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# FLIGHT MANUAL SUPPLEMENT FOR THE SAILPLANE

# Glasflügel 304 eS

## 0.1 Record of revisions

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 left hand margin, and the Revision No. and the date will be shown on the bottom left hand of the page.

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Table of Contents

# SECTION 1

## 1. General

## 1.1 Introduction

The sailplane flight manual supplement has been prepared to provide pilots with information for the safe and efficient operation of the ***Glasflügel 304 eS*** sailplane.

This manual includes the material required to be furnished to the pilot by JAR-22. It also contains supplemental data supplied by the sailplane manufacturer.

## 1.2 Certification basis

This type of sailplane has been approved by EASA in accordance with JAR-22, Amendment 7, 1st September, 2003; CS-22, Amendment 2, 5th March, 2009 and Special Conditions defined in CRI H-101 and CRI E-101.

## 1.3 Warnings, cautions and notes

Not affected.

## 1.4 Descriptive data

***Glasflügel 304 eS*** is a self-sustaining sailplane version of the HPH 304S–Shark equipped with electric motor and foldable propeller.

*Power-plant*

Sailplane is equipped with a high-tech powerful FES front electric propulsion system developed for high performance sailplanes. Main parts of the FES system are:

- Brushless electric motor
- Controller for motor
- Foldable propeller
- Battery packs (FES-BP-14S) with internal BMS (Battery Management System)
- Charger (1200W or 600W)
- FCU (FES control unit) instrument
- LXUI box with Shunt (for current and voltage measurements)
- FCC box (FES connecting circuit)
- Power switch
- DC/DC converter (converts high voltage to 12V)

## 1.5 Three view drawing

Not affected.

# SECTION 2

## 2. Limitations

## 2.1 Introduction

Section 2 includes operating limitations, instrument markings, and basic placards necessary for safe operation of the Front Electric Sustainer system.

The limitations included in this section and in Section 9. have been approved by the EASA.

## 2.2 Airspeed

Airspeed limitations and their operational significance are shown below:

| | Speed | IAS [km/h] | *KIAS* | IAS [mph] | Remarks |
|---|---|---|---|---|---|
| $V_{PO}$ | Maximum speed with rotating propeller | 160 | *86* | 100 | Do not exceed this speed with rotating propeller (at any power setting) |
| $V_{POmin}$ | Minimum speed to start motor | 80 | *43* | 50 | Do not start rotate motor below this speed |
| $V_{POmax}$ | Maximum speed to start motor | 160 | *86* | 100 | Do not start rotate motor above this speed |

## 2.3 Airspeed indicator markings

Airspeed indicator markings and their color-code significance are shown below:

| Marking | Value or range IAS | | | Significance |
|---|---|---|---|---|
| | [km/h] | *KIAS* | [mph] | |
| Blue line | 100 | 54 | 62 | Best rate-of-climb speed $v_y$ |

## 2.4 Weight

Maximum weight in baggage compartment 2 kg *4.4 lbs*

## 2.5 Center of gravity

There is no change in permitted CG position.

## 2.6 Approved manoeuvres

Not affected.

## 2.7 Manoeuvring load factors

Not affected.

## 2.8 Flight crew

Not affected.

## 2.9 Kinds of operation

Not Affected.

## 2.10 Minimum equipment

The instruments as well as the appropriate parts of the minimum equipment must be of an approved type.

*Minimum equipment*

- 1 Airspeed indicator (color marked as in par.2.3.)
- 1 Altimeter
- Outside air temperature indicator (OAT) with sensor (when flying with water ballast)
- 1 Magnetic compass
- FES FCU Instrument unit
- 1 set of four-point safety harness
- 1 automatic or manual parachute
- 1 Sailplane Flight Manual
- Limitation placards in the cockpit

**WARNING**

Aerobatic maneuvers and Intentional spins are prohibited.

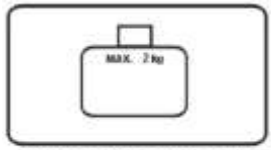
## 2.11 Aerotow

Not affected.

## 2.12 Other limitations

Not affected

## 2.13 Limitation placards




MAX. LUGGAGE COMPARTEMENT

| AIRSPEED LIMITATION IAS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $V_{PO}$ | Powrplant max. oper. speed | 160 | km/h | 86 | KIAS | 100 | mph |
| $V_{POmax}$ | Max. speed to start motor | 160 | km/h | 86 | KIAS | 100 | mph |
| $V_{POmim}$ | Min. speed to start motor | 80 | km/h | 43 | KIAS | 50 | mph |

FCU UNIT must be turned ON
during the flight

## 2.14 Power-plant

**WARNING**
**Glasflügel 304 eS** is a sustainer system, and it is prohibited from taking-off solely.

### 2.14.1 Motor

- Maximum power: 23 kW (30 hp) at 4500 RPM;
- Recommended RPM: 3000 RPM;
- Continuous power: 16kW continuous power at 100V.

