

Flight Manual LS1-f

0 Amendments, list of effective pages, table of contents

0.1 Amendments

Any revision of the present manual, except actual weighing data, must be recorded in the following table and in case of approved sections endorsed by the responsible airworthiness authority.

The new or amended text in the revised page will be indicated by a black vertical line in the right hand margin, and the Revision No. and the date will be shown on the bottom left hand of the page.

No.	Page	Description	Date	Inserted Signature
1	0.0-7.6	Combination of the initial flight manuals of the Variants LS1-f and LS1-f (45), new standardized format	May 2011	
2	1.1 -1.4, 2.1, 2.2, 2.6 – 2.9, 3.1 – 3.3, 4.1 – 4.14, 5.1, 5.2, 6.1 – 6.5, 7.1 – 7.5, 8.1 – 8.4, 9.1	Miscellaneous changes to the contents of the latest amendments of the initial flight manuals	May 2011	
3	0.1,0.3, 0.4, 0.6, 1.3, 1.4, 2.2-2.5, 2.7-2.9, 4.1, 4.3, 4.4, 4.12 - 4.14, 5.2, 6.1, 6.2, 6.4, 6.5, 7.3	TN63-LS: Winglets, wing-fuselage junctions, aileron end plates, increase of max. mass of non-lifting parts	May 2017	

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0.2 List of effective pages

Section	page	issued	replaced	replaced	replaced
0	0.1	May 11	See last revision		
	0.2	"			
	0.3	"			
	0.4	"			
	0.5	"			
	0.6	"	May 2017		
	0.7	"			
1	1.1	May 11			
	1.2	"			
	1.3	"	May 2017		
	1.4	"	May 2017		
2	2.1	May 11			
	2.2	"	May 2017		
	2.3	"	May 2017		
	2.4	"	May 2017		
	2.5	"	May 2017		
	2.6	"			
	2.7	"	May 2017		
	2.8	"	May 2017		
	2.9	"	May 2017		
	2.10	"			
3	3.1	May 11			
	3.2	"			
	3.3	"			
4	4.1	May 11	May 2017		
	4.2	"			
	4.3	"	May 2017		
	4.4	"	May 2017		
	4.5	"			
	4.6	"			
	4.7	"			
	4.8	"			
	4.9	"			
	4.10	"			
	4.11	"			

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List of effective pages cont.

Section	page	issued	replaced	replaced	replaced
4	4.12	May 11	May 2017		
	4.13	"	May 2017		
	4.14	"	May 2017		
5	5.1	May 11			
	5.2	"	May 2017		
	5.3	"			
6	6.1	May 11	May 2017		
	6.2	"	May 2017		
	6.3	"			
	6.4	"	May 2017		
	6.5	"	May 2017		
7	7.1	May 11			
	7.2	"			
	7.3	"	May 2017		
	7.4	"			
	7.5	"			
8	8.1	May 11			
	8.2	"			
	8.3	"			
	8.4	"			
9	9.1	May 11			

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1.4 Descriptive data

The LS1-f and LS1-f (45) are single-seater high performance sailplanes with conventional T-type horizontal tailplane.

