SOUTH AFRICAN CIVIL AVIATION AUTHORITY

AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

			Reference:	CA18/2/3/10426		
Aircraft Registration	ZU-IBN	**Date of Accident**	24 February 2024	**Time of Accident**	0714Z	
Type of Aircraft	L39C Albatros		**Type of Operation**	Type (Part 94)		
Pilot-in-command Licence Type	Private Pilot Licence	**Age**	64	Licence Valid	Yes	
Pilot-in-command Flying Experience	**Total Flying Hours**	776.70	**Hours on Type**	71.6		
Last Point of Departure	Middleburg Airfield (FAMD), Mpumalanga Province					
Next Point of Intended Landing	Middleburg Airfield (FAMD), Mpumalanga Province					
Damage to Aircraft	Substantial					
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)						
FAMB field at Global Positioning System (GPS) co-ordinates determined to be (S °40' 58", E 029° 26' 13.9"), at a field elevation of 4886 feet (ft)						
Meteorological Information	Wind Direction: 140; Wind Speed: 5kt; Air Temperature: 20°C; Visibility: 9999m					
Number of People On-board	1+0	**Number of People Injured**	1	**Number of People Killed**	0	**Other (On Ground)** 0

Synopsis

On Saturday morning, 24 February 2024, a pilot on-board the L39C Albatros ex-military aircraft with registration ZU-IBN intended to conduct a private flight from Middleburg Airfield (FAMB) in Mpumalanga province with the intention to land back at the same airfield. The flight was conducted under visual meteorological conditions (VMC) by day and under the provisions of Part 94 of the Civil Aviation Regulations (CAR) 2011 as amended.

The pilot stated that he conducted the pre-flight inspection, secured the rear cockpit for single-seat operation, and completed engine run-up and cabin pressurisation checks. After taxiing to Runway 32, he initiated the take-off roll at 105 knots (kts) but was unable to achieve rotation despite several attempts. An eyewitness reported that about 200 metres past the runway intersection, the aircraft's nose lifted slightly but the nosewheel remained on the runway. The rear canopy detached and struck the tail fin before it hit the ground. The aircraft could not lift off thereafter. Unaware of the canopy that had separated, the pilot reduced the throttle and engaged the toe brakes, but the brakes failed because the nose gear weight-on-wheels switch had disabled during the take-off roll, which prevented normal braking. The pilot activated the emergency brakes, but the right main landing gear tyre burst as the aircraft veered off the runway. The pilot increased engine power and tried to rotate the aircraft to clear the concrete perimeter fence ahead of his flight path, but it impacted the fence and stopped about 80m beyond the fence facing east.
The investigation revealed that the aircraft's failure to rotate was due to the aircraft not achieving the required rotation speed of 130 kt and, thus, the subsequent rear canopy separation aggravated the situation by inducing air separation that led to increased drag and the resultant severe turbulence. This disruption reduced flight control effectiveness.

Probable Cause/s and/or Contributory Factors

The aircraft was rotated before it reached the required speed and failed to climb. The pilot attempted to abort take-off by applying the brakes whilst the main wheels remained on the ground, but this had no effect as the aircraft's weight had shifted off of the nose gear. The aircraft overshot the runway and impacted the perimeter fence.

- Lack of recency training
- Lack of sufficient Runway End Safe Area
- Separation of the rear canopy
-

SRP Date	11 February 2025	Publication Date	12 February 2025

Occurrence Details

Reference Number	**:** CA18/2/3/10426
Occurrence Category	**:** Category 3
Type of Operation	**:** Private (Part) 94
Name of Operator	**:** Lovett R N
Aircraft Registration	**:** ZU-IBN
Aircraft Make and Model	**:** Aero Vodochody; L39C Albatros
Nationality	**:** South African
Place	**:** Middleburg Airfield (FAMB)
Date and Time	**:** 24 February 2024 at 0714Z
Injuries	**:** Serious
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) of the South African Civil Aviation Authority (SACAA) was notified of the occurrence on 24 February 2024 at 0800Z. 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 and Operator 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. The investigator 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 investigation of the accident
   Aircraft — the L39C Albatros 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 clarity of the report. Modifications to images used in this report were limited to cropping, magnification, file compression; enhancement of colour, brightness, and contrast; or addition of text boxes, arrows, or lines.*

Disclaimer

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

Table of Contents

Abbreviation	Description
°	Degrees
°C	Degrees Celsius
AIID	Accident and Incident Investigations Division
ATF	Authority-to-fly
CAR	Civil Aviation Regulations
C of R	Certificate of Registration
CRS	Certificate of Release to Service
CVR	Cockpit Voice Recorder
DA	Density Altitude
FAMB	Middleburg Aerodrome
FDR	Flight data Recorder
ft	Feet
GPS	Global Positioning System
hPa	Hectopascal
kt	Knots
kN	Kilo-Newton (Power)
m	Metres
METAR	Meteorological Aerodrome Report
PA	Pressure Altitude
PPL	Private Pilot Licence
QNH	Altitude Above Mean Sea Level
SACAA	South African Civil Aviation Authority
SAWS	South African Weather Service
VMC	Visual Meteorological Conditions
WOW	Weight-on-wheels
Z	Zulu (Term for Universal Co-ordinated Time - Zero Hours Greenwich)

1. FACTUAL INFORMATION

1.1. History of Flight

1.1.1. On Saturday morning, 24 February 2024, a pilot on-board the L39C Albatros ex-military aircraft with registration ZU-IBN took off on a private flight from Middleburg Airfield (FAMB) in Mpumalanga province with the intention to land at the same take-off airfield. The flight was conducted under visual meteorological conditions (VMC) by day and under the provisions of Part 94 of the Civil Aviation Regulations (CAR) 2011 as amended.

1.1.2. The pilot reported that he conducted the pre-flight inspection, as well as secured the rear cockpit for a single cockpit operation from the front. He then closed the rear canopy, latched it, climbed into the front cockpit seat, and started the engine. He performed the engine run-up checks with no anomalies noted. During this time, the pilot also conducted the cabin pressurisation check and found it in a satisfactory state. Thereafter, he taxied the aircraft to Runway 32 and aligned it for take-off. During the take-off roll at 105 knots (kts), the pilot pulled back the control stick to initiate rotation; the nose lifted slightly but could not continue to lift as there was no elevator response (lift). Despite the pilot's multiple attempts to lift-off, the aircraft could not rotate.

1.1.3. An eyewitness reported that the pilot rotated the aircraft approximately 200 metres (m) past the intersection of Runway 32 and 02, and the nose lifted slightly whilst the nosewheel remained on the runway. At this point, the rear canopy detached from the aircraft and struck the tail fin (vertical stabiliser) before it hit the ground. The aircraft could not take off afterwards.

