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INVESTIGATION REPORT

Accident to the HELI-SPORT SRL CH 77 RANABOT[1] identified 83ARG

on 13 July 2018
at Saint-Raphaël (Var)

[1] Ultralight helicopter.

Time	Around 09:30[2]
Operator	Private
Type of flight	Cross country
Persons on board	Pilot and passenger
Consequences and damage	Pilot and passenger fatally injured, ultralight destroyed
This is a courtesy translation by the BEA of the Final Report on the Safety Investigation published in November 2020. As accurate as the translation may be, the original text in French is the work of reference.	

[2] Except where otherwise indicated, the times in this report are in local time.

Error message on the instrument panel, autorotation, collision with the ground, fire

1 - HISTORY OF THE FLIGHT

Note: The following information is principally based on statements, and data from the FlyBox computer.

The pilot[3] took off at around 08:15 from a private helipad in Montauroux (Var). He stopped at Fayence aerodrome (Var) to pick up a passenger, then headed in the direction of Saint-Raphaël.

[3] The pilot owned the ultralight.

Whilst he was flying over a hill north-east of Saint-Raphaël at a height of around 500 ft, witnesses heard a reduction in the engine's power then saw the main rotor blades spinning slowly. They then saw the ultralight descend and pick up speed. The ultralight collided with the ground. A fire broke out upon impact.

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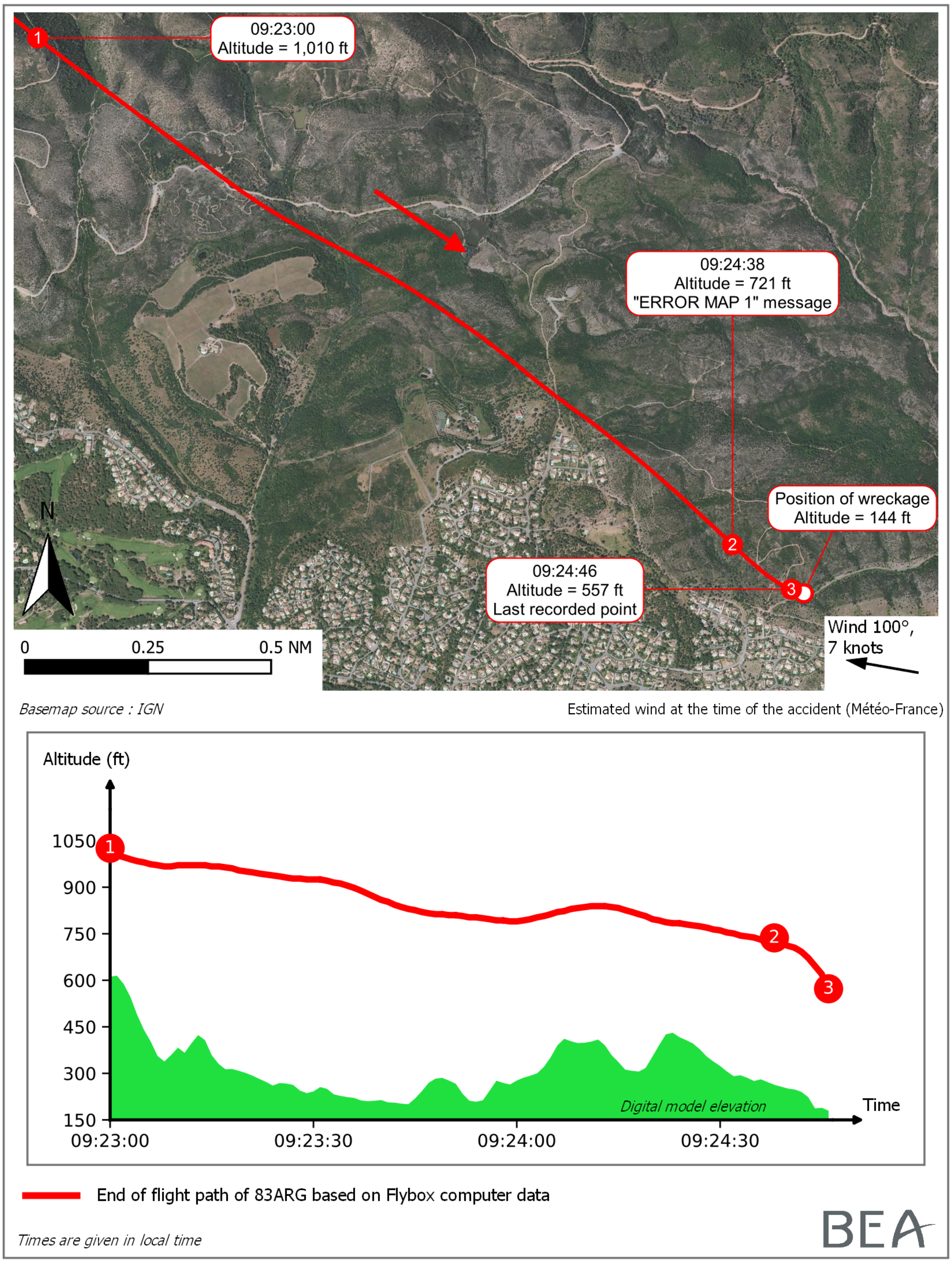


