AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:		CA18/2/3/10417	
Aircraft Registration	**ZS-IRW**	**Date of Accident**		6 February 2024		**Time of Accident**	0948Z
Type of Aircraft	Grumman G-164A			**Type of Operation**		Agricultural (Part 137)	
Pilot-in-command Licence Type	Commercial Pilot Licence (CPL)			**Age**	31	Licence Valid	Yes
Pilot-in-command Flying Experience		**Total Flying Hours**		922.2		**Hours on Type**	360.6

Last Point of Departure	Klippan Private Airstrip, Mpumalanga Province
Next Point of Intended Landing	Middelburg Aerodrome (FAMB), Mpumalanga Province
Damage to Aircraft	Substantial

Location of the accident site with reference to easily defined geographical points (GPS readings if possible)

South of Wonderfontein Colliery at GPS position 25°52'14.29" South 029°53'43.90" East, at an elevation of 5 732 feet

Meteorological Information	Surface wind: 280º/2kts; temperature: 26ºC; dew point: 15ºC; CAVOK

Number of People On-board	1 + 0	**Number of People Injured**	0	**Number of People Killed**	0	**Other (On the Ground)**	0

Synopsis

On Tuesday morning, 6 February 2024, a pilot on-board a Grumman G-164A aircraft with registration ZS-IRW took off on a crop-spraying operation from Middelburg Aerodrome (FAMB) to Klippan private airstrip, both in Mpumalanga province. The pilot was scheduled to conduct crop-spraying in Klippan Farm. Eleven loads of chemicals were uplifted and sprayed on the farm without incident. After completing the eleventh load, the pilot prepared to return to Middelburg Aerodrome for a full-stop landing. After take-off and during the climb, approximately 800 feet (ft) above ground level (AGL), the engine stopped. There was no indication in the cockpit to warn the pilot about the engine stoppage. After assessing the height and the surrounding area, the pilot identified a field in a coal mine on which to execute a forced landing. The aircraft landed on soft, muddy terrain and nosed over; the engine and the right main landing gear separated from the fuselage. The aircraft was substantially damaged; however, the pilot was not injured.

Probable Cause

In-flight engine stoppage, likely due to the failure of the switch for the magnetos which caused the pilot to conduct a forced landing which was unsuccessful.

Contributory Factor

Internal excessive wear, foreign material build-up, and electrical arcing on the selector switch.

SRP Date	11 March 2025	Publication Date	12 March 2025

Occurrence Details

Reference Number	**:** CA18/2/3/10417
Occurrence Category	**:** Category 1 (Accident)
Type of Operation	**:** Agriculture (Part 137)
Name of Operator	**:** Platorand Lugbespuiting
Aircraft Registration	**:** ZS-IRW
Aircraft Make and Model	**:** Grumman American Aviation Corporation, G-164A
Nationality	**:** South African
Place	**:** South of Wonderfontein Colliery, Mpumalanga Province
Date and Time	**:** 6 February 2024 at 0948Z
Injuries	**:** None
Damage	**:** Substantial

Purpose of the Investigation

In terms of Regulation 12.03.1 of the Civil Aviation Regulations (CAR) 2011, 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.

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.

Investigation Process

The Accident and Incident Investigations Division (AIID) was notified of the occurrence on 6 February 2024 at 1000Z. The occurrence was classified as an accident according to the CAR 2011 Part 12 and the International Civil Aviation Organisation (ICAO) STD Annex 13 definitions. Notifications were sent to the State of Registry, Operator, Design and Manufacturer in accordance with the CAR 2011 Part 12 and the ICAO Annex 13 Chapter 4. The States did not appoint an accredited representative and/or advisor. Investigators were dispatched to the accident site.

Notes:

1. *Whenever the following words are mentioned in this report, they shall mean the following:*
   Accident — this investigation accident
   Aircraft — the Grumman G164A involved in this accident
   Investigation — the investigation into the circumstances of this accident
   Pilot — the pilot involved in this accident
   Report — this accident report

2. *Photos and figures used in this report were taken from different sources and may have been adjusted from the original for the sole purpose of improving the clarity of the report. Modifications to images used in this report were limited to cropping, magnification, file compression; enhancement of colour, brightness, contrast; or addition of text boxes, arrows, or lines.*

Disclaimer

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Abbreviation	Description
°	Degrees
°C	Degrees Celsius
a/c	Aircraft
AGL	Above Ground Level
AIID	Accident and Incident Investigations Division
AMO	Aircraft Maintenance Organisation
AMSL	Above Mean Sea Level
AOC	Aircraft Operating Certificate
CAR	Civil Aviation Regulations
C of A	Certificate of Airworthiness
C of R	Certificate of Registration
CPL	Commercial Pilot Licence
CRS	Certificate of Release to Service
CVR	Cockpit Voice Recorder
EDS	Energy Dispersive X-ray Spectroscopy
FAMB	Middleburg Aerodrome
FDR	Flight Data Recorder
ft	Feet
GPS	Global Positioning System
hPa	Hectopascal
IIC	Investigator-in-charge
Km	Kilometre/s
Kt/s	Knots
m	Metres
METAR	Meteorological Aerodrome Report
QNH	Barometric Pressure Adjusted to Sea Level
RWY	Runway
SACAA	South African Civil Aviation Authority
SAWS	South African Weather Service
SEM	Scanning Electron Microscope
TTSN	Total Time Since New
UP	University of Pretoria
UTC	Universal Co-ordinated Time
VDL	Valid only with correction for defective distant vision
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
Z	Zulu (Term for Universal Co-ordinated Time - Zero Hours Greenwich)

1. FACTUAL INFORMATION

1.1. History of Flight

1.1.1. On Tuesday morning, 6 February 2024, a pilot on-board a Grumman G-164A aircraft with registration ZS-IRW took off on a crop-spraying operation from Middelburg Aerodrome to (FAMB) Klippan private airstrip with the intention to conduct crop-spraying in the Klippan area. The flight was conducted under visual meteorological conditions by day and under the provisions of Part 137 of the Civil Aviation Regulations (CAR) 2011 as amended.

