AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:		CA18/2/3/10443	
Aircraft Registration	ZS-KNE	**Date of Accident**		21 April 2024		**Time of Accident**	1330Z
Type of Aircraft	Cessna 172 RG			**Type of Operation**		Private (Part 91)	
Pilot-in-command Licence Type	Private Pilot Licence (PPL)		**Age**	30		**Licence Valid**	Yes
Pilot-in-command Flying Experience	**Total Flying Hours**			154.7		**Hours on Type**	94.3
Last Point of Departure	Witbank Airport (FAWI), Mpumalanga Province						
Next Point of Intended Landing	Witbank Airport (FAWI), Mpumalanga Province						
Damage to Aircraft	Destroyed						
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)							
At GPS co-ordinates: 25° 50' 34.2" South 029° 11' 22.3" East, at an elevation of 5 155 feet (ft).							
Meteorological Information	Surface wind:030°/ 5 kt; temperature: 31°C; dew point: 12°C; CAVOK						
Number of People On-board	1 + 3	**Number of People Injured**	0	**Number of People Killed**	4	**Other (On Ground)**	0

Synopsis

On Sunday afternoon, 21 April 2024, a pilot and two passengers (one male and one female) on-board a Cessna 172 RG aircraft with registration ZS-KNE took off on a private flight from Nelspruit Airport (FANS) to Witbank Airport (FAWI), both located in Mpumalanga province. After landing at FAWI, one of the passengers (female) disembarked from the aircraft, and two more passengers (males) boarded the aircraft. Clear weather conditions prevailed at the time of the flight which was conducted under visual meteorological conditions (VMC) and under the provisions of Part 91 of the Civil Aviation Regulations (CAR) 2011 as amended.

According to the passenger who had disembarked from the aircraft at FAWI, the flight to FAWI was uneventful. There were no anomalies with the aircraft, and the engine performance was normal. The passenger further stated that the pilot had invited her on this flight; however, when they arrived at FAWI, the pilot asked her to disembark from the aircraft to make room for the additional two passengers. The passenger witnessed the aircraft when it taxied to Runway (RWY) 22. Later, she heard from the people at the airport that there had been a crash.

The accident occurred on the grounds of the Blesbok Coal Mine, approximately 582 metres (m) from the end of RWY 22 at Global Positioning System (GPS) co-ordinates determined to be 25° 50' 34.2" South 029° 11' 22.3" East, at an elevation of 5 155 feet (ft).

Probable Cause/s and/or Contributory Factors

The aircraft stalled after take-off due to high density altitude and exceedance of the maximum all-up weight (MAUW).

SRP Date	13 May 2025	Publication Date	14 May 2025

Occurrence Details

Reference Number	**:** CA18/2/3/10443
Occurrence Category	**:** Accident (Category 1)
Type of Operation	**:** Private (Part 91)
Name of Operator	**:** Kishugu
Aircraft Registration	**:** ZS-KNE
Aircraft Make and Model	**:** Cessna 172 RG
Nationality	**:** South African
Place	**:** Blesbok Coal Mine, approximately 582m from the threshold of Runway 22
Date and Time	**:** 21 April 2024 at 1330Z
Injuries	**:** Four Fatalities
Damage	**:** Destroyed

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) of the South African Civil Aviation Authority (SACAA) was notified of the occurrence on 21 April 2024 at 1330Z. The occurrence was classified as an accident according to the CAR 2011 Part 12 and ICAO STD Annex 13 definitions. Notification was sent to the State of Registry, Operator, Design and Manufacturer in accordance with the CAR 2011 Part 12 and the International Civil Aviation Organisation (ICAO) Annex 13 Chapter 4. The State did not appoint an accredited representative and/or advisor. The investigators did not dispatch to the accident site for this accident.

Notes:

1. *Whenever the following words are mentioned in this report, they shall mean the following:*
   Accident — this investigated accident
   Aircraft — the Cessna, 172 RG i*nvolved 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 clarity of the report. Modifications to images used in this report were limited to cropping, magnification, file compression; or enhancement of colour, brightness, contrast; or addition of text boxes, arrows, or lines.*