Technical details

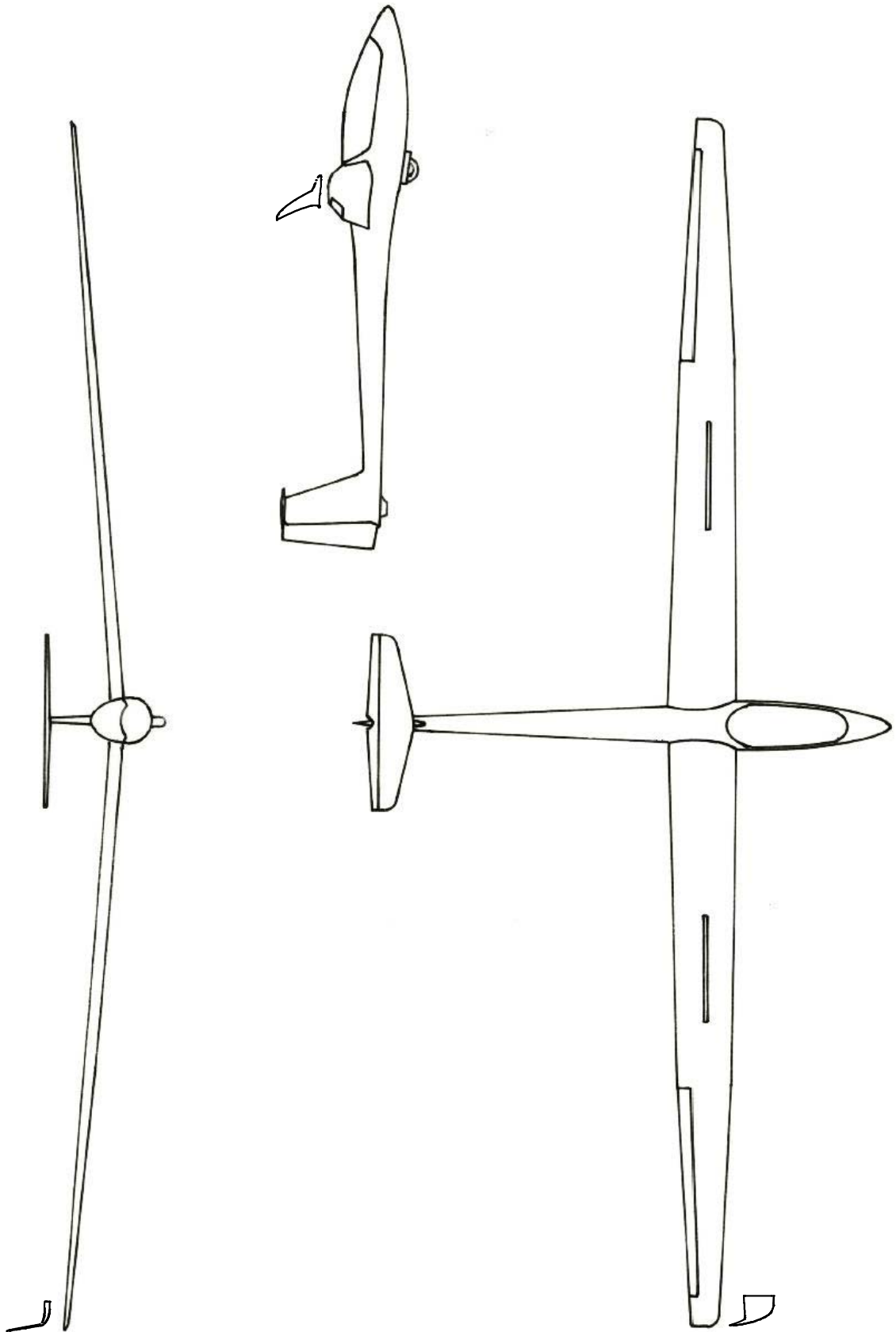
- Comfortable seating, backrest adjustable at ground.
- Large canopy for good in-flight vision.
- Sealed airbrake- and landing gear boxes.
- Retractable main wheel, spring mounted. Wheel with drum brake actuated via the airbrake handle.
- Water ballast in the wings in water bags
- Removable wingtips with winglets, **optional TN63-LS**
- Optimized wing-fuselage junction, **optional TN63-LS**
- Endplates between ailerons and wings, **optional TN63-LS**

Technical data	units	LS1-f	LS1-f (45)
Wing span	m	15	
Wing surface	m ²	9,75	
Aspect ratio	/	23,1	
Length	m	6,75	
Fuselage height	m	0,83	
Fuselage width	m	0,62	
Horizontal tail span	m	2,2	
Horizontal tail surface	m ²	0,98	
Water ballast	kg (ltr.)	max. 2* 45	max. 2*90
Empty mass with min. equipment	kg	approx. 230	aprox. 235
Wing loading (with 80kg payload)	kg/m ²	approx. 32	approx. 32
max. mass	kg	390	439
max. wing loading	kg/m ²	40	45
Max. speed VNE	km/h	250	250 with winglets 270 without winglets
Aerobatics	/	Not approved	

Note: Winglets raise the empty mass about 2 kg.

Caution: If the sailplane will be operated with winglets the use of water ballast is prohibited.

1.5 Three view drawing



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2.2 Airspeed

Airspeed limitations and their operational significance are shown below

	Speed	IAS km/h (kts.)	Remarks
V _{NE}	Never exceed speed	LS1-f and LS1-f(45) with Option winglets: 250 (135) LS1-f (45) without Option winglets: 270 (146)	Do not exceed this speed in any operation and do not use more than 1/3 of control deflection.
V _{RA}	Rough air speed	LS1-f and LS1-f(45) with Option winglets: 250 (135) LS1-f (45) without Option winglets: 270 (146)	Do not exceed this speed except in smooth air and then only with caution. Rough air is in lee-wave rotors, thunderclouds, visible whirlwinds or over mountain crests etc. Do not use more than 1/3 of control deflection.
V _A	Manoeuvring speed	170 (92)	Do not make full or abrupt control movement above this speed, because under certain conditions the sailplane may be overstressed by full control movement. Do not use more than 1/3 of control deflection.
V _W	Maximum winch-launching speed	130 (70)	Do not exceed this speed during winch- or auto-tow-launching
V _T	Maximum aerotowing speed	170 (92)	Do not exceed this speed during aerotowing.
V _{LO}	Maximum landing gear operating speed	LS1-f and LS1-f(45) with Option winglets: 250 (135) LS1-f (45) without Option winglets: 270 (146)	Do not extend or retract the landing gear above this speed.

