Flight safety with el-gliders

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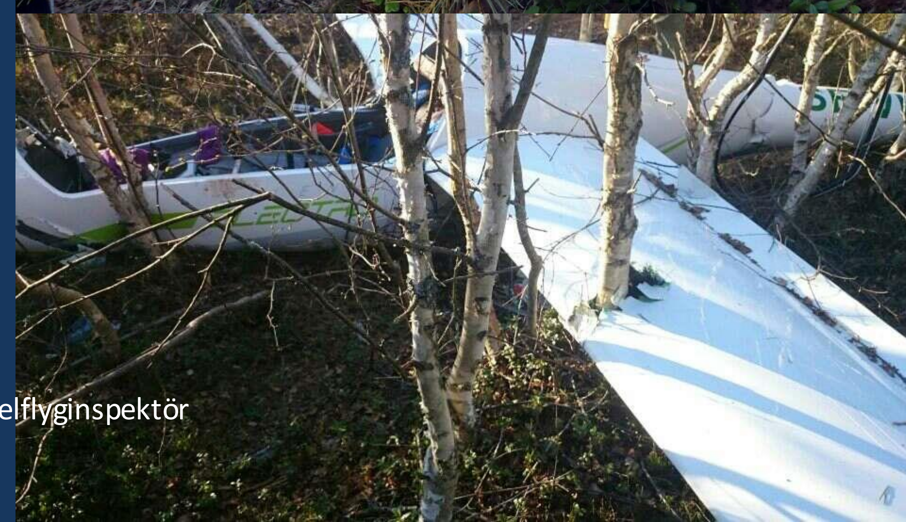
Accident with UL-glider, Silent 2 during launch

Factors:

- Not fully charged battery
- Flight started with 78 % capacity
- Low temperature → high resistance → voltage drop →lower RPM
- Due to combination of lower starting voltage and low temperature of battery pack, voltage dropped below 95V

"Low voltage, reduce power!"

-Poor climb performance (0,5 m/s)
-Low speed (close to stall speed)
-stall/spin situation



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SKOEVDE HANGAR S
Skövde, Flygplats

Facts:

The day before the accident, the pilot had carried out a self-launch with the aircraft and consumed 22 % of battery capacity.

This start was with "full throttle" for 40-45 seconds up to approx. 90 meters - with this power, the aircraft climbed 2.3-2.5 m/s.

At the accident

The flight was started with only 78% battery capacity and everything indicated that the batteries were not fully charged before the flight

The temperature recorded by the control unit at the start was only 13 degrees

The aircraft was in the hangar during the night where the temperature was below 0 degrees.

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At the start, power setting was reduced immediately during the start.
The display probably showed the text: "Low voltage! Reduce power!" already when rolling on the ground. The voltage was below 95 volts during the roll.

With this low power, the aircraft then climbed 0.6-0.7 m/s until the end of the log file.
The voltage was 97-100 volts.

With the low power (about 50%), the aircraft climbed slowly (but it went up).

The voltage was 97V and with a current of 90A until the last log before the accident. This corresponds to only 9 kW (Max power is 22 kW). According to the manufacturer, the Silent 2 can barely climb by 0.5 m/s at this power setting.

