

Record of Revisions

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2.4 Power-plant, fuel and oil

Engine manufacturer:	SOLO Kleinmotoren GmbH
Engine model:	SOLO Typ 2350
Max. power, take-off:	<i>Not applicable</i>
Max. engine rpm, take-off:	<i>Not applicable</i>
Max. power, continuous:	24 PS / 18kW
Max. engine rpm, continuous:	5400 rpm
Max. cylinder head temperature:	275°C
Fuel:	2-stroke mixture from AVGAS 100LL or unleaded MOGAS 95 ROZ
Oil grade:	Fuel-oil mixture 1:40 2-stroke oil Castrol RS 2T, Castrol Super TT, Castrol TTS or Castrol Go!2T. If none of these oils is available, alternatively two stroke oil with the designation JASO FC can be used.
Total quantity of usable fuel	10,5 Ltrs in the fuselage tank
Propeller manufacturer:	Alexander Schleicher GmbH & Co
Propeller model:	AS2F1-3/L100-56-N2

2.5 Power-plant instrument markings

The following table explains the meaning of the different lights of the power plant instrument:

Symbol	Green light	Yellow light	Red light
RPM	4400 to 5200 rpm	5200 to 5400 rpm	> 5400 rpm, continuous alarm, ignition is switched off

BAT	Flashes red: Battery voltage below 11,5 V
	Green light: power-plant is extended
	Flashes red, pulsing alarm: pay attention to LCD display! "EXTRACT": Engine lever was moved further than „Extract“-position without the engine being completely extended. "SWITCH R" or "SWITCH E": Time for extension or retraction was too long, probably an end switch is faulty. "INS_TANK": Connection to fuel tank sensor is broken; probably the fuel tank is not fitted in properly.
	Green light: power plant is retracted


With the power plant (partially) extended, a continuous alarm sound points to a limit being violated (rpm, fuel capacity). A pulsing alarm points to an error (see LCD display for explanation)

High Speed Flight (Airspeed Indicator in yellow Range)

The following consequences arise from the airworthiness requirements:

- CAUTION:** *Exceed the rough-air speed only in calm air (yellow arc of airspeed indicator).*
- CAUTION:** *Above manoeuvring speed (yellow arc of airspeed indicator), full control deflections must not be applied. At V_{NE} (red radial line) only one third of the full travel is permissible.*
- CAUTION:** *In the yellow range airbrakes may only be opened under positive g-loads, and only if this g-load is below 3.5g.*
- CAUTION:** *And generally it applies: Do not utilise the otherwise permissible range of control deflections during strong gust loads. Simultaneous, full gust loads and maneuvering loads can exceed the structural strength.*

Inflight Engine Start Procedure

- ① Power-plant main switch **ON**
- ② Airspeed below 140 km/h (76 kts)
- ③ Engine lever **EXTRACT**
- ④ Green LED  beaming?
- ⑤ Engine lever **DECO**
- ⑥ Accelerate to 120 km/h (65 kts, 75mph)
(propeller starts turning)
- ⑦ Engine lever **IGNITION ON**
(rpms increase to roughly 3000 rpm)
- ⑧ Wait until engine starts
(rpms increase above 4400 rpm)
- ⑨ Slow down to intended airspeed
(95km/h; 51kts; 60mph)

CAUTION: *Always regard the possibility of the engine not starting properly. Therefore, soar in such way, to always be able to reach an outlanding field, despite having an engine. The decision to start the engine must be made in sufficient and safe altitude.*

A minimum safe altitude to extend and start the engine must be maintained. It must be possible to retract the engine again and carry out a normal outlanding if the power-plant malfunctions. A valid value for this minimum safe altitude is about 400m (1300ft); however, this is depending strongly on pilot ability and geographic factors.

