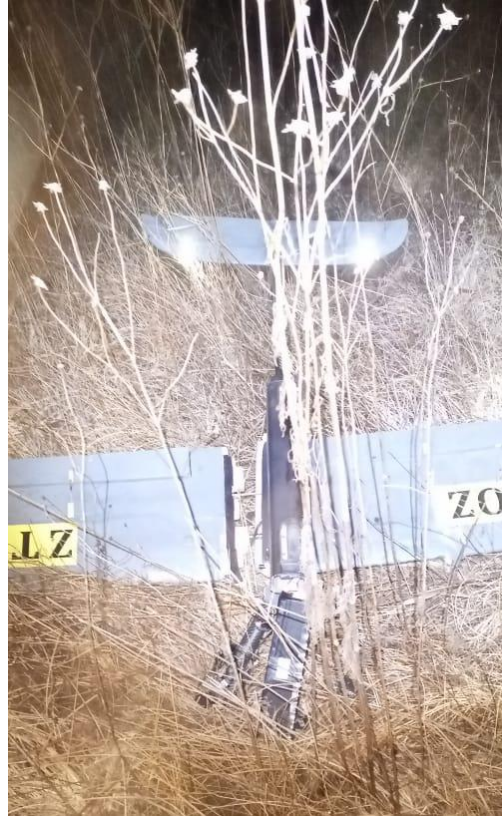


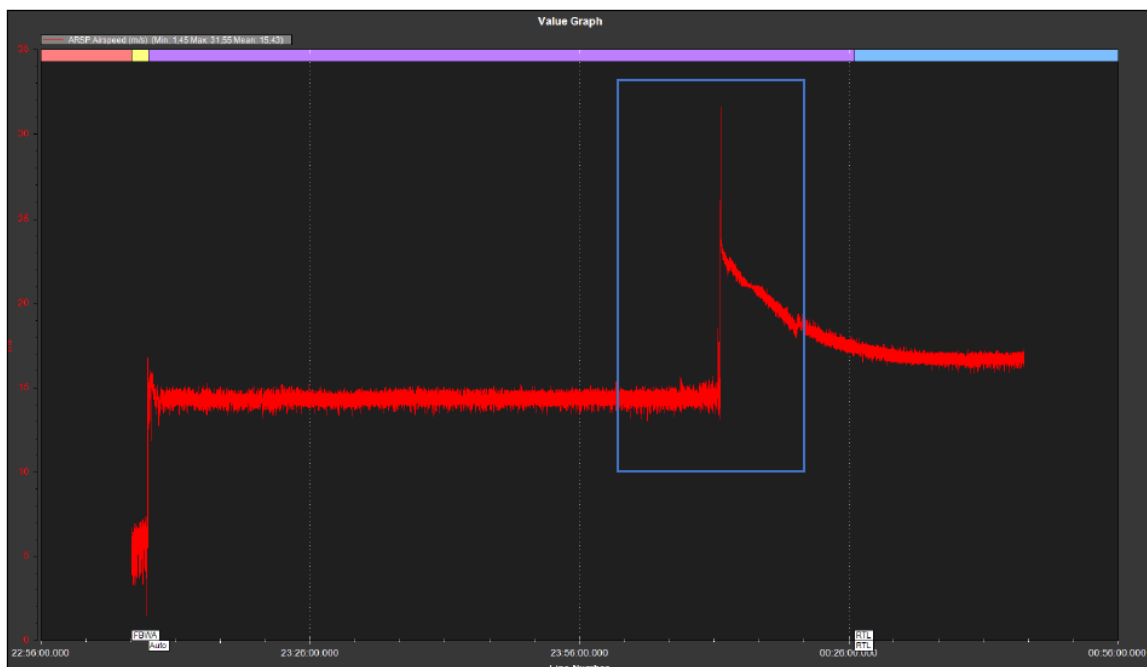
**UAS LIMITED OCCURRENCE INVESTIGATION REPORT – FINAL**

<b>Reference Number</b>	CA18/2/3/10342						
<b>Classification</b>	Accident	<b>Date</b>	30 June 2023		<b>Time</b>	2216Z	
<b>Type of Operation</b>	Unmanned Aircraft System – Surveillance (Part 101)						
<b>Location</b>							
Place of Departure	Main Road, Westonaria Ward 1, Gauteng Province		Place of Intended Landing	Main Road, Westonaria Ward 1, Gauteng Province			
Place of Occurrence	360 metres north of the Main Road, Westonaria						
GPS Co-ordinates	Latitude	26°34'46.06" S	Longitude	27°40'45.68" E	Elevation	4902 feet	
<b>Aircraft Information</b>							
Registration	ZT-UOZ		Class	4A			
Make; Model; S/N	Bathawk (Serial Number: B0017)						
Damage to Aircraft	Substantial		Total UAS Hours	1242.10			
<b>Pilot-in-command</b>							
Licence Type	Remote Pilot Licence (RPL)		Gender	Male		Age	59
Licence Valid	Yes	Total Hours	2627:20		Total Hours on Type	1290:43	
Total Hours 90 Days	203:25		Total Flying on Type Past 90 Days	21:39			
<b>People Controlling</b>	1	<b>Injuries (On ground)</b>	0	<b>Fatalities</b>	0	<b>Fatalities (on ground)</b>	0
<b>What Happened</b>							
<p>On 30 June 2023, an unmanned aircraft system (UAS) with registration ZT-UOZ was launched for surveillance operation at Transnet Freight Rail (TFR) in Westonaria Ward 1, Gauteng province. Visual meteorological conditions (VMC) prevailed at the time of the flight. The flight was conducted beyond visual line of sight (BVLOS) rules by night and under the provisions of Part 101 of the Civil Aviation Regulations (CAR) 2011 as amended.</p> <p>The pilot reported that he arrived on site and conducted the necessary checks on the UAS, and it was serviceable. At 1911Z, he launched the UAS for the first surveillance flight, which was successful. Upon the UAS's return to the launch site, the pilot conducted post-flight inspection and changed the battery in preparation for the next flight. The battery power indicated 98% at the time of launch. The UAS climbed to a height of 400 feet (ft) above ground level (AGL) with the wind speed at 15 knots (kts) from the south. At 2111Z, the pilot switched to Auto mode and started the mission. The flight continued for approximately 55 minutes without incident. The remote pilot station did not show any warning signs of the UAS's failure. During the flight, the wind had increased to 21 kts and the UAS heading was approximately 100 degrees. According to the Bathawk User Manual, <i>the UAS maximum operating wind is 12.5 m/s (24 kts)</i>. The pilot noticed that the UAS yawed and corrected itself repeatedly during the flight, and thus, decided to engage the return-to-launch function. The UAS headed to the base station but when it was still a distance away, it descended to a height of 150 ft (AGL) (45 metres) and the pilot observed an increase in oscillations (<i>back and forth movement in a regular rhythm</i>) with a significant</p>							