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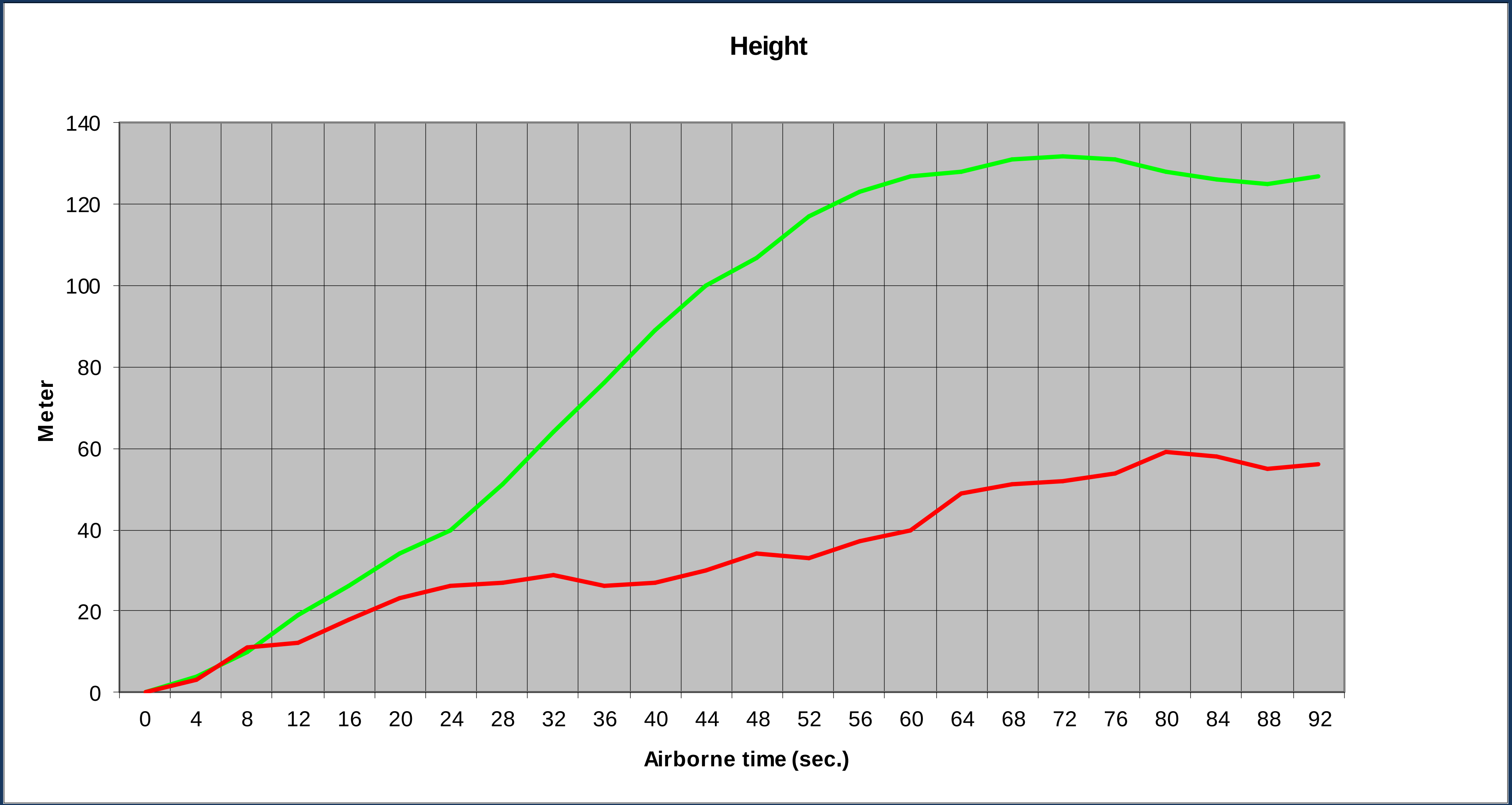