### 2.14.2 Battery packs

| | |
|---|---|
| Maximum allowed total voltage of both Battery packs | 118 V |
| Minimum allowed total voltage of both Battery packs | 90 V |
| Nominal capacity of each cell | 40 Ah |
| Energy storage capacity | 4,2 kWh |
| Maximum voltage per cell | 4,16 V |
| Middle voltage | 3,7 V |
| Minimum voltage of each cell | 3,2 V |

## 2.14.3 Power-plant instrument markings

FES power plant has a FCU instrument with high resolution sunlight visible colour display. Detailed data about FCU and its operation can be found in separate **FES FCU INSTRUMENT manual.**


Important indications and warnings there are listed in this chapter.

**NOTE**

It is always pilots decision when to stop the motor. For instance if he is in critical situation where his life is dependable on a few more minutes of engine run, he can decide to discharge battery packs even lower! However if cells will be discharged too much, they can be unrecoverable damaged!

*Below 2,8V per cell, charger will not start charging, as it is very dangerous to charge cells, which were discharged below this voltage level.*

The same is valid in case of high temperatures of power-plant components.

## 2.14.4 List of RPM warnings

| Condition | Level | FCU warning | Required action |
|---|---|---|---|
| **Warning messages of propeller speed (RPM)** | | | |
| RPM between 4300 - 4500 | yellow | **Yellow RPM digits** | *Keep attention on RPM* |
| RPM over 4500 | Red | **Red RPM digits** | *Reduce power to decrease RPM below 4500* |

## 2.14.5 List of voltage warnings

| Condition | Level | FCU warning | Required action |
|---|---|---|---|
| **Battery packs warning messages, based on total Voltage measurements** | | | |
| Total Voltage level is low at 95V | yellow | **Low Voltage, Reduce power!** | *Reduce power to keep continuous operation* |
| Total Voltage level is critical at 90V | Red | **Critical Voltage, Stop FES motor!** | *Stop FES motor* |
| **Battery pack warning messages, based on each cell Voltage measurements** | | | |
| Cell difference in single pack more than150mV | Yellow | **Cells diff. > 150mV, Reduce power!** | *Reduce power to keep continuous operation* |
| Cell difference in single pack more than300mV | Red | **Cells diff. > 300mV, Stop FES motor!** | *Stop FES motor* |
| Difference between total voltage in each pack more than 1.0V | Red | **Battery diff. > 1.0V, Reduce power!** | *Reduce power to keep continuous operation* |
| Single cell Voltage level below 2.8V | Red | **Cell critical < 2,8V, Stop FES motor!** | *Stop FES motor* |

**WARNING**

If pilot do not stop motor in case of warning ***Critical Voltage, Stop FES motor!***, red warning message appears, counting down 30 seconds. After 30 second FCU will stop motor automatically, in order to protect batteries from over discharge.

During 30 seconds of count-down pilot can decide to press throttle knob to override automatic motor stop. Message will disappear and motor will continue to run. Each override action is saved to the memory of FCU instrument.

See FCU INSTRUMEN manual section 8.3.1 for further information.

## 2.14.6 List of all temperature warnings

| Condition | Level | FCU warning | Required action |
|---|---|---|---|
| **Battery pack warning messages, based on temperature measurements of each pack** | | | |
| Battery pack temperature is below 5°C | yellow | **Battery Temp. Low < 5°C,** | *Consider that full power cannot be maintain for a longer time* |
| Temperature difference between each Battery pack is more than 3°C | yellow | **Battery diff. > 3°C, Reduce power!** | *Reduce power to keep continuous operation* |
| Temperature difference between each Battery pack is more than 6°C | Red | **Battery diff. > 6°C, Stop FES motor!** | *Stop FES motor* |
| Battery pack high temperature, more than 45°C | yellow | **Battery High > 45°C, Reduce power!** | *Reduce power to keep continuous operation* |
| Battery pack extremely high temperature, more than 55°C | Red | **Batt. Ext. High > 55°C, Stop FES motor!** | *Stop FES motor* |
| Battery pack temperature is critical, more than 75°C | Red | **Batt. Critical > 75°C, Land immediately!** | *Stop FES motor* |

| Condition | Level | FCU warning | Required action |
|---|---|---|---|
| **Motor temperature warning messages** | | | |
| Motor temperature is high, more than70°C | Yellow | **Motor High > 70°C, Reduce power!** | *Reduce power to keep continuous operation* |
| Motor temperature is extremely high, more than 90°C | Red | **Motor Ext. High > 90°C, Stop FES motor!** | *Stop FES motor* |
| **Controller temperature warning messages** | | | |
| Controller temperature is high, more than 70°C | Yellow | **Controller High > 70°C, Reduce power!** | *Reduce power to keep continuous operation* |
| Controller temperature is extremely high, more than 90°C | Red | **Contr. Ext. High > 90°C, Stop FES motor!** | *Stop FES motor* |

## 2.14.7 List of other warnings

| Condition | Level | FCU warning | Required action |
|---|---|---|---|
| **Canopy** | | | |
| Canopy is opened | yellow | **Warning, Canopy is open, Close Canopy!** | *Close canopy / check canopy sensor* |
| Canopy is still not closed | Red | **Warning, Canopy is open, Close Canopy!** | *Close canopy / check canopy sensor* |
| **Power switch** | | | |
| Motor do not start immediately | Yellow | **Warning, Check Power switch!** | *Turn on Power switch* |
| **Ventilation lever** | | | |
| Motor temperature is rising too fast! | Red | **Warning, Check ventilation!** | *Open ventilation* |
| **Fire alarm** | | | |
| Fire or smoke in battery compartment | Red | **Red light on instrument panel and sound warning** | *Proceed according section 3.7.3* |

# SECTION 3

## 3. Emergency procedures

## 3.1 Introduction

Section 3 provides checklist and amplified procedures for coping with emergencies that may occur during flight with motor in operation.