1.1.4. Unaware of the canopy separation, and with approximately 400m of the runway surface remaining, the pilot stated that he pulled (retarded) the throttle and engaged the toe brakes as he approached the end of the runway, but the brakes were ineffective. The brakes failed to activate because the aircraft's weight was off of the nose landing gear weight-on-wheels (WOW) microswitch, which is designed to disable normal braking if the control stick is pulled back during the take-off run. The pilot activated the emergency brake system, and the main landing gear wheels screeched on the runway surface. As a result, the right main landing gear tyre burst as the aircraft veered off to the right of the runway. Still at high speed and with the concrete perimeter fence ahead, the pilot increased the engine power and pulled back the control stick again to rotate the aircraft and clear the perimeter fence, but the aircraft impacted and levelled the fence. It came to a stop approximately 80m beyond the perimeter fence facing east.

1.1.5. After the aircraft had come to a stop, the pilot opened the front canopy (which fell to the ground) on the right side of the aircraft and disembarked from it. He then noticed that the engine was still running at high power and, thus, climbed on the aircraft's side steps to reach the throttle to shut down the engine, but found that the throttle lever had stuck halfway between the throttle stop and the rear cockpit throttle due to debris (from the concrete fence). Therefore, he engaged the emergency engine shutdown. The pilot sustained serious injuries to the face and left hand; he was later taken to the hospital.

1.1.6. The accident occurred on a field in FAMD during take-off at Global Positioning System (GPS) co-ordinates determined to be South °40' 58" East 029° 26' 13.9", at a field elevation of 4 886 feet (ft).

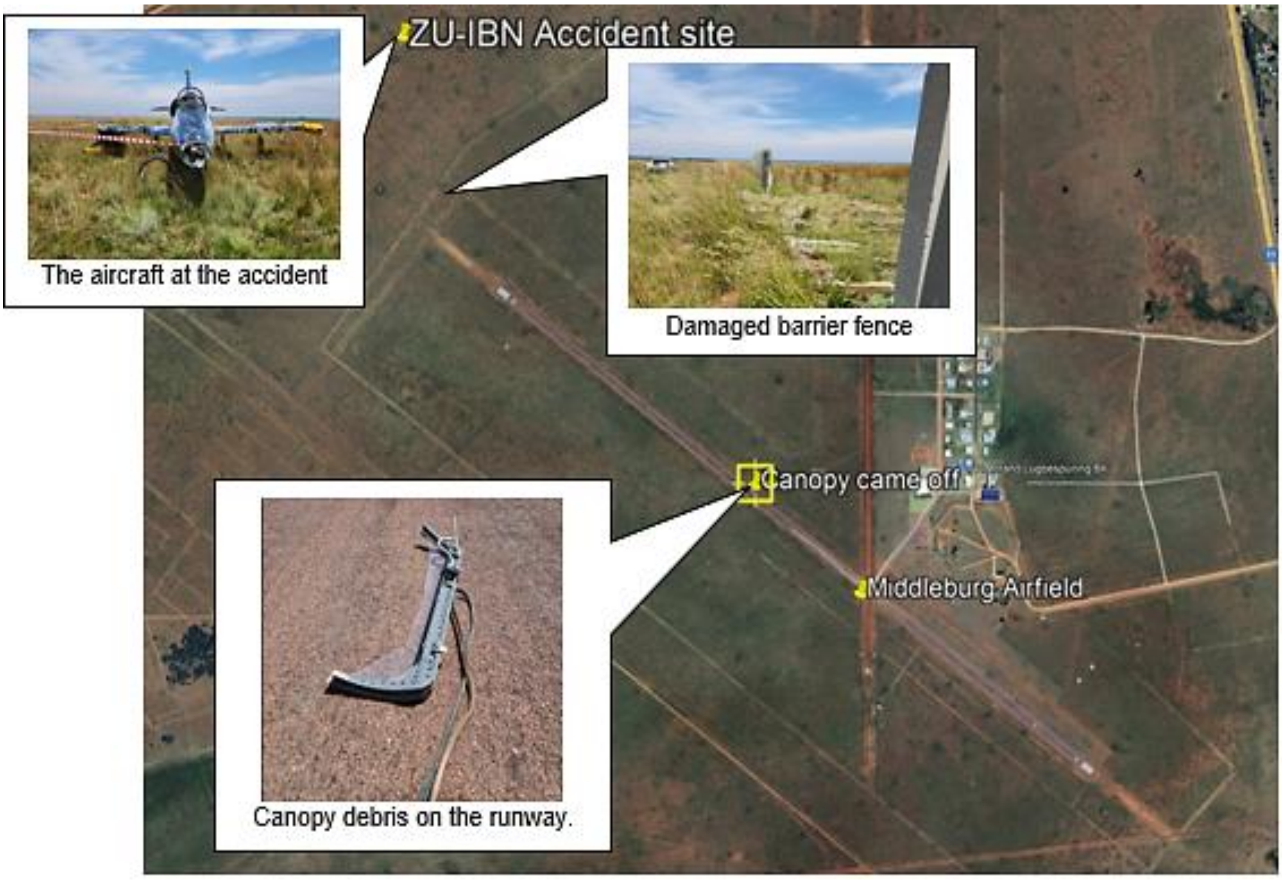

Figure 1: The view of the airfield and the accident site. (Source: Google Earth)

1.2. Injuries to Persons

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

Note: Other means people on the ground.

1.2.1. The pilot sustained serious injuries during the accident sequence.

1.3. Damage to Aircraft

1.3.1. The aircraft sustained substantially damage to the nose section, both canopies, both wings, the vertical stabiliser and the horizontal stabilisers during the accident sequence.

Figure 2: The aircraft after the accident. (Source: Operator)

1.4. Other Damage

1.4.1. Part of the FAMD perimeter fence was damaged during impact.

1.5. Personnel Information

Pilot in Command (PIC)

Nationality	South African	Gender	Male	Age	64
Licence Type	Private Pilot Licence (PPL)				
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	None				
Medical Expiry Date	4 July 2024				
Restrictions	None				
Previous Accidents	Unknown				

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

Flying Experience:

Total Hours	776.70
Total Past 24 Hours	2.4
Total Past 7 Days	2.4
Total Past 90 Days	11
Total on Type Past 90 Days	0
Total on Type	71.6

1.5.1. The pilot had a Private Pilot Licence (PPL) Airplane that was initially issued by the Regulator on 23 July 2003. The licence was reissued on 30 July 2023 with an expiry date of 31 July 2024. His Class 2 aviation medical certificate was valid; it was issued on 3 July 2023 with an expiry date of 4 July 2024. The aircraft type was endorsed on the pilot's licence.