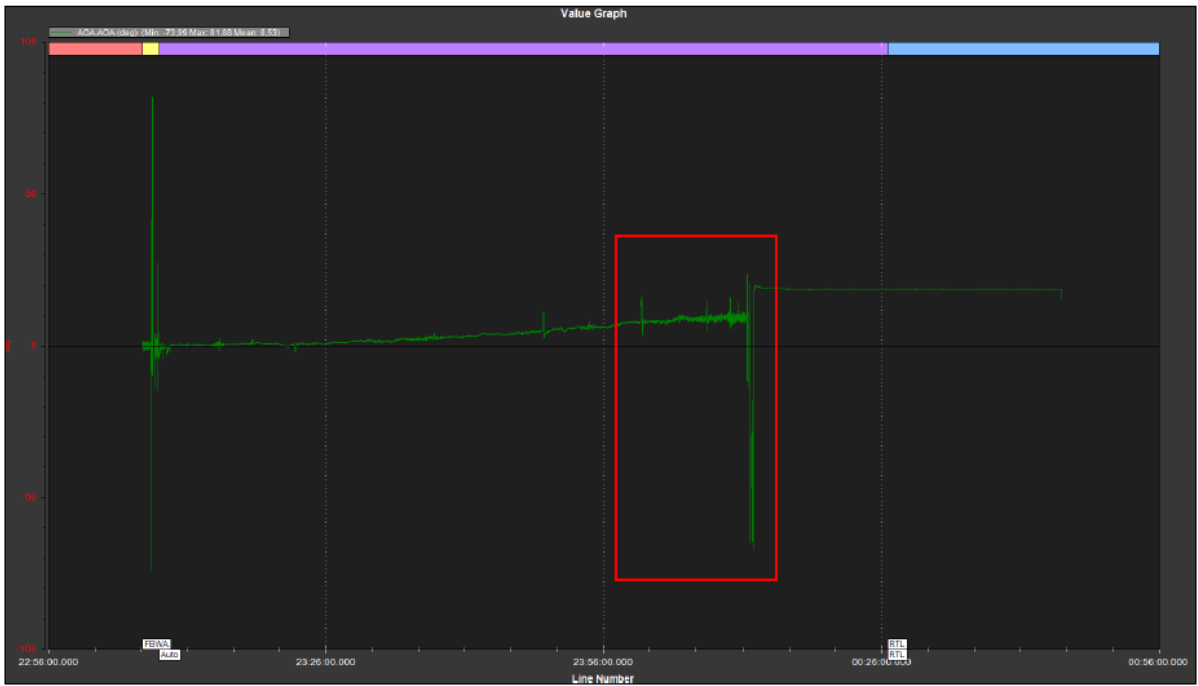
roll. The pilot engaged Loiter mode (*assisted flight mode with position and altitude hold*), however, the UAS could not maintain a level flight and it spun to the left then recovered, and thereafter, spun to the right before it impacted the terrain. The pilot and his colleagues dispatched to the last recorded location that was captured on the remote pilot station and found the UAS crashed approximately 360 metres north of the ground station. The UAS sustained substantial damage. No injuries were reported on the ground.



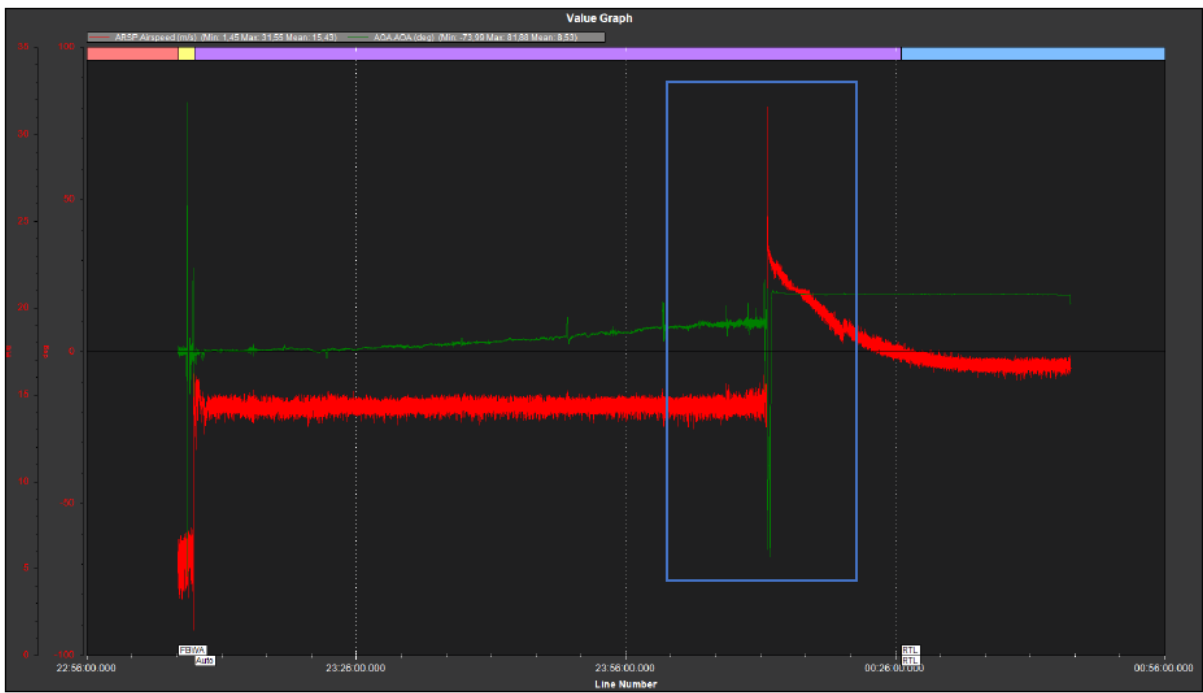
**Figures 1 and 2:** The UAS at the accident site in an inverted position with the right aileron separated (left); and damage on the UAS gimbal and front fuselage (right). (Source: Operator)



