SOUTH AFRICAN CIVIL AVIATION AUTHORITY

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

LIMITED OCCURRENCE INVESTIGATION REPORT – FINAL

Reference Number	CA18/2/3/10244						
Classification	Accident		**Date**	24 December 2022		**Time**	0830Z
Type of Operation	Private (Part 91)						
Location							
Place of Departure	Grand Central Aerodrome (FAGC), Gauteng Province		Place of Intended Landing	Zebula Lodge Estate Airstrip, Limpopo Province			
Place of Occurrence	Between the trees next to the threshold of Runway 08 at Zebula Lodge Estate Airstrip, Limpopo province						
GPS Co-ordinates	Latitude	24°45'34.5" S	Longitude	027°58'19.6" E		Elevation	4 213 ft
Aircraft Information							
Registration	ZS-PYL						
Make; Model; S/N	Reims Cessna; F172M Skyhawk (Serial Number: F172-01039)						
Damage to Aircraft	Substantial			Total Aircraft Hours	14 651.1		
Pilot-in-command							
Licence Type	Private Pilot Licence (PPL)			Gender	Male	Age	22
Licence Valid	Yes	Total Hours	198	Total Hours on Type	33.8		
Total Hours Past 30 Days	21.9		Total Flying Hours on Type Past 90 Days	33.8			
People On-board	1 + 2	**Injuries**	0	**Fatalities**	0	**Other (on ground)**	0

What Happened

On Saturday, 24 December 2022, a pilot and two passengers on-board a Reims Cessna F172M Skyhawk aircraft with registration ZS-PYL were on a private flight from Grand Central Aerodrome (FAGC) in Gauteng province to Zebula Lodge Estate Airstrip, Bela-Bela, in Limpopo province. No flight plan was filed. The flight was conducted under the provisions of Part 91 of the Civil Aviation Regulations (CAR) 2011 as amended.

The pilot reported that he made a detailed assessment of the weather conditions before departure at FAGC. The flight folio page serial number 0032 showed that 60 litres (l) of Jet A1 fuel was uplifted at FAGC, and the aircraft had a total of 132l (35 gallons / 210 pounds) in the tanks. A pre-flight inspection was conducted on the aircraft, and no anomalies were detected. After boarding the aircraft, the pilot briefed the passengers before requesting a start clearance from the FAGC control tower at very high frequency (VHF) 122.80-Megahertz (MHz). Thereafter, the pilot started the engine. After completing the engine runup checks, he taxied the aircraft to the holding point of Runway 35. Pre-departure checks were performed and, after making sure that all the engine indications were within the limits, the aircraft was ready for departure. He then opened the throttle to 2 400 revolutions per minute (RPM)/maximum power and took off.

The aircraft climbed to 7 500 feet (ft), travelling at 105 knots indicated air speed (KIAS) with the engine at cruise power setting of 2 100 RPM. The pilot reported that upon reaching Zebula Lodge Estate Airstrip, he joined overhead the runway at 5 800ft to inspect the windsock. Upon verifying the wind direction, he joined the left downwind for Runway 26. The pilot performed the downwind checks in accordance with (IAW) the Pilot's Operating Handbook (POH) and extended the flaps to 10 degrees (°) whilst travelling at 80 knots. After turning base, the pilot increased the flaps to 20°, and after turning final approach he increased the flaps to 40° (full flaps) whilst in a descent into wind in a westerly direction at 300ft per minute. After passing the threshold of Runway 26 at 80 knots, the aircraft floated for some time at about 2ft above ground level and the pilot opened the full throttle with the intention to execute a go-around. The pilot noticed that the aircraft was not climbing, and that a go-around was not a viable option anymore; he then closed the throttle and the aircraft touched down hard at an estimated position of 2/3 (two thirds) along the length of the runway with approximately 460m remaining. After touchdown, the pilot applied excessive brakes, however, the aircraft skidded whilst veering off to the right past the movement area and into the trees where it came to a stop.

A witness who was on the side of the movement area when the aircraft landed reported that he saw the aircraft floating above the runway surface at low height, then the aircraft's nose pitched up momentarily; he thought that the pilot intended to abort the landing (executing a go-around). But suddenly, he observed the aircraft impacting the ground very hard with all three wheels. The aircraft was substantially damaged; however, the pilot and the passengers were not injured. The duration of the flight was 1.5 hours and approximately 102l (27 gallons) of Jet A1 fuel remained in the aircraft tanks.

The accident occurred during daylight at Global Positioning System (GPS) co-ordinates determined to be 24°45'34.5" South and 027°58'19.6" East at an elevation of 4 213ft.

