SOUTH AFRICAN CIVIL AVIATION AUTHORITY

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

LIMITED OCCURRENCE INVESTIGATION REPORT – FINAL

Reference Number	CA18/2/3/10369								
Classification	Accident		**Date**	1 October 2023		**Time**	0554Z		
Type of Operation	Private (Part 91)								
Location									
Place of Departure	Private Farm, Varksfontein, Limpopo Province		Place of Intended Landing	Wonderboom Airport (FAWB), Gauteng Province					
Place of Occurrence	On a private farm situated 0.8 nautical miles south-west of the take-off position								
GPS Co-ordinates	Latitude	24°0'27.09"S	Longitude	28°14'10.63"E	Elevation	4068 ft			
Aircraft Information									
Registration	ZS-MTM								
Make; Model; S/N	Cessna T210N (Serial Number: 210-64478)								
Damage to Aircraft	Substantial		Total Aircraft Hours	3252.3					
Pilot-in-command									
Licence Type	Commercial Pilot Licence		Gender	Male	Age	48			
Licence Valid	Yes	Total Hours	266.8	Total Hours on Type	266.8				
Total Hours 30 Days	5.0		Total Flying on Type Past 90 Days	9.8					
People On-board	1+2	**Injuries**	3	**Fatalities**	0	**Other (on ground)**	0		

What Happened

On Sunday, 1 October 2023 at 0554Z a Cessna 210 aircraft with registration ZS-MTM was involved in an accident in Waterberg, Limpopo province. Visual meteorological conditions (VMC) by day prevailed at the time of the flight which was conducted under the provisions of Part 91 of the Civil Aviation Regulations (CAR) 2011 as amended.

According to the pilot, on Friday, 29 September 2023, he took off from Wonderboom Airport (FAWB) with two passengers on a private flight to his private farm Varksfontein airstrip in Waterberg, Limpopo province. According to a witness who was at FAWB on 29 September 2023, during the initial take-off, the aircraft made an air turn back after the pilot noticed a splash of oil on the windshield. Upon landing, the aircraft was taken to an aircraft maintenance organisation (AMO), and it was found that the oil cap was not fitted back on when the aircraft took off. Oil was added and the oil cap was fitted, whereafter, the aircraft was prepared for the second take-off. *This incident was not reported or recorded in the flight folio by the pilot, aircraft maintenance organisation (AMO) or the air traffic control (ATC) officer at the time it occurred.* The aircraft took off for the second time, and the flight to Waterberg was uneventful. The aircraft was parked in the airfield for the duration of their stay.

According to the pilot, on the morning of 1 October 2023 at approximately 0552Z, a pre-flight which included checking the fuel in the fuel tanks was conducted and all was found to be satisfactory. He then boarded the aircraft with his two passengers with the intention to return to FAWB.

The pilot stated that the take-off at the private farm was on a gravel runway in the south-western direction. During take-off, he configured the aircraft by setting power at 2700 revolutions per minute

(rpm), the manifold pressure was at 26 inches with the fuel flow of 130 pounds per hour (lbs/h), the temperature and pressure gauges were all in the green arc. Take off was uneventful. At a height of 250 feet (ft) above ground level (AGL), the pilot commenced with the after take-off checks where he retracted the landing gear and set the engine power to 2500 rpm, raised flaps to 0 degree and left the mixture unchanged at 100 pounds per hour. The aircraft subsequently experienced an engine power loss.

The pilot attempted to re-start the engine by switching the fuel tanks feeder from the left- to the right-side fuel tank, as well as switched the low auxiliary fuel pump to the "ON" position with no success. The pilot surveyed the surrounding area and identified an open field ahead of his flight path which was approximately 1.2 kilometres (km) (0.65 nautical miles [nm]) from the take-off position on which to execute a forced landing. He then broadcasted on radio and stated that his aircraft had experienced an engine power loss and that he was intending to execute a forced landing on the private farm ahead of his flight path. According to the pilot, following an engine power loss whilst committed to a forced landing, he opted not to extend the landing gear as he was flying over a mountainous terrain, and he did not want to cause drag which could limit his glide speed and end up landing on the trees or mountainous terrain.