Warning: At higher altitudes the true airspeed is higher than the indicated airspeed, so V_{NE} is reduced with altitude according to the table below, see also section 4.4.6.

Note: The strength of the airframe is proved for ± 10 m/s gusts at max. speed VNE. This means that combination of such a gust at VNE and positive manoeuvring load at the same time may overstress the airframe.

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2.3 Airspeed Indicator Markings

Airspeed indicator markings and their colour code significance are shown below.

2.3.1 LS1-f

Marking	(IAS) value or range km/h (kts.)	Significance
Green Arc	80 – 170 (43 - 92)	Normal Operating Range (Lower limit is maximum weight 1.1*VS1 at most forward c.g. with flaps neutral. Upper limit is manoeuvring speed.)
Yellow Arc	170 -250 (92 – 135)	Manoeuvres must be conducted with caution and only in smooth air
Red Line	250 (135)	Maximum speed for all operations

2.3.2 LS1-f (45)

Marking	(IAS) value or range km/h (kts.)	Significance
Green Arc	80 – 170 (43 - 92)	Normal Operating Range (Lower limit is 1.1*VS1 at maximum weight and most forward c.g. Upper limit is manoeuvring speed.)
Yellow Arc	170 -270 (92 – 146) 170 -250 (92 – 135) with Option winglets	Manoeuvres must be conducted with caution and only in smooth air
Red Line	270 (146) 250 (135) with Option winglets	Maximum speed for all operations

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2.4 Mass (weight)

Maximum take-off and landing weight with water ballast

LS1-f: 390 kg (860 lbs.)

LS1-f (45): 439 kg (968 lbs.)

Caution: If the sailplane will be operated with winglets, the use of water ballast is prohibited.

Caution: It is recommended to dump the water ballast before landing on airfields. Dump the ballast before an outlanding in any case.

Maximum take-off and landing mass without water ballast:

$$W = W_{\text{NLP}} + W_{\text{wings}}$$

W_{NLP} = Maximum mass of the non-lifting parts (see below)

W_{wings} = actual mass of the wings

Maximum weight of the non-lifting parts = 230 kg 507 lbs **without Option winglets.**

Maximum weight of the non-lifting parts = 250 kg 517 lbs **with Option winglets.**

Maximum mass in baggage compartment: 12 kg 26.5 lbs.

Caution: Heavy pieces of baggage must be secured to the baggage compartment floor.

Maximum water ballast

Caution: If the sailplane is being operated with winglets, the use of water ballast is prohibited.

Variant	mass kg (litres)	mass US.gal.	mass lbs.
LS1-f	2 x 45	2 x 11.9	2 x 99
LS1-f (45)	2 x 90	2 x 23.8	2 x 198

The max. take off mass is not to be exceeded.

Warning: Follow the loading procedures see section 6.

2.5 Centre of gravity

Centre of gravity range in flight is:

220mm (8.66 in.) up to 420 mm (16.53 in.) behind datum.

Datum= wing leading edge at the root rib.

Reference line= underside of aft fuselage boom horizontal.

C.G. diagrams and loading chart see sect. 6.

2.6 Approved manoeuvres

This sailplane is certified for normal gliding in the "Utility" category.

Aerobatics are not approved.

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2.7 Flight crew

Max. load in the seat: 110 kg (242 lbs.) unless limited by the max. permissible mass of the non-lifting parts (230 kg, 507 lbs resp. 250 kg, 517 lbs with Option Winglets).

Min. load in the seat (pilot + parachute): 60 kg (132 lbs.).

If necessary the min. cockpit load may be increased according to maintenance manual section 2.2.1 and value entered in section 6.8.4.

With these loads, the C.G. range given under section 2.5 will be kept within the limits when the empty weight C.G. is within its limits. See loading chart in section 6.

Caution: With lower pilot weights lead ballast must be added to the seat. Ballast put on the seat (lead ballast cushion) must be fastened at the safety belt anchor points.

2.8 Kinds of operation

Flights according to VFR (daylight)

Aerotow

Winch- and auto-tow launching

Aerobatics are not permitted

Cloud flying (daylight): permitted when properly instrumented (see below).

LS1-f(45) with Option winglets: Cloud flying not permitted.