Figure 1: Runway 26 at Zebula Lodge Estate Airstrip and the accident site. (Source: Google Earth)

Figure 2: The final position of the ZS-PYL aircraft post-accident. (Source: Pilot)

Zebula Lodge Estate Airstrip:

Zebula Lodge Estate Airstrip is an unlicensed private airstrip situated in Waterberg mountains in Bela-Bela, Limpopo province. It is surrounded by game lodges, nature and wildlife reserves. It accommodates private aircraft operators coming to the lodge, except air training organisations (ATOs). The airstrip has no air traffic control (ATC) services available and has a single asphalt runway orientated 08/26 that is 1 400 metres (m) in length and 13m in width. The runway surface is relatively flat and smooth. The pilot described it as being in a good condition and well maintained.

The Pilot

The pilot was initially issued a Private Pilot Licence (PPL) by the South African Civil Aviation Authority (SACAA) on 3 March 2021. The PPL was reissued by the SACAA on 13 March 2022 with an expiry date of 31 March 2024. The pilot's logbook was examined, and it was found that at the time of the accident, the pilot had flown a total of 198 hours, of which 33.8 hours were on the aircraft type (Reims Cessna F172M Skyhawk). The pilot had the aircraft type endorsed on his licence. The aircraft type conversion was conducted and overseen by the SACAA's certified Designated Flight Examiner (DFE) on 24 January 2022. The pilot had a valid Class 2 aviation medical certificate which was issued on 10 September 2019 with an expiry date of 30 September 2024. The pilot had no restrictions recorded on his licence.

Aircraft description and certification

The Cessna F172M Skyhawk is a four-seat, high wing, light aircraft manufactured by Cessna Aircraft Company in the United States of America (USA). The aircraft is equipped with a fixed tubular spring steel main landing gear struts and a steerable nose landing gear. It is powered by a four-cylinder, four-stroke, horizontally opposed Thielert TAE125-02-99 (Centurion 2.0) engine with serial number 02-02-05005 producing 135 horsepower (hp) and driving a three-bladed constant speed MTV-6-A model MT-propeller, bearing serial number 06190. The aircraft has a fuel capacity of 138.8l (36.6 US gallons) and burns around 19.6l (5.2 gallons) per hour. Approximately 11.4l (3 gallons) of fuel is unusable.

The Thielert TAE125-02-99 engine is a modified Mercedes-Benz automotive engine. The engine has a displacement of 1991 cubic centimetres (cm^3), equipped with a common rail high pressure fuel injection system, turbocharger, gearbox with reduction ratio of 1: 1.689. The engine and the propeller pitch are fully controlled by a Full Authority Digital Engine Control (FADEC) computer, which integrates the measurements of various sensors, which manages the quantity of fuel injected into the engine and propeller pitch to obtain the power required by the pilot in command (PIC). The turbocharger boosts engine power output by compressing ambient air, which is then cooled by an intercooler before the compressed air passes into the cylinders.

The aircraft was originally certified under the Civil Air Regulation (CAR) 3 requirements, amendment 8 of the Federal Aviation Administration (FAA), which issued Type Certificate number 3A12 and its corresponding Type Certificate Data Sheet (TCDS).

Subsequently on 23 August 2010, the European Aviation Safety Agency (EASA) approved a change to the type design by way of a Supplemental Type Certificate (STC) (EASA 10014287), at the request of Continental Aerospace Technologies GmbH in Germany, because of replacing the original powerplant (Continental O-300-A or O-300-B) with a TAE125-02-99 engine and a constant speed MTV-6-A model MT-propeller. A supplement POH was then compiled by the STC holder and approved by the FAA.

A review of the aircraft's maintenance records indicated that the last 100-hour mandatory periodic inspection (MPI) prior to the accident flight was certified on 21 October 2022 at 14 555.0 total airframe hours. The aircraft had logged 14 651.1 total hours at the time of the accident; meaning that it had been flown a further 96.1 hours since the last inspection. The aircraft maintenance organisation (AMO) that performed the last inspection had a valid approval certified issued by the SACAA IAW Part 145 of the CAR 2011 as amended on 23 August 2022 with an expiry date of 31 August 2023. The aircraft's Certificate of Airworthiness (C of A) was issued on 8 November 2018 with an expiry date of 30 November 2023. The Certificate of Registration (C of R) was issued to the current owner on 10 September 2018. The Certificate of Release to Service (CRS) was issued on 21 October 2022 with an expiry date of 2 February 2023 or at 14 655.0 hours, whichever occurs first.