During the forced landing, the aircraft impacted three treetops with the bottom fuselage, followed by the left wing as the aircraft was losing height rapidly. The aircraft subsequently made contact with the ground and skidded on the grass for approximately 70 metres (m). The right-wing impacted a tree stem with the leading edge towards the wing tip which caused the aircraft to spin clockwise before it stopped facing north. The aircraft sustained substantial damage to the bottom fuselage, both wings' leading edge, the wing tip covers which detached, the right-side elevator, the nose section's engine cowlings and the propeller blades. After the accident, one of the passengers was able to disembark from the aircraft and assisted the pilot and the other passenger to vacate the aircraft. They rested under the left wing. The occupants sustained serious injuries; they were airlifted to Mediclinic in Limpopo province.

The post-accident inspection

An on-site investigation revealed that the overall condition of the aircraft was intact. The aircraft was found resting on its belly and tilted to the right. The right-wing tip touched the ground, and the left-wing tip was high with all the landing gears fully retracted. No damage was noted on the fuel tanks and no fuel was found in them. The right-side elevator and the control surface sustained damage. No visible damage was noted on the engine. The cockpit inspection revealed the following: the landing gear lever was in the UP position; all flight controls were accounted for and there was continuity with no difficulties in movement; the throttle, although it was bent, it was operative with no restriction on the throttle cable movement.

Post-accident interview with the pilot revealed that there was fuel dripping from the left wing near the wing attachment root point. The first responders stated that the farm owner arrived whilst they were on site to drain fuel from the aircraft (to minimise the possibility of fire which would cause damage to his farm), however, there was nothing found in any of the fuel tanks, and there was no fuel leak observed.

According to the recovery team, upon reaching the accident site, they inspected the aircraft and the surrounding area and could not find any signs of fuel spillage or leaks. During their inspection, they noticed that the fuel mixture control lever was fully IN which meant that it was left in the rich position

during the accident sequence. The aircraft's fuel system was inspected for damage and any possible fuel leak, and no anomalies were found. The engine was examined in the field and a further extensive examination and engine run were conducted later in a controlled environment. The examination did not reveal any mechanical anomalies that would have prevented the engine from producing power during the flight.

A review of the aircraft maintenance documents was conducted with no recorded evidence noted that related to any of the aircraft systems, especially the fuel system. According to the information in the flight folio, the following evidence was revealed: the aircraft was uplifted with 228 litres (l) of fuel on 25 September 2023 prior to the flight of approximately 0.6 hours that led to a total of 3251.1 airframe hours. The pilot provided the supporting fuel slips as confirmation of the purchased fuel that was uplifted. No further entries were noted in the flight folio.

The aircraft was then flown on 29 September 2023 by the owner, accompanied by two passengers, to his farm in Waterberg. The aircraft instrument indicated that it had a total of 3252.3 airframe hours at the time of the accident. The aircraft, following an indicated fuel upliftment, had accumulated 1.2 hours for both flights. According to the fuel calculations, there should have been sufficient fuel left in the aircraft's fuel tanks, however, there was no fuel found in any of the fuel tanks and no evidence of fuel spillage noted.