Disclaimer

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Abbreviation	Description
°	Degrees
°C	Degrees Celsius
ACCID	Accident
AIID	Accident and Incident Investigations Division
AMO	Aircraft Maintenance Organisation
ARCC	Aeronautical Rescue Coordination Centre
C of A	Certificate of Airworthiness
C of R	Certificate of Registration
CAR	Civil Aviation Regulations
CAVOK	Cloud and Visibility OK
CPL	Commercial Pilot Licence
CRS	Certificate of Release to Service
CVR	Cockpit Voice Recorder
FANS	Nelspruit Airport
FAWI	Witbank Airport
FDR	Flight Data Recorder
ft	Feet
GPS	Global Positioning System
hPa	Hectopascal
kt	Knots
m	Metres
MAUW	Maximum All Up Weight
METAR	Meteorological Aerodrome Report
MHz	Megahertz
nm	Nautical Miles
PPL	Private Pilot Licence
QNH	Altitude Above Mean Sea Level
RWY	Runway
SACAA	South African Civil Aviation Authority
SA-CATS	South African Civil Aviation Technical Standards
SAWS	South African Weather Service
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 Sunday afternoon, 21 April 2024, a pilot and two passengers (male and female) on-board a Cessna 172 RG aircraft with registration ZS-KNE took off on a private flight from Nelspruit Airport (FANS) to Witbank Airport (FAWI), both in Mpumalanga province. The flight from FANS to FAWI was uneventful. The male passenger had a Private Pilot Licence (PPL). After landing at FAWI, one of the passengers (female) disembarked from the aircraft, and two additional passengers (males) boarded the aircraft. The pilot was said to have been building hours towards the issuance of a Commercial Pilot Licence (CPL). Clear weather conditions prevailed at the time of the flight which was conducted under visual meteorological conditions (VMC) and under the provisions of Part 91 of the Civil Aviation Regulations (CAR) 2011 as amended.

1.1.2 The first eyewitness was standing near a hangar at FAWI and had a hand-held radio in his person as he watched traffic movement (other aircraft landing and taking off). He stated that the aircraft taxied to Runway (RWY) 22; during the take-off roll, the aircraft had difficulty accelerating and it rotated almost near the end of the runway. After rotation, the aircraft climbed but gained height slowly. Thereafter, the aircraft yawed sharply to the right before the right wing dropped slightly, then the left wing also dropped and the aircraft nose-dived until it impacted the grounds in Blesbok Coal Mine, approximately 582 metres (m) from the threshold of RWY 22. A cloud of black smoke rose shortly after impact. The first eyewitness stated that he rushed to the scene and called for help. The mine emergency response unit responded and administered medical assistance to the injured passenger who later succumbed to his injuries on 30 April 2024.

1.1.3 The second eyewitness stated that he was driving from the main coal yard to Pit 3 on Sunday afternoon at around 1330Z. As he approached Pit 3, he saw an aircraft flying low over the stockpile towards the trees that are located opposite the stockpile. He also noticed that the aircraft's engine sounded softer compared to other aircraft that usually fly by in the area. He reported that the aircraft flew over the tree line, almost touching the trees, and over his light-duty vehicle (LDV). He then heard the aircraft's engine revving up whilst climbing and, thereafter, it yawed to the left and dived in a nose-down attitude. He further stated that he saw flames and smoke as he approached the accident site, as well as heard screams coming from the aircraft. He observed one of the occupants who vacated the aircraft and took off his yellow T-shirt that was on fire.

1.1.4 The third eyewitness stated that on Sunday, 21 April 2024, he was at a social gathering at FAWI with some of his club members. *The eyewitness had a hand-held radio with him.* At

approximately 1300Z, a Cessna 172RG with registration ZS-KNE landed at FAWI with three persons on-board; the aircraft was parked mid-section of the airport on the western side of the runway at the hangars; the three persons disembarked from the aircraft (the pilot and two passengers). A while later, a vehicle drove into the airport with two persons who joined the three people who had deplaned the aircraft. Thereafter, the pilot and three people boarded the aircraft. Around 1340Z, the ZS-KNE's engine was started with four persons on-board. When the pilot broadcasted a radio request for a "radio check", the third eyewitness stated that he responded, confirming a 5 out of 5 as the broadcast was received clearly. The aircraft proceeded to taxi to the holding point of RWY 22. Before take-off, the third eyewitness heard a broadcast on his hand-held radio stating that they intended to take-off from RWY 22.

1.1.5 According to the third eyewitness, the weather conditions were conducive for the flight with clear skies, warm temperature and a moderate to light wind blowing from the south. The aircraft took off from the northern side and, approximately two-thirds down the runway whilst in a climb, the landing gear retracted. He stated that he did not observe if the flaps were in use at the time of take-off. He observed the aircraft when it abruptly slowed down before it yawed to the left, and then right, before it stalled. He stated that it seemed there was a left rudder input at that moment. He further reported that there was a sudden loss of altitude, and the aircraft descended beyond the tree line on the south-side of the airport. Immediately thereafter, he saw a plume of smoke and he requested his friend to contact the ambulance and emergency services. The third eyewitness got into his vehicle and drove to the crash site. Upon his arrival at the accident site, there were already multiple vehicles and employees of the mine, and the aircraft was engulfed in flames. He noticed that one of the occupants had serious burn injuries and was receiving medical attention from one of the vehicles that were at the accident site. The Aeronautical Rescue Coordinating Centre (ARCC) requested the mine safety officer to cordon off the area and limit access to the site to avoid tampering with the wreckage.