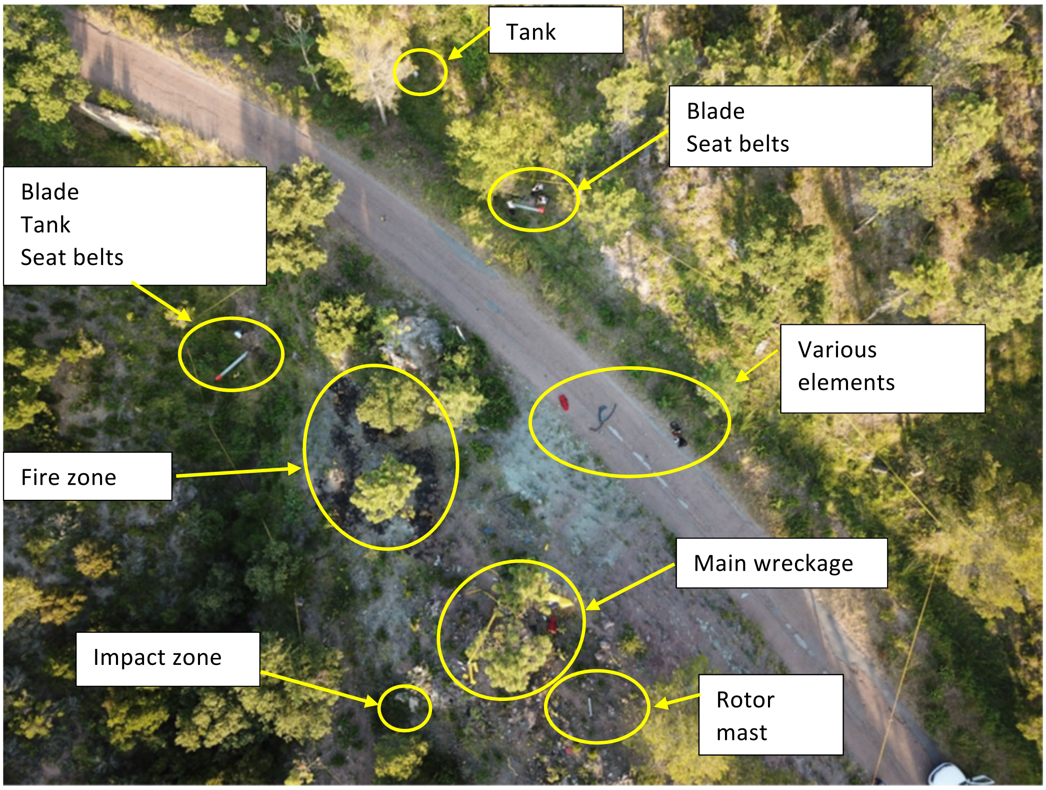
Figure 1: End of the ultralight's path

2 - ADDITIONAL INFORMATION

2.1 Examination of site and wreckage

The site of the wreckage is a sloped wooded area, near a private road. Signs of impact with the ground and vegetation constituting the initial area of impact were found around 10 m before the main wreckage. Below the wreckage, in an area approximately 10 m in diameter, signs of fire were observed. Pieces of debris were found more than 50 m further on from the main wreckage.

