SOUTH AFRICAN CIVIL AVIATION AUTHORITY

*Section/division* Accident and Incident Investigations Division Form Number: CA 12-57

# LIMITED OCCURRENCE INVESTIGATION REPORT – FINAL

| | | | | | | |
|---|---|---|---|---|---|---|
| **Reference Number** | CA18/3/2/1437 | | | | | |
| **Classification** | Serious Incident | **Date** | 15 January 2024 | **Time** | 0400Z | |
| **Type of Operation** | Aerial Works – Agricultural Spraying (Part 137) | | | | | |
| **Location** | | | | | | |
| Place of Departure | Glenside Aerodrome, KwaZulu-Natal Province | Place of Intended Landing | Glenside Aerodrome, KwaZulu-Natal Province | | | |
| Place of Occurrence | Rooidraai Farm near Winterton in KwaZulu-Natal Province | | | | | |
| GPS Co-ordinates | Latitude | 28º53'17.77" S | Longitude | 029º33'55.89" E | Elevation | 3 477ft |
| **Aircraft Information** | | | | | | |
| Registration | ZS-ART | | | | | |
| Make; Model; S/N | Thrush Aircraft Inc; S2R-H80 (Serial number: H80-116) | | | | | |
| Damage to Aircraft | Minor | Total Airframe Hours | 3 995.2 | | | |
| **Pilot-in-command** | | | | | | |
| Licence Type | Commercial Pilot Licence (CPL) | Gender | Male | Age | 61 | |
| Licence Valid | Yes | Total Hours | 11 945.7 | Total Hours on Type | 9 118.9 | |
| Total Hours 90 Days | 99.8 | Total Flying Hours on Type Past 90 Days | 99.8 | | | |
| **People On-board** | 1+0 | **Injuries** | 0 | **Fatalities** | 0 | **Other (on ground)** | 0 |

**What Happened**

On Monday morning, 15 January 2024, a pilot on-board a Thrush S2R-H80 with registration ZS-ART took off on a crop-spraying operation from Glenside Aerodrome near Winterton in KwaZulu-Natal province with the intention to land back at the same take-off aerodrome. The flight was conducted under visual meteorological conditions (VMC) by day and under the provisions of Part 137 of the Civil Aviation Regulations (CAR) 2011 as amended.

According to the pilot, after being airborne for approximately 30 minutes whilst spraying maize, the engine revolutions per minute (RPM) decayed to idle. The engine RPM increased briefly (approximately 8 seconds) and decayed to idle again. The pilot pulled up the aircraft and flew over the field; he turned the aircraft to the left whilst he scanned the area for a place to land. He identified two possible landing sites; one a dam, and the other, a maize field with a centre pivot. He opted for the maize field and landed the aircraft before he ran out of airspeed. During the landing roll in the maize field, the aircraft swerved to the left and came to a stop approximately 75 metres (m) after it had touched down. The pilot shut down the engine and disembarked from the aircraft. The aircraft sustained minor scratches due to the vegetation (maize) that rubbed against fuselage; no other damage was noted, and no person was injured during the incident.

The serious incident occurred during daylight at Global Positioning System (GPS) co-ordinates determined to be 28º53’17.77” South 029º33’55.89” East, at an elevation of 3 477 feet (ft).


**Figure 1**: The spray pattern flown by the pilot, including the forced landing circuit. (Source: Pilot)

**Figure 2**: The flattened maize crops after the forced landing. (Source Pilot)

**Figure 3**: The aircraft where it came to a stop in the maize field. (Source: Pilot)

**Figure 4**: The front view of the aircraft in the maize field.

**Figure 5**: A view of the aircraft with the propeller in the feathered position. (Source: Pilot)

MVP-50T Download and Field Observations

The aircraft was equipped with an MPV-50T, which is an engine monitoring system (see Figure 6) with a non-volatile memory. The unit was downloaded after the incident and the following data was retrieved:

*The total fuel remaining in the aircraft was 733 litres (193 US gallons).*
*There was no chip detector warning observed.*
*At 05:46:02, the Ng (Gas generator rotation speed indication) was 95%, the intermediate turbine temperature (ITT) was 625°C, and the Np (propeller speed) was 1 960 RPM with the torque at 68%.*
*At 05:47:33, the Ng had dropped to 61.1% with the ITT at 483°C, Np at 1 080 RPM and the torque at 8%.*
*Between 05:46:02 and 05:47:03, there was a slight fluctuation in torque as well as the propeller RPM which might have been an indication of a change in airspeed.*