1.1.6 The South African Police Service (SAPS) and the local fire services personnel who had arrived at the scene extinguished the fire.

1.1.7 The pilot and two male passengers were fatally injured at the scene, the third male passenger managed to vacate the aircraft with serious burn injuries; he received immediate assistance from the medical personnel before he was taken to the local hospital in an ambulance. He succumbed to his injuries on 30 April 2024. The aircraft was destroyed by post-impact fire.

1.1.8 The accident occurred on the grounds of Blesbok Coal Mine, approximately 582m from the end of RWY 22 at Global Positioning System (GPS) co-ordinates determined to be 25° 50' 34.2" South 029° 11' 22.3" East, at an elevation of 5 155 feet (ft).

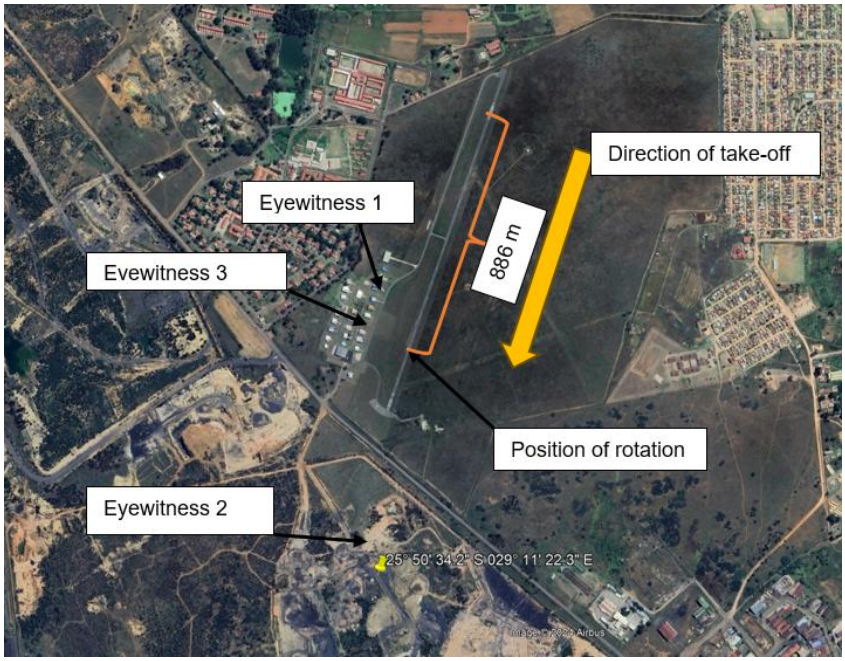


Figure 1: The yellow pin indicates the accident site. (Google Earth)

1.2. Injuries to Persons

Injuries	Pilot	Crew	Pass.	Total On-board	Other
Fatal	1	-	3	4	-
Serious	-	-	-	-	-
Minor	-	-	-	-	-
None	-	-	-	-	-
Total	**1**	**-**	**3**	**4**	**-**

Note: Other means people on the ground.

1.3. Damage to Aircraft

1.3.1. The aircraft was destroyed by impact forces and a post-impact fire.

Figure 2: The wreckage post-accident.

1.4. Other Damage

1.4.1. None.

1.5. Personnel Information

Pilot-in-command

Nationality	South African	Gender	Male	Age	30
Licence Type	Private Pilot Licence (PPL)				
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	None				
Medical Expiry Date	13 July 2026				
Restrictions	None				
Previous Accidents	None				

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

Flying Experience:

Total Hours	154.7
Total Past 24 Hours	1
Total Past 7 Days	1
Total Past 90 Days	25.4
Total on Type Past 90 Days	11.5
Total on Type	94.3

1.5.1. The pilot had a Private Pilot Licence that was initially issued on 25 April 2023. The licence was renewed on 27 March 2024 with an expiry date of 31 March 2026.

1.5.2. The pilot had a Class 2 aviation medical certificate that was issued on 14 July 2022 with an expiry date of 13 July 2027 with no medical restrictions.