2.9 Minimum equipment

As minimum equipment only the instruments and equipment specified in the equipment list (see Maintenance Manual section 8) are admissible.

2.9.1 Normal operation

a) **Airspeed indicator:** Range: 0-300 km/h (0-135kts.);

Speed range markings see sect. 2.3

b) **Altimeter:** Range: 0 – min. 10.000 m (0 – min. 30000 ft),

Altimeter with fine range pointer, 1 turn max. 1000 m (3000 ft.)

c) **Four piece symmetrical safety harness**

d) **Parachute** automatic or manual type or a suitable firm back cushion compressed approx. 8 cm (3 in.) thick

e) **Required placards, check lists, Flight manual.**

2.9.2 In addition for cloud flying

(Not permitted in the USA, Canada and Australia, not permitted LS1-f(45) with Option winglets)

Magnetic compass (compensated in the aircraft)

VHF - transceiver (ready for operation)

Variometer

Turn and bank indicator or artificial horizon

Note: Experience has shown that the installed airspeed indicator system may be used for cloud flying.

Caution: The weight of the upper part of the instrument panel shall not exceed 4 kg (8.8 lbs.).

2.12 Water ballast

Caution: If the sailplane is being operated with winglets the use of water ballast is prohibited.

Filling the water ballast is only allowed with a filling system which enables determination of the exact amount of ballast filled, e.g. water gauge or calibrated canisters. Only symmetrical loading is allowed.

After filling, balance the wings by dumping enough water from the heavy wing,.

Warning: Follow the loading chart, see section 6.8.

Don't try to fill more water into the tanks than the specified values.

The max. take-off weight must not be exceeded.

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2.13 Limitations placards

2.13.1 Limitations placards LS1-f

Without Option winglets

Type: LS1-f			
Serial No.:	Registration:		
Airspeed limits:			
Winch launch and auto tow	130 km/h	81 mph	70 kts.
Aero tow	170 km/h	106 mph	92 kts.
Manoeuvring	170 km/h	106 mph	92 kts.
Rough air	250 km/h	155 mph	135 kts.
Never exceed	250 km/h	155 mph	135 kts.
Aerobatic manoeuvres are prohibited			
Max. take-off mass	390 kg	860 lbs.	
Pilot weight incl. max:	110 kg	242 lbs.	
Parachute min:	60 kg	132 lbs.	
Lighter pilots must compensate lack of weight as suggested in Flight Manual.			

Clearly visible at right cockpit wall
with Option winglets:

Type: LS1-f			
Serial No.:	Registration:		
Airspeed limits:			
Winch launch and auto tow	130 km/h	81 mph	70 kts.
Aero tow	170 km/h	106 mph	92 kts.
Manoeuvring	170 km/h	106 mph	92 kts.
Rough air	250 km/h	155 mph	135 kts.
Never exceed	250 km/h	155 mph	135 kts.
Aerobatic manoeuvres are prohibited.			
If the sailplane will be operated with winglets, the use of water ballast is prohibited.			
Max. take-off mass	390 kg	860 lbs.	
Pilot weight incl. max:	110 kg	242 lbs.	
Parachute min:	60 kg	132 lbs.	
With lower pilot weight necessary ballast must be added.			

Clearly visible at right cockpit wall

Altitude in [m]	0-2000	3000	4000	5000	6000	7000	8000	9000	10000
VNE IAS km/h	250	237	225	214	202	191	180	170	160
Altitude in [ft]	0-6560	9843	13124	16405	19685	22966	26247	29528	32809
VNE IAS kts.	135	128	122	115	109	103	97	92	86

Clearly visible at right cockpit wall

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2.13.2 Limitations placards LS1-f (45)

Without Option winglets

Type: LS1-f(45)			
Serial No.: _____	Registration: _____		
Airspeed limits:			
Winch launch and auto tow	130 km/h	81 mph	70 kts.
Aero tow	170 km/h	106 mph	92 kts.
Manoeuvring	170 km/h	106 mph	92 kts.
Rough air	270 km/h	167 mph	146 kts.
Never exceed	270 km/h	167 mph	146 kts.
Aerobatic manoeuvres are prohibited			
Max. take-off mass	439 kg	968 lbs.	
Pilot weight incl. max:	110 kg	242 lbs.	
Parachute min:	60 kg	132 lbs.	
With lower pilot weight necessary ballast must be added.			