Height loss for extending and starting engine: **usually** about: 100 – 200 m (330 – 660 ft)


Time to extend and start the engine: about 40s

CAUTION: *It may take longer if the fuel lines had been completely empty (e.g. if engine was not used for a long time)*

Speed of best climb-rate for a medium wing loading: 95km/h (51kts, 60mph)

Maximum rpm: 5400 U/min

Remarks:


- on ④: If the green light does not appear, but  flashes red, the LCD display gives more information:
If it says "EXTRACT", the lever is too far forward. Move it back to position **EXTRACT**
If it says "SWITCH E" the endswitch may be faulty, or there was too much resistance for the spindle. Check the position of the engine in the mirror. If it is not fully extended, move the lever out of and back into position **EXTRACT**, and maybe support the spindle with a low-g manoeuvre.
- on ⑤: Opening the decompression is necessary in the beginning to overcome the top dead centre. Has the rotation speed ceased to increase, the decompression must be shut again. The air compressed in the cylinders now act as a spring and stores the energy applied. The rotational speed further rises.
Thereby engine noise amplifies, but only a glance on the tachometer or the variometer tells, whether the engine already produces power.
- on ⑥: With cold engine and high airspeed, it is possible that the engine revs reach the limit rpm. In this case the power-plant instrument would switch off the ignition for short times. This must not irritate, it is just necessary to pull away the over-speed.

It is advisable to familiarize oneself with the extending and starting procedures in the first instance within safe reach of an airfield.

Before departing to a cross-country flight it is wise to start the engine for a short time. First, to ascertain of its operational readiness, and second it may help in the real thing when the fuel lines have already been filled.

If the engine fails to start, check it over as recommended in the Engine Manual.

Inflight Engine Stop Procedure

- ① Ignition OFF
(by moving engine lever to position **DECO**)
- ② Reduce airspeed to
90km/h (49 kts, 56mph) without water ballast
100km/h (54 kts, 62mph) with water ballast
- ③ When propeller does not slow down any more,
move engine lever to position **PROPELLER FREE**
- ④ Wait until it nearly does not overcome the compression any
more and
- ⑤ Engage propeller stopper
(by moving engine-lever to position **EXTRACT**)
- ⑥ When propeller is vertical (Mirror),
move engine-lever to position **RETRACT**
- ⑦ When green LED  beams,
turn power-plant main switch **OFF**

Remarks:

- on ③: The propeller must not stand direct above the propeller stopper. Only after the rotational speed has almost completely died down, the stopper may be swivelled into the arc of the propeller.
- on ④: You can control the impetus, with which the propeller overcomes the top dead centres and finally comes to a halt at the stopper, by reducing or increasing airspeed.

Height loss during stopping and retracting the power-plant:
usually about 100 m (330 ft)

Time to stop and retract the power plant: about 50 – 70 s

NOTE: *If the engine revs up again from step ② to ③, keep the decompression longer open. Cooling down the engine usually improves the situation.
This is important, when the airspeed must be higher due to **water ballast**.*

5.3.6 Performance with engine running

The performance depends strongly upon altitude, temperature and wing loading. The following values refer to standard atmosphere and sea level.

Climb

Without water ballast a best climb rate of 1,2m/s (236ft/min) can be achieved at an airspeed of $V_Y = 95\text{km/h}$ (51kts; 59mph). Flap setting according to section 5.3.3.

Horizontal flight

The maximum speed for level flight without water ballast at sea level is $V_H = 120\text{km/h}$ (64 kts; 75 mph). The airspeed for horizontal flight decreases with height.

An altitude of 2800m (9200 ft) MSL (standard atmosphere) can be maintained with maximum wing loading and an airspeed of $V_H = V_Y = 95\text{km/h}$ (51kts; 59mph).

Flight with high wing loading

With full wing loading, the climb rate is considerable lower, therefore it is recommended to dump the water ballast.

Range

A full fuselage tank contains sufficient fuel for at least 50min of powered flight

The largest range is possible in a saw tooth flight, climbing with the speed of the best climb-rate and gliding with retracted engine and the speed of the best L/D.

Regarding density altitude, actual climb-rate and height above ground it is favourable to use the engine in several climb phases in middle height.