1.1.2. The pilot stated the following about the day before the accident flight:

"We did not conduct spraying operations the day before the accident due to unfavourable weather conditions, including mist and wind. Most of the day was spent monitoring weather conditions, and I went home early. I went to bed at approximately 1740Z and was asleep by 1815Z."

1.1.3. On the day of the accident, the pilot reported the following:

"I woke up at 0200Z, feeling well-rested. Pre-flight checks commenced at approximately 0335Z. I took off from FAMB for the private runway at around 0350Z and landed at the private runway in the Klippan area at 0416Z. After landing, I began loading chemicals for my first spraying flight. I completed a total of 11 loads to finish the field I was working on. The operations proceeded smoothly and without incident.

I refuelled with a total of 637 litres of Avgas 100LL on loads 2, 4, 8, and 11. Specifically, I took 125 litres on load 2, 164 litres on load 4 175 litres on load 8, and 173 litres on load 11, which was the final load before returning to FAMB. I also topped up the oil with 2 quarts on load 8.

I began loading the final load of chemicals at 0919Z and was airborne by approximately 0933Z to complete the field spraying. Spraying was completed at approximately 0946Z with more than ¾ fuel remaining. I then set heading and began climbing to return to FAMB.

At approximately 0948Z, during a climb near the Wonderfontein Colliery, I experienced a sudden and complete engine failure. Approximately 1.5 minutes earlier, after completing my final spray run, I checked the engine instruments and observed no indications of impending failure or abnormalities. The engine failure occurred while climbing through approximately 800 feet AGL.

Upon realising the engine was no longer running and was windmilling, I immediately turned left toward what appeared to be a suitable field. This direction also aligned with the runway we were operating from, in case the engine restarted. I declared a MAYDAY on our operations frequency 123.35 megahertz (MHz) and informed ZS-NTK, which was conducting

crop-spraying operations nearby, about the situation. I then focused on the engine instruments to diagnose the issue. I observed low manifold pressure and no oil pressure indication. I performed the vital actions for engine failure: attempting to restart, Throttle fully open, Mixture full rich, Propeller pitch set to fine, and Magnetos set to both. These actions had no effect, and the engine continued windmilling.

I then refocused on the field I had selected for the forced landing. I quickly realized that I would not be able to reach the field due to a combination of a light headwind, rising terrain, and the high drag on the aircraft, resulting in an excessive rate of descent.

The area between my position and the chosen field appeared highly unsuitable for landing, as it contained a mine road with high shoulders and berms, as well as ditches and pipes further ahead. At this point, I had no viable options to the right, as that area was occupied by open-cast mining pits and a dam.

With my altitude decreasing rapidly, I assessed that landing straight ahead in the area short of the field would likely result in significant damage to the aircraft and pose a serious risk of injury to myself.

I decided to turn toward a field slightly to my left and below my position. This field appeared more suitable than the area between me and the originally chosen field, as it seemed relatively open and free of significant terrain or obstacles. I completed the turn, leveled the wings, and prepared to flare for the forced landing.

Due to the limited time available, I was only able to close the throttle and cut the mixture just before touchdown. Unfortunately, the combination of a downhill slope in the field and a light tailwind caused the aircraft to float, preventing it from touching down early enough to stop within the remaining field. As I approached the corner of the field.

The aircraft touched down approximately 30 metres from the berm and ditch in the corner of the field. In an attempt to stop the aircraft, I applied full aft elevator and brakes, but the landing gear contacted the berm, followed by the ditch. The aircraft then nosed over and came to a rest upside down, just short of the power line poles at the field's corner.

I attempted to open both doors, but they were jammed against the long grass and dirt due to the aircraft's inverted position. I turned and kicked the side door open, breaking a hole in the Perspex.

I noticed ZS-NTK aircraft circling overhead, and I gave a wave to signal that I was OK."

1.1.4. The ZS-NTK pilot was also interviewed; he reported that he asked the pilot of ZS-IRW about his location and he informed him that he was near Wonderfontein Colliery. He then flew to the mine and circled it until he located his aircraft, thereafter, he informed their safety manager about the incident through their company frequency 123.35-Megahertz (MHz).

1.1.5. The aircraft sustained substantial damage during the accident sequence; the pilot was not injured.

1.1.6. The accident occurred during daylight at Global Positioning System (GPS) co-ordinates determined to be 25°52'14.29" South 029°53'43.90" East, at an elevation of 5 732ft.