Clearly visible at right cockpit wall

with Option winglets

Type: LS1-f (45)			
Serial No.: _____	Registration: _____		
Airspeed limits:			
Winch launch and auto tow	130 km/h	81 mph	70 kts.
Aero tow	170 km/h	106 mph	92 kts.
Manoeuvring	170 km/h	106 mph	92 kts.
Rough air	250 km/h	155 mph	135 kts.
Never exceed	250 km/h	155 mph	135 kts.
Aerobatic manoeuvres and cloud flying are prohibited.			
If the sailplane is being operated with winglets, the use of water ballast is prohibited.			
Max. take-off mass	439 kg	968 lbs.	
Pilot weight incl. max:	110 kg	242 lbs.	
Parachute min:	60 kg	132 lbs.	
With lower pilot weight necessary ballast must be added.			

Clearly visible at right cockpit wall

Table for LS1-f (45) without option winglets

Altitude in [m]	0-2000	3000	4000	5000	6000	7000	8000	9000	10000
VNE IAS km/h	270	256	243	231	218	206	195	184	173
Altitude in [ft]	0-6560	9843	13124	16405	19685	22966	26247	29528	32809
VNE IAS kts.	146	138	131	125	118	111	105	99	93

Clearly visible at right cockpit wall

Caution: If the Option Winglets is installed the table of the LS1-f must be used.

4 Normal procedures

4.1 Introduction

This section provides checklist and amplification procedures for the conduct of normal operation. Normal procedures associated with optional systems can be found in section 9.

4.2 Rigging and derigging, filling and dumping the water tanks

4.2.1 Rigging

Caution: When rigging the glider from the trailer, be sure to have enough clearance when extending the landing gear to avoid the wheel touching the ground. Lifting the fuselage with the landing gear will result in damage of the landing gear control system.

Caution: When rigging and derigging the wings the wingtips with winglets (Option) shouldn't be installed.

1. Execute the inspection prior to rigging see section 4.3.
2. Clean and lube the pins and bushings.
3. Open the canopy, extend the landing gear.
4. With a helper on the wingtip, push left wing into place, care for correct dihedral.
5. With a helper on the wingtip, push right wing into place, care for correct dihedral.
6. Sight through the wing main pin bushings to determine alignment. Push the main pins in as far as possible.
7. Secure the main pins by pulling the securing hooks to the front, rotate the handles of the pins upwards and secure the handles with the hooks.
8. Connect the airbrake quick connectors and secure the connectors according to section 4.2.2. Check manually by pulling upwards.
9. Connect the aileron quick connectors and secure the connectors according to section 4.2.2. Check manually by pulling upwards.
10. Install the horizontal tail and secure with the safety nut against the tapered bolts.
11. Install TE-probe and secure with tape against rotation.
12. Install and secure equipment like a Logger in the baggage compartment.
13. In case of an automatic parachute fix rip cord to the ring mounted to the left hand shoulder harness attachment.
14. Tape the gaps of the wing-fuselage junction and at the tailplane.
15. Execute a positive control check; one helper is needed to hold firmly the control surfaces.
16. **Option Winglets:** Install the wingtips with winglets according to section 4.2.6 if desired.

4.2.3 Filling the water ballast tanks

Caution: If the sailplane will be operated with winglets the use of water ballast is prohibited,

1. Close dump valve.
2. Rest the wing tip of the wing to be filled on the ground.
3. Connect loading funnel and load water carefully, respect section 2.12.
Do not fill tank completely, as too much water would drain into fuselage when connecting the water hose to the dump valve.
4. Connect the water hose to the dump valve (dump valve still closed).
5. Now proceed with the other wing, see items 2 – 4.
6. Test hoses for leaks and check drain holes.
7. After loading ballast, level wings and check for imbalance. Correct imbalance by draining the required amount from the heavy wing.
8. Grease the threads of the PVC parts every now and then; otherwise they may be hard to open again, because they tend to lock with water.

Warning: Never fill the wing tanks from a main pressure water supply. Filling the wing tanks with excessive pressure (more than 0.2 bar, 3 psi) will definitely burst the wing shell!

The same applies for the fin tanks.

4.2.4 Dumping the water ballast

Dumping is via one central valve located on top of the landing gear box through the landing gear box.

On the ground you may dump water from one tank if you rest the opposite wing on the ground.

1. Extend the landing gear.
2. Open dump valve, complete dumping takes about 2 minutes (LS1-f) or 4 minutes (LS1-f(45)).
3. Leave dump valve open to avoid pressure difference in water ballast-system when changing altitude.

Caution: As the water drains through the landing gear box always extend the landing gear prior to dumping the water. Otherwise the landing gear box will be filled with water and the wheel brake might become wet and will not brake sufficiently.

4.2.5 Derigging

Derigging follows the reverse of rigging, see section 4.2.1.
Water ballast must be dumped first.