From this results a theoretical range of:

In powered flight: 79 km / 42 Nm

Gained altitude: 3600m

Average altitude loss for 3x starting and retracting: 300m

Gliding with the speed of best L/D: 170 km / 92 Nm (18m)

158 km / 85 Nm (15m)

Sum: **249** km / 134Nm (18m)

237 km / 128Nm (15m)

5.3.7 Noise Data

A noise measurement was performed according to „Bekanntmachung der Lärmvorschrift für Luftfahrzeuge (LVL) vom 01.08.04 gem. Nfl II 70/04“

Established value for ASW 27-18E with TN 4 $L_{A \text{ kor}} \text{ max}$	Limit value
XX,X dB(A)	64,0 dB(A)

Power-Plant Main Switch

A 12A circuit breaker serves as main switch. It is located in the instrument panel and labelled "Engine Master switch". It is switched on by pressing the button, and opened with the red knob.

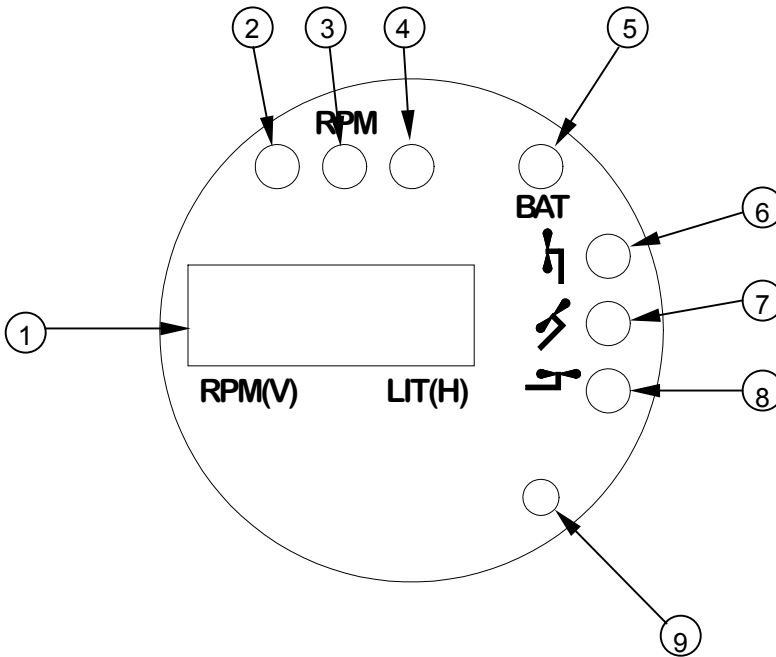
Power-Plant Instrument

The power-plant instrument of the ASW 27-18E fits in a Ø52mm housing in the instrument panel. It has several governance, monitoring and display functions:

- ① It controls the electric jackshaft, when the power-plant lever is placed in the corresponding position.
- ② It influences the ignition. Independently from the power-plant lever it shuts down the ignition, whenever the engine is not completely extended or the rotational speed exceeds the maximum permissible RPM.
- ③ It displays the state of the power-plant (retracted or extended, rotational speed, fuel quantity, voltage, elapsed time) and supplies warnings in case of limit exceedance or maloperation.
- ④ It checks the fuel quantity in the fuel tank and controls a electric fuel pump when starting the engine.

For few seconds after power on, the instrument switches all LEDs and the alarm sound on.

IMPORTANT NOTE: *A continuous alarms (=Caution) resound if limits are exceeded or undershot (rotational speed, fuel quantity, voltage). The alarm because of low fuel quantity can be acknowledged with button (9), quieting it for 4 min. Pulsing alarms (=Important notes) resound in connection with indications on the LCD display.*

Front-display of the power-plant instrument:

- 1 LCD Display
- 2 LED green, for green rotational speed range
- 3 LED yellow, for yellow rotational speed range
- 4 LED red, for maximum rotational speed
- 5 LED red, for low voltage
- 6 LED green, for fully extended power-plant
- 7 LED red, for error messages
- 8 LED green, for fully retracted power-plant
- 9 Button for display selection

Numbers in brackets in the text refer to the numbers of this figure.

Control of electric jackscrew

To extend or retract the power-plant, bring the power-plant lever in position **EXTEND** engine (see fig 7.12-1).