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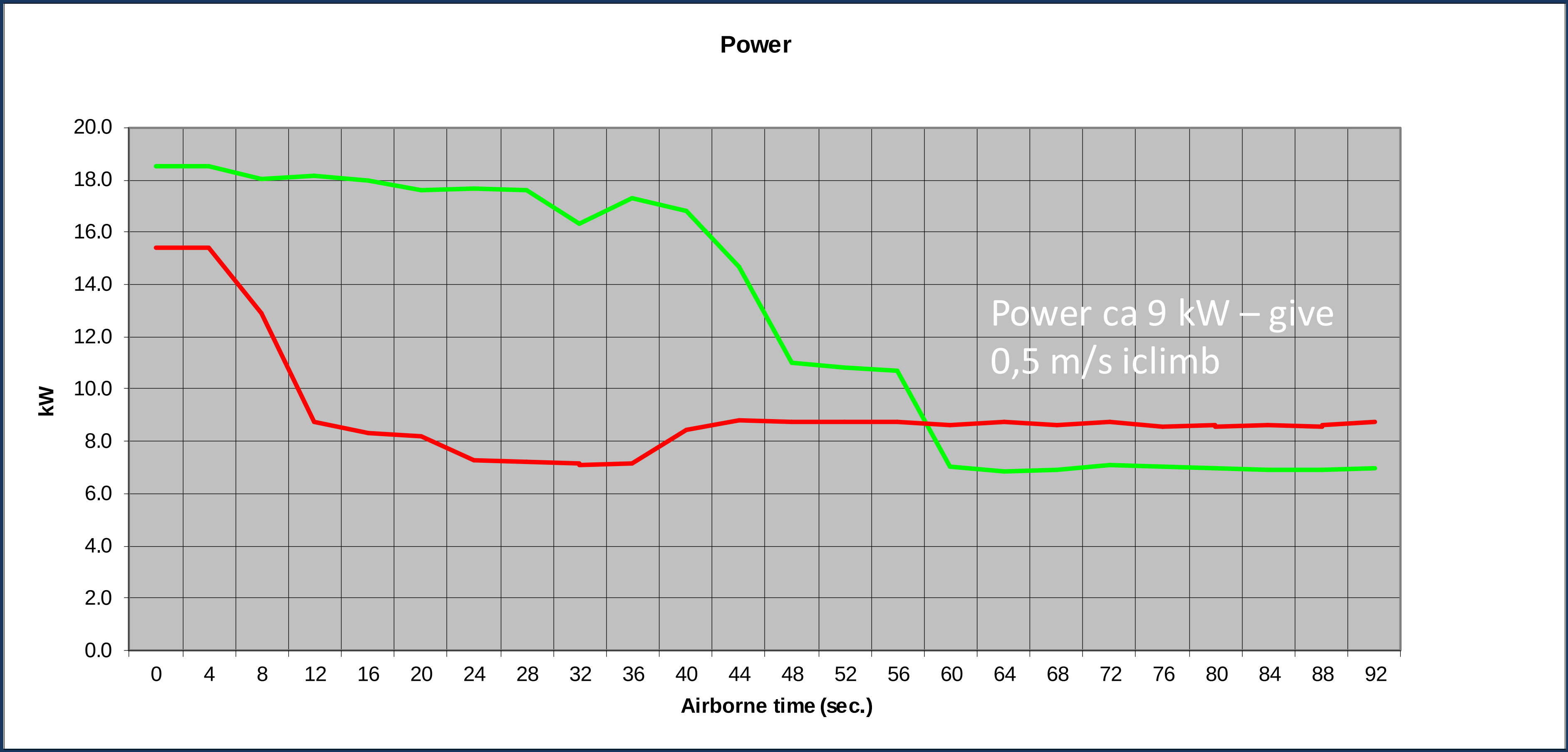
The picture shows the climb profile at the current start (red) with reference to the start the day before (green).



The image shows engine power at the current start in red with reference to the start the day before.