Caution: Lift wings far enough that you can turn the main pins. The resulting dihedral shall be maintained during the whole derigging procedure of the wings to avoid damage to the fuselage

4.2.6 Rigging and derigging the wingtips (Option winglets)

1. Remove the wingtips without winglets (if installed). To accomplish this screw tool W70 into the locking pin and pull out the pin.
2. Slide the wingtip with winglet onto the tubular spar so far that the pins at the root rib engage into the bushes, then push in firmly Push in the locking pin so far that it matches the wing surface. The pin will be locked by a ball catch. You should notice the catching.
3. Removal of the wing tips with winglets is the same procedure as described under 1.
4. Install the wingtips without winglets (if existent) following the procedure as described under 2. for trailer storage.

Note: If you don't have wingtips without winglets the trailer must be modified to hold down the wings at the tubular spars.

4.4.5 Flight with water ballast

Caution: If the sailplane will be operated with winglets the use of water ballast is prohibited.

Recommended ballast for smooth thermals:

	rate of climb		ballast	
	m/s	fpm	litres	U.S. gallons
below	1	200		none
	1 – 2	200 - 400	30	8
	2 - 4	400 - 800	60	16
more than	4	800		max. ballast

Do not exceed the maximum gross weight when loading water ballast. The maximum quantity of water allowed depends on empty weight and cockpit load (see section 6).

Warning: If there is the risk of freezing, dump all water before you reach freezing altitude, latest at +2°C (36°F), or descend to lower altitudes.

Don't dump water below freezing temperature as the water will freeze behind the valve and thus you can dump only a part of the ballast

Frozen water along the aft fuselage boom may shift the C.G. behind the rear limit.

Water ballast raises the approach speed, so it is recommended to dump the water ballast before landing. Dump the ballast before an outlanding in any case.

Filling the water ballast

See sections 4.2.3. During filling level the wings and check if the dump valves are tight. It is not allowed to fly with leaking water tanks as this may result in an asymmetric loading condition.

Dumping of the water ballast

See section 4.2.4.

In flight the water drains at approx. 0.75 lt./sec. (1.65 lbs./sec).

Caution: As the water drains through the landing gear box always extend the landing gear prior to dumping the water. Otherwise the landing gear box will be filled with water and the wheel brake might become wet and will not brake sufficiently.

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4.4.6 Flight at high altitude and at low temperatures

With temperatures below 0°C (32°F) for instance when wave flying or flying in winter, it is possible that the control circuits could become stiffer. Special care should be taken to ensure that there is no moisture on any section of the control circuits to minimize the possibility of freeze up. It could be advantageous to apply Vaseline along all the edges of the airbrake cover plates to minimize the possibility of freezing closed.

Operate the controls regularly to prevent ice build-up.

Warning: It is not allowed to carry water ballast.

Caution:

1. At temperatures below -20°C (-4°F) there is the risk of cracking the gelcoat.
2. Attention must be paid to the fact that at higher altitudes the true airspeed is greater than the indicated airspeed.

The max. speed V_{NE} is reduced according to the following table:

Table for LS1-f

Altitude in [m]	0-2000	3000	4000	5000	6000	7000	8000	9000	10000
VNE IAS km/h	250	237	225	214	202	191	180	170	160
Altitude in [ft]	0-6560	9843	13124	16405	19685	22966	26247	29528	32809
VNE IAS kts.	135	128	122	115	109	103	97	92	86

Table for LS1-f (45)

Altitude in [m]	0-2000	3000	4000	5000	6000	7000	8000	9000	10000
VNE IAS km/h	270	256	243	231	218	206	195	184	173
Altitude in [ft]	0-6560	9843	13124	16405	19685	22966	26247	29528	32809
VNE IAS kts.	146	138	131	125	118	111	105	99	93

Caution: If the Option winglets is installed, the table of the LS1-f must be used.

3. Dump the water ballast before you reach freezing altitude or descend to lower altitudes.
4. Do not fly below 0°C (32°F) when your glider is wet (e.g. after rain).

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4.4.7 Flights in rain and thunderstorms

Rain drops, frozen fog and ice cover may change the wing section characteristics to such an extent, that flight characteristics will decrease. The minimum stall speed rises considerably. Therefore the approach speed must be increased.

Warning: Flights and especially winch launches in the vicinity of thunder storms must be avoided. In case of a lightning strike the composite structure may be damaged or destroyed. The sailplane is not equipped with a lightning protection system.

4.4.8 Cloud flying

Cloud flying is only permitted without water ballast!

LS1-f(45): Cloud flying is not permitted.

Take care to fly smoothly and coordinated. It is prohibited to use a spin as a method for losing altitude in cloud. In case of emergency, pull out the airbrakes fully before exceeding a speed of 170 km/h and dive with max. 170 km/h (92 kts.) to leave the cloud.