## 3.2 Canopy jettison

**WARNING**
Before canopy jettison, stop motor and switch OFF power switch, if there is still enough time to do that.

1. Switch OFF power switch
2. Grasp (from below) the red grips (right and left of the canopy frame)
3. Pull them back
4. Push the canopy upward.

## 3.3 Bailing out

**WARNING**
Before you bail out, stop motor and switch OFF power switch, if there is still enough time to do that.

1. Switch OFF power switch
2. Direct the sailplane to an uninhabited place if time permits
3. Canopy jettison acc. to 3.2
4. Release safety harness and spread them aside
5. Bend you legs under the body
6. Roll over the cockpit frame

## 3.4 Stall recovery

Not affected.

## *3.5 Spin recovery*

Not affected.

## *3.6 Spiral dive recovery*

Not affected.

## *3.7 Other emergencies*

### 3.7.1 Motor fail to start

In the event that the motor fail to start, continue flying as a pure glider.

**NOTE**
Check if you maybe forgot to switch the Power switch ON.
Reminding message (on the FCU)"Check power switch"
should appear if there was high enough throttle set.

### 3.7.2 Power loss during flight

If power is lost during flight, push the control stick forward gently, to sustain desired airspeed! Than you can do next actions:

Check first if you maybe unintentionally switched OFF power switch! If this actually happened, just switch Power switch ON again and adjust throttle knob.

If Power switch was not unintentionally switched OFF, as described in 1st point, proceed with next actions:

- switch OFF "Power switch" and then also FCU.
- turn ON FCU and check it for any strange behaviour.
- If everything is Ok switch on Power switch and try to start motor again.

If motor starts and there is any strange behaviour under power:

- stop the propeller from the wind milling phase with the electronic brake.
- After propeller is stopped, switch OFF Power switch

In case that you are not able to stop propeller, you will need to land with the propeller in wind milling phase. In such situation try to land carefully on both landing wheels simultaneously, to avoid possible damage of the propeller.

**WARNING**
Try to avoid landing into high grass or similar.

**NOTE**
L/D of sailplane with propeller in wind milling phase is only a little degraded, so you might have enough time to choose a suitable landing place

**NOTE**
If there is a grass runway in good condition available it is probably better to use it than concrete runway. If there is a grass runway with some holes than it is probably better to use a concrete runway if is available.

**NOTE**
Read FES FCU instrument manual for detailed behaviour and necessary actions after appearance of certain messages or LED lights.

## 3.7.3 Fire

Fire in battery compartment during the flight can be recognized by fire alarm. If the fire alarm starts (beeping and red light appears on instrument panel) proceed immediately according section 3.7.3.2.

**NOTE**

Fire alarm is based on smoke or temperature detection. If there is a high amount of dust particles inside battery compartment fire alarm may start warning. Keep battery compartment clean.

**NOTE**

Buzzer beeping can be switched off by "FIRE ALARM" switch on instrument panel

Other evidence of possible fire in battery compartment is continuously increasing temperature of battery packs after power was reduced. In this case you should land safely as soon as possible to prevent in flight fire.

If battery temperature signal disappear during the flight you should land at closest appropriate airfield and check temperature and condition of battery packs.

**CAUTION**

When the battery temperature is continuously increasing after power reduction land as soon as possible.
When battery temperature signal disappear during the flight land at closest appropriate airfield.

### 3.7.3.1 Fire on the ground

- Switch OFF the “Power switch”
- Switch OFF all instruments
- get out of cockpit
- extinguish fire

3.7.3.2 Fire during flight

- stop motor immediately
- switch OFF the “Power switch”
- open front ventilation if not already opened
- open canopy side window
- land as soon as possible (or bail out if appropriate)
- extinguish fire after landing

## 3.7.4 Loss of 12V electrical power in flight

**During soaring flight:**
If electronic instruments (radio, flight computer, FCU etc) stop working, during soaring flight, than continue to fly as a pure sailplane. In such case you will not be able to start FES.
However in case that FCU still works, you can try to start motor if necessary.

**During powered flight:**
If FCU stop working during powered flight, then also motor stops working. However propeller would still rotate as windmill and it would not be possible to stop it. You will need to land with rotating propeller. In such case try to land on both landing gears simultaneously, to avoid damage of propeller.

In case that only some of the instruments would stop working during powered flight, but motor and FCU would still works fine, then you can continue to use motor.