1.6. Aircraft Information

1.6.1 Aircraft Description (Source: Pilot's Operating Handbook [POH])

The airplane is an all-metal, four-place, high-wing, single-engine airplane equipped with retractable tricycle landing gear and designed for general utility purposes. The construction of fuselage is a conventional formed sheet metal bulkhead, stringer, and rear carry-through spars to which the wings are attached, a bulkhead with attaching plates at the base of the forward doorposts for the lower attachment of the wing struts, and the forgings and structure for the retractable main landing gear in the lower aft portion of the fuselage centre section. Four engine mount stringers are also attached to forward doorposts and external forward to the firewall. A tunnel incorporated into the fuselage structure below the engine, in front of the firewall, is required for the forward retracting nose wheel.

The externally braced wings containing the fuel tanks, are constructed of a front and rear spar with formed sheet metal ribs, doublers and stringers. The entire structure is covered with aluminium skin. The front spars are equipped with wing-to-fuselage and wing-to-strut attach fittings. The aft spars are equipped with wing-to-fuselage attach fittings and are partial-span spars. Conventional hinged ailerons and single-slot type flaps are attached to the trailing edge of the wings. The ailerons are constructed of a forward spar containing balance weights, formed sheet metal ribs and "V" type corrugated aluminium skin joined together at the trailing edge. The flaps are constructed basically the same as ailerons, with the exception of balance weights and the addition of formed sheet metal leading edge section.

The empennage (tail assembly) consists of conventional vertical stabiliser, rudder, horizontal stabiliser, and elevator. The vertical stabiliser consists of a forward and aft spar, formed sheet metal ribs and reinforcements, a wrap-around skin panel, formed leading edge skin, and dorsal. The rudder is constructed of a formed leading edge skin containing hinge halves, a centre wrap-around skin panel, ribs, an aft wrap-around skin panel which is joined at the trailing edge of the rudder by a filler strip, and a ground adjustable trim tab at the base of the trailing edge. The top of the rudder incorporates a leading-edge extension which contains a balance weight. The horizontal stabiliser is constructed of a forward and aft spar, ribs and stiffeners, centre upper and lower skin panels, left and right upper and lower skins panels, and formed leading edge skins. The horizontal stabiliser also contains the elevator trim tab actuator. Construction of the elevator consists of formed leading edge skins, a forward spar,

ribs, torque tube and bellcrank, left upper and lower "V" type corrugated skins, and right upper and lower "V" corrugated skins incorporating a trailing edge cut-out for the trim tab. The elevator trim tab consists of spar, rib and upper and lower "V" type corrugated skins. Both elevators tip leading edge extensions incorporated balance weights.

Airframe:

Manufacturer/Model	Cessna Aircraft Company, Cessna 172 RG	
Serial Number	172RG0363	
Year of Manufacturer	1980	
Total Airframe Hours (At Time of Accident)	4875.6	
Last Inspection (Date & Hours)	3 March 2024	4 856.5
Hours Since Last Inspection	19.1	
CRS Issue Date	4 March 2023	
C of A (Issue Date & Expiry Date)	30 September 2023	30 September 2024
C of R (Issue Date) (Present Owner)	27 September 2018	
Type of Fuel Used	Avgas 100LL	
Operating Category	Standard Normal Category	
Previous Accidents	The aircraft was involved in a runway excursion on 23 January 2015.	

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

Engine:

Manufacturer/Model	Lycoming O-360-FIA6
Serial Number	L-28174-36A
Hours Since New	4856.5
Hours Since Overhaul	1467.7

Propeller:

Manufacturer/Model	MC Cauley B2D34C220/80VHA-3.5
Serial Number	140614
Hours Since New	1467.7
Hours Since Overhaul	672.9

1.6.2 According to the engine logbook, the left and right magnetos in the engine were removed and sent to an approved overhaul facility for the 500-hour/4-year inspection as required by the maintenance manual. They were re-installed on 22 February 2024.

1.6.3 The alternator part number DOFF103008R serial number H-N110092 was removed and sent to an approved facility for the 500-hour inspection as required by the maintenance manual. They were re-installed on 23 February 2024.

1.6.4 The aircraft underwent a 100-hour mandatory periodic inspection (MPI) on 5 March 2024 at 4 856.5 hours after which a Certificate of Release to Service (CRS) was issued with an expiry date of 4 February 2025 or at 4 956.5 hours, whichever comes first.

1.7. Meteorological Information

1.7.1 The following official weather report was obtained from the South African Weather Service website.

Wind Direction	090°	Wind Speed	3kt	Visibility	CAVOK
Temperature	31°C	Cloud Cover	None	Cloud Base	None
Dew Point	05°C	QNH	1021 hPa		

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 prior to 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 prior to the flight.