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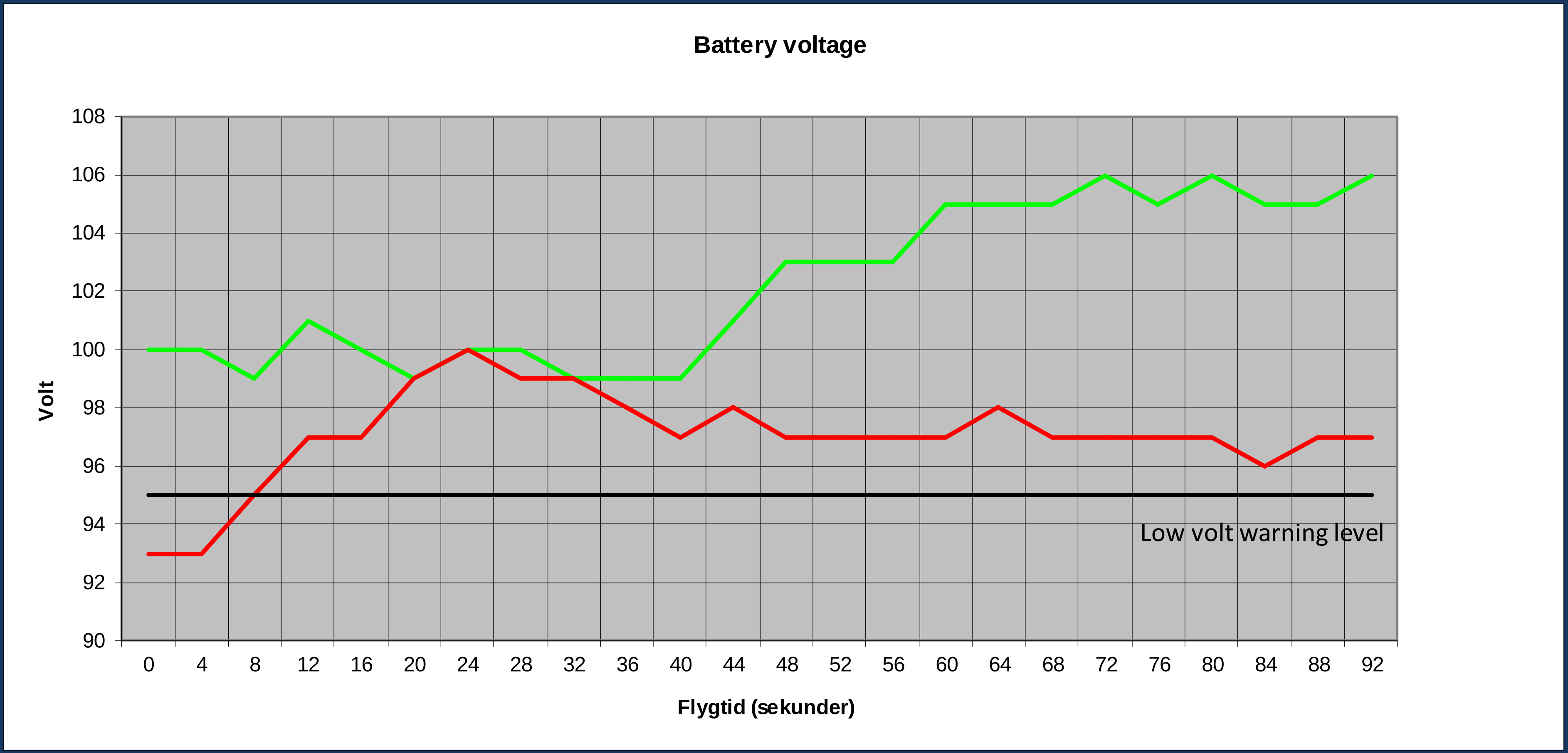
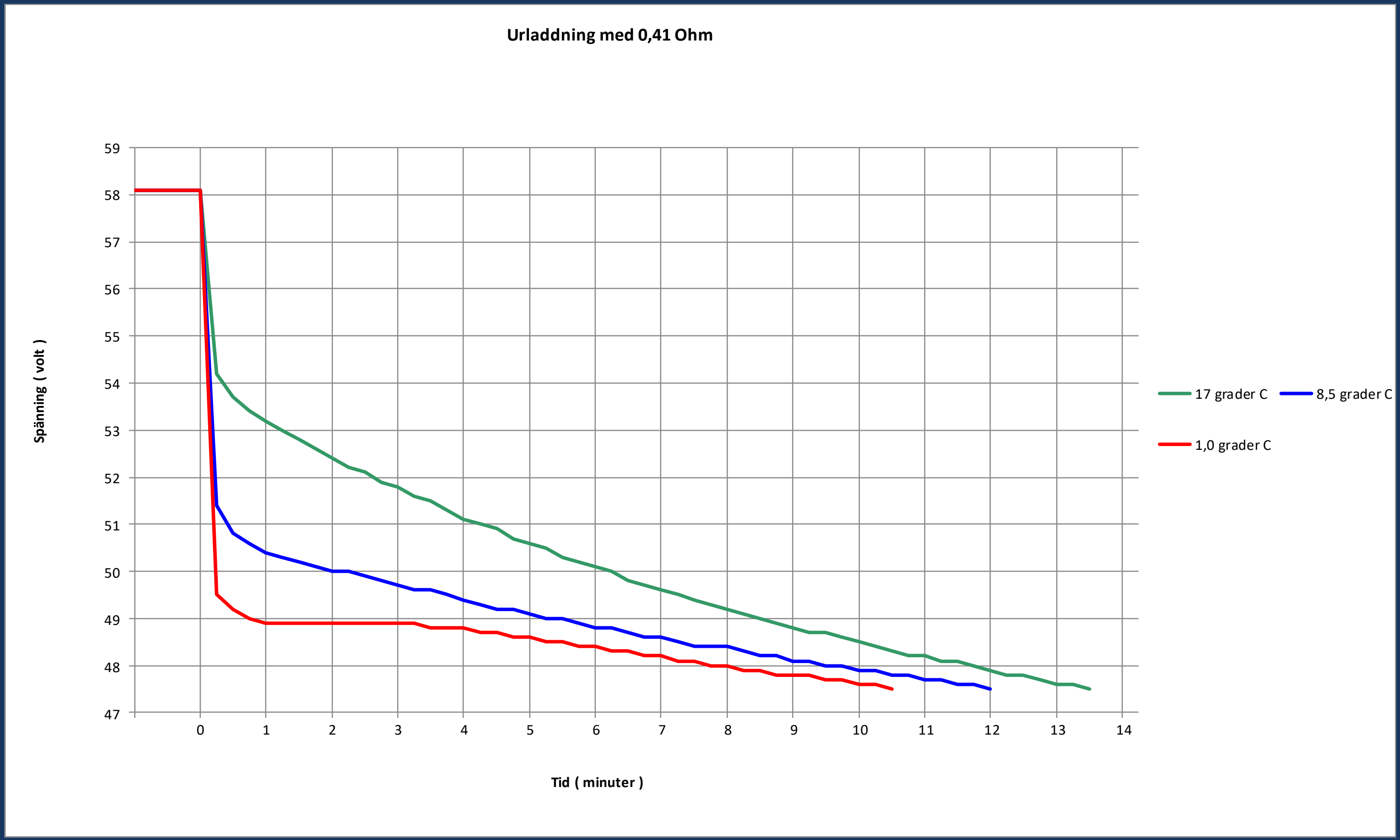


