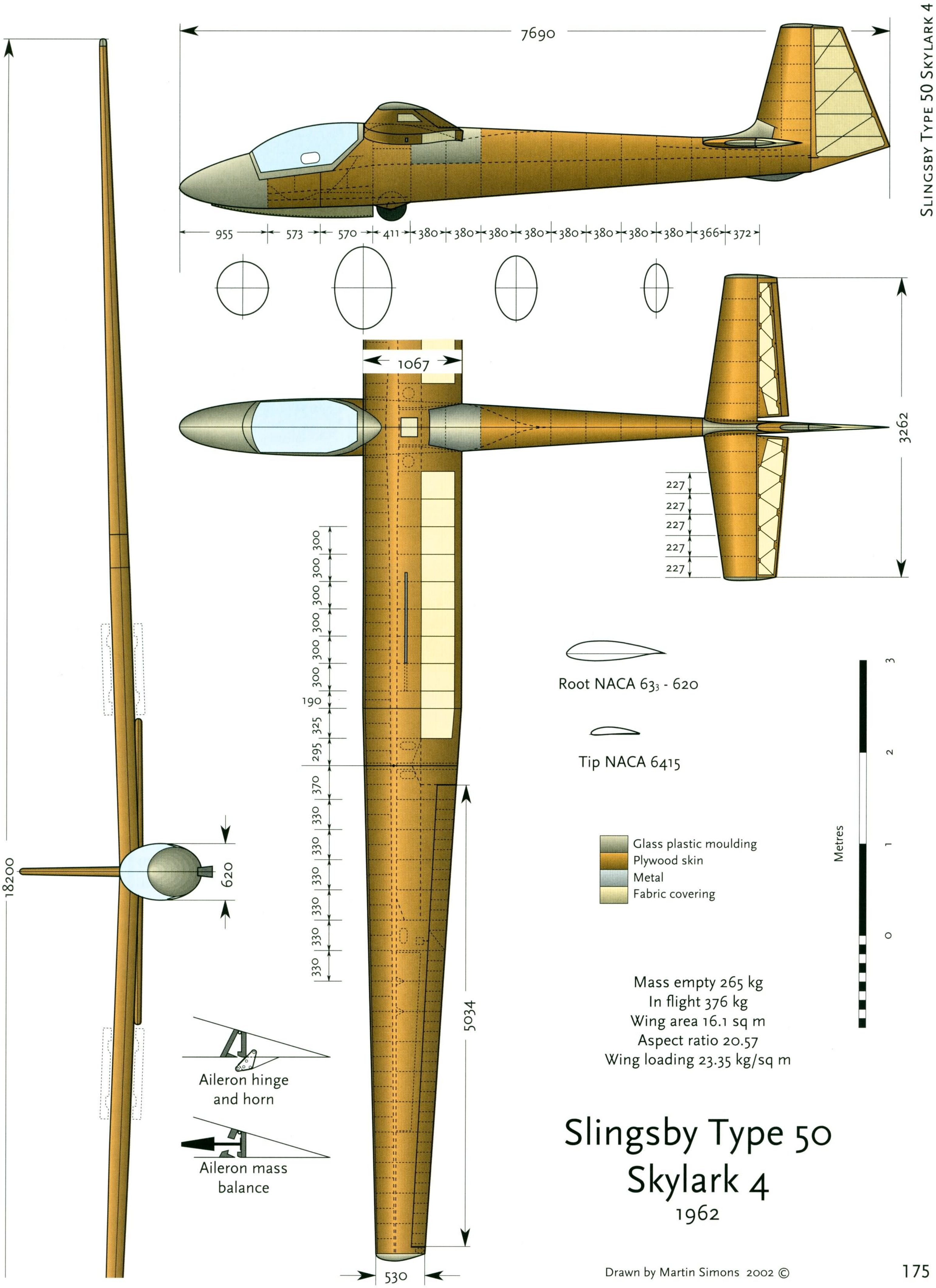

Mass empty 265 kg
In flight 376 kg
Wing area 16.1 sq m
Aspect ratio 20.57
Wing loading 23.35 kg/sq m