1.10. Aerodrome Information

1.10.1. The accident occurred approximately 582m from RWY 22 at FAWI.

Aerodrome Name	Witbank Airport (FAWI)
Aerodrome Location	Witbank, Mpumalanga Province
Aerodrome Status	Registered and Unlicensed
Aerodrome GPS coordinates	25°49’46” South, 029°11’41” East
Aerodrome Elevation	5 155 ft
Runway Headings	04/22
Dimensions of Runway Used	1 123m x 11m
Heading of Runway Used	RWY 22
Surface of Runway Used	Asphalt
Approach Facilities	None
Radio Frequency	123.50 MHz

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

1.12.1. The wreckage was found in an inverted position with the nose facing north-west. The wreckage was contained in one area. The fuselage was consumed by the post-impact fire. The tail section was still intact with impact damage observed on the left elevator tip. The pitch control surfaces were still secured. The flight control cables were still intact and secured to their respective control surfaces. The left and right wings had impact damage; buckling and deformation were also noticed in the mid-section, outboard sides and on the leading edge. The landing gear was found retracted.

Figure 3: The aircraft after impact.

Figure 4: The deformed left-wing tip and aileron.

Figure 5: The deformed right wing.

1.12.2. The engine was still secured in the cradle. The exterior condition of the engine appeared intact. The propeller flange was still connected to the engine. One of the three propeller blades had dislodged from the hub. The propeller blades were found twisted in the middle section and the tips were slightly bent backward. Deep impact markings on the leading edge indicated power signatures.

Figure 6: The damaged propeller blades.

Figure 7: The damaged leading-edge tip.

1.13. Medical and Pathological Information

1.13.1 The post-mortem report was not available at the time of compiling this report. Should the post-mortem report contain substantive information which would be considered new evidence at the time of its release, this investigation would be reopened.

1.14. Fire

1.14.1 The post-impact fire destroyed the aircraft.

1.15. Survival Aspects

1.15.1 The accident was not considered survivable as the cabin structure was damaged by impact forces and the aircraft was destroyed by post-impact fire.

1.16. Tests and Research

1.16.1. The aircraft maintenance organisation (AMO) personnel removed all four cylinders from the engine. No cracks were found on the cylinders and there was no visible internal damage.

The piston conrods were found intact and all pistons and conrod moved freely. The engine was split into two halves to reveal the crankshaft and big end bearings. The crankshaft rotated freely and there were no visible signs of overheating. The propshaft also showed no evidence of damage or buckling. The camshafts had no evidence of damage. All gears were still intact. One of the magnetos was burnt because of the post-accident fire; attachment points and gears where the magneto attaches were in good condition. Besides the external fire damage, the interior of the engine was found to be in good condition. All evidence revealed that there was sufficient lubrication at the time of the accident which indicates that the engine was functioning normally. All accessory drive gears and drive trains were intact at the time of teardown inspection. The components moved (turned) freely.