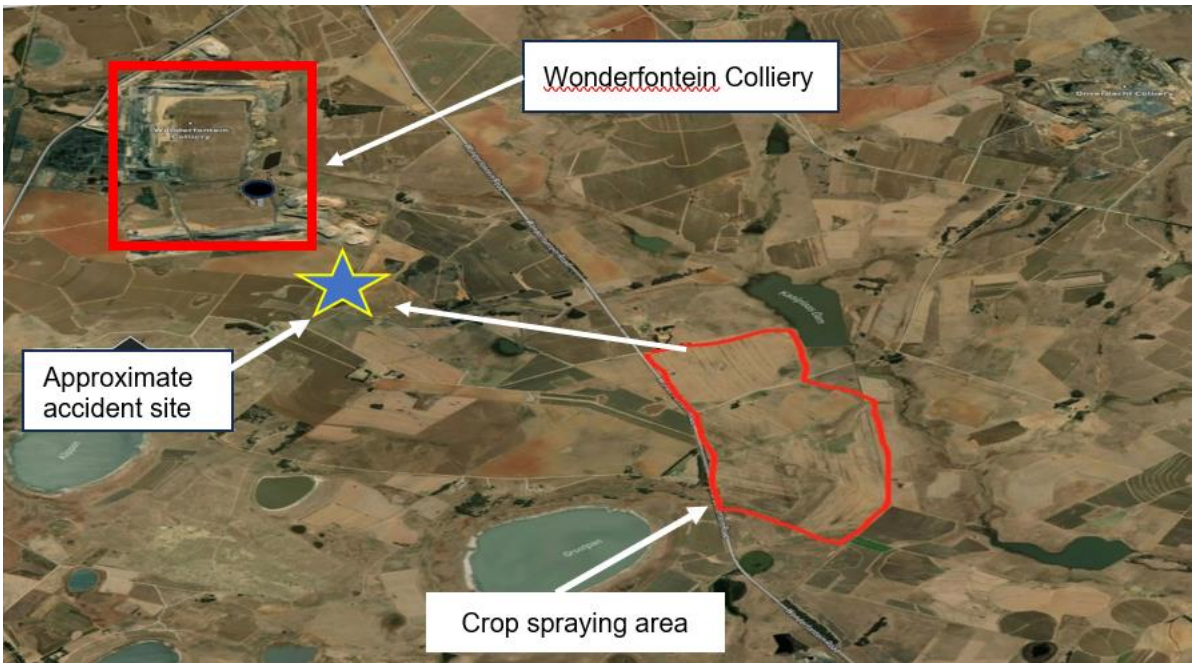

Figure 1: The location of the accident site, south-east of Wonderfontein Colliery. (Source: Google Earth)

1.2. Injuries to Persons

Injuries	Pilot	Crew	Pass.	Total On-board	Other
Fatal	-	-	-	-	-
Serious	-	-	-	-	-
Minor	-	-	-	-	-
None	1	-	-	1	-
Total	**1**	**-**	**-**	**1**	**-**

Note: Other means people on the ground.

1.3. Damage to Aircraft

1.3.1. The aircraft was substantially damaged during the accident sequence.

Figure 2: The aircraft as it came to rest in an inverted attitude.

1.4. Other Damage

1.4.1. None.

1.5. Personnel Information

Pilot-in-Command (PIC)

Nationality	South African	Gender	Male	Age	31
Licence Type	Commercial Pilot Licence (CPL)				
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	Instrument and Agricultural Ratings				
Medical Expiry Date	30 September 2024 (Class 1)				
Restrictions	VDL, valid only with correction for defective distant vision				
Previous Accidents	None				

Note: Previous accidents refer to past accidents the pilot was involved in, when relevant to this accident.

Flying Experience:

Total Hours	922.2
Total Past 24 Hours	0.3
Total Past 7 Days	0.3
Total Past 90 Days	113.5
Total on Type Past 90 Days	111.8
Total on Type	360.6

1.5.1. The pilot was initially issued a Commercial Pilot Licence (CPL) on 28 July 2021 under the provisions of Part 61 of the CAR 2011. The licence was revalidated on 17 September 2023 with an expiry date of 31 July 2024.

1.5.2. The pilot was issued a Class 1 medical certificate on 6 September 2023 with an expiry date of 30 September 2024.

1.5.3. The aircraft maintenance engineer (AME) who certified the last maintenance inspection prior to the accident flight had a valid AME Licence that was reissued on 23 April 2022 with an expiry date of 9 July 2024. The AME's licence had Pratt & Whitney Radial engine series endorsed on it.

1.6. Aircraft Information

1.6.1. Aircraft Description (Source: www.skybrary.aero)

The Grumman G-164A Ag-Cat is a single-engine agricultural biplane designed for aerial spraying and crop dusting. It features a rugged biplane configuration for excellent lift and stability, a Pratt & Whitney radial engine, and a robust fixed landing gear for rough field operations. Its cockpit offers clear visibility, and the aircraft is equipped with a hopper and spray booms for efficient dispersal of chemicals. The Ag-Cat is widely used in agriculture and forestry for tasks like pesticide application and firefighting.

Figure 3: The file picture of ZS-IRW aircraft. (Source: https://www.jetphotos.com)

Airframe:

Manufacturer/Model	Grumman American Aviation Corporation/G-164A	
Serial Number	984	
Year of Manufacture	1972	
Total Airframe Hours (At Time of Accident)	9695.8	
Last Inspection (Date & Hours)	20 November 2023	9658.8
Airframe Hours Since Last Inspection	37.0	
CRS Issue Date	20 November 2023	
C of A (Issue Date & Expiry Date)	5 May 2023	31 May 2024
C of R (Issue Date) (Present Owner)	14 December 2021	
Operating Category	Agriculture (Part 137)	
Type of Fuel Used	Avgas 100LL	
Previous Accidents	Date: unknown Ref: 7238 *An aircraft conducting crop-spraying in the Normandein area struck an object during take-off, damaging the right-side lower wing. The pilot/owner performed improper repairs which caused further damage to the main spar, rendering it uneconomical to repair. The aircraft continued flying for several hours before the incident was reported to the CAA. Additionally, the spraying operation was conducted without approval from an authorised operator.* *Probable Cause.* *During takeoff, the aircraft struck an object on the ground, causing substantial damage to the leading edge of the right-side lower wing.* 21 November 1998 Source: J10/2/6972 *During a ferry flight from Koppes to Uitkoms near Petrus Steyn, the pilot experienced a complete loss of power. Utilizing the aircraft's altitude, he glided over the power lines and performed a forced landing in a maize field. Due to the soft, wet ground from recent rains, the aircraft nosed over on landing, causing substantial damage to the left wing, vertical stabilizer, and horizontal stabilizer. The pilot was uninjured.* *Probable Cause.* *Fuel drained from the carburettor was found contaminated with water and a yellowish*	

	substance. After cleaning the carburettor, the engine started but it ran rough. Moisture, likely from exposure to bad weather post-accident, was removed from the magnetos. Once addressed, the engine started and ran smoothly. 20 January 2020 (Source:CA18/2/3/9854) *A Grumman G-164A aircraft (ZS-IRW) took off from Middelburg Aerodrome for crop spraying at a farm in Doornkop. After successfully completing two chemical loads, the aircraft returned to base, uplifted a third load, and resumed spraying. During the third spray pattern, at approximately 50 feet AGL, the engine lost power and stopped. The pilot immediately jettisoned the remaining chemicals to reduce weight and performed a forced landing on a soft, muddy field. The aircraft flipped over upon landing, sustaining substantial damage, but the pilot was uninjured.* *Probable Cause.* *The investigation determined that the engine failure was caused by a failed impeller bearing and a broken impeller gear, leading to a supercharger malfunction.*

Note: Previous accidents refer to past accidents the aircraft was involved in, when relevant to this accident.