Slingsby Type 50 Skylark 4

1962

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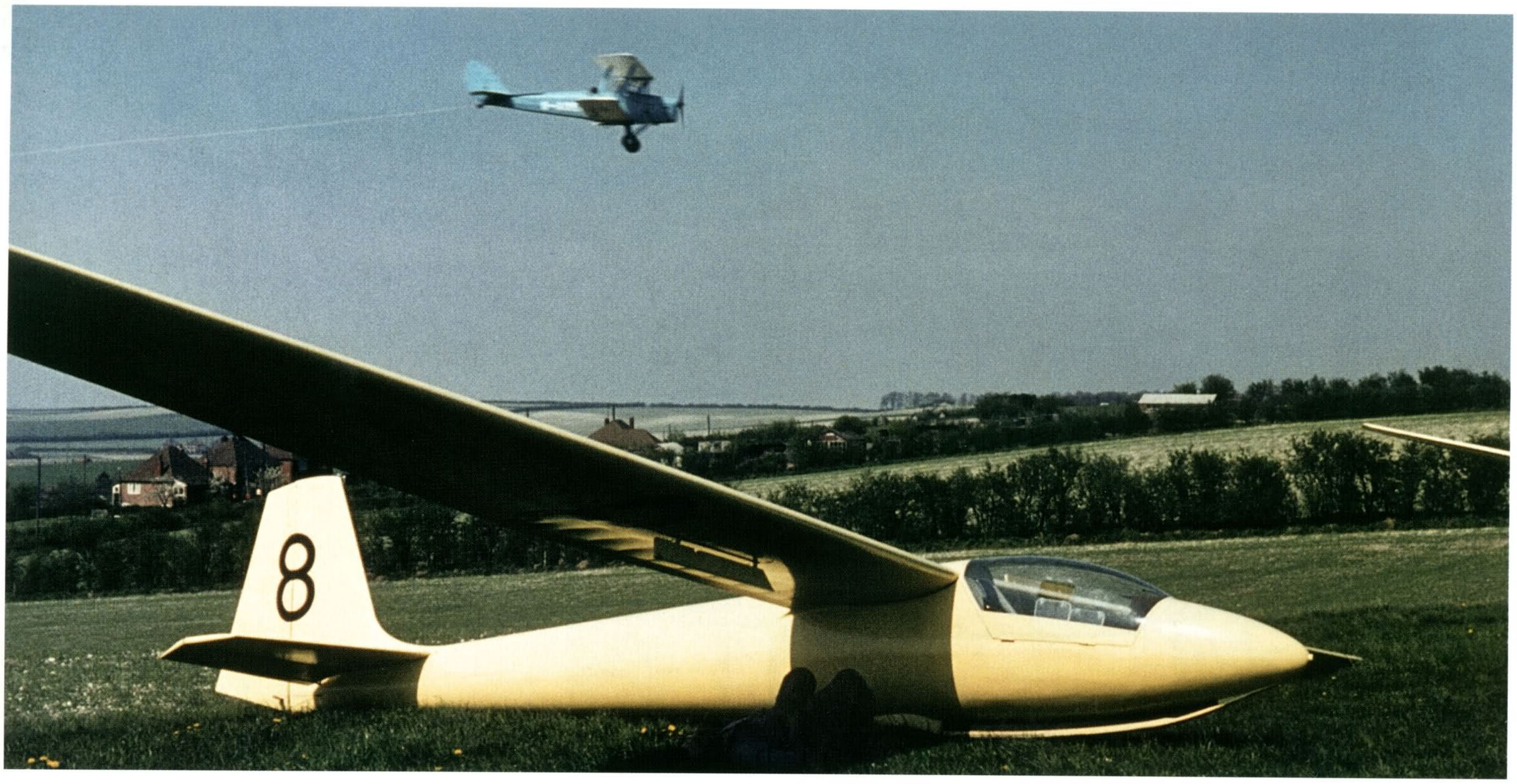


Above: Geoffrey Stephenson (in 1939 the first pilot to cross the English Channel in soaring flight) flew this Skylark 4 at Dunstable.

