# Flight test of LS7-WL  serial #7089  D-8182 “UG”

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## A little history

The design of the LS7 was completed on Wolf Lemke’s drawing board in 1987. It was conceived as the follower of the LS4 (in its turn the direct follower of the LS1), which, with over 1000 built, stands out as the biggest commercial success of Rolladen-Schneider Gmbh.
The prototype of the LS7 flew late that year, and serial production started in spring 1988.


The design was thought as radically different from the LS4, with the highest performances in mind. The machine was studied along the leading design guidelines of the time, which called for a high aspect ratio (the wingspan to mean chord ratio, 23 for the LS7) and a small wing area (9.74 m2 compared to the 10.50 m2 of the LS4). The wing loading was intentionally on the high side, though carbon fiber was extensively used in the construction (wing spar and skins, tailplane) along with aramid fiber (ailerons, elevator). This construction allowed an empty weight as low as 235 kg. All-up, it was a machine definitely aimed to the success in competitions, rather than leisure flying.
Similar characteristics can be spotted in its contemporaries, the ASW-24 (follower of the ASW-19), with 10.0 m2 wing area and 22.5 aspect ratio, and the SZD-55 (only 9.6 m2 and 23.44 a/r). This bunch of new designs had to face the Discus, whose design was a bit older and based on different concepts (10.58 m2 and an a/r of 21.3), but nonetheless extremely good.
The nominal L/D of the LS7 war nearly three points higher than its forerunner (43 at 105 km/h versus 40.2 at 102 km/h), and the polar was flatter at higher speeds even without waterballast.
In 1991 the WL variant with winglets was introduced, and retrofit was made possible on all the previously built gliders. From then on, nearly all LS7s sold were LS7-WLs, and many older aircraft were converted to winglets.


Construction of the LS7 was abandoned in 1993, after only 164 were built. A good deal of these were sold on the British market, where the LS7 has continued to be the most sought after standard class glider before the advent of the LS8.

## How is it made ?

The LS7 has the unmistakable family feeling of the whole LS production, coming from the very same fuselage as the LS6 and the simple double-trapeze wing plan form of all the LS. The look is so close to that of its successor the LS8 (mainly due to the peculiar shape of the big winglets) that, at first glance, only a very trained eye can tell the difference. A close inspection reveals the wing's narrower chord, particularly at the tip, as being the most recognizable feature of the LS7 versus the LS8 (also due to this latter being prepared to receive the 18m extended tips).

Not a surprise : since the most expensive part of a glider to design and produce is the fuselage, all builders have resolved to "recycle" fuselage shapes in order to somewhat reduce the investment costs when a new model is launched. Therefore Rolladen-Schneider, in spite of having in the molds their $10^{th}$ type, only have produced two fuselages so far (except for that of the open class LS5, which never evolved beyond the prototype stage): the roomier fuselage of the LS1, which equipped with small modifications the LS3, LS4 and LS9, and the smaller one of the LS6, shared with the LS7 and LS8. I'm not sure about the brand new LS10. Each time the wing-fuselage connection had to be redesigned to accommodate the different chords and profiles.

Incidentally, this concept of "recycling" has been pushed to extremes with the LS8 design, which is nothing but a LS6 with the wing molded in a single piece, flaps locked in the neutral position. Early tests of the type were carried on in the British Standard class championship, where the local LS dealer Martyn Wells flew a LS6-X, a stock LS6 with the flaps set permanently to neutral and the flap control leverages removed. The LS8 was born, and if one looks at the success (and the selling price!) of this machine, it becomes clear how good a reimbursement it has proven to the LS factory for the commercial disappointment of the LS7, for which a totally new wing had been designed and built.

We have already described the double-trapeze plan form of the wing, with its small chord that gives only 9.74 m2 of surface and an aspect ratio of 23, a high value for a standard class glider. A table is provided at the bottom for those interested in comparing numbers. The all-kevlar ailerons have a maximum chord of only 12cm and extend further than 50% of half wingspan, partially overlapping the Schempp-Hirth double plate type airbrakes. The airfoil (a modified Wortmann section) thickness is particularly small, and the minimum radius of the leading edge gives the wing a "sharp" look. Each wing contains, in front of the main spar, a water ballast bag of 50 or 75 liters capacity.