The image shows the battery voltage at the current start in red with reference to the start the day before.

When discharging a cold battery, the voltage drops rapidly at first but then stabilizes somewhat due to the internal heating of the battery.
was higher.



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From Flight Manual:

9.1 Introduction

The electric powerplant installed in the Silent 2 Electro is intended for self-launcing and shorter periods of powered flight for the purpose of sustaining soaring flight. The system is not intended, nor recommended for taxiing.

While the system is intended for self-launching, and is very effective for this purpose, self-launching places considerably higher loads on the system and in particular the batteries. For this reason, it is strongly recommended that self-launching only takes when the batteries are fully charged.

- Always self-launch with freshly charged batteries.
- Never self-launch when the battery temperature is very low. See temperature wanings for details.
- Always respond to any warning messages promptly – particularly those demanding that motor power be reduced or the motor stopped.

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Fig. 9.6 – Example of warning message

YELLOW - 1st warning level
The pilot must PAY ATTENTION to the parameter shown in the message and perform the operation suggested to overcome the matter. To confirm the message and then proceed to resolve the matter it is nessesary to press the Throttle/Brake knob (B).

RED - 2nd warning level
The pilot must take IMMEDIATE ACTION to resolve the matter indicated.

Voltage Warnings

Condition	Level	Message, action required
Voltage is low (95V)	Yellow	Low voltage, Reduce power

Temperature warnings:

Condition	Level	Message, action required
Battery pack temperature is below 5°C	Yellow	Battery Low < 5°C, Do not self-launch!

WARNING:

In the interests of pilot safety, it is possible for the pilot to override critical warning messages. For example, a pilot may choose to ignore a (Red) Critical Low Voltage warning and continue to use the motor in order to aviod a more serious incident, despite the fact that the batteries may be irreparably damaged.

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Analysis:

- ✓ Everything indicates that low temperature led to high internal resistance in the battery pack, resulting in lower power as a result, which likely contributed to the accident.
- ✓ Information on battery charging, battery temperature and handling of warning messages is described in the flight manual.

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Analysis :

- ✓ During roll on ground, the pilot noticed a low voltage warning with a recommendation to reduce thrust, which was likely done, significantly impairing takeoff performance. The aircraft later took off and climbed at a low rate of climb, about 0.5 m/s with the power used. The speed was low, close to stall speed and at the end of the flight the aircraft stalled and went into an incipient spin. The aircraft crashed.
- ✓ Factors that contributed to the accident - batteries had not been fully charged, that they had a low internal temperature after being installed in the aircraft during a cold night in the hangar and thus lost voltage faster than at normal temperature. Contributing could be info via warning text about low voltage with a recommendation to reduce thrust, which the pilot probably did at the start.
- ✓ Special tests with batteries with limited charge level and low temperature (1 gr.) provide direct warning.