# SECTION 4

## 4. Normal procedures

## 4.1 Introduction

Section 4 provides checklist and amplified procedures for the conduct of normal operation. Normal procedures associated with optional systems can be found in section 9.

## 4.2 Rigging and de-rigging

Not affected.

## 4.3 Daily inspection

Daily inspection should be performed before each flight day opening, both after rigging the sailplane and parking in a hangar.
When inspecting the sailplane check for cracks in surface finish, blisters or uneven surface, and if in doubt, check with authorized, specialized personnel.

1

f) Perform FES test run as described in chapter 4.3.3
g) Check the FES system visually especially propeller blades condition
h) Perform Fire and smoke alarm function test (described in 304eS Maintenance manual supplement section 1.3.6.1)

### 4.3.1 Charging the Battery packs

Detailed instructions about charging of Battery packs are described in separate **FES battery pack manual.**

**NOTE**
It is recommended to charge Battery packs fully just a day or two before flight is planned. However plan charging so that there will be enough time for properly completed charging process!

## 4.3.2 Installation of Battery packs into sailplane

1. Open cover
2. Check that Power switch (Key) is OFF
3. Check that FCU instrument and all other instruments (Flight computer, Flarm, Radio, Transponder, PDA...) are switched OFF

**WARNING**

*Make sure that both battery packs are fully charged before installation into sailplane. Both battery packs* must have *approximately the same voltage level of each cell (close to 4.16 V per cell). There should be less than 1V difference, between total voltage level of each battery pack!*

4. Check that BMS switch of each battery pack is OFF and carefully inspect the housing of each battery pack for any mechanical damages
5. Put one pack into the fuselage so that contacts are facing forward
6. Slide it back to rear position
7. Put another pack into the fuselage so that contacts are facing rearward
8. Place fixation plates to marked positions
9. Tighten battery pack fixation knobs
10. Insert and secure temperature sensor connectors, to each battery pack
11. Insert RED (+ contact) pin on cable to front pack, and BLACK/BLUE (battery v 2.4) (– contact) pin on cable to rear pack power connectors
12. Close cover

### 4.3.3 Motor starting on the ground

1. Remove propeller covers and a tail dolly
2. Open battery compartment cover
3. Check that Power switch is OFF
4. Insert connecting cable between the battery packs
5. Switch ON BMS switch of each battery pack
6. Seal battery compartment cover with glider tape
7. Seat into the glider, and close canopy
8. Check that no one is around propeller zone, in front of glider or in line of propeller
9. Switch on FCU
10. Switch on Power switch
11. Wait about 8 second, for FCU to show all battery bottles
12. Start motor but use only low power to check proper operation
13. Check if propeller braking and automatic positioning are working fine
14. Switch OFF Power switch
15. Switch OFF FCU

**CAUTION**
In case that you would like to test system at maximum power, somebody needs to hold a fuselage tube down, and hold a glider.

## *4.4 Pre-flight inspection*

Additionally:

13. Check POWER Switch OFF
14. Turn FCU ON

## *4.5 Normal procedures and recommended speeds*

### 4.5.1 Takeoff and climbing

*Aerotow*

**WARNING**
It is not allowed to start FES motor during aero tow!

*Winch-launching*

**WARNING**
It is not allowed to start FES motor during winch launch! Towing rope must be always released before running FES motor.

### 4.5.2 Cruise and climbing with running motor

FES can be used for long continuous cruise at low power settings, or climbing at higher power settings!

**CAUTION**
During motor operation, ventilation must be fully opened

**Motor starting procedure during flight:**

1. Check if FCU instrument was turned on.
2. Turn ON Power Switch
3. Check if there is green LED ON (left lower LED), check Voltage level (If there is no green LED or red LED is blinking motor will not run). Read FES FCU instrument manual for detailed FCU description
4. Start motor with Throttle knob rotating in clockwise direction gently.

Use about 4kW of power for horizontal flight, and more for climbing. Maximum climb rate depends on glider type and it is affected by its weight, speed, flaps position etc.
Available maximum power is reducing slowly due to voltage drop, during discharging of battery packs. Maximum power can be used only until any of temperature values reach yellow warning. (motor and controller at 70 deg, battery packs at 45 deg)!

**NOTE**
You can reduce power in thermals, and use more power in sinking air

Do not use high current at lower voltages; this mean below 95V.

Always try to fly as much as possible on lower power settings where efficiency of complete system is the highest!

During powered flight always keep the FCU turned ON. Switch OFF Power switch if motor is not running.

4.5.2.1 Propeller stop with electronic braking

To stop propeller with electronic braking, you need to rotate Throttle knob in counter-clockwise direction for 1 step, from zero throttle, so that throttle line on display starts blinking red!

**NOTE**
For successful stop the motor should reach minimum 700 RPM, otherwise braking will not working, due to insufficient induced voltage (regeneration function of controller is used for propeller braking).

**In the air there is nearly always enough RPM. But if you want to test electronic braking on the ground, make sure you set at least 1000 RPM, and rotate throttle knob quickly in counter clockwise direction!**

#### 4.5.2.2 Propeller positioning

Your system is equipped with automatic positioning of blades, the electronics will rotate them in horizontal position.
After electronic braking stops motor, wait for 2-3 second, until RPM data shows zero RPM. After that automatic positioning will start! You can always stop automatic positioning by pressing throttle knob.