1.5.2. The pilot had a total of 1169.10 hours which were accumulated from both airplane and helicopter operations. A total of 776.70 flying hours were accumulated on airplanes, of which 71.6 hours were acquired on the aircraft type.

1.5.3. According to available records, the pilot had not flown the aircraft in 12 months. The South African Civil Aviation Technical Standards (SA-CATS) Part 94.02.1 (6,2b) states the following:

Part 94.02.1

6. Continuation training

After completion of the conversion onto type, it will be the responsibility of the pilot and the aircraft owner to ensure that the pilot remains current on type. As a guideline, the following should be used –

(1) Ground training:
An emergency, handling, limitations, and procedural quiz must be completed at least every second month.

(2) Flying training:
To remain current, the pilot must –

(a) complete at least 12 hours, as pilot-in-command of an ex-military aircraft, over twelve months; or

(b) should this not be the case, or if the pilot has not flown the specific type for a period exceeding three months, the pilot must undergo a check flight with a flight instructor who is current on the type; and

(c) undergo at least one check flight on type not later than six months since the previous check flight on type with a flight instructor who is current on type.

1.6. Aircraft Information

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

An L39C Albatros is a single-engine, two-seater tandem cockpit, subsonic aircraft manufactured by Aero Vodochody of Czechoslovakia. The aircraft's primary mission is basic advanced training. Its characteristic with external armament stores also enable it to fulfil the operational training and ground attack roles under flight conditions of good visibility. The aircraft is powered by a by-pass turbofan engine developing approximately 16.9 kN standard day, sea level static thrust. The aircraft can take off with a maximum weight of 5 600 kg and with a maximum weight of 4 500 kg at a speed of 112-120 KIAS. The aircraft's canopy jettison and ejection seat system were decommissioned for civilian operation. The aircraft's design features a weight on wheels (WOW) microswitch fitted on the nose landing gear (NLG) that prohibits/disables the brake system effectiveness when the aircraft weight is off the nose landing gear during take-off and landing. This is a failsafe designed to prevent accidental braking, especially during take-off when the pilot is constantly manning the rudder pedals for directional control. The same NLG WOW microswitch assists in preventing accidental landing gear retraction when the aircraft is on the ground.

Airframe:

Manufacturer/Model	Aero Vodochody/ L39C Albatros	
Serial Number	132036	
Year of Manufacture	1977	
Total Airframe Hours (At Time of Accident)	1350	
Last Inspection (Date & Hours)	20 April 2023	1292.9
Airframe Hours Since Last Inspection	57.1	
CRS Issue Date	20 April 2023	
ATF (Issue Date & Expiry Date)	26 May 2023	31 May 2024
C of R (Issue Date) (Present Owner)	15 February 2015	
Operating Category	Part 94	
Type of Fuel Used	Jet A1	
Previous Accidents	None	

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

Engine:

Manufacturer/Model	Ivchenko AI-24A Turbofan
Serial Number	9052524900329
Part Number	AI-24A
Hours Since New	883.3
Hours Since Overhaul	199.4

1.6.2. The aircraft had an Authority-to-fly (ATF) that was issued by the Regulator on 26 May 2023 with an expiry date of 31 May 2024. The aircraft had a Certificate of Registration (C of R) that was issued to the current owner on 13 February 2015. The aircraft's mandatory periodic inspection (MPI) was conducted after which a Certificate of Release to Service (CRS) was issued on 20 April 2023 at 1 292.9 airframe hours with an expiry date of 19 April 2024 or at 1 392.9 airframe hours, whichever comes first. The aircraft had 1 350 hours at the time of the accident; it had accumulated 57.1 hours since the last MPI.

Cockpit and Canopy Jettison System (Source: Pilot Operating Handbook)

Both the front and the rear cockpit are pressurized. The canopies provide the pilots with the necessary visibility from the cockpits, make the cabin aerodynamic, and seal it. The two canopies together consist of four parts: windshield, an openable part of the front cockpit, mid-panel, and an openable part of the rear cockpit The cabin is designed to accommodate two pilots, two ejection seats, and related emergency equipment, various blocks, components, and devices that control the airplane, the engine, and various other systems. Each cockpit is covered by a canopy.

Canopy Jettison System
On this aircraft, both the canopy jettison system, the ejection seat system, and other safety defense systems were decommissioned during the aircraft's retirement and were not functional.

Civil Aviation Regulation; Part 94, Subpart 06: Operations of Ex-military Aircraft
According to the Civil Aviation Regulation Part 94.06.13, all ex-military (warbirds) aircraft are to be decommissioned of all weaponry, jettison systems, ejection seat systems, and any equipment used for military operation before operations for civilian use.
(c) Ejection Seats
Where ejection seats are an integral part of the aircrew escape system, as specified in the relevant Flight Manual or Aircrew Notes, they shall be fully serviceable for all flights unless specifically exempted, and all occupants shall have been suitably instructed in their use.

The Regulation was not followed as both the jettison and ejection seat systems were decommissioned after the military retired the aircraft. In an emergency situation, pilots of these aircraft rely on the ejection system for survival. If the ejection system is non-operational, it could result in death or serious injury to the pilot.

Emergency Braking Procedure
There is an emergency brake lever located on the left console in each cockpit. Both Flight

Manuals contained essentially the same instructions for coping with a loss of normal braking capability. The instructions were that in the event of a loss of normal braking, the required action is for one of the pilots to pull one of the emergency brake levers in a gradual manner. Braking is then applied equally and simultaneously to both wheels, bypassing the anti-skid system.

1.6.3. Aircraft Take-off Procedure (Source: Pilot's Operating Handbook)

Before starting the take-off roll, mentally go through the "About" procedure and relevant take-off data.

1. *Engine instruments: Check within limits (RPM; EGT and oil pressure).*
2. *Caution and warning lights: Out*
3. *Take-off clearance: Request*
4. *Clock: Start flight time counting*
5. *Throttle: TAKE UP position*
6. *Wheel brakes: Release*
7. *Maintain directional control initially by differential braking and then by rudder. The rudder becomes effective at approximately 60km/h (32kt).*
8. *At 150km/h IAS (81kt), smoothly raise the nose wheel. An aircraft in clean configuration will become airborne at approximately 180 to 190 km/h IAS (81kt to 102.6kt).*

Note: The aircraft at full configuration with an MTOW of 5 700kg requires a take-off length of approximately 550m at V2 of 120kts (222km/hour IAS)

CAUTION: Exceeding the Max gear extended speed of 330km/h IAS (178.19 kts) may cause damage to landing gear doors and prevent their subsequent operation.