1.6.2. The aircraft was issued a Certificate of Release to Service (CRS) on 20 November 2023 with an expiry date of 19 November 2025 or at 9758.8 airframe hours, whichever occurs first.

1.6.3. During the on-site inspection, it was observed that the left tank had ruptured and fuel spilled on the ground. The right tank remained intact; approximately 200 litres of fuel was drained from it. The fuel was checked for contamination, and none was found.

1.6.4. According to available information, the magneto switch is classified as an 'on-condition' item which means that it is not tracked as a life-limited component. Therefore, the magneto switch is replaced based on its condition.

1.6.5. According to available information, the magneto switch was an original component. The Aircraft Maintenance Manual (AMM) specifies that the magneto switch is to be visually inspected and tested for operational condition at every 100 hours mandatory periodic inspection (MPI); however, the AMM does not require disassembly or internal inspection of the magneto.

1.6.6. According to the flight folio, the magnetos had several issues with timing, which were rectified each time they malfunctioned.

1.6.7. Description and Operation of the Magneto Switch
(Source: Grumman G-164A, Aircraft Maintenance Manual)

The magneto switch controls the aircraft's ignition system by managing the electrical current to the magnetos, which generate the spark for the engine. It typically has positions for "OFF," "LEFT," "RIGHT," "BOTH," and sometimes "START." In normal operation, it is set to "BOTH" for redundancy. During pre-flight checks, the pilot tests each magneto individually and confirms the engine shuts down when set to "OFF." Both magnetos are grounded, *immediately cutting off the ignition system.*

This causes a complete engine shutdown, as there is no spark to ignite the fuel-air mixture in the cylinders

Failure modes include internal wear, electrical arcing, debris build-up, and grounding issues, which can lead to malfunction. Regular maintenance and pre-flight testing are crucial to ensure reliable operation.

Failure Modes:

- *Internal Wear: Contact surfaces may degrade over time, leading to intermittent or unreliable connections.*
- *Electrical Arcing: Repeated use can cause arcing that erodes contact points, leading to a switch malfunction.*
- *Foreign Material Build-Up: Dirt or debris inside the switch can interfere with electrical contacts, causing intermittent issues.*
- *Grounding Issues: If the grounding mechanism fails, the engine may continue to operate even when the switch is in the "OFF" position.*

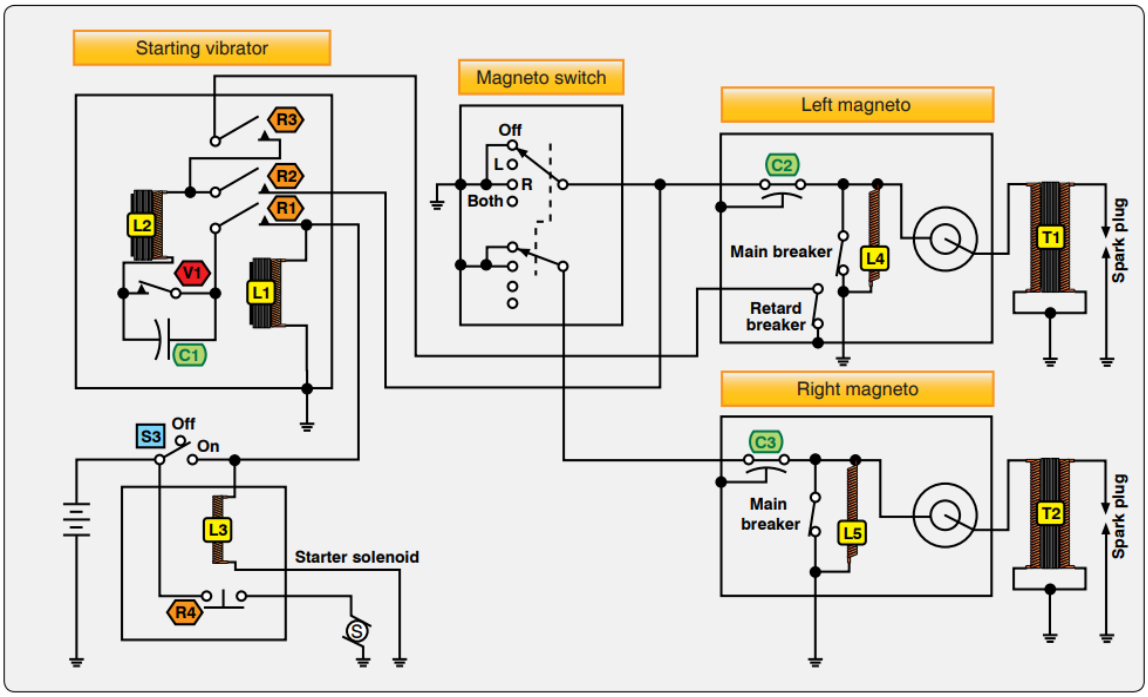

Diagram 1: Schematic of the magneto and ignition system.

Engine:

Manufacturer/Model	Pratt & Whitney R1340-S1H1-G
Serial Number	10464
Hours Since New	9695.8
Hours Since Overhaul	1 695.8

1.6.8. According to the engine maintenance manual, the engine is overhauled at 2 000 hours or every three years. According to the work pack, the engine was last overhauled on 5 December 2020 at 8 000 hours. The engine had 304.2 hours remaining until the next overhaul.