**NOTE**
Positioning does not work if Canopy message is active, or if throttle is set to zero power instead of braking!

In settings it is possible to adjust:
-time between steps from 50ms to 1 sec
-power used for positioning at 115V and at 90V
-number of steps after hall sensor for position is detected

### 4.5.3 Approach and landing

#### 4.5.3.1 After landing

After landing or in the end of flying day always take out both batteries out of the sailplane and (depending on its voltage and planned operation) recharge or safely store them according detailed charging instructions in FES Battery pack manual.

**WARNING**
Always remove connecting cable between the packs after landing.

4.5.3.2 Taking Battery packs out of sailplane

1. Check that Power switch (Key) is OFF
2. Check that FCU instrument and all other instruments (Flight computer, Flarm, Radio, Transponder...) are switched OFF
3. Open cover
4. Take out connecting cable between the packs
5. Take out RED + and BLACK - power connectors
6. Fix supply cables to the side of battery compartment box
7. Remove both temperature sensor connectors, from each battery pack
8. Fix temperature sensor cable to the side of battery compartment box
9. Un-tighten battery pack fixation knobs
10. Take the fixation plate out
11. Firmly grip the front battery by a carrier strap
12. Lift it out of the fuselage and put it on safe place
13. Firmly grip the rear battery by a carrier strap and slide it forward along the bottom of the battery compartment
14. Lift the Battery pack out of the fuselage and put it on safe place
15. Close cover

**WARNING**

Make sure that Power switch is OFF before removing connecting cable; (or Power fuse)

**CAUTION**

Make sure you put battery packs on a dry and safe place. Read FES Battery pack manual.

### 4.5.4 Flight in rain and icing conditions

It is allowed to fly trough light rain, with running motor if necessary. However use only lower RPM settings, suitable for horizontal flight, to avoid damaging propeller blades. Stop motor if rain becomes stronger. Never use motor in icing conditions. Ice building on propeller can cause severe vibrations and damage of sailplane.

**WARNING**
Avoid flying close to lightning activity and in icing conditions!

### 4.5.5 Aerobatics

**WARNING**
Aerobatics manoeuvres with engine running are prohibited!

### 4.5.6 Flying without battery packs and propeller

**NOTE**
Reason of these alternations can be power-plant system maintenance or sailplane mass reduction. Maximal mass reduction can be approximately 32kg.

G 304eS sailplane can be used in following configurations:

- Equipped with Battery packs and motor and its accessories (standard configuration).
- With battery packs removed. See chapter 4.5.6.1 for requirements of use.
- With battery packs and propeller blades removed. See chapter 4.5.6.2 for requirements of use.
- With propeller blades removed. See chapter 4.5.6.3 for requirements of use.

4.5.6.1 Flying without battery packs

It is possible to fly with G 304eS with battery packs uninstalled only in case when following requirements are fulfilled:

1. Position of CG lies within permitted range. See chapter 6.6 for proper CG position determination.
2. All free objects from battery compartment have been removed.
3. Cables for battery packs connection have been properly insulated by electrical tape and fasten to the cables mounts using cable ties.
4. Capacity of front Pb battery is sufficient for intended flight.

**NOTE**
Additional Pb battery in the battery compartment is optional equipment.

4.5.6.2 Flying without propeller blades and battery packs

It is possible to fly with G 304eS without propeller blades and battery packs uninstalled only in case when following requirements are fulfilled:

1. Position of CG lies within permitted range. See chapter 6.6 for proper CG position determination.
2. All free objects from battery compartment have been removed.
3. Cables for battery packs connection have been properly insulated by electrical tape and fasten to the cables mounts using cable ties.
4. Capacity of front Pb battery is sufficient for intended flight.

**NOTE**
Additional Pb battery in the battery compartment is optional equipment.

5. Propeller blades have been properly uninstalled and gaps between spinner and rest of fuselage sealed. See **FES-HPH-P1-102 Propeller manual, chapter 5** and **304eS/MMSupp chapter 3.22** for propeller blades installation/removal instruction.

4.5.6.3 Flying without propeller blades

It is possible to fly with G 304eS without propeller blades only in case when following requirements are fulfilled:

1. Position of CG lies within permitted range. See chapter 6.6 for proper CG position determination.
2. Propeller blades have been properly uninstalled and gaps between spinner and rest of fuselage sealed. See **FES-HPH-P1-102 Propeller manual, chapter 5** and **304eS/MMSupp chapter 3.22** for propeller blades installation/removal instruction.

**WARNING**
Never turn on Power switch when propeller blades are not installed.

# SECTION 5

## 5. Performance

***5.1 Introduction***

***5.2 Approved data***

***5.3 Non-approved data***

5.3.1 Speed polar
5.3.2 Demonstrated crosswind performance
5.3.3 Rate of climb
5.3.4 Range
5.3.5 Maximal altitude that can be sustained.

## 5.1 Introduction

Section 5 provides approved data for airspeed calibration, stall speeds and non-approved further information.