At higher speeds up to V_{NE} pull out the airbrakes very carefully because of high aerodynamic and g-loads.

You may extend the landing gear in addition to increase the sink rate.

Warning: Flight in thunderstorm clouds is prohibited.

4.4.9 Aerobatics

Aerobatic manoeuvres are prohibited

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5.2 Stall speeds

The given speeds are the minimum achievable speeds during level flight in km/h and (kts.).

LS1-f:

Airbrakes retracted:	70 – 65 km/h (38 – 35 kts.) without water ballast 80 – 75 km/h (43 – 40 kts.) with water ballast
Airbrakes extended:	80 – 75 km/h (43 – 40 kts.) without water ballast 90 – 85 km/h (49 – 46 kts.) with water ballast

LS1-f (45):

Airbrakes retracted:	70 – 65 km/h (38 – 35 kts.) without water ballast 85 – 80 km/h (46 – 43 kts.) with water ballast
Airbrakes extended:	80 – 75 km/h (43 – 40 kts.) without water ballast 95 – 90 km/h (51 – 49 kts.) with water ballast

5.3 Demonstrated crosswind performance

The demonstrated crosswind velocity is 15 km/h (8 kts) according to the airworthiness requirements.

5.4 Gliding performance

Wing loading	kg/m ²	32	35	40	45
Min. sink at V	m/s	0,6	0,65	0,7	0,75
	km/h	72	80	85	90
Max. L/D at V	/	37	37,5	38	38,5
	km/h	85	90	95	100

The wing fuselage joint, the horizontal tailplane - fin joint and the cutout for the tailplane fixing nut should be taped and the aircraft thoroughly cleaned to obtain maximum performance.

The polars apply to a "clean" aircraft.

With dirty wings, especially at the leading edge, or flight in rain the performance drops accordingly.

Option Winglets: Winglets at the wingtips increase the best L/D by about 2 points.

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6 Mass (weight) and balance

6.1 Introduction

This section contains the payload range within which the sailplane may be safely operated.

A procedure for calculating the in-flight C.G. is also provided.

A comprehensive list of all equipment available for this sailplane is contained in the maintenance manual.

6.2 Weighing procedures

See maintenance manual LS1-f section 2.

Datum: Wing leading edge at the root rib.

Reference line: Lower side of aft fuselage boom horizontal.

6.3 Weighing record

The result of each C.G. weighing is to be entered in section 6.8.4. If the min. cockpit load has changed this data is to be entered in the cockpit placard as well.

6.4 Basic empty mass and C.G.

Actual data see section 6.8.4. With the empty weight C.G. and the cockpit loads within the limits of the table in section 2.3 of the MM, the in-flight C.G. limits will not be exceeded.

6.5 Mass of all non-lifting parts (WNLP)

Maximum weight of the non-lifting parts = 230 kg 507 lbs **without**
Option winglets.

Maximum weight of the non-lifting parts = 250 kg 517 lbs **with**
Option winglets.

WNLP is to be determined as follows:

$WNLP = WNLP \text{ empty} + \text{cockpit load (pilots, parachute, baggage, trim ballast, removable items of equipment etc.)}$.

$WNLP \text{ empty} = \text{Total empty weight incl. permanently installed equipment minus weight of the wings}$.

6.6 Max. mass (weight)

Caution: If the sailplane will be operated with winglets the use of water ballast is prohibited

Maximum take-off weight and landing weight:

Variant LS1-f: 390 kg (860 lbs.)

Variant LS1-f (45): 439 kg (968 lbs.)

Max. mass without water ballast: Maximum take-off and landing mass =

$W_{NLP} + W_{\text{wings}}$

W_{NLP} = Maximum mass of all non-lifting parts (see above)

W_{wings} = actual mass of the wings

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6.7 Useful loads (payload)

Max. payload **without** water ballast

= max. weight without water ballast - empty weight

Max. payload **with** water ballast

= max. weight with water ballast - empty weight

The data is recorded in section 6.8.5.

6.8 Loading chart

6.8.1 Cockpit load

Cockpit load see weighing report section 6.8.4.

With lower pilot weight necessary ballast must be added in the seat. Ballast put on the seat (lead ballast cushion) must be fastened at the connections of the safety belts.

6.8.2 Baggage

max. 12 kg (26.5 lbs)

Heavy pieces of baggage must be secured to the baggage compartment floor.

The added load in the fuselage must not exceed the max. payload without water ballast (W.B.) see weighing report section 6.8.4.

6.8.3 Water ballast in the wing tanks

Caution: If the sailplane will be operated with winglets the use of water ballast is prohibited

Max. capacity:

Variant LS1-f: 90 kg (198 lbs.), (23.8 US.gal.)