*At 05:47:37, the Ng peaked at 84.9%, ITT 628°C, Np at 1 520 RPM, and the torque was 38%. This increase in engine parameters occurred after the pilot engaged the emergency circuit and advanced the emergency lever.*
*At 05:50:20, the aircraft came to a stop after the forced landing with the engine at ground idle Ng at 62.9%, ITT at 509°C, and torque at 18%. The pilot then switched off the engine.*

*No evidence of fuel contamination was observed visually, no metal particles were found in the oil sample, no metal particles were found in the oil screens, and no broken or loose linkages were found in the Fuel Control Unit (FCU) or Propeller Governor. All components were found intact and without any surface defects, damage or leaks. A post-incident borescope inspection was conducted, and no abnormalities were observed.*


**Figure 6:** The MVP-50T unit on-board the ZS-ART taken post-incident. (Source: Operator)

Fuel Sample

The operator took a fuel sample from the header tank of the aircraft before the aircraft was recovered from the maize field; the sample was sent to a chemistry laboratory. The report concluded that the sample met the marker for illuminating paraffin. No further analysis or conclusions were drawn from the sample.

**Diagnosis**

**Analysis as requested.**
**Authentix A1 marker for illuminating paraffin detected.**

| Tests | Sample Number: BA93109 | SPECIFICATIONS |
|---|---|---|
| | RESULTS | UNITS |
| Density @ 20°C | 0.782 | kg/l |
| Viscosity @ 40°C | 1.1 | cSt |
| Flashpoint | 53 | °C |
| Water Content | 0.005 | % |
| 90% Recovery Temperature | 226 | °C |
| Total Contamination | 2.9 | mg/kg |
| Sulphur | 19 | mg/kg |
| Sulphur | 0.0019 | % |
| Residue | 1.3 | % |
| Cetane Index | 47.5 | |
| Lead | | ppm |

**Visual Inspections / Additional Tests**

| | RESULTS | UNITS |
|---|---|---|
| Appearance | Clear | |
| Free Water | None Observed | |
| Visible Debris | None Observed | |
| Colour | Pale Straw Yellow | |
| Fungal Contamination | Not Requested | cfu/ml |
| Bacterial Contamination | Not Requested | cfu/ml |
| Total Acid Number | Not Requested | |
| Illuminating Paraffin Marker | Present | |
| Biodiesel | Not Requested | % |

**Particle Count**

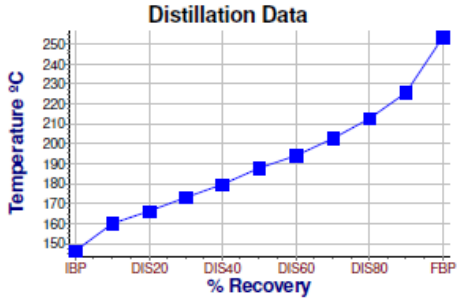
| 4 micron | 6 micron | 14 micron | Cleanliness |
|---|---|---|---|
| 3543 | 740 | 66 | 19/17/13 |

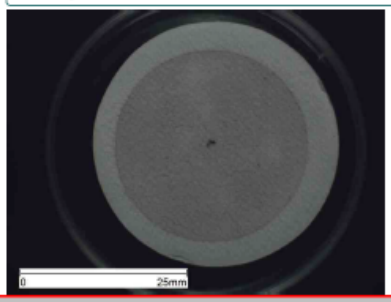
| | | | |
|---|---|---|---|
| Iron | : | Silicon | : |
| Aluminium | : | Manganese | : |
| Magnesium | : | Sodium | : |
| Zinc | : | Vanadium | : |
| Lead | : | | |

Elemental Analysis ppm

**Distillation Table And Graph**

| | |
|---|---|
| IBP | 146 |
| 10 | 160 |
| 20 | 166 |
| 30 | 173 |
| 40 | 179 |
| 50 | 188 |
| 60 | 194 |
| 70 | 203 |
| 80 | 213 |
| 90 | 226 |
| FBP | 254 |
| Rec % | 98.0 |






~ End Of Report ~

Fuel Control Unit (FCU)

The FCU with part number LUN6590.71-8 and serial number 203003 was removed from the engine; it was sent to the original equipment manufacturer (OEM). The OEM made the following observations:

*All measured characteristics were found within limits, except for the starting characteristics which were found slightly out of limits. However, this corresponds to performed FCU adjustments by adjusting elements in the field.*

*Disassembly was performed with the focus on the Main Metering Valve (MMV) which detects initial corrosion on the sleeve but on non-functional surfaces (Figure 7), therefore, it did not affect the FCU function although this indicated presence of water in the fuel. The Blade Relay Valve (BRV) was checked to ensure it functioned as expected. It was found to be operating optimally, and no increased clearances were identified. The BRV passed the functional test on sub-assembly level. No failure was found at FCU level.*

**Figure 7:** Corrosion on the main metering valve.

Fuel Pump

The Fuel Pump with part number LUN6290.04-8 and serial number 881061 was removed from the engine; it was sent to the OEM. The following observations were made:

*The fuel pump successfully passed the functional test without any deviation, and no degradation in performance was observed. Based on the functional test result, the fuel pump was not disassembled.*

Meteorological Information

The weather information in the table below was obtained from the pilot questionnaire (form CA 12-03).

| | | | | | |
|---|---|---|---|---|---|
| Wind Direction | Calm | Wind Speed | Calm | Visibility | 9999 m |
| Temperature | 19ºC | Cloud Cover | Nil | Cloud Base | CAVOK |
| Dew Point | Unknown | QNH | Unknown | | |

**Findings**

1. <u>Personnel Information</u>

1.1 The pilot had a Commercial Pilot Licence (CPL) that was initially issued on 24 April 2008. His last skills test was conducted on 30 August 2023, after which the licence was reissued with an expiry date of 31 August 2025. The pilot had flown a total of 11 945.7 hours, of which 9 118.9 hours were on the aircraft type.

1.2 The pilot was issued a Class 1 aviation medical certificate on 29 March 2023 with an expiry date of 31 March 2024.

2. Aircraft Information

2.1 The last maintenance inspection that was conducted on the aircraft before the incident flight was certified on 24 December 2023 at 3 954.9 airframe hours. The aircraft accrued 40.3 hours since the maintenance inspection.

2.2 The aircraft had a valid Certificate of Airworthiness (C of A) that was initially issued on 14 June 2013. The latest C of A had an expiry date of 30 June 2024. The aircraft was airworthy when it was dispatched for the flight.

2.3 The aircraft's Certificate of Registration (C of R) was issued to the present owner on 7 June 2013.

2.4 The aircraft was issued a Certificate of Release to Service (CRS) on 4 January 2024 with an expiry date of 3 January 2025 or at 4 054.9 airframe hours, whichever occurs first.

2.5 The aircraft was fitted with a General Electric H80-100 engine with serial number 134017. The engine was operated for 2 099.2 hours since new at the time of the incident.

2.6 The fuel sample that was taken and submitted to a chemistry laboratory for analysis did not reveal any presence of contaminants in the fuel.

2.7 The FCU was removed from the engine and was sent to the OEM for examination. The main metering valve displayed evidence of corrosion, but it did not have any effect on the functionality of the unit.

2.8 The fuel pump was removed from the engine and was sent to the OEM for testing. It passed the function test without any deviation.

3. Aircraft Maintenance Organisation (AMO)

3.1 The AMO that certified the last maintenance inspection on the aircraft prior to the incident flight had a valid AMO approval certificate (AMO 0149) that was issued by the Regulator (SACAA) on 5 September 2023 with an expiry date of 31 August 2024.

4. Operator

4.1 The operator had an Air Operating Certificate (AOC) that was issued by the Regulator on 24 November 2023 with an expiry date of 30 November 2024.

**Probable Cause**

During a crop-spraying operation, there was a sudden reduction in engine power and the pilot opted to perform a forced landing on a maize field. The cause of the reduction in engine power could not be established with certainty. However, the presence of water in the fuel could not be excluded as a possibility as the main metering valve in the FCU displayed evidence of corrosion which is associated with water being present in the fuel system.

**Contributing Factors**

None.

**Safety Action(s)**

None.

**Safety Message**

None.

**About this Report**

*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 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 desktop inquiries 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 apportion blame or liability.*

**Disclaimer**

**This report is issued by:**

**Accident and Incident Investigations Division**
**South African Civil Aviation Authority**
**Republic of South Africa**