Propeller:

Manufacturer/Model	Hamilton Standard 23D40-311
Serial Number	230382
Hours Since New	9695.8
Hours Since Overhaul	2 920.3

1.6.9. According to the aircraft's Propeller Maintenance Manual, the propeller requires a 1500-hour midlife inspection, followed by an overhaul at 3000 hours. Therefore, the time between overhaul (TBA) of the propeller is 3000 hours or every three years. According to the work pack, the last overhaul was conducted on 5 December 2020 at 6775.5 airframe hours. The propeller had approximately 80 airframe hours remaining until the next overhaul.

1.7. Meteorological Information

1.7.1. The weather information below was obtained from the pilot questionnaire. The nearest aerodrome with a meteorological aerodrome report (METAR) data was Witbank Aerodrome (FAWI) in Mpumalanga province, located approximately 76 kilometres (km) from the accident site.

Wind Direction	340°	Wind Speed	04kt	Visibility	9999m
Temperature	27°C	Cloud Cover	Nil	Cloud Base	Nil
Dew Point	13°C	QNH	1022hPa		

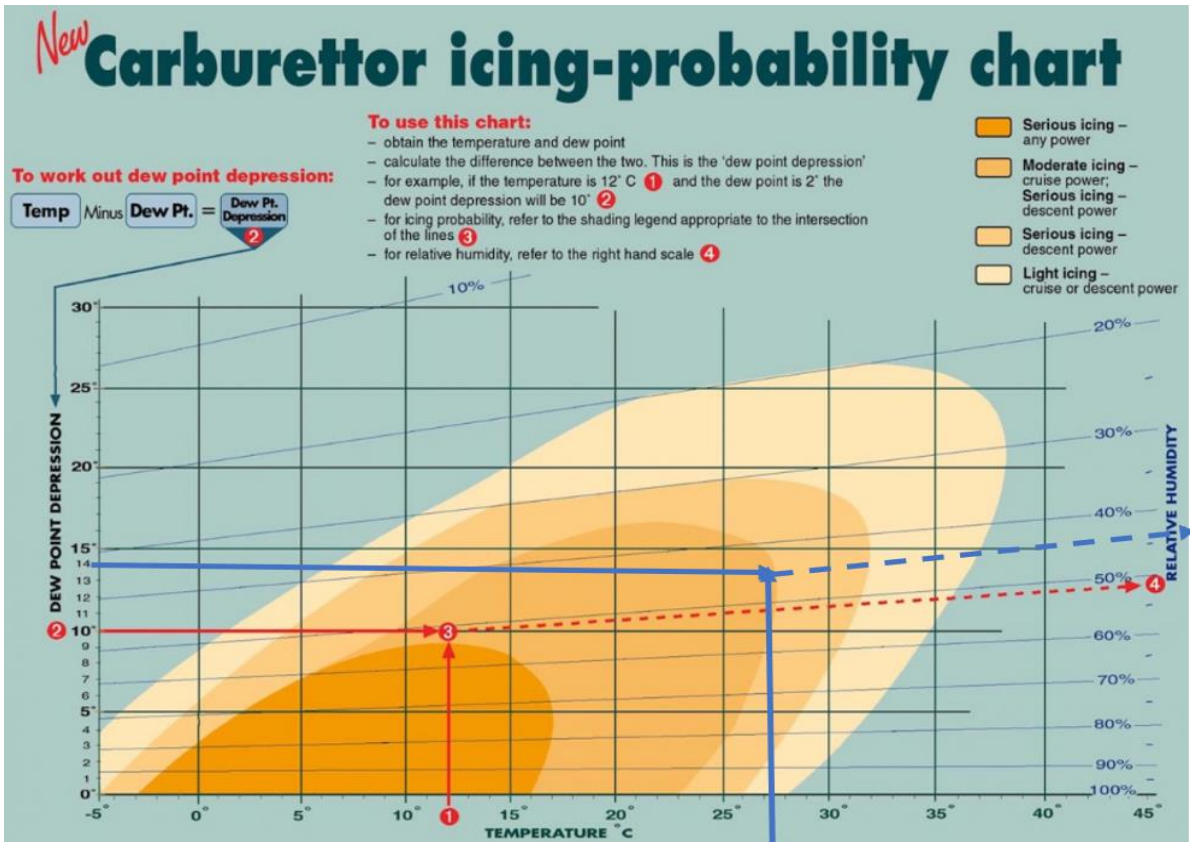

Figure 4: Icing-probability Chart.

1.7.2. The carburettor icing-probability chart on the day of the flight indicated a dew point depression of 14°C with a temperature of 27°C, and a dew point of 13°C with relative humidity at 42%. This did not place the engine at risk as the aircraft was in the climb phase.

1.8. Aids to Navigation

1.8.1. The aircraft was equipped with standard navigational equipment as approved by the Regulator (SACAA). There were no records indicating that the navigational equipment was unserviceable before the flight.

1.9. Communication

1.9.1. The aircraft was equipped with a standard communication system as approved by the Regulator. There were no recorded defects with the communication system before the flight.

1.10. Aerodrome Information

1.10.1 The accident occurred on an open field in Klippan, which was approximately 47 nautical miles from FAWI.

1.11. Flight Recorders

1.11.1. The aircraft was neither equipped with a flight data recorder (FDR) or a cockpit voice recorder (CVR), nor was it required by regulation to be fitted to the aircraft type.

1.12. Wreckage and Impact Information

The aircraft landed and rolled approximately 30m on the soft soil south-east of Wonderfontein Colliery. During the landing roll, the landing gear struck a berm and a pole which laid across the landing path. This caused the aircraft to nose over and impact a wire which supported the pole before it rested.

The aircraft's wings, ailerons, wing support struts, vertical stabiliser, nose landing gear, propeller, engine and engine thrust mounts were damaged. The right main landing gear and engine detached from the fuselage during the accident sequence. The wreckage distribution was localised in the vicinity of the accident site.

Figure 5: The aircraft at the accident site.

Figure 6: The aircraft in an inverted position.

1.12.1. The instrument panel was found intact and had no signs of damage. The magneto switch was in the OFF position.

Figure 7: The instrument panel.