The green light (6) indicates, that the power-plant is fully extended. The green light (8) indicates the power-plant is completely retracted.

If the power-plant is not fully extended, but the power-plant lever is moved beyond position **EXTEND**, the red light (7) flashes, a pulsing alarm tone sounds and the LCD (1) displays the word **EXTRACT**.

If the power-plant lever does not receive a signal from the end-switch for an unusual long time, it stops the jackscrew. The red light (7) flashes, a pulsing alarm tone sounds and the LCD (1) displays **SWITCH R** respectively **SWITCH E**. The possible fault may be either a faulty end-switch, a jammed engine mount or low voltage. The alarm can be acknowledged with button (9), restarting the jackscrew again. As long as there is no signal from the end-switch saying "fully extended", the ignition is blocked. (see section 3.7)

Influence on ignition

The power-plant instrument features own relays to block ignition independently from the pilot's ignition switch. It blocks ignition as long as the power-plant is not fully extended and as soon as the maximum rotational speed is exceeded.

IMPORTANT NOTE: *If the current supply of the power-plant instrument is interrupted, it cannot block the ignition.*

Control of the electric fuel pump

To support the pneumatic fuel pump for the start, the power-plant instrument activates the electric fuel pump under the following conditions:

- The engine is completely extended
- The power-plant lever is forward of position **EXTEND**
- The rotational speed is below 4200RPM

Display of power-plant status

Section 2.5 describes the modes of the LCD-Display (1).

A sensor at the magnetic flywheel measures the rotational speed. It is displayed in the permanent display at the left side. When the engine runs with its target speed the green LED (2) lights. The yellow LED (3) warns of approaching the maximum RPM. When reaching the maximum rotational speed, the ignition is switched off and the red LED (4) beams.

The red LED (5) lights, whenever the battery voltage falls below 11,5V.

Fuel monitoring

A sensor monitors the content of the fuselage tank. The display is calibrated for flight attitude. Therefore, on ground, it deviates from the actual fuel quantity. Also in flight the angle of attack varies, thus a calibration more accurate than for half a liter (0.13 US Gal.) is not reasonable. The scale on the fuselage itself is calibrated for ground attitude.

When the fuel quantity of the fuselage tank sinks below 2,5Ltrs (0.66 US Gal) for over 5s, a alarm resounds and the display starts to blink.

The calibration of the fuel sensor was done with fuel-oil mixture based on AVGAS 100LL. Mixtures based on other fuel qualities may lead to deviating indications. Thereby the deviation is largest with full tank and zero with empty tank.

The power-plant instrument can be set to other qualities. The fuel tank must be filled full and the power-plant retracted. Press button (9) four times until **Calibr. ?** appears at the display. Then keep button (9) pressed for five seconds to perform the calibration.

After the calibration, the power-plant instrument assumes that the signal from the fuel sensor corresponds a full tank. With a full tank, the difference between flight and ground attitude is small.

Display- and warning-ranges of the power-plant instrument:

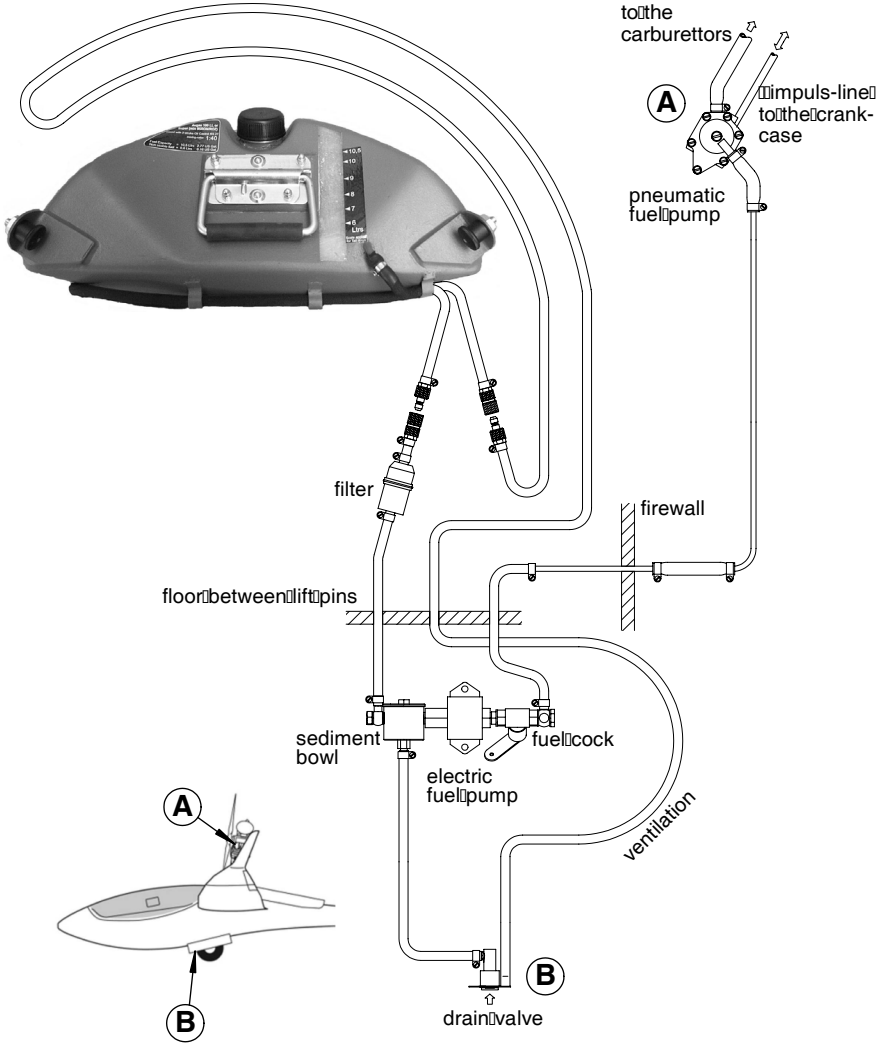
Type	Display-range	Optical	Acoustic
Rotational speed	400 – 9990 rpm	See section 2.5	> 5400 rpm permanent alarm
Battery voltage	10 – 15V	< 11,5V LED (5) blinks	< 11,5V permanent alarm
Fuel quantity	0 – 10,5Ltrs	< 2,5Ltrs LCD blinks	< 2,5Ltrs permanent alarm
Elapsed time counter	Counts above 2000 rpm		
Electric fuel pump	Runs under certain conditions, see above		
Prop brake open and engine not fully extended		LED (7) blinks	Pulsed alarm
Running time of jackscrew		> 20s LED (7) blinks	> 20s pulsed alarm
Missing signal of fuel sensor		LED (7) blinks	Pulsed alarm

Rear-view mirror

A rear-view mirror in the cockpit is necessary to check the correct position of the propeller before retracting the power-plant.

7.13 Fuel System

Fig. 7.13-1 Overview of the fuel system:



Power Plant

Engine Manufacturer	SOLO Kleinmotoren GmbH
Engine	SOLO 2350
Max. Continuous Power	24 PS / 18 kW
Max. permissible Endurance Speed	5400 RPM
Max. Cylinder Head Temperature	275°C
Fuel	2-stroke mixture with AVGAS 100LL or unleaded MOGAS 95 ROZ
Lubrication	2-stroke oil Castrol RS 2T, Castrol Super TT, Castrol TTS or Castrol Go!2T. If none of these oils is available, alternatively two stroke oil with the designation JASO FC can be used.
Propeller Manufacturer	Alexander Schleicher GmbH & Co.
Propeller	AS2F1-3/L100-56-N2

Oxygen Installation

Oxygen equipment must be approved

For oxygen systems fitted, the relevant section of the appertaining Inspection Release Certificate states the overhaul time limit. Over and beyond this, the oxygen bottles may have to be re-inspected by a technical inspection institute at other intervals in accordance with pressure vessel regulations existing in the country of operation.

Safety Harness

For the safety harness installed the life time limitation according to the appropriate maintenance instructions given by the harness manufacturer apply.