9. *With a positive rate of climb at airspeed 220 km/h IAS (118.8 kts) and altitude 20m AGL minimum: Landing gear Up; Mechanical indicators: check.*
10. *Airspeed 250km/h IAS, altitude 500 m AGL minimum: Flaps: UP; Electrical and mechanical indicators: check.*
11. *Trim: As required.*

NOTE: Flaps are automatically retracted at airspeed 310km/h IAS. Overcoming this speed with flaps extended can cause, an unexpected change in aircraft behaviour (unexpected flaps restriction).

The Take-off Data: Factor Calculations

The aircraft requires relevant take-off data for a safe and effective take-off.

The calculations based on the pilot's submission are presented in the left column (below); and the calculations presented in the right column are more detailed and are based on the correct values. The pilot's calculations are brief and had used incorrect values to determine the take-off data. The pilot determined the density altitude to be 840 ft which was 960 less than the actual calculated density. The final density altitude calculation made by the pilot was determined to be 5 380 ft instead of 6 170 ft which was lower than the actual density altitude at the time.

Take-off Data by the Pilot

DA-Density Altitude

DENSITY ALTITUDE	
DA = PX ALT + (120 x 20° – ASI (13) PX ALT + **(120 x 7)** DA = PX ALT + **840**	DA = PX ALT + (120 x (20°C - ISA at 4880 ft)) Not sure what this ASI(13) is but temperature decreases at 2° per 1 000 ft of ascent, thus ISA is 15° at MSL 13° at 1 000 ft AMSL 11° at 2 000 ft AMSL 09° at 3 000 ft AMSL 07° at 4 000 ft AMSL 5.24° at 4 880 ft AMSL (round to 5°C) DA = PX ALT + (120 x (20°C - 5°C)) PX ALT + **(120 x 15°C)** DA = PX ALT + **1 800 ft**
PRESSURE ALTITUDE	
PX ALT = Elev (4 880 ft) + (1013-1030) x OAT20°C = 4 880 + (-17 mb) **x 20°C** = 4 880 – 340 ft PX ALT = **4 540 ft** (1 383 m)	PX ALT = Elevation + (QNE – QNH) x 30 The 30 is for every 30 ft the pressure drops 1 millibar (No idea why he uses temperature to multiply) PX ALT = 4 880 + (1013-1030) x 30 = 4 880 + (-17 mb) **x 30** = 4 880 – 510 ft PX ALT = **4 370 ft** (170 ft difference) (1 331 m)
FINAL DENSITY ALTITUDE CALCULATION	
DA = 4 540 + 840 ft = **5 380 ft** (1 640 m)	DA = 4 370 + 1 800 ft = **6 170 ft** (1 880 m) (790 ft & 240 m difference) But if I remember correctly the QNH on the Altimeter photo showed 1020 mb and not 1030mb, which brings the DA to **6 470 ft** He did say that he did not remember the QNH I the email **(that's 1 590 ft higher than FAMB)**

According to the pilot's calculations (left column), the calculated density altitude is 5 380 ft and the aircraft's required take-off speed is determined to be 102 kts. There was no further indication on how the pilot determined the rotation speed.

The information below was derived from the aircraft type's performance calculation chart.

Take-off Data Calculations

To calculate the take-off data for the L39C Albatros, provided conditions need to be factored in, including field elevation, temperature, weight and runway conditions. This will allow the determination of the take-off factor, density altitude, take-off speed and take-off distance.

Given conditions are:

- Field elevation: 4880 ft
- QNH (Pressure at the location): 1021 hPa
- QNE (Standard Pressure): 1013.25 hPa

- Temperature: 20°C
- Wind Speed: 5 knots at 140°
- Aircraft Empty Weight: 3455 kg
- Pilot Weight: 85 kg
- Fuel Onboard: 580 kg
- Runway Surface: Dry concrete
- Runway In Use: RWY 32

Aircraft Gross Weight: Gross Weight = Aircraft empty weight + pilot + fuel

= 3455kg + 85kg + 580kg = 4120kg

= 4120kg

Density Altitude is the altitude at which the air density is equivalent to the air density at a given temperature and pressure.

Pressure Altitude (PA) = {(QNE-QHH)/QNE} x 145442.16 + Field Elevation

= {(1013.25-1021)/1013.25} x145442.16 + 4880

=3769 ft(3768.74ft)

Density Altitude Calculations (DA)

To calculate the density altitude, Temperature Deviation must be determined: (Temp Dev)

Temperature Deviations from standard (ISA). The standard Pressure Altitude at Mean Sea Level is (ISA Pressure): 1013.25 hPa at a standard temperature of 15°C.
The temperature on the day was 20°C.
Temperature Deviation = Given Temp – ISA

= 20°C-15°C

= 5°C

DA= Pressure Altitude + 120x Temp Dev

= 3769 + 120 x 5°C

= 4370 ft

The take-off factor accounts for the effects of density altitude, temperature and weight on the take-off performance. Based on the aircraft's performance charts, the take-off distance increases with altitude and temperature. For the L39C, at a density altitude of 4 370 ft and a 20°C temperature, the take-off factor is 1.25. This is an approximation based on typical performance charts for this aircraft type.

Calculation of the Required Take-off Speed (V1/Vr)

The take-off speed (also known as **V1** for decision speed or **Vr** for rotation speed) depends on the aircraft's weight and can be approximated based on the aircraft's performance data. At sea level, the L39C has a typical take-off speed of approximately 81-102 kts. The typical take-off distance for the L39C on a dry runway is around 550m. At a density altitude of **4370 feet**, the take-off speed is generally increased by about **5-10%** due to lower air density. To adjust for the 4370ft density altitude, the sea level distance was multiplied by the take-off factor of (1.25). This is an approximation based on typical performance charts for this aircraft type.

Take-off Distance - Sea level take-off distance x Take-off Factor.

Take Off Distance = 550 X 1.25
= 687.5 meters

Take-off speed(V2) = Take-off factor x sea level take-off speed
= 1.25 x 120 kt
= 150 kt

Rotation Speed (Vr) will likely be around:
Vr = 130 kt

1.7. Meteorological Information

1.7.1. The weather information below was obtained from the pilot questionnaire form received on 24 February 2024 at 0700Z.