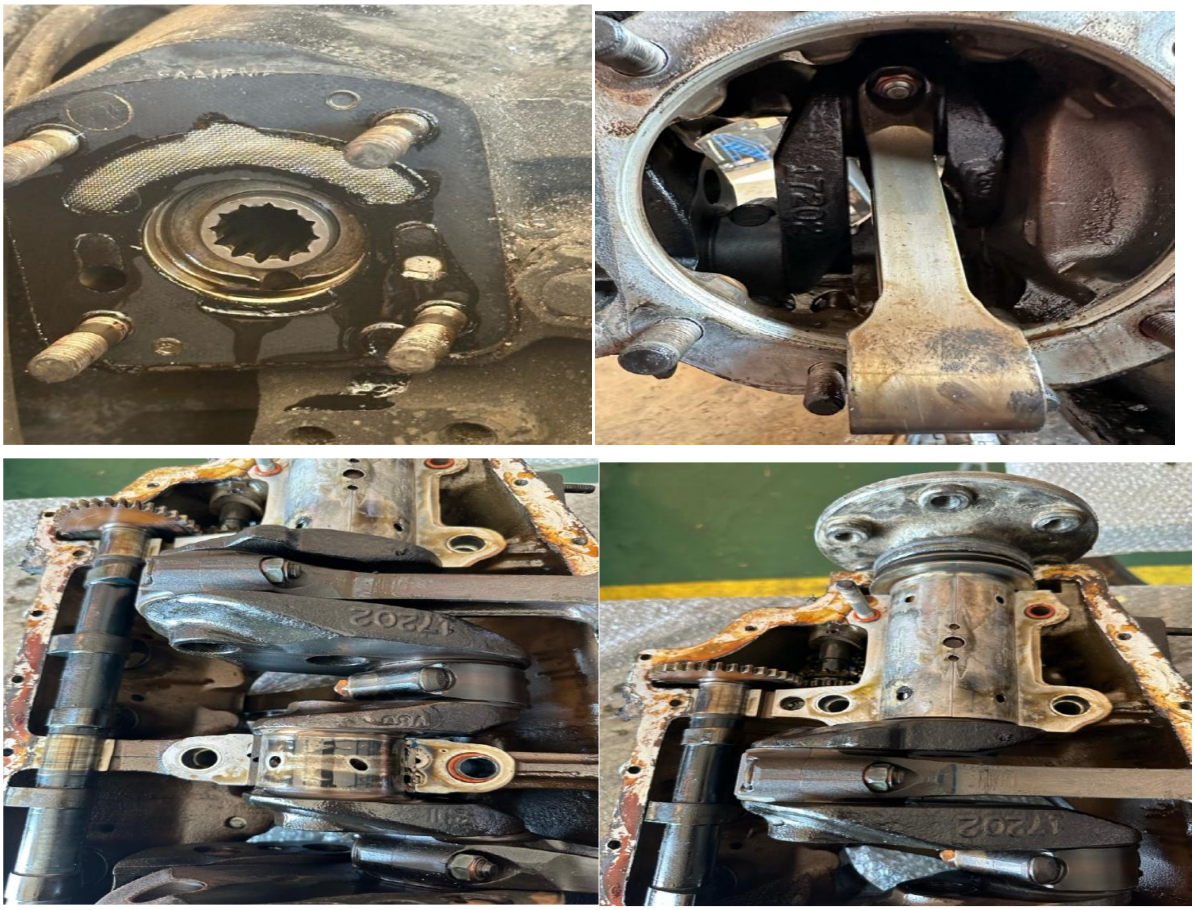


Figure 8: Cylinder and the camshaft images.

1.17. Organisational and Management Information

1.17.1. The private flight was conducted under the provisions of Part 91 of the CAR 2011 as amended.

1.17.2. The AMO that conducted the last mandatory periodic inspection (MPI) had the AMO Certificate that was issued on 25 January 2024 with an expiry date of 31 January 2025.

1.18. Additional Information

1.18.1 Weight and Balance

	Weight (lbs)	Arm(in)	Moment (in-lbs)
Aircraft empty weight	1840.5	39.12	72 000.36
Pilot and front passenger	382.8	37	14163.6
Rear passengers	424.6	73	30995.8
Baggage	0	0	0
Fuel	36USG x 6 (216)	46	9 936
Take off weight	2863.9	44.37	127095.76

Table 1: Weight and Balance of the aircraft.

The maximum certified take-off mass for the aircraft is 2650. Prior to the accident flight, the aircraft weight was 2863.9.

Note: The following pilots' weight was taken from their previous medical assessment records.

- Pilot (Flying) – 70kg (154.32lbs)
- Passenger who had a PPL licence – 89kg (196.2 lbs) (this passenger was seated at the back)

The following weights were utilised for the additional passengers for a seating configuration 1-5 seats as per South African Civil Aviation Technical Standards (SACATS) 91.07.11.

Passenger seats	1 – 5	6 – 9	10 – 19
Male	104kg	96kg	92kg
Female	86kg	78kg	74kg
Children	35kg	35kg	35kg

Table 2: Standard weight for people on-board the aircraft.

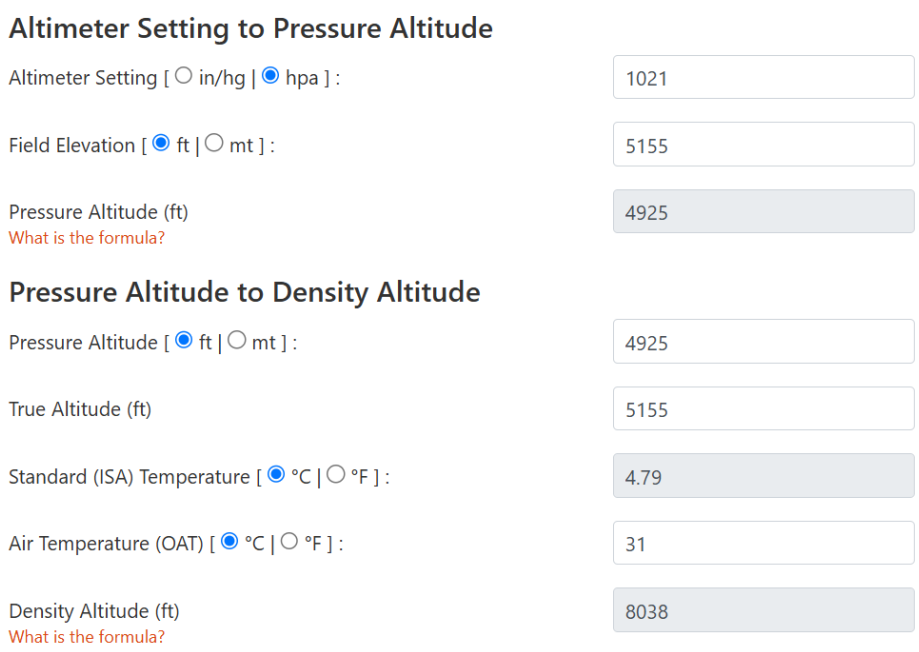
- Male Passenger (no.1) 104kg (229 lbs) – based on CAT 91.07.11
- Male Passengers (no.2) 104kg (229 lbs) – based on CAT 91.07.11