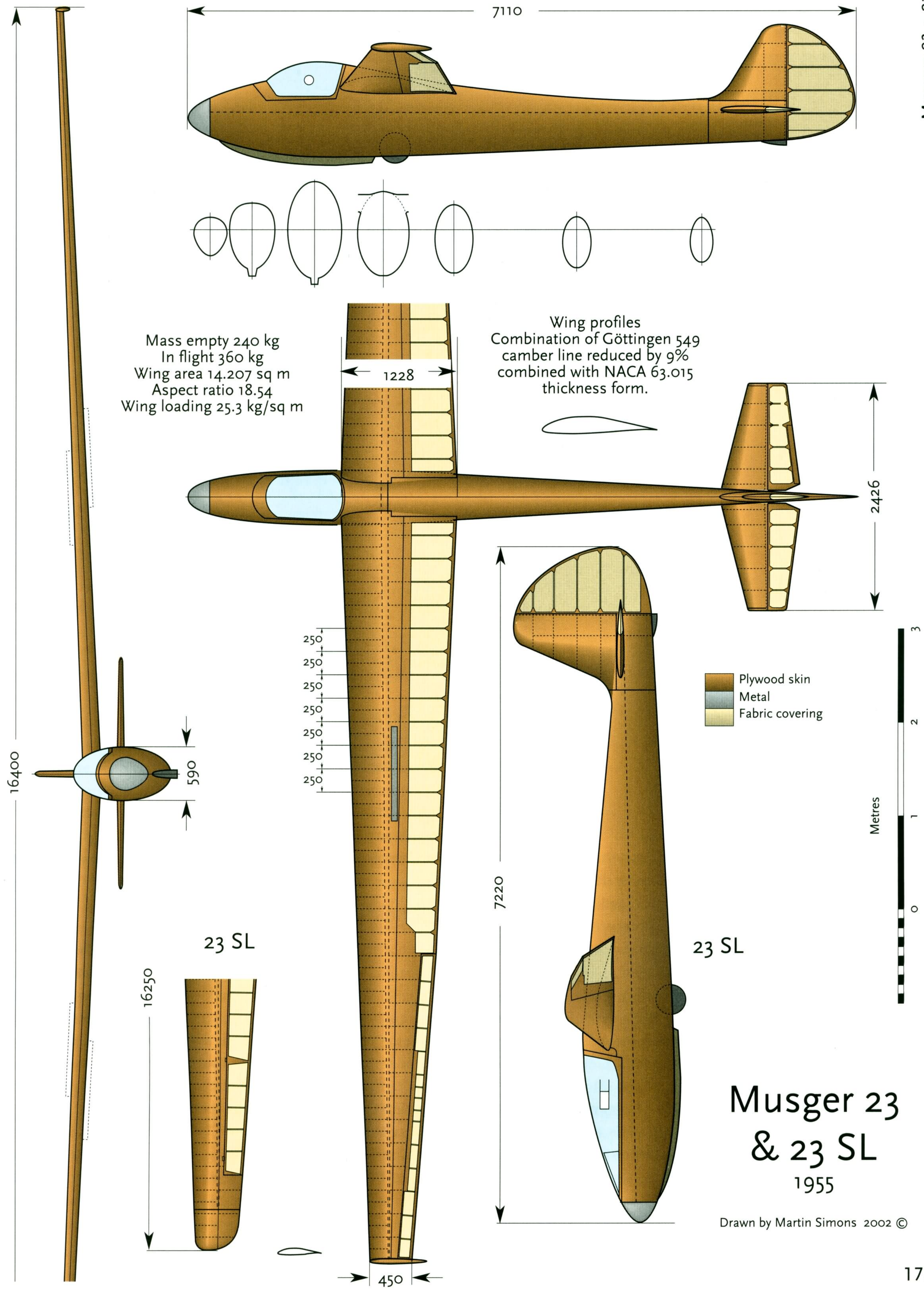
Right: Philip Wills transferred his contest number 1 to his Skylark 4, seen here (with the author's young daughter) at Dunstable. In the background is the old 'Sky'.

provement in the high speed glide, and together with the reduced parasitic drag of the fuselage, a worthwhile advance on the Skylark 3. After tests, however, a degree of tip washout was thought necessary so some of the advantage was lost. The best glide was about three points better at 36: 1. Handling also was improved. The ailerons were longer but narrower in chord, more responsive but with lighter stick loads. The structural methods and materials were hardly changed. The three piece wing, with its heavy centre section, was easier to rig because the fuselage was lower.

In the World Championships where the Skylark 4 competed, in Argentina, the British pilots discovered, if they did not already know, that in good soaring weather they had little chance against the much faster Polish Zefirs, the American Sisu and HP - 11. Criticisms of the Slingsby design were voiced by some, who pointed to various small details such as protruding canopy hinges, an open wheel well, some air leakages and lack of refinement. The finish was not perfect when compared with some other Open Class aircraft. The Company's attitude was that the sailplane was inexpensive and these relatively minor matters could be righted by the owners if they needed the best possible performance. Everyone agreed the Skylark handled very well, considering it was over eighteen metres in span. It showed up well when the thermals were weak. Dick Johnson in the USA provided confirmation of all this. He spent a lot of effort in 'cleaning up' his Skylark and won the US Nationals two years running in 1963 and 1964. These contests were flown in mediocre soaring weather. Such successes helped sales. A total of 63 of the Skylark 4 were built at the Yorkshire factory, with three more from kits in New Zealand.

Musger 23 & 23SL

The Oberlerchner Company had built Musger's Steinadler two seat sailplanes. In 1954 he began the design of a new single-seater which became the Mg 23 and flew in 1955. It was a wooden sailplane with orthodox construction and layout but with an unusual wing profile. This was a combination of the old, well known and successful Göttingen 549 camber line with one of the laminar flow NACA 6 series thickness forms. The camber governs the ideal lift coefficient.


7110
Mass empty 240 kg
In flight 360 kg
Wing area 14.207 sq m
Aspect ratio 18.54
Wing loading 25.3 kg/sq m
1228
Wing profiles
Combination of Göttingen 549
camber line reduced by 9%
combined with NACA 63.015
thickness form.
2426
16400
590
250
250
250
250
250
250
250
7220
Plywood skin
Metal
Fabric covering
Metres
0
1
2
3
23 SL
16250
23 SL
450
Musger 23
& 23 SL
1955
Drawn by Martin Simons 2002 ©

Above. The Musger Mg - 23 was entered by the Austrian team in the World Championships at St Yan in 1956. It was chosen again for 1958 at Leszno.