Variant LS1-f (45): 180 kg (198 lbs.), (17.6 US.gal.)

Warning: Filling the water ballast is only allowed with a filling system which enables determination of the exact amount of ballast filled, e.g. water gauge or calibrated canisters. Don't try to fill more water into the tanks than the specified values. It is only allowed to fly with symmetric wing ballast!

The total amount of ballast is dependent on the empty mass and the fuselage load and can be determined from the tables in section 6.8.5.

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6.8.5 Ballast chart (total ballast)

Caution: If the sailplane will be operated with winglets the use of water ballast is prohibited

To determine the max. allowable total water ballast.

Fuselage load = pilot + baggage etc. but without water ballast.

All values in kg (l) 1 kg = 2.2046 lbs. 3.785 kg (l) = 1 US gal.

a) Ballast chart (total ballast) LS1-f: payload fuselage/ empty mass

	200	205	210	215	220	225	230	235	240	245	250
60	179	174	169	164	159	154	149	144	139	134	129
65	174	169	164	159	154	149	144	139	134	129	124
70	169	164	159	154	149	144	139	134	129	124	119
75	164	159	154	149	144	139	134	129	124	119	114
80	159	154	149	144	139	134	129	124	119	114	109
85	154	149	144	139	134	129	124	119	114	109	104
90	149	144	139	134	129	124	119	114	109	104	99
95	144	139	134	129	124	119	114	109	104	99	94
100	139	134	129	124	119	114	109	104	99	94	89
105	134	129	124	119	114	109	104	99	94	89	84
110	129	124	119	114	109	104	99	94	89	84	79

Example: Empty mass 230 kg, Pilot + parachute 95 kg => max. amount of water ballast 65 kg, in case the wing tanks can take up this amount.

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Caution: If the sailplane will be operated with winglets the use of water ballast is prohibited.

b) Ballast chart (total ballast) LS1-f (45):

payload fuselage/ empty mass

	228	230	232	234	236	238	240	242	244	246
60	151	149	147	145	143	141	139	137	135	133
65	146	144	142	140	138	136	134	132	130	128
70	141	139	137	135	133	131	129	127	125	123
75	136	134	132	130	128	126	124	122	120	118
80	131	129	127	125	123	121	119	117	115	113
85	126	124	122	120	118	116	114	112	110	108
90	1210	119	117	115	113	111	109	107	105	103
95	116	114	112	110	108	106	104	102	100	98
100	111	109	107	105	103	101	99	97	95	93
105	106	104	102	100	98	96	94	92	90	88
110	101	99	97	95	93	91	89	87	85	83

Example: Empty mass 230 kg, Pilot + parachute 95 kg => max. amount of water ballast 114 kg, in case the wing tanks can take up this amount.

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7.7 Wheel brake

Activation via steel cable coupled to the airbrake control.

The brake begins to function with airbrakes nearly fully extended.

The wheel brake is an emergency brake and should be used only when necessary to minimize wear.

Wheel with drum brake type Tost Liliput

7.8 Airbrakes

Schempp-Hirth type airbrakes on upper wing surface.

Activation via pushrods, connection with L'Hotellier swivel joints with additional securing device according to section 4.2.2 and L'Hotellier balls at wing side pushrods.

Overcentre-locking in fuselage, spring mounted airbrake caps.

7.9 Water ballast System

Caution: If the sailplane will be operated with winglets the use of water ballast is prohibited.

Water bags, capacity:

Variante LS1-f: 90 kg (198 lbs.), (23.8 US.gal.)

Variante LS1-f (45): 180 kg (198 lbs.), (17.6 US.gal.)

Dump valve on landing gear box. Dumping is via the landing gear box.

7.10 Cockpit

Fiberglass shell.

Controls for landing gear (black), trim (green) and dive brakes (blue) are located on the left side of the cockpit.

Controls for tow release (yellow) and pedal adjustment (black) at left hand side of instrument panel; canopy emergency release and ventilation are located at right hand side of instrument panel.

Canopy lock (red) on both sides of canopy.

Water ballast valve control (black) located on right side of cockpit.

Backrest adjustable at ground..

7.11 Canopy

One piece hinged up front, assisted by a gas-strut. Instrument cover accommodates compass.

Material Plexiglas clear or optionally light blue.

Emergency release, see section 7.20.

7.12 Tow hooks

"Safety release Europa G72, G73 or G88" for winch- and aerotow installed near the C.G.

Additionally (Option TN59): "nose release E72, E75 or E85" installed in the fuselage nose, only for aerotow.

Both hooks are operated by the same handle.