1.13. Medical and Pathological Information

1.13.1. None.

1.14. Fire

1.14.1. There was no pre- or post-impact fire.

1.15. Survival Aspects

1.15.1. The accident was considered survivable as there was no damage to the cockpit and cabin areas that would have caused serious injury to the pilot. The pilot had his safety harness on and it did not fail during the accident sequence.

Figure 8: A view of the cockpit as it came to rest in an inverted attitude.

1.16. Tests and Research

1.16.1 (a) The Pratt & Whitney R1340, 9-cylinder radial reciprocal engine (Photo 1) with serial number 10464 was recovered from the accident site and sent to the University of Pretoria (UP) laboratory to determine the most probable causational factor/s of the failure during operation.

1.16.2 The pilot reported a 'sudden' engine failure without pre-warning indications.

Photo 1: The engine post-accident.

1.16.3. Visual Inspection Results

Engine Assembly (Diagram 2)

The visual inspection revealed damage and fractures to the engine mount frame (cradle) consistent with the reported impact sequence (Photo 2, red arrow). No indications of pre-existing damage and/or fractures were noted. The engine casing and cylinder assemblies revealed no signs of breaching (Photo 3).

One sparkplug per cylinder was removed. The sparkplugs revealed no clear indications of excessive wear (high temperature) and/or soot build-up. The engine was then rotated, and the inspection revealed continuity throughout with no resistance to rotation and/or indications of mechanical failure/s within the connecting rods, crankshaft assembly including the bearings and the accessory gearbox assembly.

During the rotation test, continuity was confirmed between the accessory gearbox drives and the 2x magnetos (Photo 4, red dashed circle), starter motor and the generator assemblies.

The fuel mixture control unit (carburettor) showed extensive impact damage (Photo 5).

The propeller assembly revealed no clear indications of malfunction while the damage was consistent with a low/no RPM on impact (Photo 6).

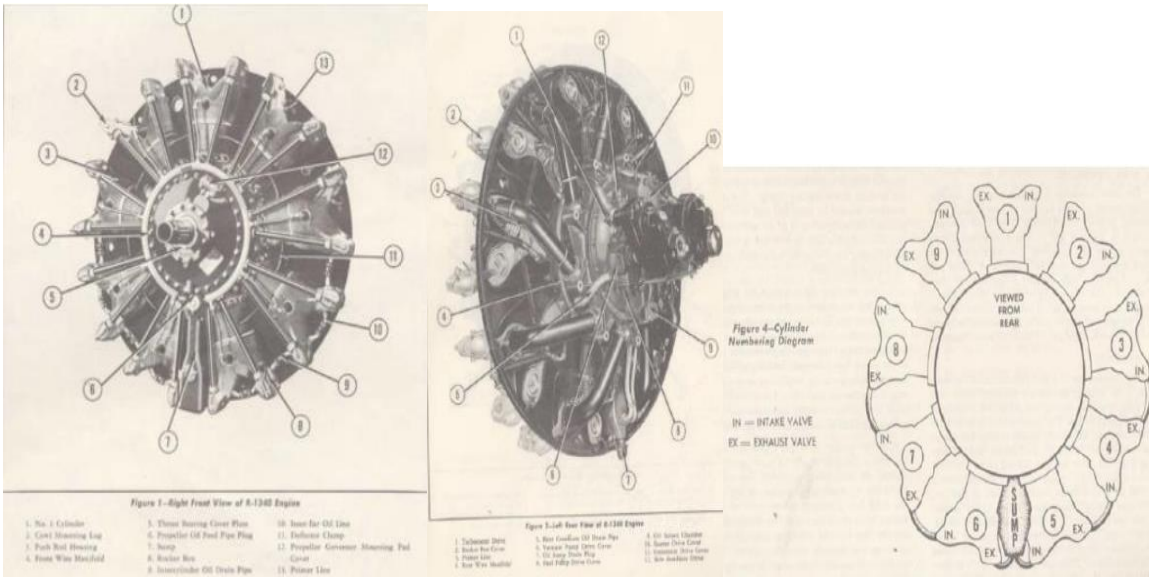

Diagram 2: Pratt & Whitney R1340 assembly.

Photo 2: Engine cradle condition (digital).

Photo 3: Cylinder and Crankcase conditions (digital).

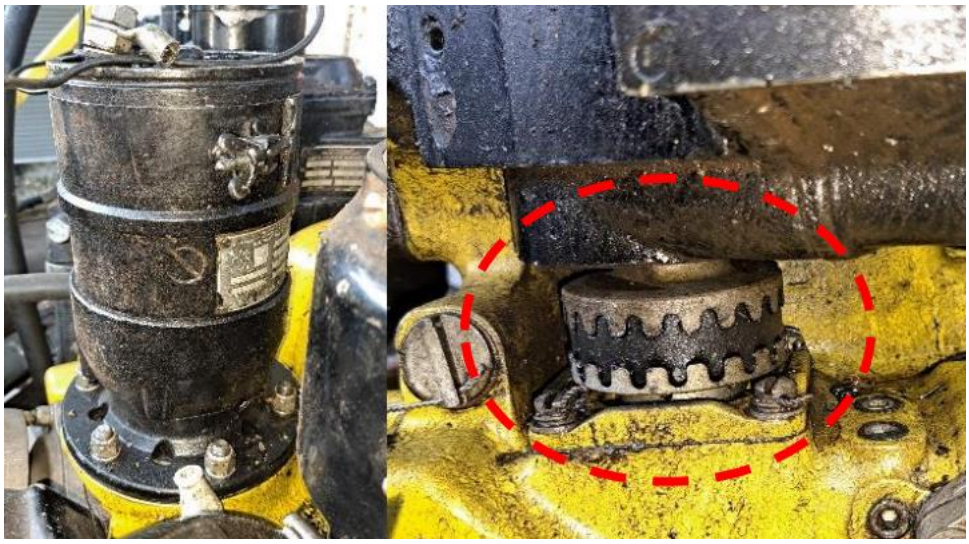

Photo 4: Accessories conditions (digital).