The data in the charts has been computed from actual flight tests with the sailplane using average piloting techniques.

## 5.2 Approved data

Not affected.

## *5.3 Non-approved data*

### 5.3.1 Speed polar

It was proved by measurements that influence of propeller blades to glide performance is only about 1 L/D point in entire speed range.

### 5.3.2 Demonstrated crosswind performance

Not affected.

### 5.3.3 Rate of climb

Maximum rate of climb is available only for a few minutes with fully charged Battery packs. As voltage is reduced, then also maximum rate of climb is reduced.
Maximum altitude gain that can be reached at a standard atmosphere conditions is greatly dependable on sailplane weight. To achieve maximum altitude gain you should use about 15kW of power (not full power, as total efficiency is better at lower power settings). Usually suitable climbing speed it is about 100 km/h (54 KIAS, 62 mph) at positive flap setting.

**CAUTION**
Always take care that propeller blades are cleaned. Unclean leading edge reduces propeller efficiency, and climb rate.

### 5.3.4 Range

The maximum range of powered cruising flight, without water ballast is about 100km (62 miles), depending on lift-sink conditions.
The optimum cruising speed and flap position is about 110 km/h (59 KIAS, 68 mph) at around 3000-3500 RPM and 4kW of power, at positive (as used in thermals) position of flaps.

### 5.3.5 Maximal altitude that can be sustained.

Maximal altitude that can be sustained was determined by calculation.

| | |
|---|---|
| Calculated max altitude | 6000m ISA |
| Demonstrated max altitude | 2800m ISA |

# SECTION 6

## 6. Weight and Balance

*6.3 Maximum permitted load of permanent tail water ballast tank*

*6.4 Maximum permitted load of wing water ballast tank*

*6.5 Maximum permitted load of drainable tail water ballast tank*

*6.6 Founding of CG position in case of motor and battery packs removed.*

## 6.1 Introduction

Not affected.

## 6.2 Weight and Balance Record and permitted payload-range

Not affected.

## 6.3 Maximum permitted load of permanent tail water ballast tank

Not affected.

## 6.4 Maximum permitted load of wing water ballast tank

Not affected.

## 6.5 Maximum permitted load of drainable tail water ballast tank

Not affected.

## *6.6 Founding of CG position in case of battery packs removed.*

**WARNING**

Position of sailplane CG in case motor and battery packs removed must be determined by weighting of sailplane in intended configuration. Sailplane CG and empty weight must lie in permitted range of Trim plan (G304S/FM chapter 2.5) Weighting procedure is described in G304S/MM.

For preliminary estimation of CG position following equation can be used. Permitted CG range is 251-378 mm.

CG calculation - battery packs removed:

$$CG = \frac{m_{empty} \cdot CG_{empty} - m_{pil} \cdot 430 - 32320}{m_{empty} + m_{pil} - 32}$$

| | | |
|---|---|---|
| $m_{empty}$ | [kg] | Empty weight of fully equipped sailplane |
| $CG_{empty}$ | [mm] | CG position of empty fully equipped sailplane |
| $m_{pil}$ | [kg] | Pilot and parachute weight |

:

# SECTION 7

## 7. GENERAL SAILPLANE AND SYSTEMS DESCRIPTION

## 7.1 Introduction

This Section provides description and operation of the propulsion systems.

## 7.2 Cockpit controls

*Cockpit Ventilation*

During powered flight, front ventilation valve in centre of the spinner, should be opened. This is important as during powered flight, especially at high power settings, motor needs sufficient amount of cooling air. On the instrument panel, close to the handle which operates ventilation valve, is a sticker, which clearly identifies in which position of control handle, ventilation is opened.

When is pushed forward, than ventilation is opened! Also from amount of air coming into cockpit and its noise, is quite evident to the pilot if ventilation is opened or not. So there is no indication on FCU about position of ventilation lever, however FCU instrument monitors how quickly motor temperature is rising in time. If motor temperature rising is faster than it is usual, then pilot gets red warning message "Check ventilation".

**WARNING**

If temperature of motor is raising too fast, check if ventilation valve is opened – ventilation lever must be pushed fully forward!

*Throttle control*

Throttle is controlled via FCU instrument unit rotating knob. Rotate the knob in clockwise direction to increase motor power and counterclockwise to degrease motor power or stop the motor.
Detail information about FCU instrument operation there are listed in **FCU Instrument manual**.

## *7.3 Instrument panel*

### 7.3.1 FCU instrument

Detailed information about FCU Instrument unit there are listed in **FCU Instrument manual.**


1. ON/OFF switch - for FCU power supply
2. Throttle/brake knob (Rotary encoder button)
   - by rotation clockwise is used as throttle from 0-100% of Power
   - by rotation counter clockwise is used as electronic propeller brake
   - by pressing is used for changing menus and resetting alarms
3. Red led - shows different alarm codes from controller see Maintenance manual chapter 3.24
4. Green led - shows normal operation of controller
5. Red led - turns on if there are some red warning messages from FCU active

### 7.3.2 Power switch

Important part of FES system is “Power switch”, which is used to connect batteries with motor controller!