The road is the only safe landing area in the vicinity.



Source: justice – SRTA

Figure 2: Aerial view with areas of debris

Examination of the site found that, on its final path, the ultralight had a horizontal or slightly banked attitude with a high horizontal energy and moderate vertical energy.

Both of the main rotor blades were broken where they attached to the rotor mast. These failures were the result of stresses borne by the ultralight when it collided with the ground.

Except for the yaw control, the continuity of the controls could not be checked.

All of the damage observed was caused when the ultralight collided with the ground.

2.2 Additional examinations

The examination of the engine, performed at the manufacturer's around one year after the accident, showed that:

- white deposits were present in some components of the engine fuel system;
- the lubrication and cooling systems were continuous;
- the engine unit was in good condition with satisfactory lubrication;
- the mechanical assemblies moved freely;
- the ignition system was damaged; its continuity could not be determined;
- the turbocharger was damaged and blocked;
- the throttle control was disconnected and its associated flap was ¾ closed. The position of the control at the time of impact could not be determined.

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It was not possible to determine whether the deposits found in some components of the engine fuel system were caused by incorrect storage of the wreckage or if they were present prior to the accident.

2.3 Examination of computers

The FlyBox computer saves data in an internal memory. The computer was damaged. Binary data was extracted from the computer and decoded with the help of the equipment manufacturer. Data pertaining to the occurrence flight was recorded and was notably used to plot the path shown in figure 1.

At the last recorded point, the altitude was 550 ft, i.e. height of more than 300 ft. The last seconds of the flight were therefore not recorded. This can be explained by the sudden stop of the computer upon impact.

The engine parameters were nominal up to 9:24:37 (i.e. nine seconds before the recording ended). At this time, the intake pressure in the air manifold measured by the MAP1 sensor suddenly dropped and a MAP1 error[4] was recorded. From this moment, the change in fuel pressure was consistent with the variations in pressure measured by the MAP2 sensor indicating that the engine governor used the information from this sensor and subsequently remained nominal.

[4] Analysis of the intake pressure parameter associated with this sensor showed that the value dropped from 22 inHg to 6 inHg in one second. The appearance of the error was therefore caused by the sudden variation in value, beyond the threshold triggering detection of the sensor failure (see § 2.4.2).

At the same time, the engine's rotation speed began to decrease. The intake pressure and the fuel pressure increased slightly then dropped significantly. In the absence of engine failure, these variations can be explained by a controlled reduction of power, either by the lowering of the collective pitch lever, consistent with the initiation of an autorotation, or by the rotation of the throttle control twist grip to the idle position.

The rotor speed, which was 104% during cruise flight, dropped to 82% (4 seconds after the reduction in engine rotation speed), before increasing again to 94% at the last recorded point[5].

[5] The rotor speed associated with an autorotation is around 96%.

Analysis of the previous flight parameters showed no engine operating anomaly and no record of a failure associated with the MAP1 sensor.

The MAP1 sensor was tested at the engine manufacturer's and was found to be operating correctly. The MAP2 sensor was not retrieved.

2.4 Ultralight information

2.4.1 General

The ultralight was delivered in February 2016.

The last known maintenance operation, the "*100 hour*" inspection, was performed on 18 December 2017, in compliance with the maintenance manual. According to the pilot's logbook, the ultralight had been regularly operated since this last inspection and had logged around 25 flight hours. The last flight recorded in the logbook had been on 21 June 2018, three weeks prior to the accident.

2.4.2 Description of systems

The ultralight is equipped with an EPA POWER SA-R917Ti engine developed from a Rotax 914 engine, equipped with an EMS[6], which among other functions, governs the engine.

[6] Engine Monitoring System.