Left: The MG 23SL at the International Vintage Soaring Meet 2000, Harris Hill, Elmira.

It also is chiefly responsible for the pitching moment of the resulting profile, which in turn determines the twisting forces on the wing, the tail loads at different airspeeds and the general balance equations. The thickness form is what mainly determines the extent of laminar flow in the boundary layer, and the width of the low drag range on either side of the ideal lift coefficient. What particular reasons Musger had for adopting this combination is not known but the outcome was quite satisfactory.

To preserve the smooth surface required, the ribs over the forward portion of the wing were closely spaced and the fabric covered areas did not begin until well behind the main spar. Wing tip bodies, 'salmons' as they are often called, were fitted, mainly to protect the ailerons when a tip dragged on the ground.

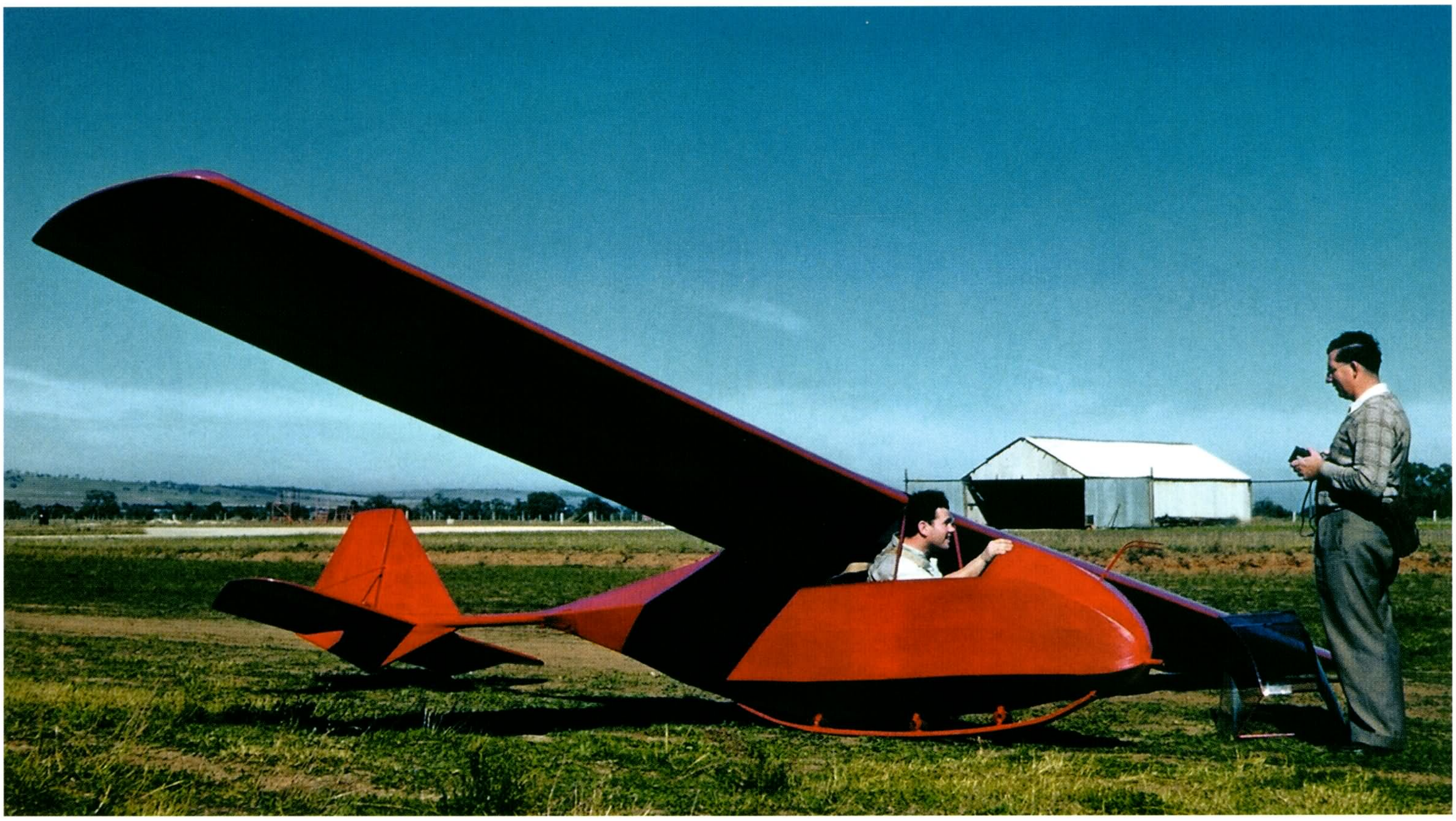
After nine of the MG 23 had been built, Musger produced the MG 23SL, which used the same basic wing. The ailerons were redesigned with greater chord and located further inwards away from the tips. The tip bodies were removed and the tips rounded. The fuselage was improved in shape with a contoured canopy and enlarged vertical tail areas