Always turn ON first FCU, and then “Power Switch” if you want to run motor!

**WARNING**

Make sure that FCU instrument is switched ON, before Power switch is turned ON!

## 7.4 Landing gear system

Not affected.

## 7.5 Seats and safety harness

Not affected.

## 7.6 Pitot and static system

The static pressure orifices are located on both sides of the fuselage. Total pressure is read in the fin leading edge. Keep the static pressure holes clean; refer to 304S Flight manual 4.3 Daily inspection.

## 7.7 Airbrake system

Not affected.

## 7.8 Baggage compartment

The baggage compartment may carry up to 2 kg (4.4 lbs) of baggage including all installed equipment.

## 7.9 Water-ballast system

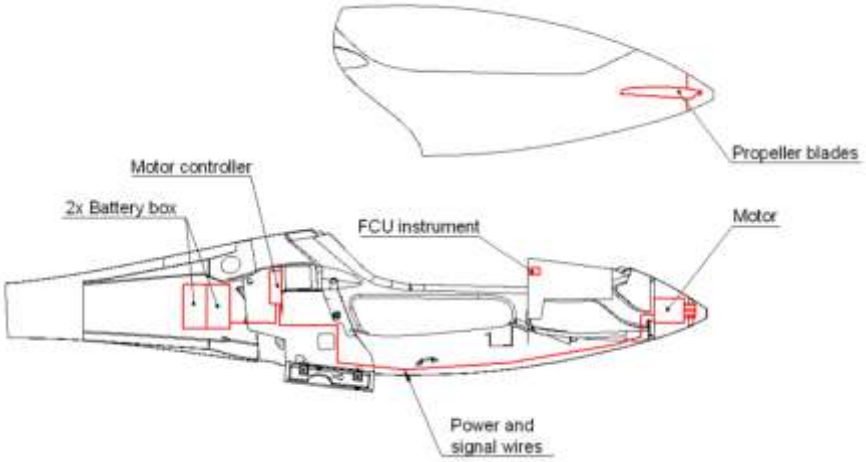
Not affected.

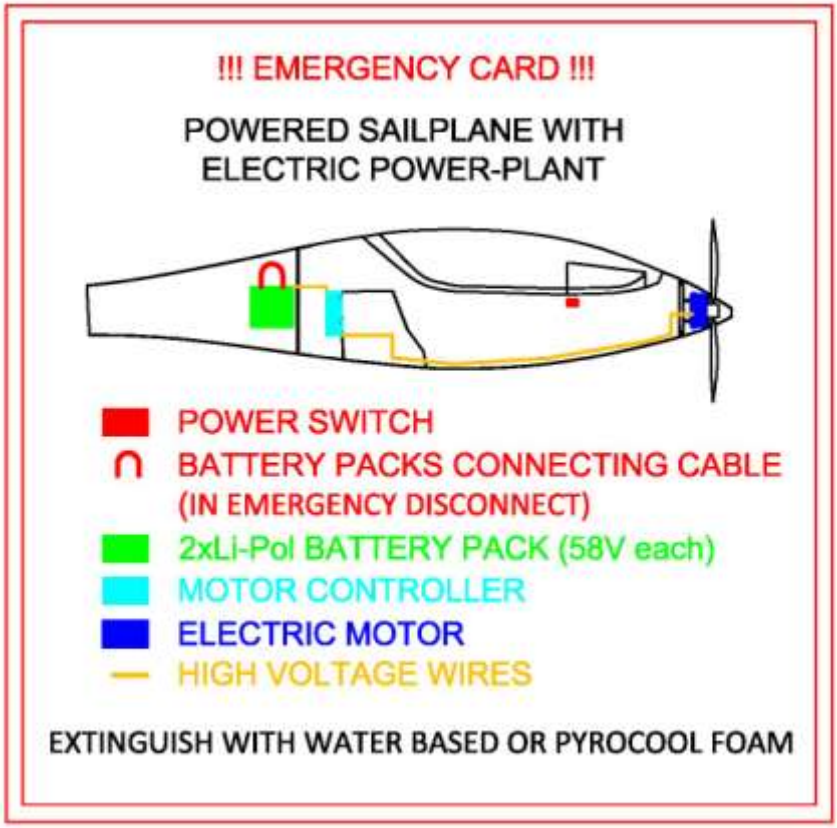
## *7.10 Power-plant*

### 7.10.1 General

Sailplane is equipped with a high-tech powerful FES front electric propulsion system developed for high performance sailplanes. Main parts of the FES system are:

- Brushless electric motor
- Controller for motor
- Foldable propeller
- Battery packs (FES-BP-14S) with internal BMS (Battery Management System)
- Charger (1200W or 600W)
- FCU (FES control unit) instrument
- LXUI box with Shunt (for current and voltage measurements)
- FCC box (FES connecting circuit)
- Power switch
- DC/DC converter (converts high voltage to 12V)






**CAUTION**
Emergency card must be placed in sailplane cockpit during all sailplane operation with battery packs installed.