The collective pitch control is conventional and comprises a throttle control twist grip. In normal operation, these controls are interconnected: when the collective pitch is increased, the throttle control grip twists, the flap associated with the throttle control opens and vice versa.

A governor automatically ensures that the engine speed remains within the normal operating range. The pilot can override the governor by blocking rotation of the twist grip, the pitch/throttle coordination is then controlled manually by the pilot.

The ultralight is also equipped with a GNSS FlyBox computer equipped with a screen on the instrument panel (Mini EIS[7]). This computer uses the sensors and probes of the engine monitoring system. Essential engine parameters[8] or, if necessary, alarms, are displayed on the main page of the screen.

[7] Engine Information System.

[8] Engine rotation speed (RPM), intake pressure (MAP), oil pressure and temperature, cylinder head temperature (CHT) and exhaust gas temperature (EGT).

Figure 3: Example of display of essential engine parameters on the Mini EIS

The ultralight flight manual specifies that if the EMS detects out-of-limit engine parameters, an alarm light illuminates on the alarm bar of the instrument panel and an "*ENGINE ANOMALY*" voice alarm is heard. The associated emergency procedure then requires the pilot to determine which engine parameters are concerned and to land as soon as possible for investigation. The engine manufacturer specifies that the limit values of the intake pressure parameter resulting in the triggering of an alarm are 3 and 88 inHg.

The ultralight flight manual contains no additional information pertaining to the use of the EMS and no information pertaining to the use of the Mini EIS screen. It directs operators to the equipment manuals.

The Mini EIS user manual specifies that the computer constantly monitors all sensors and probes. When a measurement exceeds the limit value defined by the operator in the FlyBox computer, an alarm is activated. The parameters display page is then replaced with a page that identifies the alarm (displayed in white on a black background). The CAUTION alarm light flashes and a voice alarm is heard. Once the alarm has been identified, the pilot must press a pushbutton. The screen then displays the page that corresponds to this measurement and the gauge flashes until the anomaly is corrected.

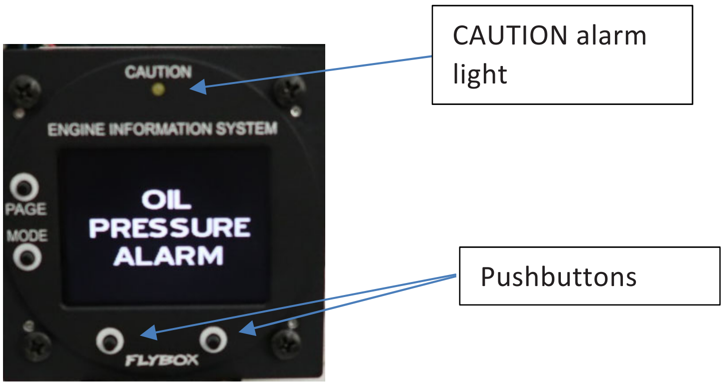

Figure 4: Example of an alarm

The Mini EIS user manual also specifies that there is another type of alarm, known as the "*sensor alarm*", which is activated when the computer receives no information from a sensor. The engine manufacturer says that a sensor alarm of this type will also be activated if there is a sudden variation in the value of the associated parameter. In terms of the MAP, this would be the case if the value received varies by more than 15 inHg in one second. The parameters display page is then replaced with a page that identifies the alarm (displayed in red on a black background).

The equipment user manual specifies that, in this case, the cables and sensor must be checked for damage. There is no associated procedure and it does not specify that the pilot needs to press the pushbutton to go back to the main page.

Examples of alarms are listed in the equipment manual but the MAP alarm is not mentioned.

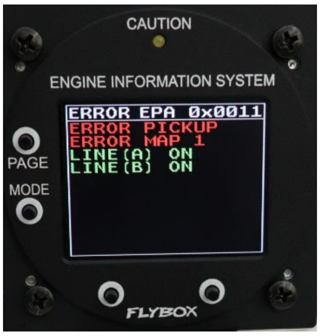

Figure 5: Example of a sensor alarm

2.5 Meteorological information

The meteorological conditions estimated at the site of the accident were as follows:

- wind 100° for 7 knots;
- CAVOK;
- temperature 27°C;
- dew point 19.5°C.