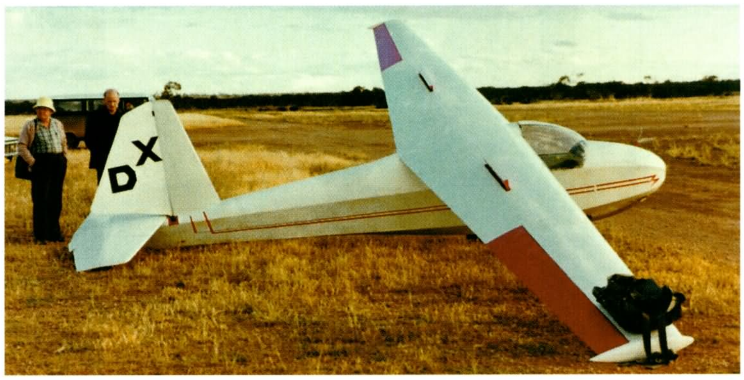
The MG 23 was used to break most of the existing Austrian National records and competed in the World Championships in 1956 and 58. There were some exports. The total of all versions built was twenty six.

Schneider ES 54 Gnome

In the later nineteen forties and early fifties there was a vigorous campaign, emanating largely from the Australian pilot Fred Hoinville, for sailplanes to be made smaller and cheaper. Hoinville had represented Australia in the 1952 World Championships. His articles appeared in the relevant magazines around the world. It was accepted that a small sailplane could never expect to compete on equal terms with a large one, but it would enable many more aspiring pilots to get into the air and experience soaring flight.

Harry Schneider, Edmund's son, decided in 1955 to build a small sailplane with a laminar flow wing profile, to see, or demonstrate, what such an aircraft might be like and what it could do. The result was the ES 54 Gnome, of 7.62 m (25 ft) wing span, a rectangular wing plan with rounded tips, a pod and boom layout with a simple tail





Above: The ES 54 Gnome was an experiment with a very small, light sailplane. It flew successfully in June 1955 but performance was very limited and no orders were received. Right: The ES 56 Nymph with a NACA six digit wing profile, performed well for its size and pilots liked it, but only four were built

unit, and a laminar profile. (Schneider does not remember which profile was used.) It took about 500 hours to build the prototype.

The Gnome, with Harry Schneider as test pilot and Hoinville present as a witness, made its first flights by auto tow on May 1st 1955. It proved quite safe in flight and handled well but the performance was very much as expected, poor! Modifications of the fuselage to improve ground clearance and keep the tail clear of the ground on take off, were made but no soaring was ever done. Schneiders were prepared to produce kits for home assembly, if there was sufficient interest

There were in fact only three enquiries, and no firm orders. The project was abandoned in 1956. The only Gnome ever built was sold to a gliding club at Port Pirie.