1.18.2 The following Fuel Uplift record was obtained from the aircraft's fuel records/slip:

The Cessna 172 RG total fuel capacity is 66 United States Gallons (USG).

- On 19 April 2024, the aircraft was uplifted with 66 USG (fuel). On the same day, the aircraft was flown for two hours. *The aircraft burns 10 Gallons of fuel per hour*. Therefore, 20 USG was used.
- On the day of the accident flight (21 April 2024), the aircraft departed from FANS to FAWI, which was a 1-hour flight.
- At the time of the accident, the aircraft had approximately 36 USG of fuel on-board.

1.18.3 Density Altitude Calculation



1.18.4 The following information is an extract from the FAA-H-8083-3A

The first real consequence of poor lift at low speeds is a high stall speed. The second consequence of poor lift at low speeds is the manner in which lift and drag vary with speed in the lower ranges. If the pilot attempts to increase lift by increasing pitch attitude, airspeed will be further reduced resulting in a further increase in drag and sink rate as the airplane slides up the back side of the power curve. The sink rate can be arrested in one of two ways:

- *Pitch attitude can be substantially reduced to reduce the angle of attack and allow the airplane to accelerate to a speed above VMD, where steady flight conditions can be reestablished. This procedure, however, will invariably result in a substantial loss of altitude.*
- *Thrust can be increased to accelerate the airplane to a speed above VMD to reestablish steady flight conditions. It should be remembered that the amount of thrust required will be quite large. The amount of thrust must be sufficient to accelerate the airplane and regain altitude lost. Also, if the airplane has slid a long way up the back side of the power required (drag) curve, drag will be very high and a very large amount of thrust will be required.*

The following information is an extract from https://www.aviatortips.com/how-does-high-density-altitude-affect-aircraft-performance

The impact of density altitude on horsepower can vary depending on several factors, such as the type of engine, altitude, and the specific environmental conditions encountered. However, it is evident that high density altitude conditions generally lead to a noticeable reduction in horsepower. As density altitude increases, the air becomes less dense, which results in fewer oxygen molecules available for combustion within the engine. This affects the engine's ability to maintain an optimal fuel-to-air mixture, consequently reducing its power output, including horsepower.

1.18.5 The following information is an extract from the FAA Handbook-8083-3B

The incipient phase occurs from the time the airplane stalls and starts rotating until the spin has fully developed. This phase may take two to four turns for most airplanes. In this phase, the aerodynamic and inertial forces have not achieved a balance. As the incipient phase develops, the indicated airspeed will generally stabilize at a low and constant airspeed and the symbolic airplane of the turn indicator should indicate the direction of the spin. The pilot should not use the slip/skid ball (inclinometer) to determine spin direction. The location of the instrument in the airplane determines how the ball will move rather than the direction of the spin. For example, the ball mounted on the left side of the airplane will always move to the left, even in spin with rotation to the right. The pilot should initiate incipient spin recovery procedures prior to completing 360° of rotation. The pilot should apply full rudder opposite the direction of rotation. The turn indicator shows a deflection in the direction of rotation if disoriented. Incipient spins that are not allowed to develop into a steady-state spin are the most commonly used manoeuvre in initial spin training and recovery techniques.

An aircraft stall results from a rapid decrease in lift caused by the separation of airflow from the wing's surface brought on by exceeding the critical AOA. A stall can occur at any pitch attitude or airspeed. Stalls are one of the most misunderstood areas of aerodynamics because pilots often believe an airfoil stops producing lift when it stalls. In a stall, the wing does not totally stop producing lift. Rather, it cannot generate adequate lift to sustain level flight. Since the CL increases with an increase in AOA, at some point the CL peaks and then begins to drop off. This peak is called the CL-MAX. The amount of lift the wing produces drops dramatically after exceeding the CL-MAX or critical AOA, but as stated above, it does not completely stop producing lift. In most straight-wing aircraft, the wing is designed to stall the wing root first. The wing root reaches its critical AOA first making the stall progress outward toward the wingtip. By having the wing root stall first, aileron effectiveness is maintained at the wingtips, maintaining controllability of the aircraft. Various design methods are used to achieve the stalling of the wing root first. In one design, the wing is "twisted" to a

higher AOA at the wing root. Installing stall strips on the first 20–25 percent of the wing's leading edge is another method to introduce a stall prematurely.