Given the light weight of the wing (59-60 kg. including the winglet), when flying with the bigger tanks full the weight of the water carried exceeds that of the wing which contains it.
The tailplane is classic, with a carbon fixed part and a kevlar elevator.
The fuselage, as it has been pointed out, is that of the LS6 in its 15m configuration (the LS6-18 and LS8-18 have a bigger rudder to counteract the increased adverse yaw). It's built of fiberglass, and incorporates a tail water tank in the vertical fin of 5.5 liters of capacity (4.1 liters when combined with the optional tail fin battery receptacle). The TOST CG hook is on the undercarriage leg, and is retracted in flight together with the wheel. A nose tow hook is optional.
The landing gear has shock absorbers, but is equipped with the highly inefficient 4.00-4 wheel of the whole LS production, with its ridiculous drum brake, activated with simultaneous pressure on both rudder pedals. A scandal as it may sound, when you order a brand new LS8 today (spending the equivalent of a small sized home…), you get the same toywheel to play with. To make the brake work a little better, the brake lining on the pads has to be replaced with a much softer compound, which wears quickly but gives a better emergency braking effect. Forget daily use anyway. A TOST disc brake can be fitted and individually approved, but with a long and expensive modification work. The biggest drawback is that the brake caliper, due to insufficient space inside the landing gear box, has to be installed face down, in a close to ground and fairly prone to damage position. A tailwheel or tailskid are fitted.
Instruments are connected to no less than 8 static ports, on the sides of the nose and the fuselage tail boom. Total pressure and TE compensation both come from the fin.
The long canopy lifts off forwards, taking the instrument panels with it.


## Cockpit and controls

Those who know the LS6 will definitely feel at home here. The cockpit layout is most classic, and boarding the glider with the ample space left by the lifted canopy is easy.
To the left there are the airbrakes lever, with a stiff overcenter lock (inside the wings), and the trim indicator/regulator ball. The yellow tow release handle is located high to the left, in an optimal position. In front of the stick there is the trimmer release lever, very practical to use. Trimming range is about 80-180 km/h with the balance we will describe later. Low to the left of the stick there is the black pedals' position regulation handle. Having to double as a wheel brake activator, the rudder pedals' system has a complicated sliding mechanism and is often prone to a fastidious lateral play. The ventilation handle is on the top of the instrument panel, and it moves a metal flap in the front of the cockpit. The system isn't one of the best, and becomes easily stuffed with debris when flying from a grass runway, having to be cleaned with a vacuum fairly often.
To the right the short and practical landing gear lever is found. Its operation is safe, with good unmistakable locks. On the same side there are the waterballast tanks single lever, and a seat backrest inclination slider which can be operated in flight. Thanks to the possibility of sliding fore and aft (on the ground) the backrest base, and to the seatpan shape with the typical "bump" at knees level, finding a comfortable seating position is easy for every body size. This makes flying the LS7 easier than many other gliders, no pain even after many hours. For underweight pilots there is a threaded stub in front of the rudder pedals to receive up to four lead bars (2.45 kg each, compensating for 5 kg. of pilot weight).
Standard equipment is completed by the oxygen flask tube to the left of the main bulkhead , zippered pocket on the right cockpit wall, and a shelf for the main battery in the baggage compartment (max. load 5 kg.), where there is room for an ELT and a barograph.
The canopy unlocks by two side levers on its frame. By pulling the right hand lever further, the front linkage is released in an emergency. For this eventuality a temporary hinge (Röger-hook) is fitted at the rear end.


## Rigging

Due to unsparingly use of carbon fiber, the LS7 parts are light. Each wing weighs around 57-58 kg. without the tip, and the winglets mounting hardware itself (a steel bar protruding from the wingtip, where a spring-loaded pin holds the winglet in place) makes it easy to grab and handle the outer end. The LS7 can be easily rigged with the wife/girlfriend, if you take care of the wing root (I tested it several times, and am still married to the same woman…).
Wing spars are of the fork-and-tongue type, so the port wing (the “fork”) has to be inserted first, followed by the starboard one. Two main pins with a classic spring-loaded lock hold the wings in place, all the controls and waterballast system connections are automatic (unlike the LS4’s and LS6’s earlier versions). After pinning in the winglets, the very light tailplane is rigged and fastened by the proven LS crank wheel system. Elevator connection is of course automatic.