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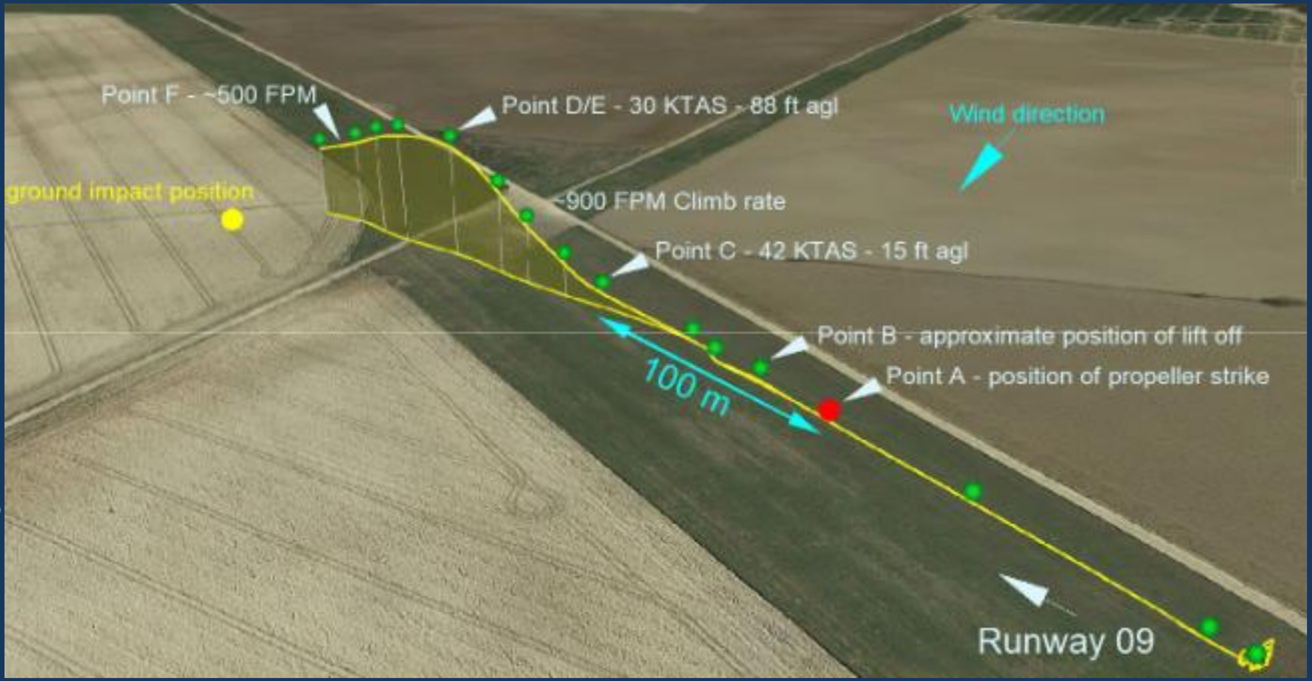
Accident with UL-glider, Silent 2 during laucnh

During the ground roll for a self-launched takeoff, the motor glider suffered a propeller strike shortly before it got airborne. The eyewitness evidence and recorded data showed that the glider climbed steeply to about 100 ft before stalling and entering an incipient spin to the left.



From AAIB-27238

- While the FMM recommends pilots familiarise themselves with the stalling characteristics of the glider it does not specifically direct them to explore how those characteristics differ during powered flight.
- In a section called 'Electric Powerplant Use and Maintenance' the FMM states '*Always self-launch with freshly charged batteries*', but this does not appear in the 'Operating Limitations' section of the FMM.

While the glider was self-launch capable, the pilot generally preferred to winch launch to conserve battery power in case he ran out of natural lift while cross-country flying. Prior to 23 April 2021 (the day of the accident), the pilot's previous self-launch was 8 months earlier, and that had been his first self-launch since completing his initial training in January 2020

The pilot had not charged the FES batteries between launches on the day of the accident and reported being unaware the FMM stated that self-launches should be carried out with fully charged batteries.