The weather report was obtained from the pilot's questionnaire

Wind Direction	160°	Wind Speed	10 knots	Visibility	> 10km
Temperature	27°C	Cloud Cover	Nil	Cloud Base	Nil
Dew Point	N/a	QNH	N/a		

Post-accident examination of the wreckage and analysis

An assessment of the accident site was made based on the eyewitness' version and photographic evidence. The skid mark made by the right main gear wheel tyre was observed on the runway surface/movement which indicated excessive braking until the aircraft came to a stop, approximately 430m from the touchdown point. The aircraft sustained impact damage on the left-wing leading edge inboard area and wing support strut. The left main landing gear strut collapsed during the accident sequence after colliding with a tree stump.

Figure 3: The aircraft at the accident site with sustained damage highlighted in the yellow windows. (Source: Pilot)

Figure 4: The skid mark made by the right main gear wheel tyre as the aircraft passed the movement before coming to a stop between the trees.

The aircraft remained upright, leaning on its left wing and the left horizontal stabiliser. The engine and the cockpit/cabin area were intact. The fuel tank selector handle was found in the OFF position, it rotated smoothly through all the other positions with the detents plainly noted in each position. The left and the right front seats were correctly attached or fitted to the rails on the cockpit floor. The throttle control lever operated normally through its whole range. The engine was visually examined, and no pre-accident abnormalities were noted. The fuel system was checked and no defects were identified. The control columns moved freely when tested and the flight control continuity was confirmed on all flight control surfaces.

The pilot retracted the flaps to the UP position post-accident. The elevator was trimmed properly at neutral position. There was no evidence of any in-flight mechanical failures that would have resulted in the loss of control. The computed weight and balance by the pilot indicated that the aircraft was 316 pounds (lbs) below its maximum gross operating weight of 2 450lbs on departure from FAGC. The table below shows the weight and balance calculation.

	Mass (lbs)	Limit (lbs)	CG (in)	FWD / AFT Limits (in)
BEM	**1 639**	**-**	**37,0**	**35,0 / 47,3**
Payload	495	811	-	-
Zero Fuel Mass	**2 134**	**2 450**	**39,6**	**36,8 / 47,3**
Fuel Tanks	210	318	-	-
Ramp Mass	**2 344**	**2 457**	**40,4**	**38,9 / 47,3**
Taxi Fuel	30	-	-	-
Takeoff Mass	**2 314**	**2 450**	**40,3**	**38,6 / 47,3**
Fuel To Destination	180	-	-	-
Landing Mass	**2 134**	**2 450**	**39,6**	**36,8 / 47,3**

The Aircraft Flight Manual (AFM) states that the maximum take-off weight (MTOW) for this aircraft is 2 450lbs (1 111kg).

According to the AMO that conducted the last re-weighing of the aircraft on 30 August 2022, the aircraft was weighed with 6.4 quarts (6.1l) of Aeroshell engine oil (in the engine compartment and oil filter). The Halon portable fire extinguisher and first aid kit were in the cabin. There was no fuel in the tanks.

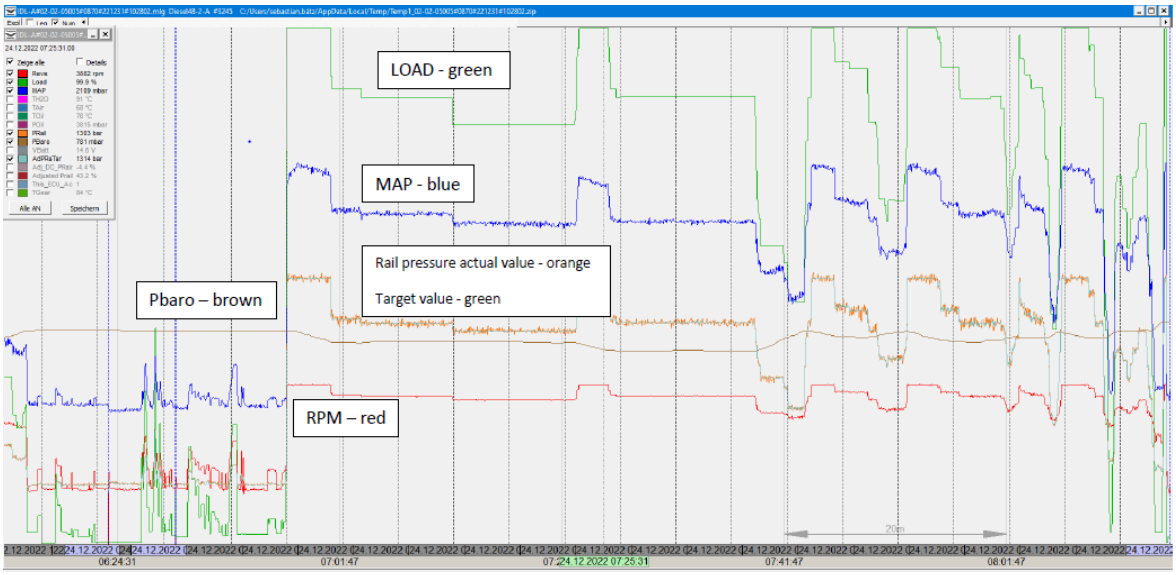
The passengers, baggage and Jet A1 fuel quantity weights that were considered for the weight and balance calculation prior to take-off were provided by the pilot in the weight and balance calculation that was made available to the investigator. According to the computed weight and balance, the take-off weight was 316lbs below the MTOW for this aircraft with 132l (35 gallons) of Jet A1 fuel on-board.