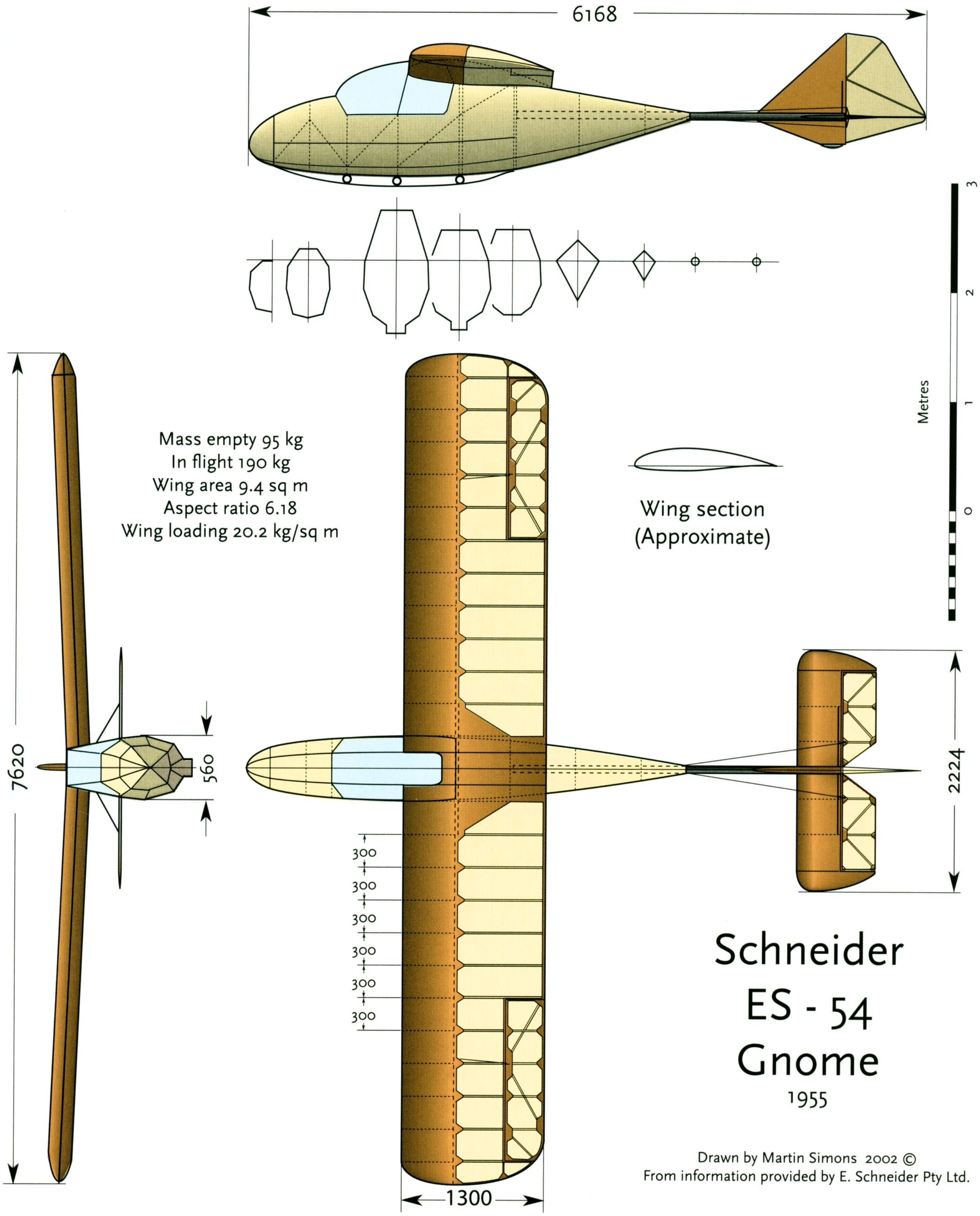
Hoinville's wishes might have been fulfilled by a good hang glider, had any been available at that time. He made his living as a skywriter and aerobatic show pilot but was killed in 1959 in an accident when taking off in a motor glider.

Schneider ES 56 Nymph

The ES 56 Nymph was designed for the smaller clubs in Australia where cost was a major consideration and the demand for large span, high performance sailplanes very limited. The span was 11.9 m (39 ft). It had a laminar flow wing profile and care was taken to get the best possible wing surface with a simple wooden structure. The main wing spar was set well back and the wing ribs closely spaced. The plywood skin was carried back beyond the spar. To save the weight and cost of wing root fittings, the wing was build in one piece. To take this by road was not too difficult since it could be carried on an open trailer. The wing, in horizontal position, was supported in cradles high enough to let the wing tip go above a small towing car such as a Volkswagen. The fuselage was a simple plywood skinned box with a rounded turtle back and blown plastic canopy. The tail unit was slightly unusual in having the horizontal surface mounted behind the fin.

Soon after completing the test flights, Harry Schneider on January 8th 1956 flew the prototype from an auto-towed launch at Gawler north of Adelaide to gain his Gold C distance badge with a 310 km flight into the neighbouring state of Victoria.

Despite this and other good results, only four of the Nymph were built. It was less popular than its stablemate, the ES - 57 Kingfisher.