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The pilot observed that for an aborted takeoff, when compared with a standard cable release mechanism, the ergonomics of the FES control system were less intuitive. In an emergency requiring immediate motor shutdown, diverting attention away from flying the aircraft to locating and operating the FES throttle knob would be highly distracting at a critical stage of flight. Unlike pulling a cable release toggle, shutting down the FES was neither an instantaneous nor instinctive action. He considered that it would be safer if future designs for FES gliders incorporated a more intuitive and ergonomic means of cutting engine power.

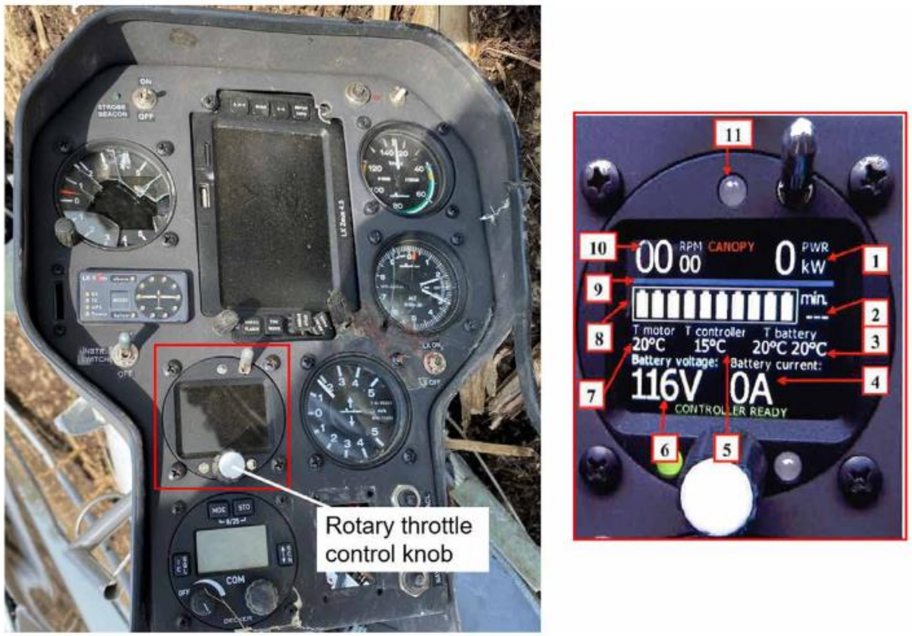

Figure 7

FCU instrument in the cockpit instrument panel (left) and enlarged detail (right)

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BGA has published and sent a 'Safety Briefing' to Silent 2 Electro

Guidance specific to the Silent 2 Electro

Test flying of a Silent 2 Electro in support of an accident investigation has identified several features associated with the type that pilots may not be aware of:

1. Very light stick forces in pitch combined with high levels of friction in the controls. This means the pilot receives minimal feedback on how the aircraft is responding to control inputs. Flying with a more forward cg should increase stability and stick forces.
2. Very little physical or aural indication that a stall is approaching with full power.

7. Procedure for an aborted take-off. Cutting the power quickly using the FES rotary knob is not as easy or as intuitive as pulling back on a throttle lever (for example in a TMG). Pilots should on all occasions complete a comprehensive self-brief for the take-off and any eventualities. This should always contain a point on the take-off run where the acceleration of the aircraft can be checked. Pilots should mentally rehearse what they would do in the event of needing to abort a take-off to be able to correctly react to a problem.

5. The flight manual does not provide a take-off or climb speed. A climb speed of 50 kts provides normal handling and should ensure a good margin to stall

Other accidents to Silent 2 Electro

On 19 October 2015 a Silent 2 Electro, registration G-CIYA, experienced a similar accident on takeoff from Husbands Bosworth Airfield in Leicestershire. During the initial climb following a self-launch, the aircraft entered an incipient spin. One wing struck the roof of a farm building, before the other wing and fuselage struck the ground. The pilot was seriously injured. The investigation did not reveal any malfunction or defect to account for the accident. Although the pilot was experienced and current in light aircraft, gliders and motor-gliders, he had not flown the aircraft type before. The full details are published in AAIB Bulletin 7/2016[22]. The report did not mention any indications of a propeller strike.