Photo 5: Fuel control unit damage (digital).

Photo 6: Propeller blade conditions (digital).

1.16.4. Borescope Inspection: Engine Assembly

The cylinder areas were internally inspected through a borescope.

The inspection revealed no clear indications of excessive cylinder wall wear/corrosion, piston head damages, intake/exhaust valve head damage, intake/exhaust valve seat damage and/or any other clear discrepancies (Photo 7) that could have contributed to the reported sudden stoppage of the engine during operation. No clear indications of high-temperature exposure were noted.

Photo 7: Borescope inspection (digital).

1.16.5. Oil Filter Analysis

Debris was removed from the oil filter for high-magnification inspection (Photo 8). The SEM and EDS analysis revealed no clear indications of excessive engine wear particulates and/or foreign matter ingestion.

Photo 8: Oil filter.

1.16.6. Magneto Selector Switch Inspections

The magneto selector switch was available and removed for laboratory inspection (Photo 9). The switch body revealed no clear indications of a loose turning knob, fractures and/or high temperature exposure to the electrical terminals. There was no clear resistance to rotation. The electrical continuity test between the terminals corresponded with to the required selection

during a rudimentary test.

The magneto selector switch was opened under controlled conditions for an internal inspection. The inspection revealed notable wear to the individual contact surfaces (Photos 10 and 11). Indications of foreign material build-up and electrical arcing were noted (Photo 12).

Photo 9: Magneto selector switch.

Photo 10: Magneto switch contact conditions (Stereo).

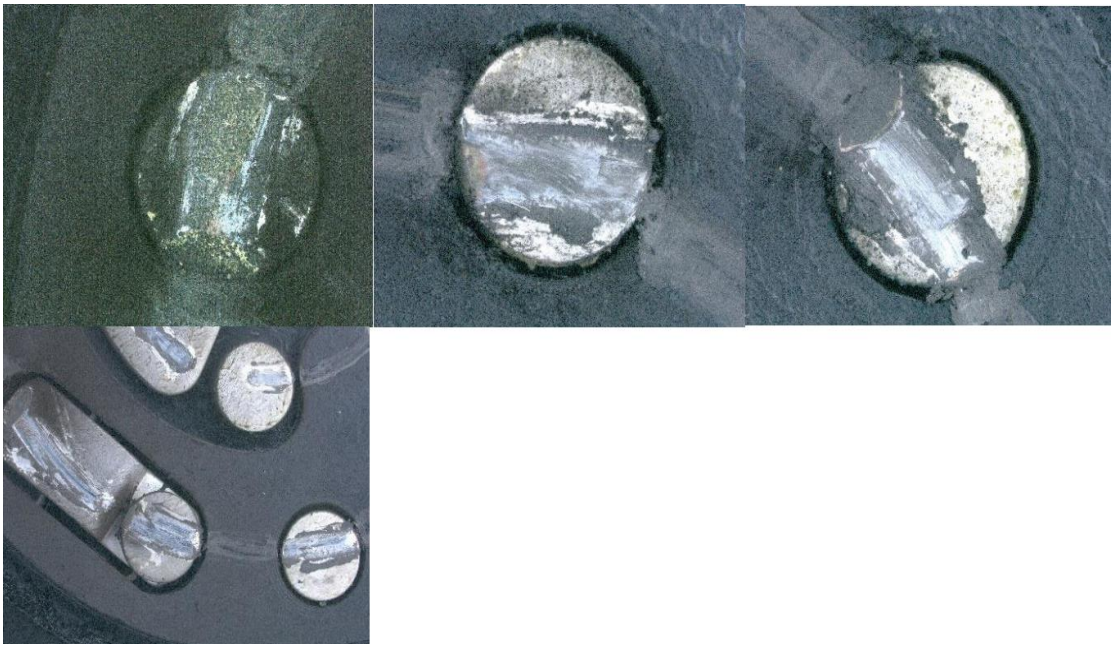

Photo 11: Magneto switch contact conditions (Stereo).

Photo 12: Magneto switch contact conditions (Stereo).

Conclusions:

It can be derived that the most probable cause of the sudden stoppage is an electrical failure with emphasis on the conditions that will allow both magneto assemblies to malfunction due to wear, the accumulated foreign material build-up and electrical arcing. The most probable condition then is when both magnetos are inadvertently 'earthed' during operation. It can be considered a low probability that the PIC will decisively introduce this condition via the Magneto Selector switch during flight (OFF). The combination of the noted wear, and electrical arcing

isolates the possible malfunction of the Magneto Selector switch during flight as the most probable causational factor.

1.17. Organisational and Management Information

1.17.1. This was an agricultural operation (crop-spray) flight operated under the provisions of Part 137 of the CAR 2011 as amended.

1.17.2. The operator had a valid Air Operating Certificate (AOC) that the Regulator issued on 28 August 2023 with an expiry date of 31 August 2024. The Agricultural Operations (Part 137) was endorsed on the AOC.

1.17.3. The SACAA-approved aircraft maintenance organisation (AMO) maintained the aircraft. The AMO was issued an AMO Certificate on 11 October 2023 with an expiry date of 31 October 2024.

1.18. Additional Information

1.18.1. The aircraft Pilot's Operating Handbook does not contain data relating to emergency procedure.

1.19. Useful or Effective Investigation Techniques

1.19.1. None.

2. ANALYSIS

2.1. General

From the available evidence, the following analysis was made with respect to this accident. This shall not be read as apportioning blame or liability to any organisation or individual.

2.2. Analysis

<u>Man</u>

2.2.1. The pilot's licence and medical certificate were valid, and the pilot met all regulatory requirements for operating the aircraft, including type endorsement and medical fitness. The pilot was well rested.

2.2.2. The engineer had a valid licence and met all regulatory requirements to conduct maintenance on the aircraft.

Mission

2.2.3. This was an agricultural operations (crop-spray) flight conducted under the provisions of Part 137 of the CAR 2011 as amended. The operator had valid certificates to operate and maintain the aircraft.