Wind Direction	140°	Wind Speed	05 kt	Visibility	9999m
Temperature	20°C	Cloud Cover	NIL	Cloud Base	NIL
Dew Point	0°C	QNH	1021 hPa		

1.7.2. Good weather conditions prevailed at the time of the flight.

1.8. Aids to Navigation

1.8.1. The aircraft was equipped with standard navigational equipment as approved by the Regulator. 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

Aerodrome Name	Middleburg (FAMB)	
Aerodrome Location	Mpumalanga Province	
Aerodrome Status	Licensed	
Aerodrome GPS coordinates	25°40'29.54"South, 029°25'50.29"East	
Aerodrome Elevation	4880 ft	
Runway Headings	14/32	02/20
Dimensions of Runway Used	1800m X 15m	1345m X 25m
Heading of Runway Used	32	
Surface of Runway Used	Asphalt	
Approach Facilities	None	
Radio Frequency	127.95 MHz	

1.10.1 The aerodrome had Runway End Safe Area of approximately 230m length between RWY 32 and the perimeter fence.

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 accident occurred during take-off at FAMB. The aircraft impacted the concrete perimeter fence about 230m beyond the end of the runway and levelled it before it stopped approximately 80m outside of the airfield (see Figure 3). The area where the accident occurred had long grass.

1.12.2. The aircraft's rear canopy debris was found approximately 1 100m from the threshold of the runway. The runway intersection is 680m from the RWY 32 threshold; this is the point where the pilot should have started rotating the aircraft. However, the aircraft's rotation was initiated about 1100m from the threshold of RWY 32, which was approximately 400m beyond the required point of take-off (see Figure 3). The front canopy was found on the ground near the right-side of the front cockpit. The pilot stated that it fell (detached) when he was exiting the cockpit.

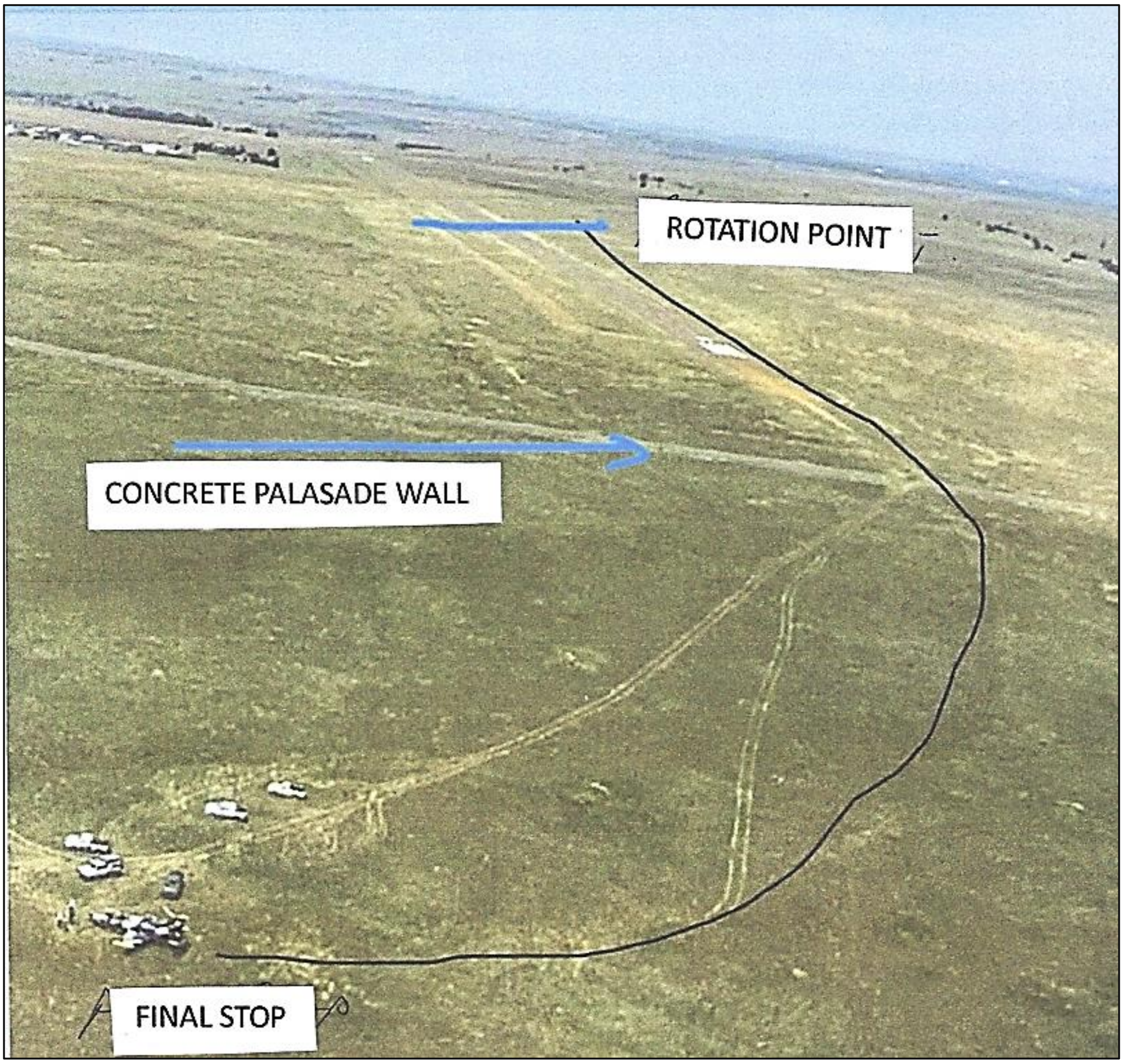

Figure 3: The accident site. (Source: Operator)

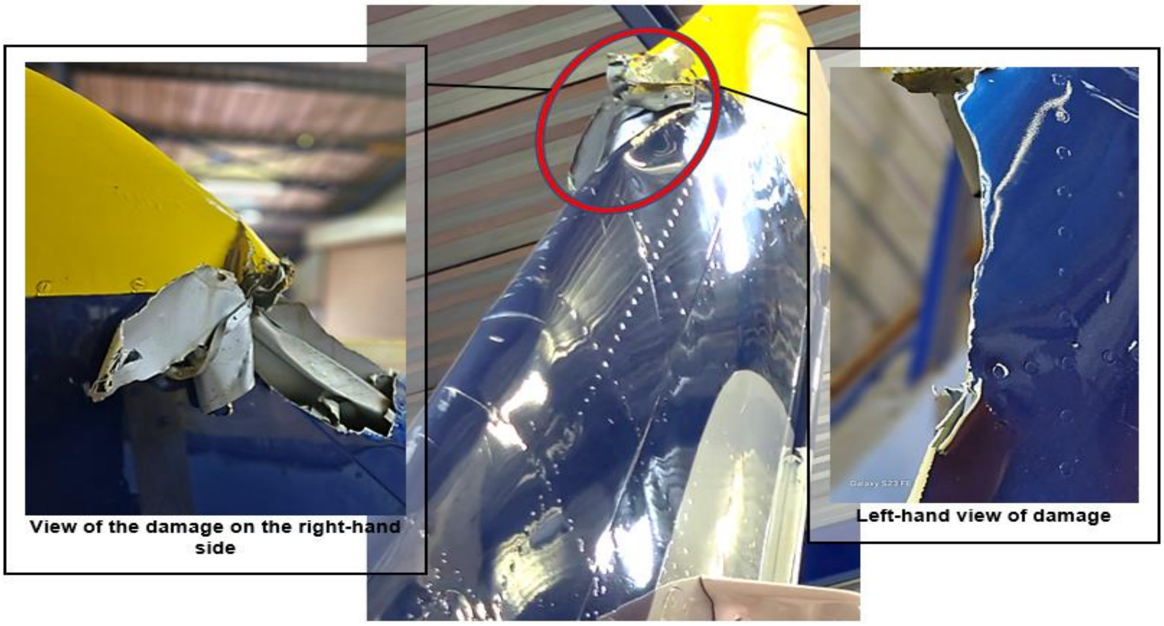

Figure 4: The damaged vertical stabiliser.