The main wheels and brakes were examined post-accident. The main wheels hubs and tyres were in good condition. The brake callipers and friction pads were generally in a good condition (unworn condition). No evidence of hydraulic leakage was observed, and the main wheels rotated freely. All three tyres were found to be correctly inflated and the treads were well defined. A review of the aircraft's maintenance records indicated that the aircraft inspections and maintenance requirements were performed at the required times, and applicable Airworthiness Directives (ADs) and Service Bulletins (SBs) were complied with.

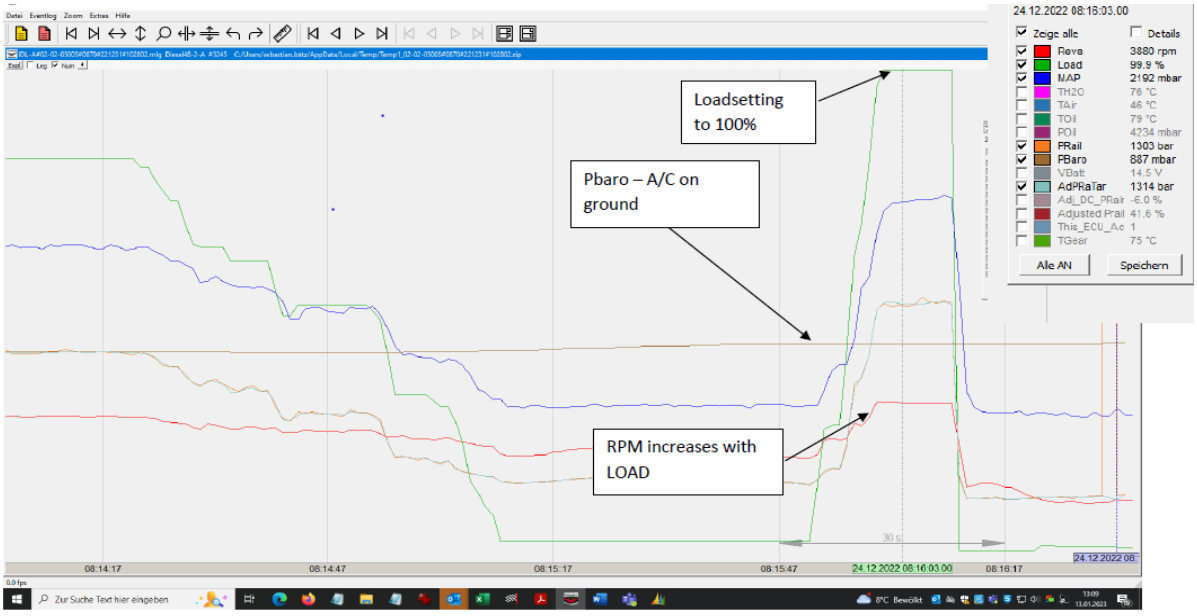
Records indicated that the engine had accumulated 767.0 hours since overhaul on 31 July 2019; and the propeller acquired 1 382.3 hours since overhaul on 19 June 2014. Maintenance records showed no discrepancies that would have affected the engine operation or performance.

The FADEC computer was removed, and its non-volatile memory was downloaded. The parameters (load setting, the manifold air pressure [MAP], fuel pressure) indicated normal values. Upon reaching Zebula Lodge Estate Airstrip during the final approach for Runway 26, the parameters showed a decrease in engine RPM and the throttle after it (throttle) was opened at 100% as the pilot tried to abort the landing.

The throttle was closed before touchdown. Fuel pressure was recorded at 1 303 bars and the MAP at 2 192 millibars (mbar). The recorded parameters did not show any indication of an impending engine failure or power loss.