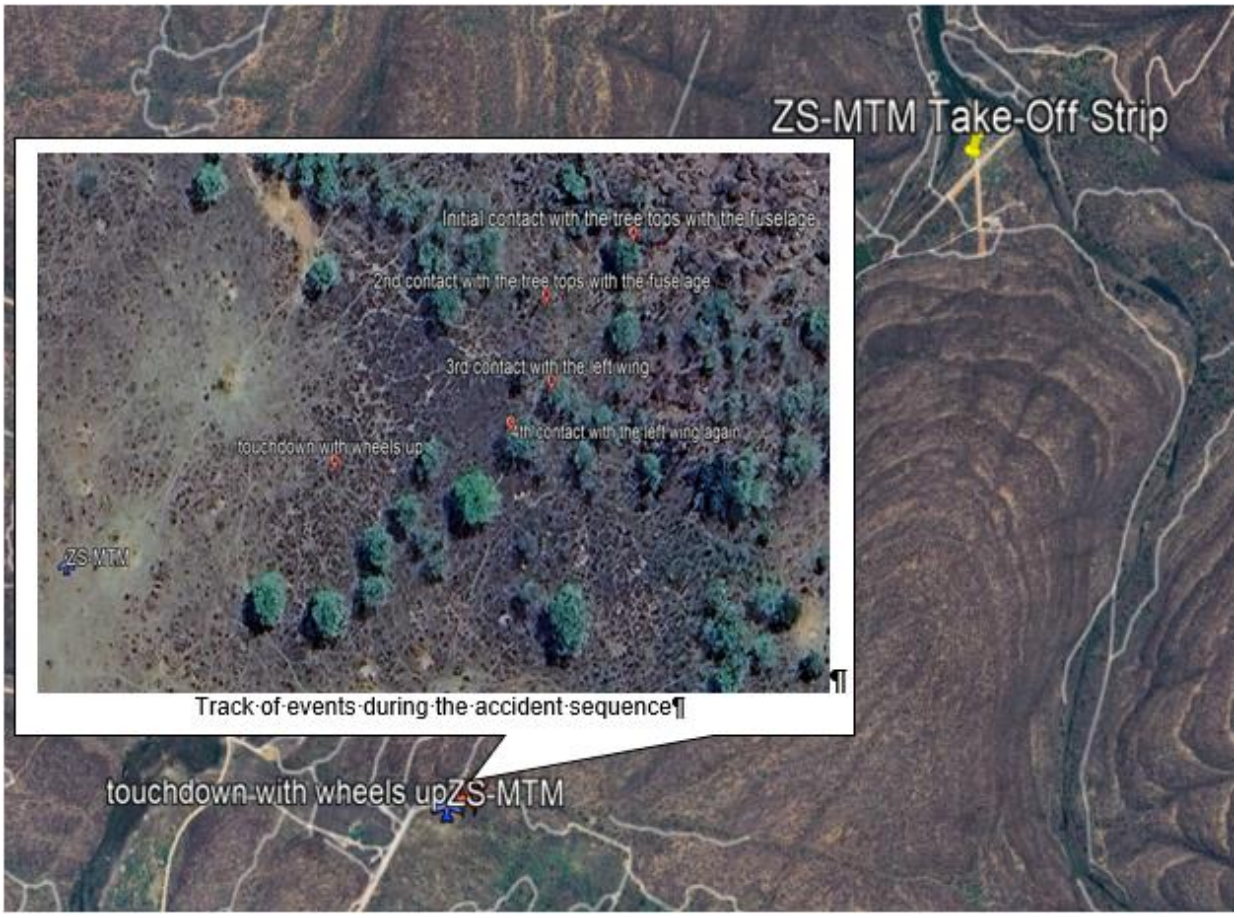

Figure 1: An overview of the accident site and the take-off site. (Source: Google Earth)