The investigation revealed that the rear canopy separated and impacted the vertical stabiliser and it disintegrated.

1.12.3. The aircraft's nose section, front canopy windshield, both wings and elevators sustained damage due to impact with the concrete barrier fence (Figure 2). Debris from the concrete barrier fence was found in the engine compartment, cockpit and on the surface of the wings.

Figure 5: Left- and right-air intake with debris.

1.12.4. The cockpit's ejection seat and the canopy jettison systems were non-functional (no evidence of activation). The canopy jettison activation mechanism and the jettison pins were removed, the holes for both cockpits were covered with seal tape, and there was no activation mechanism. The external handle of the rear canopy was found locked and latched, and the left rear canopy lock hook was jammed and locked with damage consistent with concrete fence impact. The other three canopy lock hooks were functional and locked properly when checked.

1.12.5. Both the left and right horizontal stabilisers sustained the same damage on the leading edge after impacting the concrete perimeter fence (see Figure 6). The concrete debris was found on both damaged points. Post-accident, the elevators, rudder and aileron input control were found without fault.

Figure 6: Damage to the horizontal stabiliser with evidence of concrete debris.

1.12.6. A post-accident, the canopy hinges and latch hooks on the hinge side (right side of the cockpit) were slightly damaged due to the opening and closing (operation) of the canopy over time. Three of the rear canopy latches were not damaged except for the left-side rear latch claw (see Figures 7 and 8); the claws had no signs of being forced open. The latches closed and locked properly; there was not enough space for the canopy pins to pull past the gap of the latch claws. The paint on the top of the latch claws was damaged when the latch system was checked. This is typically the point where the pins on the canopy side contact the top of the claws if the pins are not hooked in place and the canopy closing mechanism is already in the closed position. The canopy closing system, which is lever-operated, was inspected and no defects were found.

Figure 7: The chipped paint on the top side of both the right front latch claw and rear latch claw of the rear cockpit.

Figure 8: Rear cockpit left-side latch claws after the accident.

1.13. Medical and Pathological Information

1.13.1. The pilot sustained serious injuries to his face and left hand; he was taken to the hospital in an ambulance after the accident.

1.14. Fire

1.14.1. There was no pre- or post-impact fire during the accident sequence.

1.15. Survival Aspects

1.15.1. The accident was considered survivable due to the attitude at which the aircraft impacted the concrete fence.

1.16. Tests and Research

1.16.1. An approved person (AP) conducted the post-accident inspection of the aircraft's rear canopy latches (the AP was rate on the aircraft type).

The Aircraft Canopy Locking Mechanism Inspection

The rear cockpit latches (right front and rear) and the left-side front latch claw were found in good condition, and they operated as expected. However, the rear left latch claw had jammed in closed position and had scratch marks near it.

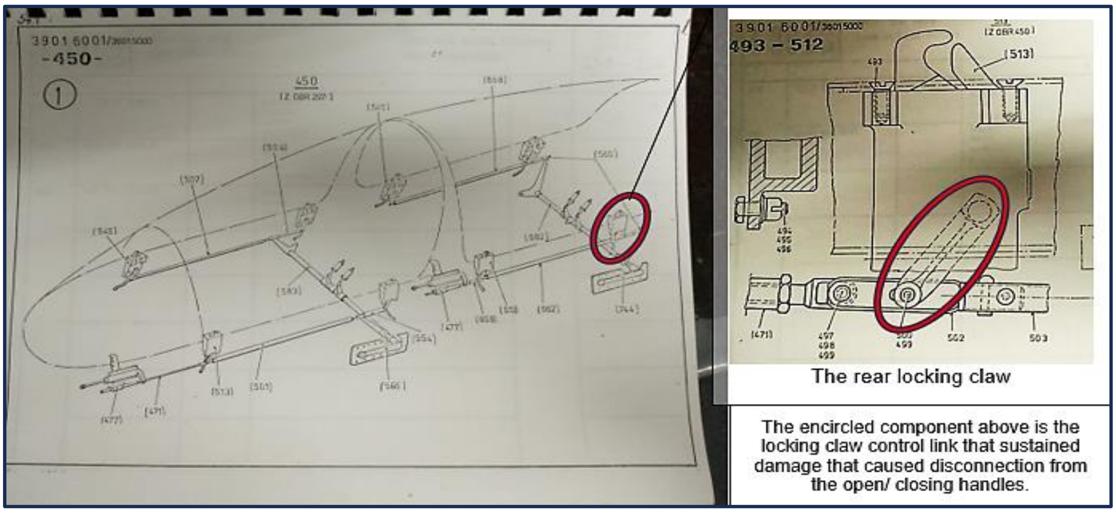

Figure 9: Canopy locking mechanism schematics. (Illustrated Part Catalogue)

Subsequent inspection and tests revealed that the rear right latch claw was not jammed but one of its control links that connect to the canopy locking handle had failed; it moved freely by hand. Additionally, there was a gap between the latch claws when they were in the locked position. The malfunctioning canopy latch system suggested potential maintenance (rigging) issues.

1.17. Organisational and Management Information

1.17.1. The aircraft was operated in a private capacity under the provisions of Part 94 of the Non-Type Certificated Aircraft (NTCA).

1.17.2. The AP who maintained the aircraft had an Approved Person Certificate that was issued by the Regulator on 25 August 2022 with an expiry date of 24 August 2024. The aircraft type was endorsed on the AP's maintenance and operational specifications (Ops Spec).

1.18. Additional Information

1.18.1 Safety Alert Released by Federal Aviation Administration (FAA) Safety Alert for Operators (SAFO13003_FAA)

The FAA released a Safety Alert for Operators (SAFO) dated 6 February 2013 directed to owners, operators, repair stations, and mechanics holding Airframe and Powerplant (A&P) certificates, concerning service difficulties and safety issues associated with the Aero Vodochody L39C and L39ZA variants. According to the agency, aircrew had experienced one or both canopies separating from the aircraft or partially opening in-flight.