2.6 Pilot information

The pilot had logged around 120 flight hours on a category 6 ultralight, of which around 50 hours in dual flight. He had begun his training[9] in June 2013 and had flown regularly since obtaining his licence. In December 2017, he had performed a dual flight to practise landing on snow and had also performed an autorotation exercise.

He had also held a private pilot licence for aeroplanes and a pilot licence for gliders.

[9] Autorotation exercises are performed during training until the student is able to perform this manoeuvre with ease and knows how to maintain adequate speed and rotor speed.

2.7 Statements

A first witness stated that he had heard and seen the ultralight coming from Mont-Vinaigre and heading towards the sea, flying at a height that he estimated to be 100 m. He had then heard a strange noise coming from the engine. He had looked at the ultralight and observed that the blades were turning slowly. The ultralight was in stepped descent. He heard the engine operate again for around 10 seconds. The ultralight had then taken a nose-down attitude and had picked up speed. The witness had been able to hear the aerodynamic whistle associated with speed. He did not see the end of the path due to the high terrain and vegetation but he heard the noise of the ultralight colliding with the ground followed by an explosion. He had immediately contacted the emergency services.

A second witness said that he had heard spluttering. He had then seen the ultralight regain a little height before descending nose down. The blades were turning slowly. The witness thought that the pilot had seen the road and had wanted to land.

2.8 Previous occurrences

The importer reported that another Ranabot operator had performed an autorotation after the appearance of an error message on the Mini EIS screen, thinking that he was dealing with an engine failure. The autorotation and landing took place without incident and the pilot shut down the engine without any problems. After analysing the incident, the pilot said that he had undoubtedly unknowingly blocked the throttle control twist grip during the autorotation and had therefore not noticed that the engine was operating nominally.

Feedback from instructors about helicopters equipped with a throttle control twist grip on the collective pitch control shows that some pilots who have little experience can apply too much pressure to the grip without realising.

The investigation[10] pertaining to the accident of the Robinson R22 registered F-GHHT on18 August 2013, concluded that the pilot had probably applied too much pressure to the throttle control grip following an increase in stress caused by a heightened workload when arriving over the aerodrome. He had therefore unintentionally inhibited automatic pitch/throttle coordination and had not been aware that he was responsible for the coordination.

[10] https://www.bea.aero/les-enquetes/evenements-notifies/detail/event/diminution-de-la-vitesse-de-rotation-du-rotor-principal-autorotation-atterrissage-dur-basculement/

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3 - CONCLUSIONS

***The conclusions are solely based on the information which came to the knowledge of the BEA during the investigation. They are not intended to apportion blame or liability*.**

Scenario

The pilot flew at a height of around 500 ft above an area of wooded hills.

One of the two intake pressure sensors in the air manifold sent erroneous values to the engine parameter display computer. An error message without voice alarm was then displayed on the instrument panel instead of the engine parameters, without the governing of the engine being altered. The investigation was unable to determine what caused the failure of this sensor.

The pilot probably started an autorotation and lowered the collective pitch lever. The engine rotation speed then significantly dropped whilst the rotor speed remained within a range compatible with that of an autorotation.

Given the low height and the unfavourable surrounding environment, the pilot did not manage to complete an autorotation in total safety. The ultralight collided with the vegetation, then the ground. Due to the lack of data recorded at the end of the flight, it was not possible to determine the pilot's last actions.

Contributing factors

The following factors may have contributed to the pilot's decision to perform an autorotation:

- The display ergonomy of alarms and error messages may have caused confusion, red generally being used for alarm messages requiring immediate action.
- An inadequate description of the MAP sensor error and its display in the Mini EIS user manual.

Measures taken by the manufacturer of the ultralight since the accident

As a result of operator feedback, a new computer has been designed to display the engine parameters. In the event of an alarm or error message, the parameters remain displayed on the screen and messages are displayed at the bottom of the screen, in amber in the event of an error and in red in the event of an alarm.

Figure 6: New display of engine parameters in the event of an error message