Machine

2.2.4. The aircraft was first registered to the present owner on 14 December 2021. The inspection and the Certificate of Release to Service (CRS) complied with the regulations. The wreckage distribution was localised to the accident site, south part of Wonderfontein Colliery.

Engine Functionality Before Impact

The inspection revealed no significant pre-existing mechanical failures or performance issues in the engine or its major components. Spark plugs, crankshaft, connecting rods and accessory systems were operational before the accident flight. The magnetos had issues with timing. The oil filter showed no significant signs of excessive engine wear, particulate matter or foreign object ingestion. The engine had an adequate fuel supply with no blockage in the fuel lines. The fuel was checked for contamination, and none was found.

Impact as the Primary Cause of Damage

The observed damage to the engine mount frame, carburettor, and other components were caused by the impact sequence and were consistent with no-power at the time of the crash.

No Power at Impact

Damage to the propeller assembly and other findings suggested that the engine was not delivering power at the time of impact.

Borescope Inspection: Engine assembly

The borescope inspection revealed no internal damage or anomalies in the cylinders, piston heads, valves, or valve seats, and no signs of excessive wear, corrosion or high-temperature exposure.

Magneto Switch Inspection

The magneto selector switch appeared externally intact and passed basic electrical tests. However, internal inspection revealed worn contacts, foreign material build-up, and electrical arcing, which could cause intermittent magneto failure and contribute to engine stoppage. The magnetos are on-condition items which means that they will not be removed or internally

inspected unless they are malfunctioning. This also meant that the magnetos had never been overhauled or internally inspected in 9 695.8 hours since fitted to the engine.

Given the wear on the magneto contact poles, foreign material build-up, and electrical arcing in the selector switch, it is likely that both magnetos failed and caused the engine stoppage.

Weather

2.2.5. Fine weather conditions prevailed at the time of the flight; the weather had no bearing on this accident.

3. CONCLUSION

3.1. General

From the available evidence, the following findings, causes and contributing factors were made with respect to this accident. These shall not be read as apportioning blame or liability to any organisation or individual.

To serve the objective of this investigation, the following sections are included in the conclusion heading:

- **Findings —** are statements of all significant conditions, events, or circumstances in this accident. The findings are significant steps in this accident sequence, but they are not always causal or indicate deficiencies.
- **Causes —** are actions, omissions, events, conditions, or a combination thereof, which led to this accident.
- **Contributing factors —** are actions, omissions, events, conditions or a combination thereof, which, if eliminated, avoided or absent, would have reduced the probability of the accident occurring, or would have mitigated the severity of the consequences of the accident. The identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil, or criminal liability.

3.2. Findings

Pilot

3.2.1. The pilot was initially issued a Commercial Pilot Licence (CPL) on 28 July 2021 under the provisions of Part 61 of the CAR 2011. The licence was revalidated on 17 September 2023 with an expiry date of 31 July 2024.

3.2.2. The pilot was issued a Class 1 medical certificate on 6 September 2023 with an expiry date of 30 September 2024.

AME

3.2.3. The aircraft maintenance engineer (AME) who certified the aircraft had a valid AME licence that was reissued on 23 April 2022 with an expiry date of 9 July 2024. The AME's licence had Pratt & Whitney Radial engines series endorsed on it.

Aircraft

3.2.4. The aircraft was issued a Certificate of Registration (C of R) on 14 December 2021.

3.2.5. The aircraft was initially issued a Certificate of Airworthiness (C of A) on 5 May 2021. The C of A was reissued on 5 May 2023 with an expiry date of 31 May 2024.

3.2.6. The last annual inspection of the aircraft was conducted and certified on 20 November 2023 at 9 658.8 airframe hours. The accident occurred at 9 695.8 total airframe hours which meant that the aircraft had accrued 37 airframe hours since the last annual inspection.

3.2.7. The aircraft was issued a Certificate of Release to Service (CRS) on 20 November 2023 with an expiry date of 19 November 2025 or at 9 758.8 airframe hours, whichever occurs first.

3.2.8. The AMO which conducted the last MPI of the aircraft had an AMO Certificate that was issued on 11 October 2023 with an expiry date of 31 October 2024.

3.2.9. The inspection revealed no significant pre-existing mechanical failures or performance issues in the engine or its major components. Spark plugs, crankshaft, connecting rods, and accessory systems appeared operational before the accident flight.

3.2.10. The oil filter showed no significant signs of excessive engine wear, particulate matter or foreign object ingestion. The engine had an adequate fuel supply with no blockages in the fuel lines; the fuel was also not contaminated.

3.2.11. The magneto selector switch was intact and passed basic electrical tests.

3.2.12. The internal inspection of both magnetos revealed worn contacts poles, foreign material build-up, and electrical arcing, which could have likely caused magneto failure and the engine stoppage.

Operator

3.2.13. The operator had an Air Operating Certificate (AOC) that was issued by the Regulator on 28 August 2023 with an expiry date of 31 August 2024.

3.3. Probable Cause/s

3.3.1. In-flight engine stoppage, likely due to the failure of the switch for the magnetos which caused the pilot to conduct a forced landing which was unsuccessful.

3.4. Contributory Factors

3.4.1 Internal excessive wear, foreign material build-up, and electrical arcing on the magneto selector switch.

4. SAFETY RECOMMENDATIONS

4.1. General

The safety recommendations listed in this report are proposed according to paragraph 6.8 of Annex 13 to the Convention on International Civil Aviation and are based on the conclusions listed in heading 3 of this report. The AIID expects that all safety issues identified by the investigation are addressed by the receiving States and organisations.

4.2. Safety Recommendation/s

4.2.1. It is recommended that the Regulator investigates the possibility to mandate the internal inspection or overhaul of magnetos at 100-hour inspection and, subsequently, overhaul the magnetos at every 500-hour intervals.

4.2.2 It is recommended that the type certificate holder investigates the possibility to add internal magneto inspection and overhaul at every 100- or 500-hour intervals.

5. APPENDICES

5.1. None.

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