These instances have occurred with a CANOPY LOCKED indication from the aircraft's annunciator panel warning light. Analyses of these events show a potential for a false indication from the canopy unlock light. Some of the possible causes for this problem include misalignment of the microswitches sensing the canopy position; failure of the latches on the right side of the canopy to fully engage, possibly caused by a physical obstruction or foreign object interfering with the latches; the canopy hold-open bar becoming distorted and obstructing the right-side canopy latches; and the canopy latches becoming misaligned, subject to wear, corrosion, faulty components, or improper maintenance.

It is advised that the actions below be accomplished every 100 hours of flight time, or as incorporated into the aircraft's inspection program:

1 *Inspect the micro switches in the front and rear canopy lock mechanism and make sure they are functioning and aligned per instructions in the Aero Vodochody factory maintenance manual. Perform these checks with the canopy both installed and removed.*
2. *Inspect the canopy for any foreign objects that may interfere with the right-side latching mechanism.*
3. *Inspect the condition of the hold-open bars at the front and rear canopies. The bars are located on the right rear portion of the front canopy or the right front section of the rear canopy. They should not be bent, distorted, or otherwise damaged.*
4. *With the canopy removed, inspect the canopy latches and verify the latches are holding and the springs are tight per procedures in the Aero Vodochody factory maintenance manual.*

5. *Place placards given front and rear seat occupants asking them to ensure that the canopy is secure before flight.*
6. *Amend the aircraft checklist to include checking the canopy to ensure that it is secure.*

   The FAA says that owners, operators, repair stations, and mechanics that operate and maintain Aero Vodochody L39C and L39ZA airplanes should familiarize themselves with the information found in this SAFO, and in the associated Airworthiness Certification job aid.

1.18.2 *The 5 Characteristics of Canopy Design (Sources: https://aircraftdesignguide.com/wp-content/uploads/2020/03/4-Guidelines-for-the-Design-of-Aircraft-Windshield-Canopy-Systems-Chapter-Two.pdf).*

The canopy design is dependent on the mission intended for the use of the aircraft. These design requirements must include such physical factors as structural loads, environmental exposure, pressures, temperatures, and bird strike impact. Fighter attack aircraft are designed for a high speed, and low altitude and may be required to withstand very high "g" forces. The canopy is designed to provide the aerodynamic characteristics to allow the necessary operational requirements. Operational profile drags resulting from the coefficient of friction on the canopy increase with the canopy shape profile. The canopy is designed to compensate for force imbalance. During operation, the aerodynamical centre of pressure along the canopy is probably closest to the rear cockpit.

If the L39C Albatros loses its rear canopy during the take-off run, the primary concerns would centre around aerodynamic instability, increased drag, structural integrity, and control difficulties.

Aerodynamic Principles (Source: Introduction to Flight by John D. Anderson 8th Edition)
Anderson's textbook covers the fundamental principles of aerodynamics, including how airflow around the aircraft's fuselage, control surfaces, and canopies contribute to drag, stability, and control. The loss of a canopy would disrupt the airflow and increase drag and turbulence, affecting overall stability and performance.

Increased Drag and Turbulence:

- *The rear canopy is part of the fuselage, and it contributes to the streamlined shape of the aircraft. Losing the rear canopy would expose the rear cockpit and disrupt the smooth flow of air around the fuselage. This would likely lead to a substantial increase in aerodynamic drag, especially during the take-off run when the aircraft is accelerating through relatively low speeds.*

- *The loss of the rear canopy would also generate turbulent airflow at the rear of the aircraft. The disturbed flow would increase drag, reduce the aircraft's efficiency, and make it harder to maintain acceleration and speed during the critical early stages of take-off.*
- *The turbulent air could also result in unpredictable movements of the aircraft, potentially making the flight control system harder to manage, and the pilot may need to apply additional corrective inputs to maintain stable flight.*

NASA Technical Reports on Aerodynamics and Canopy Effects (Source: NASA Technical Reports (NTRS) - Aerodynamic Studies on Aircraft Canopy Loss Effects.)
NASA and other aerospace organizations publish reports on aircraft aerodynamics, including the effects of canopy loss on supersonic and subsonic aircraft. These reports discuss the role of the canopy in minimizing drag, maintaining control, and ensuring smooth airflow, all of which would be affected by its loss.

Disturbed Airflow Over Control Surfaces

- *The* L39C Albatros *has tandem seating, meaning the front and rear cockpits are aligned one after the other. The loss of the rear canopy would create a large, open space at the rear of the fuselage, which would cause aerodynamic flow disturbances. These disturbances could have direct consequences for the tailplane (horizontal stabiliser) and rudder, as the turbulent air could cause control surface effectiveness to degrade.*

- *The disrupted airflow could cause pitching or yawing instability, as the flow would no longer be evenly distributed around the aircraft's fuselage and tail section. These instabilities are particularly dangerous during the take-off run, when the aircraft is still at a relatively low speed, and any loss of control or destabilization could compromise the ability to maintain a straight take-off roll.*

"Aircraft Design: A Conceptual Approach" by Daniel P. Raymer Source: Raymer, Daniel P. (2012). Aircraft Design: A Conceptual Approach, 5th Edition. AIAA.)

Raymer's book explains aircraft design, focusing on aerodynamics and stability. It provides insight into how drag, airflow over control surfaces, and other aerodynamic effects are critical for take-off performance, which would be disrupted by the loss of a canopy.

Impact on Flight Performance and Acceleration

- *Reduced acceleration: The increased drag caused by the missing rear canopy could reduce the aircraft's acceleration during the take-off run. This is*

- *particularly problematic in the early stages of take-off when the aircraft is most sensitive to drag and power requirements.*
- *In extreme cases, if drag becomes too significant, the aircraft may fail to achieve take-off speed within the runway's available distance. The aircraft might need to abort the take-off and attempt to stop, which could create an additional risk of damage, particularly if the runway is short.*

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 had a Private Pilot Licence (PPL) Airplane that was originally issued by the Regulator on 23 July 2003. The licence was reissued on 30 July 2023 with an expiry date of 31 July 2024. The pilot's Class 2 aviation medical certificate was issued on 3 July 2023 with an expiry date of 4 July 2024. The aircraft type was endorsed on the pilot's licence.

2.2.2. The pilot accumulated a total of 776.70 flying hours with 71.6 hours logged in the aircraft type. The pilot had not flown the L39C Albatros for more than a year prior to the accident flight. Moreover, he had no recent theoretical and practical training on this specific aircraft type in the year that he had not flown the aircraft. This might have contributed to inadequate emergency response during the accident.