## 7.10.2 Motor description

G304eS Sailplane is equipped with synchronous permanent magnet motor with electronically controlled commutation 3 phase system. Basic motor data there are listed below:

Motor manufacturer: LZ design d.o.o.
Motor model: FES HPH M100

- Maximum power: 23 kW (30 hp) at 4500 RPM;
- Recommended RPM: 3000 RPM;
- Continuous power: 16kW continuous power at 100V.
- Max. Torque 75 Nm
- Max. Current 200 A
- Max Voltage 180V

More detailed data about motor which is used on G 304 eS powered sailplane there are described in separate **FES HPH M100 MOTOR manual.**

## 7.10.3 Propeller description

Propeller consists of hub connected to the motor and two foldable, fixed pitch propeller blades. Material of blades is carbon composite which provides good dumping characteristics of propeller. Basic propeller characteristics of propeller there are listed below:

Manufacturer: LZ design d.o.o.
Model: FES-HPH-P1-102

- Number of blades 2
- Propeller diameter 1000 $^{+20}_{-0}$ mm
- Max. propeller speed 4500 RPM
- Max. power on propeller 23 kW

More detailed data about propeller which is used on G 304 eS powered sailplane there are described in separate **FES HPH P1 102 PROPELLER manual.**

### 7.10.4 Wiring

FES wiring consists of power, signal and 12V wires, and different types of connectors.

DC/DC converter is used to convert high voltage from FES battery packs, to 12V which is used to supply instruments, and main contactor. It also charge 12V battery if installed.

Main contactor is used to connect and disconnect traction batteries (FES battery packs) to motor controller. There is installed also precharge resistor.

### 7.10.5 Control Units

Motor controller is used to convert high voltage DC to three phase AC voltage which goes to motor. It also send RPM and controller temperature by CAN bus to FCU instrument.
Ventilators are used to cool down motor controller.
Power switch (double pole) is used to give 12V power to main contactor, supply to electronic circuit board in motor controller.
BMS inside of battery packs is used to balance and to control charging. It can be connected to PC with a special cable in order to monitor charging process with BMS Control software. During flight BMS is sending data to FCU instrument, about temperature of the pack and voltage levels of each cell.

### 7.10.6 Main Fuse

325A power fuse protect the whole system in case of a high power short-circuit.

## 7.10.7 FCU control unit description

FCU control unit serves for controlling of FES power-plant. FCU unit enables power setting of motor, monitoring of remaining energy in accumulators and monitoring of important power-plant parts temperatures. In case of improper use of power-plant, low voltage in accumulators, warnings are displayed at FCU unit.

## 7.10.8 Battery packs installation

Two battery packs are installed aft the wing in battery compartment. Battery packs can be removed after flight from fuselage compartment for recharging of batteries. During flight there are battery packs fixed by strutting in compartment.

## 7.10.9 Battery pack description

FES battery pack is build from 14 cells which are wired in serial. For FES application two packs are needed. Lithium Polymer (LiPo) cells produced by Kokam manufacturer are used.

Each Battery pack is equipped with internal BMS (Battery Management System) which is fixed above the cells, and is equipped with 16 LEDs to monitor its operation.

Basic technical data of battery packs:

| | |
|---|---|
| Weight | 15,5 kg |
| Box dimensions | 154x220x257 mm |
| Cell type | SLPB100216216H |
| Capacity of each cell | 43Ah |
| Number of cells | 14 |
| Energy storage capacity | 2,1 kWh |
| Max total voltage | 58,3 V |
| Min total voltage | 42 V |
| Max current | 250 A |

# SECTION 8

## 8. Sailplane handling, care and maintenance

## 8.1 Introduction

Not affected.

## 8.2 Power-plant inspection periods

Refer to the Operating, Maintenance and Repair Manual, Document G304eS/MM_Supp for more information on the sailplane periodical inspections.

## 8.3 Sailplane alterations or repairs

Not affected.

## 8.4 Ground handling / road transport

Propeller

On the ground propeller blades should be protected with a special blade protection covers, which prevents propeller blades from opening. Do not forget to remove propeller covers before flight!

**CAUTION**

Make sure that propeller is in horizontal position when lifting Real part of fuselage to attach tail dolly.

**WARNING**

Newer use a propeller or spinner for pushing, pulling or tail lifting!

Battery packs

During the sailplane car transport always remove batteries out of the sailplane. Use special box (can be ordered from manufacturer) for battery storage during the transport. Always transport batteries in car luggage compartment, pushed forward up to the front wall. Transportation box should be additionally secured, so that it cannot move backward during acceleration, or forward at braking.

For further information about battery packs car transport refer FES BATTERY PACK GEN2 manual.

**CAUTION**
Do not leave battery packs in the parked car under sun in hot summer, as they might be exposed to high temperatures.

**NOTE**
If you want to manufacture your own battery transporting box. Ask manufacturer for information about box necessary box qualities to ensure safe transport of the battery packs. Appropriate venting of transport box must be assured.

## *8.5 Cleaning and care*

Not affected

## *8.6 Tie down*

Do not leave FES equipped sailplane outside on the rain, unless is covered with high quality all weather covers. Protect motor and battery compartment from water entering. Take Battery packs out of the glider and store them on dry place!