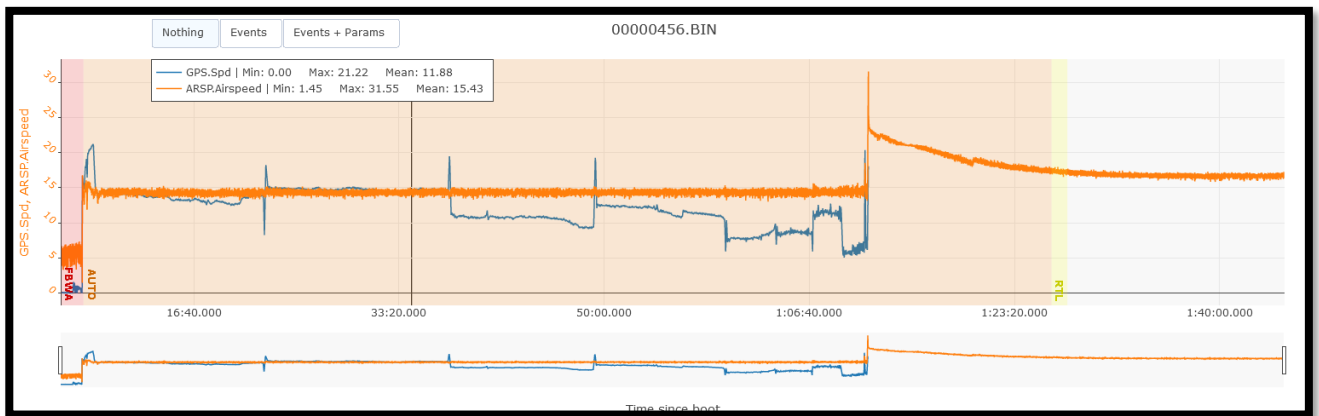
**Figure 3:** The airspeed stayed consistent during the flight until the nose pitched down, increasing the stall. (Source: Operator)



**Figure 4:** The aircraft (UAS) indicated consistent increase in the Angle of Attack before it stalled. (Source: Operator)



**Figure 5:** The air speed sensor was faulty during the return-to-launch stage. This led to the increase in the Angle of Attack. (Source: Operator)



**Figure 6:** The airspeed shows a consistent speed before the stall. Ground speed, however, shows that there was a decrease in speed before the stall. (Source: Operator)

The information below is an extract from the operator's Log Analysis Report (LAR):

- **Sequence of Events**

At 21:06 UTC: The pilot plugged in the battery and armed the aircraft.

At 21:07 UTC: The pilot launched the aircraft and started the flight operation.

At 22:09 UTC: The UAS reached waypoint #7, then turned towards LZ.

At 22:17 UTC: The aircraft started stalling and the nose pitched down and the UAS rapidly decreased altitude.

At 22:18 UTC: The aircraft impacted the ground.

- **Findings**

1. The aircraft (UAS) system shows a consistent speed throughout the flight. However, towards the return to home location stage, the aircraft (UAS) system did not indicate the correct speed.
2. While the aircraft was returning to home, the auto mode was consistently increasing the Angle of Attack to stay at altitude and decreasing the air speed (due to increase in wind, as well as battery issues).