2.2.3. The pilot activated the emergency brakes system which caused the tyres to screech, subsequently, one of the tyres burst. This indicated that appropriate emergency protocol might not have been fully understood or executed whilst under pressure.

2.2.4. The pilot's take-off calculations were incorrect due to the use of erroneous value (13), the source of which is unknown. Additionally, the pilot used an outside air temperature of 20°C in his pressure altitude calculations. These errors led to inaccuracies in the performance charts which resulted in the calculated rotation speed of 102 knots. This indicates that the pilot's familiarity with the aircraft type may have been insufficient. It also seemed that there was a lack of understanding during the take-off data calculations.

Machine

2.2.5 The aircraft had an Authority-to-fly (ATF) that was issued by the Regulator on 26 May 2023 with an expiry date of 31 May 2024. The aircraft's Certificate of Registration (C of R) was issued to the current owner on 13 February 2015.

2.2.6 The MPI of the aircraft was conducted after which a Certificate of Release to Service (CRS) was issued on 20 April 2023 at 1 292.9 airframe hours with an expiry date of 19 April 2024 or at 1 392.9 airframe hours, whichever comes first. The aircraft had 1 350 hours at the time of the accident flight. The aircraft had accrued 57.1 hours after the said MPI.

2.2.7 The AP who maintained the aircraft had an Approved Person Certificate that was issued by the Regulator on 25 August 2022 with an expiry date of 24 August 2024. The aircraft type was endorsed on the AP's maintenance and operational specifications (Ops Spec).

2.2.8 The aircraft, a subsonic trainer jet, reached a rotation speed of 105 kts, which is higher than the required minimum rotation speed of 81 kts under standard sea-level conditions. The pilot anticipated that rotation would occur at this speed for the intended take-off. However, this value was incorrect, as the pilot relied on erroneous data during the performance calculations. Given the high-density altitude and the prevailing environmental conditions, the correct rotation speed should have been approximately 130 kts with a take-off speed closer to 150 kts.

2.2.9 The rear canopy separated from the aircraft which contributed to the inability of the aircraft to lift-off due to aerodynamic instability. Canopy separation during take-off increased drag due to airflow separation which led to severe turbulence and instability that complicated the aircraft controls. The aerodynamic effects of canopy separation diminished the effectiveness of flight control surfaces and compromised safe manoeuvrability during take-off.

2.2.10 The rear canopy separated during take-off due to the malfunctioning latch mechanism. The broken push rod link on the left rear latch rendered the remaining latches insufficient to secure the canopy; hence, the detachment which led to loss of control.

2.2.11 The normal braking system was disabled due to the weight-on-wheels (WOW) microswitch being off. This safety design which prevents accidental braking during take-off left the pilot without the effective brake option. There was a slight lift of the nose section after the elevator was engaged but it could not continue to lift after the canopy separation. Post-accident tests confirmed that the elevator was functional.

2.2.12 The pilot activated the emergency brake system which caused the tyres to screech; as a result, one of the tyres burst which was an indication that appropriate emergency protocols might not have been fully executed (under pressure). The aircraft overshot the runway and impacted the perimeter fence due to lack of sufficient Runway End Safe Area.

2.2.13 The aircraft was not compliant with the Civil Aviation Regulations concerning decommissioning military systems, particularly regarding ejection seats and canopy jettison systems. Their absence might have contributed to the pilot's inability to safely exit in an emergency situation.

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) Airplane that was originally issued by the Regulator on 23 July 2003. The licence was reissued on 30 July 2023 with an expiry date of

31 July 2024. The pilot's Class 2 aviation medical certificate was issued on 3 July 2023 with an expiry date of 4 July 2024. The aircraft type was endorsed on the pilot's licence.

3.2.2. The pilot had not flown the L39C Albatros aircraft in more than a year and had no recent theoretical or practical training on the type. This lack of recent training may have impaired the pilot's ability to effectively manage the emergency, particularly in terms of responding appropriately under pressure.

3.2.3. The aircraft had an Authority-to-fly (ATF) that was issued by the Regulator on 26 May 2023 with an expiry date of 31 May 2024. The aircraft's Certificate of Registration (C of R) was issued to the current owner on 13 February 2015.

3.2.4. The aircraft was maintained by an approved person (AP) who had the relevant certification. The AP's maintenance and operational specifications included the L39 aircraft type.

3.2.5. The aircraft did not reach the required rotation speed of 130 kts as the recorded value of 105 kts was incorrect due to the usage of erroneous data during the performance calculations. Whilst the 105 kts exceed the minimum required rotation speed of 81 kts, this figure is only applicable at sea level and does not account for the high-density altitude and the prevailing conditions at the time of the flight.

3.2.6. The rear canopy separated during take-off, which led to increased drag and aerodynamic instability; this significantly reduced the effectiveness of the aircraft's control surfaces. Furthermore, this exacerbated the situation which caused the aircraft's condition to deteriorate. The canopy detachment compromised the aircraft's ability to achieve proper lift-off which resulted in loss of control.

3.2.7. The separation of the canopy was due to a malfunctioning latch mechanism which had a broken push rod link on the left rear latch. This failure rendered the remaining latches insufficient to hold the canopy in place and, as a result, led to its detachment.

3.2.8. The aircraft's normal braking system was disabled due to the weight-on-wheels (WOW) microswitch being off. This prevented the pilot from engaging the brakes during take-off.

3.2.9. There was an attempt to use the emergency braking system, but this led to tyres screeching and the subsequent burst of one of the tyres. This indicated that the emergency protocol may not have been fully understood or properly executed under pressure. The aircraft overshot the runway and impacted the perimeter fence due to lack of sufficient Runway End Safe Area.

3.2.10. The absence of decommissioned military systems such as the ejection seats and canopy jettison system in the aircraft may have contributed to the pilot's inability to safely exit the aircraft in an emergency situation, further complicating the response to the canopy separation.

3.3. Probable Cause/s

3.3.1. The aircraft was rotated before it reached the required speed and failed to climb. The pilot attempted to abort take-off by applying brakes whilst the main wheels remained on the ground, but this had no effect as the aircraft's weight had shifted off of the nose gear. The aircraft overshot the runway and impacted the perimeter fence.

3.4. Contributory Factor/s

3.4.1. Lack of recency.

3.4.2. Lack of sufficient Runway End Safe Area

3.4.3. Separation of the rear canopy.

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 Message

4.2.1. Safety message: In the interest of safety, pilots and owners are advised to always adhere to the Civil Aviation Regulations 2011 to ensure the safe operation of the aircraft.

5. APPENDICES

5.1. None.

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