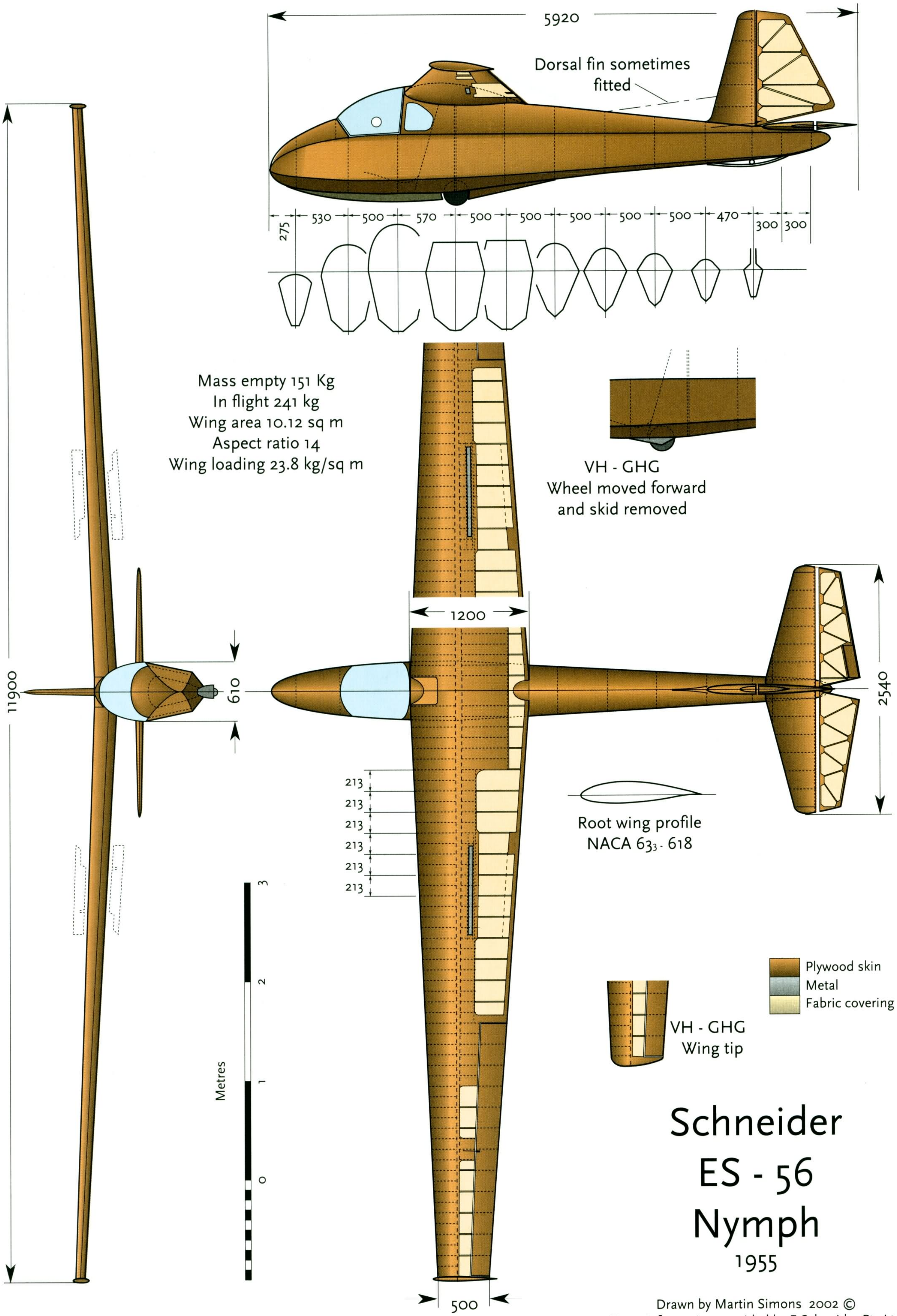


Mass empty 95 kg
In flight 190 kg
Wing area 9.4 sq m
Aspect ratio 6.18
Wing loading 20.2 kg/sq m

Schneider ES - 54 Gnome

1955

Drawn by Martin Simons 2002 ©
From information provided by E. Schneider Pty Ltd.



Schneider ES - 56 Nymph

1955

Drawn by Martin Simons 2002 ©
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The 20 metre, all-metal 'Meteor' was breathtaking when it first appeared in 1955. Ten years later it was still competing in the World Championships. On the right is the Standard Austria

Right: The Meteor at South Cerney, 1965. Note the retracting wheel and skid.

Ikarus Meteor

The Meteor was designed by the same Yugoslavian group that had produced the Orao in 1950, Boris Cijan, Stanko Obad with Miho Mazovec. It created a sensation when it appeared at the 1956 World Championships.

The Yugoslavian Government sponsored the design and no expense was spared. It was without doubt the most advanced sailplane of its time. Twelve years after its first flights the Meteor was still competitive at World Championships level. Flown by Saradic in 1956, it placed fourth and was fifth in 1958. Ten years after its first flight the Meteor, flown now by Ciril Kriznar, placed 5th at South Cerney in 1965 and competed again in 1968. Even after so long, it was not out of place among the glass-plastic sailplanes.

From the European viewpoint in 1956 the most remarkable feature of the Meteor was that it was all metal. With a very large span and high aspect ratio, and the ever-increasing emphasis on high speeds, such a sailplane probably could not have been built at all in wood. As it was, the weight and wing loadings were not excessively high. The best glide ratio was measured at 42:1, but it was probably more significant that the Meteor had an outstanding glide at high airspeeds.