Water ballast must be filled following this sequence : open dump valve lever in the cockpit, left wing on the ground, fill fin tank first. Without disconnecting the fin tank filling tube, fill left wing, then close dump valve lever, and put right wing to the ground (with a weight at the tip). Open the separate right wing valve via a knob in the baggage compartment, then fill right wing. Close knob, et voilà. Unlike the LS6, the wing tanks have a dump hole each and don't communicate.
Control surfaces are completely sealed, and both the wing and tailplane are equipped with zig-zag turbulators. Quality of construction and finish are excellent, just as was expected by the purchasers of one of the highest performance gliders of its time.

## Uniform Golf

I purchased UG early in 1999, upgrading from my DG-300, after one year of research work. A high credit must go to the former owner, my now friend Louis Dresse of Belgium, for the extreme care taken in its maintenance. The glider looked 10 months rather than nearly 10 years old! A nice Cobra trailer came with the glider, and performed the duty of the 1200 km. trip home flawlessly.


Before flying UG for the first time, I made some minor custom arrangements. The wingtip skids were replaced with higher LS8 skids, the former LS4-type ones being too low. The instrument panel was rearranged for the new Filser DX50 combined flight computer, and a Bohli compass replaced the Airpath on the coaming. An ACK ELT pointer was installed in the baggage compartment, and two trim weights were installed in the nose to account for my lighter weight. Careful weight and balance followed.

## How does it fly ?

If you cared to read this far, this is probably the single most interesting answer you're waiting for.

It’s been said already that the LS7 was born as a racing machine, one designed to the most advanced concepts of the time. In spite of that, Wolf Lemke managed to retain the well renowned general comfort and easy handling features of all of his creations.

Probably due to the advanced concepts which inspired its design, the LS7 has paid like its contemporary, the ASW24, the toll of not being fully understood at the beginning by its pilots and even its inceptors. Just like the ASW24 bore the name of a difficult glider in turbulent conditions, the LS7 was deemed (probably also due to the higher base wing loading) a poor climber in thermals. And just like the ’24 has undergone modifications (B version wing profile and adoption of winglets), the LS7 has seen in the introduction of the WL variant the attempt to offset what was recognized as a design fault. But –alas! – the worst had already happened, and word of mouth had definitely killed both machines, to the great advantage of the Discus and others.
That said, let’s go back to the original question : how does the LS7WL fly ? Following notes are based on personal experience (4 flying seasons and several hundred kms.) and contacts made with LS7 pilots from Britain, Germany and France I made before deciding to buy it, plus notes and indications from the designer himself.

General handling characteristics

Thanks to the comfortable seating position, the docile and harmonious controls and the complete sealing which makes it very quiet, the LS7 is a glider of rare pleasure to fly. The long, sensitive ailerons give a 45°-45° roll rate of slightly less than three seconds at medium speed, about one second less than the vast majority of other standard class machines (LS8 included). A very pleasant feature in mountain flying, this is a major improvement over the “deafer” machines of the previous generation, which have thicker airfoil sections (DG300, LS4 …).
In spite of being light, the LS7 has an excellent streamlined shape, and accelerates quickly when the nose is lowered. It’s a glider you can fly with two fingers on the stick, and follows without delay the pilot’s inputs. Adverse yaw in turns is small, due to the great difference of excursion between opposing ailerons, and it’s easily counteracted with a limited rudder amount.
The all-carbon wing is stiff without excess, and promptly transfers air mass movements to the pilot’s senses. When gliding at high speed (above 200 km/h), however, the ride can get rough if there is a turbulence (but in that case you should keep within the green arc anyway).
Aileron authority at take off is almost immediate,


only with a cross or tail wind and water ballast it is advisable to start the take-off run with half airbrakes out. When the tail lifts, keeping control is extremely easy, and the glider becomes airborne on its own shortly thereafter. I never had a winch launch in it, so I can't tell about its handling on the wire.
The big airbrakes break off the glide angle to about 1:6, thus making steep approaches easy. The float and ground run are of course longer than with a flapped machine, but amply within the needs for a field landing. The negative note, as already pointed out, comes from the inefficient drum wheelbrake.