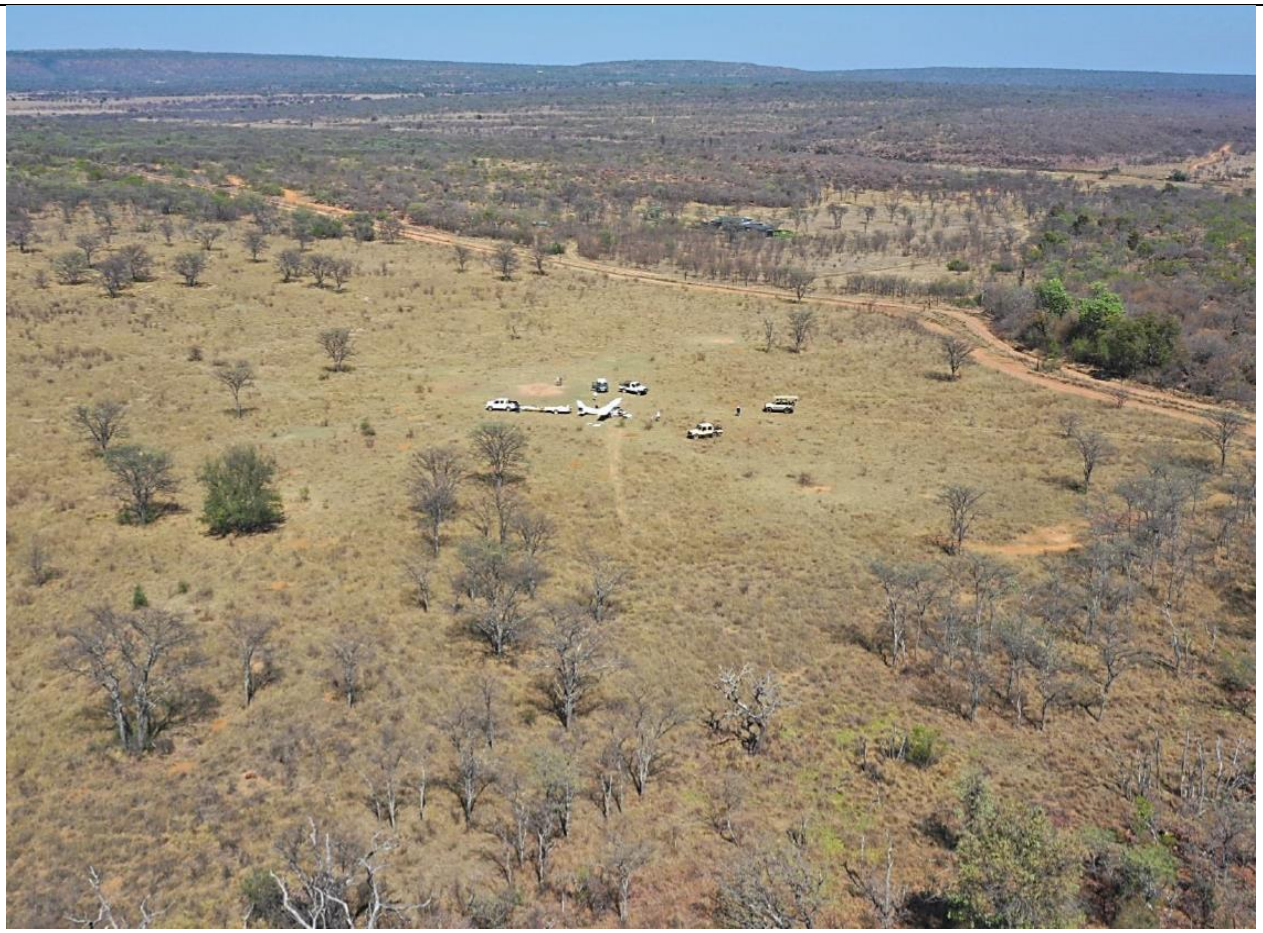

Figure 2: Arial photo of the accident site. (Source: Insurance Assesor)

Figure 3: The first of the trees that the aircraft impacted.

Figure 4: The aircraft as it came to rest at the accident scene. (Source: Pilot)

About the Aircraft:

The information below is an extract from the Pilot's Operating Handbook

The Cessna 210 is a six-seat, high-performance aircraft equipped with fully retractable landing gear. It is fitted with a single turbocharged, direct-drive, air-cooled, horizontally opposed, fuel-injected, six-cylinder engine with 520 cu.in displacement. It is a high-wing configuration design for general aviation which was first flown in January 1957 and produced by Cessna until 1985.