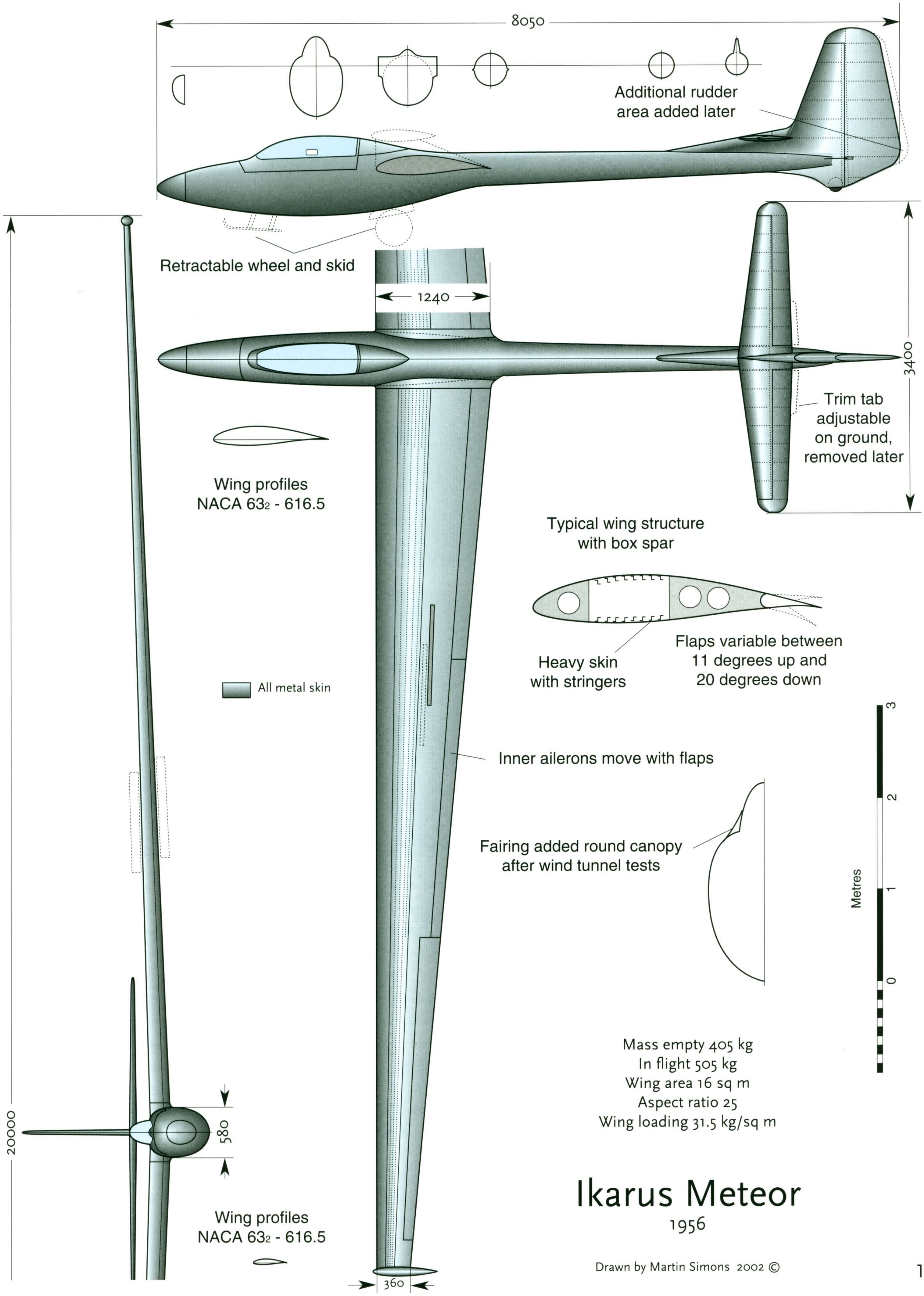
The wing required very accurate jigging and workmanship during construction, and much careful filling and smoothing afterwards. Camber flaps were fitted, to be lowered for circling and raised slightly to improve the high speed glide. Wing tip bodies ('salmons') were fitted to try to reduce the strength of the tip vortices.

The fuselage had as small a cross section as possible, with a reclining seat. To reduce the surface area exposed to skin friction it contracted to a slender tail boom behind the wing. The cockpit canopy was a teardrop shape. This, after some flow separation was discovered, was further improved later. An orthodox tail unit was used, with the horizontal surface raised above the wing wake on a sub fin mounting, but not to the full height of a T tail. The main landing wheel was fully retractable and there was a small forward skid, which also retracted in flight.

Apart from successes in the Yugoslavian competitions, the Meteor in 1958 broke the World records for speed over triangular courses of 100 and 300 km. Two of the Meteor were built and remained in use at the gliding centre at Vrsac for many years after their competition days were over.

Pfenninger Elfe M

The Elfe series of sailplanes began with the tiny Elfe 1 of 1939. It was designed by Werner Pfenninger with a span of only 9 metres. There followed a version with 11 metre span. Pfenninger, an aerodynamicist, was already becoming interested in designing laminar flow aerofoil sections, not only for sailplanes but also for turbine blades. He tested some of his sections at very low Reynolds number in the wind tunnel. The Pfenninger profiles were designed indepen-



Mass empty 405 kg
In flight 505 kg
Wing area 16 sq m
Aspect ratio 25
Wing loading 31.5 kg/sq m

Ikarus Meteor

1956

Drawn by Martin Simons 2002 ©