Wing loading and balance

In spite of the limited empty weight (235 kg), the small wing area makes the wing loading a notch higher than standards like the Discus, DG300 and LS4. Only the SZD55 has a smaller wing, but it's significantly lighter (210 kg). It must be said that the difference with the LS8 isn't enormous, because the latter has a 10.5 m2 wing, but its average empty weight is nearly 25 kg. higher.
A lightweight pilot like me (65 kg), with two lead trim weights in the nose has a bottom wing loading of 32 kg/m2, about 10% higher than I used to have on the DG300, which isn't too much.
Maximum take-off weight is limited to 485 kg, and can only be obtained with the larger 150 lt. ballast tanks, giving a wing loading of 50 kg/m2. In general use I discovered that a wing loading of 40 kg/m2 (60 liters of water in my case) gives an excellent compromise between cruising and climbing performance, and the machine tolerates it perfectly. I never take off with a lesser wing loading, not even on lighter days.
Balance needs a commentary apart. At first, LS7 pilots used to aim for a rearward CG position, as was common practice with most standard class gliders. Permitted in-flight CG position range, from the flight manual, is 250-400mm behind Datum point (leading edge of wing at root). With time, it was discovered that the LS7 doesn't conform to the general rule, and that it flies and climbs much better with a slightly advanced CG. After my purchase I asked Wolf Lemke, and he indicated 350mm as the best option. Carefully centered on that value, my LS7WL completely fulfilled the expected performances.

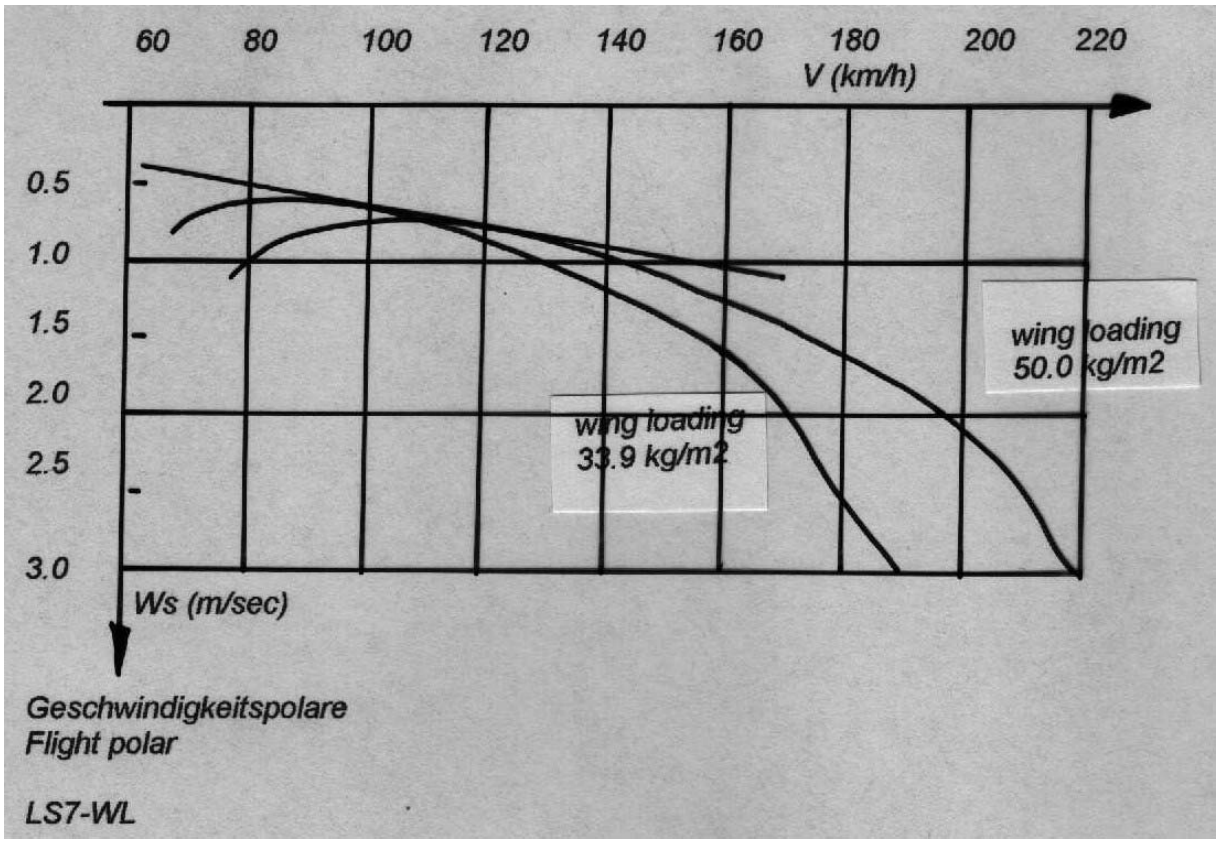
Climbing

With a mean typical wing loading of 40 kg/m2 and the described CG position, the LS7WL climbs in average as any other current standard class machine, provided it is flown to the optimal circling speeds shown by the polar and recommended by the designer. The glider tolerates circling speeds as low as 70 km/h with no problems, but if you want to climb efficiently you have to fly it at 85 km/h empty, up to 105 km/h when fully loaded. Other gliders (the DG300 for sure, by personal experience) are less critical in this respect and can