The wing never completely stops producing lift in a stalled condition. If it did, the aircraft would fall to the Earth. Most training aircraft are designed for the nose of the aircraft to drop during a stall, reducing the AOA and "unstalling" the wing. The nose-down tendency is due to the CL being aft of the CG. The CG range is very important when it comes to stall recovery characteristics. If an aircraft is allowed to be operated outside of the CG range, the pilot may have difficulty recovering from a stall. The most critical CG violation would occur when operating with a CG that exceeds the rear limit. In this situation, a pilot may not be able to generate sufficient force with the elevator to counteract the excess weight aft of the CG. Without the ability to decrease the AOA, the aircraft continues in a stalled condition until it contacts the ground. The stalling speed of a particular aircraft is not a fixed value for all flight situations, but a given aircraft always stalls at the same AOA regardless of airspeed, weight, load factor, or density altitude. Each aircraft has a particular AOA where the airflow separates from the upper surface of the wing and the stall occurs. This critical AOA varies from approximately 16° to 20° depending on the aircraft's design. But each aircraft has only one specific AOA where the stall occurs.

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

Man

2.2.1 The pilot was initially issued a PPL on 25 April 2023. The licence was renewed on 27 March 2024 with an expiry date of 31 March 2026. The pilot had a Class 2 aviation medical certificate that was issued on 14 July 2022 with an expiry date of 13 July 2027 with no medical restrictions. The pilot and three (male) passengers were on-board the aircraft at departure from FAWI. The increased weight and high-density altitude may have resulted in degraded performance of the aircraft. The degraded performance of the aircraft and the increased weight may have resulted in a higher stall speed.

Machine

2.2.2 According to the engine logbook, the left and right magnetos in the engine were removed and sent to an approved overhaul facility for the 500-hour/4-year inspection; they were re-installed on 22 February 2024. The alternator part number DOFF103008R serial number H-N110092 was removed and sent to an approved facility for the 500-hour inspection; it was re-installed on 23 February 2024. The aircraft underwent a 100-hour MPI on 5 March 2024 and a Certificate of Release to Service (CRS) was issued on 4 March 2024 at 4 856.5 hours with an expiry date of 4 February 2025 or at 4 956.5 hours, whichever comes first. The AMO that certified the inspection was issued an AMO Certificate on 25 January 2024 with an expiry date of 31 January 2025. The engine examination revealed that the engine was in good condition before the accident; the damaged parts were a result of the accident. The weight of the aircraft exceeded the MAUW.

Environment

2.2.3 The high temperatures on the day may have contributed to the degraded aircraft performance due to high-density altitude. Based on the calculated weight and balance and the increased density altitude, the aircraft was unable to sustain lift and, subsequently, stalled.

2.2.4 It is probable that the pilot did not consider the increased weight, weather conditions and the performance of the aircraft at departure. There was no evidence of flight planning to indicate that these factors were considered by the pilot.

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

3.2.1 The pilot had a Private Pilot Licence (PPL) that was initially issued on 25 April 2023. The licence was reissued on 27 March 2024 with an expiry date of 31 March 2026.

3.2.2 The aircraft type was endorsed on the pilot's licence and logbook. The pilot had a Class 2 aviation medical certificate that was issued on 14 July 2022 with an expiry date of 13 July 2027 with no medical restrictions.

3.2.3 The aircraft underwent a 100-hour mandatory periodic inspection (MPI) on 5 March 2024 at 4 856.5 hours after which a Certificate of Release to Service (CRS) was issued with an expiry date of 4 February 2025 or at 4956.5 hours, whichever comes first.

3.2.4 The aircraft maintenance organisation (AMO) that conducted the last MPI was issued the AMO Certificate on 25 January 2024 with an expiry date of 31 January 2025.

3.2.5 The AMO was authorised to conduct maintenance on the aircraft type. The engine was recovered to the AMO for further inspection after the accident. Post-examination engine report revealed that the engine was in good condition before the accident.

3.2.6 The environmental conditions at the time of the accident revealed that the density altitude was high. The maximum take-off weight was exceeded.

3.2.7 The degraded performance of the aircraft contributed directly to the stall condition.

3.3. Probable Cause/s

3.3.1 The aircraft stalled after take-off due to high density altitude and exceedance of the maximum all-up weight (MAUW).

3.4. Contributory Factor/s

3.4.1. None.

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. None.

5. APPENDICES

5.1. None.

This report is issued by:

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