Fuel system

The fuel system consists of two vented integral fuel tanks (one in each wing), two fuel reservoir tanks, a fuel selector valve, auxiliary fuel pump, fuel strainer, engine-driven fuel pump, fuel air control unit, fuel manifold, and fuel injection nozzles. The fuel from any of the wing fuel tanks is directed to the collector tank (reservoir) depending on the selected tank before it feeds to the engine. Both fuel tanks provide a total amount of 534lbs (329litres) usable fuel for aircraft operations. The aircraft type can either be flown with fuel selected to either the left or right tank.

Aircraft Performance specification and limitations

Gross weight (take-off and landing): 3400lbs-4100lbs
Standard Empty weight: 2150lbs-2500lbs
Maximum baggage allowance: 120-200lbs

Flight load factor (flap up): +3.8g to -1.52g
Flight load factor (flap down): +2.0g to -0g

Weight and Balance Calculations:
On the day of the flight, the weight of the aircraft was calculated as follows:
Pilot and two passengers' weight: 714.3lbs
Baggage: 46lbs
Fuel at the time of take-off: 284.4lbs
Total weight calculations: 3195lbs
The maximum allowable take-off weight is 3400lbs

Fuel Calculations:
The fuel calculation at a higher fuel flow setting of 13lbs/hr. for the flight duration of 1.2 hours was as follows: an indicated uplifted fuel of 228 litres (360.24lbs) was considered for the calculations: The flight duration at the time of the accident was 1.2 hours since the last fuel upliftment.

130lbs/hr. X 1.2hr. = 156 lbs
The aircraft, for the indicated flight duration, had consumed 156lbs (98.7 litres) of fuel.

Performance for a normal operation (take-off):
Extracted from the Pilot's Operating Handbook

Normal take-off flaps up*:*
At 4000ft above sea level 132lbs/hr with engine set on 2850 rpm.
Wing flap 10° preferred.
Power: 36.5 inches Hg and 2700rpm (5 minutes limit)
Mixture: Adjust to 178-186 lbs/hr.
Elevator control: lift nose wheel at 60 to 70KIAS.
Note: When the nose wheel is lifted, the gear motor may run 2-3 seconds to restore hydraulic pressure.
Climb Speed: 80-90 KIAS
Brakes: Apply momentarily when airborne.
Landing gear: Retract in climb out.

Enroute climbing: (Normal Climbing)
Airspeed: 100-120KIAS
Power: 30inches Hg and 2500rpm
Mixture: Lean to 120 lbs/hr.
Note: On hot days, it may be necessary to utilize the auxiliary fuel pump to maintain 120lbs fuel flow.
Cowl flaps Open as required.
Note: On hot days at higher altitudes, be alert for fuel vapor.

Engine failure during take-off and restart procedure.
Airspeed: 85KIAS
Mixture: IDLE cut-off
Fuel On-Off Valve: Off (pull-out).
Wing Flaps: AS required (30 recommended)
Ignition Switch: OFF
Master Switch: OFF

Engine failure during flight (Restart Procedures)
Airspeed: 85KIAS
Fuel Selector Valve: Both (The aircraft can only fly on individual fuel tank as per selection (left or right).
Auxiliary fuel pump: ON
Throttle: Half Open.
Mixture: Lean from full rich until restart occurs.