Engine

For the engine SOLO 2350 the maintenance instructions of the engine manual apply. Maintenance intervals are specified there. Latter information may be published in Technical Notes, if applicable.

Propeller

For the propeller AS2F1-3 the maintenance instructions of the propeller manual apply. Maintenance intervals are specified there. Latter information may be published in Technical Notes, if applicable.

Only applicable to U.S. registered gliders!

4.3 Airworthiness Limitations

The following components are time limited or limited by number of launches:

1. The FRP-structure (FRP = Fibre Reinforced Plastic) is limited to 12000 service hours. Extension seems to be possible in the future. Special inspections starting at 3000 service hours have to be performed. For details, see chapter 4.1 of this manual.
2. The brake line hose has a time limit of 6 years, which can be extended on a 100-hour inspection basis.
3. For the TOST tow releases see the instructions given by TOST with every individual tow release.
4. For oxygen supply systems regard the time limit of the individual pressure vessel as well as the individual overhaul time limits of the components.
5. For the safety harness system time limit, see the instructions given by the harness manufacturer with the individual harness system.
6. For the engine refer to the inspections defined by the engine manufacturer.
7. The propeller is to be inspected according to the propeller manual.

For details applying to 2. through 7. see chapter 4.2 of this manual.

12.4 List of Maintenance Documents for Fitted Equipment

- a) Operating Manual for Tow Release Coupling Series "Europa G 88" Safety Tow Release, in the latest valid issue; or Operating Manual for the Tow Release Coupling, Series: Safety Tow Release "Europa G 72" and Safety Tow Release "Europa G 73", in the latest valid issue.

Operating Manual for Tow Release Coupling, Series Nose Tow Release Hook "E 22", in the latest valid issue.

- b) WHEEL and BRAKE ASSEMBLIES CATALOGUE
Component Maintenance Manual,
Appendix A – Wear Limits and Torque Values

A1. Brake Lining Wear Limits

A2. Brake Disc Minimum Thickness

A3. Brake Assembly Back Plate Tie Bolt Torques

issued by Parker Hannifin Corporation, Avon, Ohio, USA
www.parker.com

- c) Engine Manual SOLO 2350, in its currently valid edition.

Maintenance instruction for the engine SOLO 2 350 after 5 years of operation, in its currently valid edition.

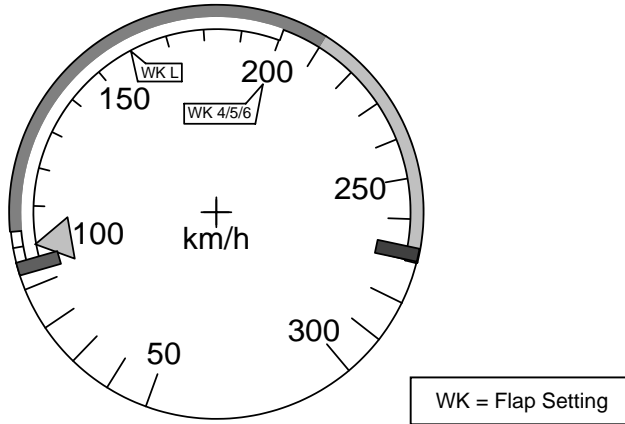
- d) Operating and Maintenance Manual for the propeller AS2F1, series AS2F1-3, in the latest valid edition.

Technical Note 2 for AS Propeller, in the latest valid edition, informing about service life limitations

12.5 Air Speed Indicator Markings

If the markings are on the cover glass of the instrument, there must be means to maintain the correct alignment of the glass cover with the face of the dial (JAR 22.1543 a).

Each arc and line must be wide enough, located to be clearly visible to the pilot, and must not mask any portion of the dial (JAR 22.1543 b).



	km/h	kts	mph
Red radial line	270	145	167
Yellow arc	210 – 270	113 - 145	130 – 167
Green arc	104 – 210	56 – 113	65 – 130
White arc	96 – 200	51 – 108	59 – 124
Text “WK L” or “L”	160	86	100
Text “WK 4/5/6” or “4/5/6”	200	108	124
Yellow triangle	100	54	62
Blue radial line	95	51	59