be flown more carelessly, whilst with a LS7 the “heavy hand” is paid in cash. Just one more reason to pursue as far as possible a clean and exact piloting style – which, after all, pays off with any glider.
An interesting point of view on this subject was brought to my attention by the well-known Walter Eisele. He claims there is no appreciable performance difference between the LS7 and LS8, when both are flown correctly by pilots who know what they are doing. The reason for some disappointing competition results of the 7 versus the 8 and others is, Walter says, that LS7 pilots climbing in gaggles tend to uniform their flying speeds to that of other gliders in the gaggle, which is usually too slow for the LS7. Hence the glider climbs less than it should. I don’t fly competitions, but I found myself in the air with many other gliders and pilots of my same skill level, and never ever felt handicapped by a machine which refused to climb.
I have no experience of the wingletless version, but I’m told that the climbing performance is slightly worse (in numbers, while considerations on balance, speeds and piloting skills stay valid), due to the increased induced drag, particularly detrimental at low speeds.

Cruising

The LS7 takes its revenge on these grounds. Asked a specific question, Wolf Lemke admitted that the LS8 isn’t superior to the LS7 in a glide (as it isn’t the LS6-15m with zero flaps…). The 43 points of L/D are all there, and the polar is flat up to about 180 km/h, which makes glides a breeze.




It must be said that above 160 km/h the WL version pays a tribute to the wingletless machine, because at higher speeds the winglets generate more profile drag than the induced drag they can suppress. But how much time do we spend flying above 160 km/h? If we do spend a lot, then the conditions must be so good that the negative effect of winglets can be forgotten.

Conclusions

Further to the technical considerations made, practical experience shows that the LS7WL is a standard class glider perfectly in line with the others in all conditions. If one has high level competition in mind, that’s probably not the right machine, but for performance flying and club racing this glider is a winner. After all, with the average club pilot, the machine accounts for only 20% of total flight performance, while the remaining 80% can be ascribed to the “human factor”.
As we said, a good number of LS7s have been sold on the high level British market at the end of the ‘80s – beginning of the ‘90s, thanks to a competent dealer but also to many convincing competition results. It’s difficult to believe that a glider which “cannot climb” could consistently win championship and several other events face to the Discus, ASW24 etc. in relatively poor average conditions like the British ones.

One last interesting detail is that the LS7 and LS7WL's handicap factor is 1.06 (which entitles it to be flown in the Club class), equal to that of the DG300 and LS4 which have inferior performances, and two points lower than that of the ASW24, Discus, LS3, etc.

## Two good reasons to buy it

- it's as beautiful as a LS8 but costs half its price, mainly due (or thanks to…) the bad name that apparently stuck with it
- it's a modern, performing, easy to rig and pleasant to fly glider, built with extreme care and quality. A very good value for money indeed.

Technical features comparison table

| Type | Wing area | Aspect ratio | Wing loading * | L/D max |
|---|---|---|---|---|
| ASW-24 | 10.00 | 22.5 | 30.0-48.5 kg/m2 | 44 at 105 km/h |
| DG-300 | 10.27 | 21.9 | 30.2-48.7 kg/m2 | 40 at 89 km/h |
| Discus b | 10.58 | 21.3 | 28.5-47.3 kg/m2 | 42.5 at 100 km/h |
| LS-4 | 10.50 | 21.4 | 29.5-46.2 kg/m2 | 40.2 at 102 km/h |
| LS-7WL | 9.74 | 23.0 | 31.3-46.7 kg/m2 | 43 at 105 km/h |
| LS-8 | 10.50 | 21.4 | 30.5-46.2 kg/m2 | 43 at 105 km/h |
| SZD-55 | 9.60 | 23.4 | 29.2-49.0 kg/m2 | 43 at 85 km/h |

(*) with minimum empty weight, pilot weight 70 kg. and maximum possible waterballast load

my little son Filippo (1 ½ years old) enjoying the easy handling of the LS7WL !