The aircraft took off from a field elevation of 3877 feet with a calculated density altitude indication determined to be 5604ft at a given air temperature of 23ºCelcius and a QNH of 1018. The Density Altitude calculations below were conducted using the following source: https://wahiduddin.net/calc/calc_da.htm

Density Altitude Calculator				
Elevation	3877	◉ feet	○ m	
Air Temperature	23	○ deg F	◉ deg C	
Altimeter Setting	1018	○ in Hg	◉ hPa	
Dew Point	0	○ deg F	◉ deg C	
Calculate Reset				
Density Altitude	5604	feet	1708	m
Absolute Pressure	26.09	in Hg	883.4	hPa
Air Density	0.0647	lb/ft3	1.036	kg/m3
Relative Density	84.61	%	84.61	%
Estimated AWOS	5500	feet	1676	m
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Table 1: Density Altitude Calculation.

The meteorological information was obtained from the South African Weather Service (SAWS) compiled for Lephalale which is situated approximately 60km north-west of the accident site. Lephalale was the closest weather station and, thus, was used as a reference point:

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Findings

1. The pilot had the Private Pilot Licence (PPL) which was initially issued by the Regulator on 11 October 2022. The licence renewal was issued on 13 April 2023 with an expiry date of 30 April 2025.

2. The pilot's Class 2 aviation medical certificate was issued on 17 March 2023 with an expiry date of 31 March 2024. The pilot's training was conducted on the aircraft type and was also endorsed on his licence. He accumulated a total of 266.8 hours on the aircraft type.

3. The aircraft was issued the Certificate of Airworthiness (C of A) by the Regulator on 28 August 2023 with an expiry date of 30 September 2024. The aircraft's last maintenance was conducted and certified on 23 August 2023. The aircraft was issued the Certificate of Release to Service (CRS) at 3240.4 airframe hours with an expiry date of 22 August 2024 or at 3340.4

airframe hours, whichever comes first. The aircraft was flown a further 11.9 airframe hours following the said maintenance.

4. The aircraft was maintained by the Regulator-approved aircraft maintenance organisation (AMO) which had an AMO certificate that was issued on 3 November 2022 with an expiry date of 30 November 2023.

5. The aircraft was last uplifted with a total fuel of 228 litres on 25 September 2023, and a flight of 0.6 hours was conducted. On 29 September 2023, the aircraft took off and made an air turn back immediately after take-off and landed back at FAWB whereafter it was taxied to the hangar. Later, the aircraft took off for the intended flight to a farm approximately 190 km (102 nautical miles [nm]) north of FAWB in Limpopo province. The aircraft was parked until its return flight to FAWB on Sunday morning. The aircraft can either be flown with fuel selected to the right or the left fuel tank. Despite the fact that no fuel was available in the fuel tanks following the accident and with no evidence of fuel spillage, the fuel calculations indicated that there should have been sufficient fuel on-board the aircraft fuel tanks, enough for the flight duration of the intended flight.

6. The aircraft was found with the fuel selector selected to the right-side tank as the pilot had advised that he switched the fuel section from left to right following the engine power loss. The flap selection lever was in the UP position. The landing gear lever was also in the UP position as the aircraft was landed wheels-up.

7. The fuel mixture was in a fully IN position. The throttle lever was pulled out fully and had been bent, which was attributed to the accident sequence damage. According to the engine restart procedure, the throttle is required to be in a half-open position and the mixture control selected to lean position whilst attempting to recover engine power. However, the altitude at which the aircraft was at, was not sufficient.

8. An examination of the airplane and related systems revealed no pre-existing anomalies. The engine was examined in the field, moreover, an extensive examination and engine run were conducted later in a controlled environment post-accident. The examinations did not reveal any mechanical anomalies that would have prevented the engine from producing power during the flight.

Probable Cause(s)

In-flight engine stoppage due to fuel exhaustion which resulted in an unsuccessful forced landing.

Contributing Factor(s)

Insufficient or no pre-flight as the aircraft was found without evidence of fuel on-board following the accident and there was no evidence of fuel leak or fuel tank damage.

Safety Action(s)

None.

Safety Message

To avoid injuries or damage to property, pilots are advised to always conduct a proper pre-flight inspection to prevent such accidents.

About this Report

The decision to conduct a limited investigation is based on the 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 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.

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