### Findings

1. The pilot was initially issued a Remote Pilot Licence (RPL) with visual line of sight (VLOS) and beyond visual line of sight (BVLOS) ratings on 25 April 2019. His last skills test was completed on 9 March 2023, and his licence was renewed on 25 March 2023 with an expiry date of 31 March 2025.
2. His Class 3 medical certificate was issued on 13 March 2023 with an expiry date of 31 March 2024 with medical restrictions.
3. The remote maintenance technician (RMT) who certified the last inspection was initially issued an RMT licence on 28 March 2018. The licence was renewed on 27 July 2022 with an expiry date of 26 July 2024.
4. The operator was issued a Remotely Piloted Aircraft Systems Operating Certificate (ROC) on 31 October 2022 with an expiry date of 31 October 2023.
5. The UAS was initially issued a Remotely Piloted Aircraft Systems Letter of Approval (RLA) on 24 April 2019 which was renewed on 31 May 2023 with an expiry date of 30 April 2024.

6. The UAS's last mandatory periodic inspection (MPI) was conducted at 1222.03 total hours. It accumulated a further 20.07 hours since the last MPI.

Bathawk User Manual:

*Time/Distance/Speed*

- *Calculations based on the average groundspeed can be made to determine the estimated duration of the mission.*
- *Time (hrs) = Distance (km)/Speed(km/h)*
- *Distance (km) = (Speed (km/h) \* Time(hrs))*
  
- *Example: Wind is 270°(W) at 20km/h, RPAS flying speed is 40km/h. When going east (090°) to 10km distant the RPAS groundspeed will be 60km/h and will take 10 minutes (10/60\*60) but coming west from 10km distant the GS will be 20km/h and will take 30 minutes (10/20\*60). Without wind the time both ways will be 15 minutes (10/40\*60).*
- *Any wind change speed and direction during a mission can obviously have a dramatic effect on the time required to complete the mission.*
- *Observing environmental wind speed and direction at all times is vital to the safety of the mission.*

*Airspeed (take off, cruise, landing, stall, maximum)*

*Take Off 10.5m/s (19kts), Cruise 12.5m/s (24kts), Landing 10.2m/s (20kts), Stall 9.2m/s (18kts) and Maximum 23m/s (45kts).*

7. The downloaded logs showed that the UAS experienced low airspeed and an increase in the Angle of Attack which resulted in a stall, and thus, led to the crash. According to the UAS user manual, the change in wind direction will either increase or decrease the UAS's speed. The speed can decrease to below allowable operating speed which could result in a stall.

<b>Probable Cause</b>
The UAS experienced low airspeed due to the change in wind direction which increased the Angle of Attack, and thus, led to the stall.
<b>Contributing Factor(s)</b>
None.
<b>Safety Actions</b>
The operator issued the following safety actions and mitigations: <ol style="list-style-type: none"> <li>1. Pilots should maintain their flight and remain aware of changing weather conditions.</li> <li>2. Pilots should change modes to recover from stalls. However, they should also be trained to correctly address similar situations.</li> </ol>
<b>Safety Message and/or Safety Recommendation/s</b>
None.
<b>About this Report</b>
<i>The decision to conduct a limited investigation is based on factors including whether the cause is known and the evidence supporting the cause is clear, the level of safety benefit likely to be obtained from an</i>

*investigation and that will determine the scope of an investigation. For this occurrence, a limited investigation has been conducted, and the Accident and Incident Investigations Division (AIID) has relied on the information submitted by the affected person/s and organisation/s to compile this limited report. The report has been compiled using information supplied in the initial notification, as well as from follow-up desk top enquiries to bring awareness of potential safety issues to the industry in respect of this occurrence, as well as possible safety action/s that the industry might want to consider in preventing a recurrence of a similar occurrence.*

*All times given in this report are Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.*

**Purpose**

*In terms of Regulation 12.03.1 of the Civil Aviation Regulations (CAR) 2011 and ICAO Annex 13, this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and not to apportion blame or liability.*

**Disclaimer**

*This report is produced without prejudice to the rights of the AIID, which are reserved.*

**This report is issued by:  
Accident and Incident Investigations Division  
South African Civil Aviation Authority  
Republic of South Africa**