On 1 May 2017 a Silent 2 Electro suffered a stall and spin shortly after takeoff from Skövde Airport in Sweden. The pilot was seriously injured. The accident was not investigated by the Swedish Accident Investigation Authority but the AAIB obtained some information from the Swedish Soaring Federation that the takeoff was carried out with low batteries, and that the pilot may have reduced power in response to a low voltage warning, which resulted in the aircraft climbing poorly followed by a stall and spin.

On 22 July 2021 there was a fatal accident involving a Silent 2 Electro, registration D-MANS, near Conthey, Switzerland. The aircraft appeared to have stalled while ridge soaring. This accident is the subject of an ongoing investigation by the Swiss Transportation Safety Board.

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Alisport Silent 2 Electro, N66911: Accident occurred June 04, 2019 near Danbury Municipal Airport (KDXR), Fairfield County, Connecticut

Silent 2 Electro glider was substantially damaged when it impacted trees and a residence while on landing approach to Danbury Municipal Airport (DXR), Danbury, Connecticut. The sport pilot sustained minor injuries.

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The pilot thought he had 20 minutes of power left and was on his final approach to the airport, but the battery-operated glider ran out of power.

SAFETY INVESTIGATION REPORT

CAA OCCURRENCE 17/7177

PIPISTREL TAURUS ELECTRO G2

ZK-GEL

BATTERY FIRE AND SUBSEQUENT IN-FLIGHT BREAK-UP

KAIKOHE, NORTHLAND

16 NOVEMBER 2017

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Fire

During the wreckage examination, evidence of an in-flight fire was identified. The fire appeared to have originated from, and was isolated to, the battery pack located behind the pilot's seat (see Figure 3).

The safety investigation identified other international occurrences involving lithium polymer battery thermal events. Although these involved different models of glider, a combination of two additional areas of interest are of note:

- The battery packs had experienced some degree of impact, with the potential to compromise the battery structure.
- The batteries had not been charged in accordance with the manufacturer's recommendations.

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3. Conclusions

3.1 During flight, one of the lithium polymer batteries fitted to the glider experienced a thermal event.

3.2 At the time of the in-flight battery thermal event, the glider had completed the take-off phase and was actively gliding with the motor retracted.

3.3 The pilot was presented with a challenging in-flight emergency.

3.4 It is likely that the pilot was attempting to return to the aerodrome to carry out an emergency landing.

3.5 The glider was in a high-speed descent, when the wings failed due to structural overload.

3.6 The accident was not survivable.

Two Battery Fires in Self-Launching Sailplanes

DEAN SIGLER / 12/01/2017 / BATTERIES, SUSTAINABLE AVIATION / LEAVE A COMMENT

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A Really Hot Landing

Shortly after landing, an HPE glass-wing 304 eS/Shark FES sailplane "suffered a battery burn." The August 10, 2017 incident took place at Parham Airfield in Sussex, the UK. According to Klaus Burkard's blog. "During the roll-out, the 55-year-old pilot smelled fire, while at the same time smoke was pouring into the cockpit from behind. The pilot was able to leave the aircraft uninjured after a [rolling to a] standstill."

FIRE BLEW HATCH COVER OFF ON ROLLOUT. FLAMES WERE EXTINGUISHED BY FOAM-TYPE CHEMICAL

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The pilot reported that in January, one of the battery boxes fell about 20 centimeters (eight inches) from his car to the ground. He apparently saw no damage to the case at that time. Because he did not mark or write down the ID for that battery pack, it was not possible after the fire to determine "whether the battery that had caught fire was the same one that had fallen out of the car before."

Not Wonderful Choices

Klaus explains that for ultralight sailplanes powered by any electric power system, a batt fire in the air is a major problem. One can't jettison the batteries and popping the ballist recovery parachute might cause it to ignite. The pilot's only hope, in that case, would be leave the airplane and parachute to safety.

DAMAGE TO FRONG BATTERY BOX ON BRITISH SAILPLANE. BOTH INCIDENTS WERE "LUCKY" IN OCCURRING AFTER A SAFE LANDING

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Other safety considerations?

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