Graph 1: The values recorded in the last segment of the flight. (Source: Continental Aerospace)



Graph 2: The values recorded in the last segment of the flight. (Source: Continental Aerospace).

The aircraft was recovered to Springs Airfield (FASI) in Gauteng province. On Tuesday, 24 January 2023, the engine was started and was allowed to run at a low power setting. Following the satisfactory indication of the engine performance on the FADEC computer, power was increased in stages until it was evident that it was capable of operating at full power IAW the Operator's Manual.

The Reims Cessna F172M Skyhawk aircraft model requires 853ft (260m) to take off and 722ft (220m) to land. A go-around was initiated at 2ft above the runway surface at an estimated position of 2/3 along the length of the runway, an indication that the distance available was sufficient for a safe go-around.

Post-accident, the pilot reported that the flaps were reduced to 20° when a go-around was initiated. Because the aircraft was powered by a 135 horsepower (hp) turbocharged engine, the pilot's testimony seemed erroneous as it should have climbed without struggle, considering the good weather conditions that prevailed on the day and that the aircraft was operated within its allowable weight limit.

Scrutiny of the pilot's file held at the SACAA facility indicated that the pilot was properly certificated and was qualified for the flight. There was no evidence that medical or psychological problems might have affected his performance.

The aircraft was considered airworthy at the time of the flight. The investigation concluded that a go-around seemed to have been initiated with the flaps still extended to 40°, which resulted in a huge drag and the subsequent loss of lift. Normal practice IAW the POH is to reduce the wing flap setting to 20° immediately after full power is applied.

BALKED LANDING

(1) Thrust Lever – FULL FORWARD
(2) Wing Flaps – RETRACT TO 20° (immediately after Thrust Lever FULL FORWARD)
(3) Climb Speed – 58 KIAS/ 68 mph
(4) Wing Flaps – 10° (until all obstacles are cleared)
(5) Wing Flaps – RETRACT after reaching a safe altitude and 65 KIAS/ 75 mph

Findings

(i) The pilot was reissued the PPL by the SACAA on 13 March 2022 with an expiry date of 31 March 2024.

(ii) The pilot had a valid Class 2 aviation medical certificate, which was issued on 10 September 2019 with an expiry date of 30 September 2024. The pilot had no restrictions listed on his licence.

(iii) This flight was conducted under the provisions of Part 91 of the Civil Aviation Regulations (CAR) 2011 as amended.

(iv) At the time of the accident, the pilot had flown a total of 198 hours, of which 33.8 hours were on the aircraft type.

(v) Based on the weather report from the pilot questionnaire, no significant weather was present at the time of the flight.

(vi) The last 100-hour MPI prior to the accident flight was certified on 21 October 2022 at 14 555.0 airframe hours. The aircraft had logged 14 651.1 total hours at the time of the accident; meaning that it had been flown a further 96.1 hours since the last inspection.

(vii) The AMO that performed the last inspection had a valid approval certified that was issued by the SACAA IAW Part 145 of the CAR 2011 as amended on 23 August 2022 with an expiry date of 31 August 2023.

(viii) The C of A was issued on 8 November 2018 with an expiry date of 30 November 2023.

(ix) The C of R was issued to the current owner on 10 September 2018.

(x) The Certificate of Release to Service (CRS) was issued on 21 October 2022 with an expiry date of 2 February 2023 or at 14 655.0 hours, whichever occurs first.

(xi) The duration of the flight was 1.5 hours, and approximately 102l (27 gallons) of Jet A1 fuel remained in the aircraft tanks.

(xii) The aircraft was 316lbs below its maximum gross operating weight at take-off from FAGC.

(xiii) The pilot and the passengers sustained no injuries.

Probable Cause

The pilot seemed to have initiated a go-around with the flaps still extended to 40° which resulted in the massive drag and the subsequent hard landing towards the end of the runway. The aircraft exited the runway and came to a stop between trees.

Contributing Factor

Unknown.

Safety Action(s)

Pilots are advised to ensure that they do not float over the runway, and that they are always prepared for a go-around.

Safety Message and/or Safety Recommendation/s

None.

About this Report

The decision to conduct a limited investigation is based on factors including whether the cause is known and the evidence supporting the cause is clear, the level of safety benefit likely to be obtained from an investigation and that will determine the scope of an investigation. For this occurrence, a limited investigation has been conducted, and the Accident and Incident Investigations Division (AIID) has relied on the information submitted by the affected person/s and organisation/s to compile this limited report. The report has been compiled using information supplied in the initial notification, as well as from follow-up 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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This report is issued by:

Accident and Incident Investigations Division

South African Civil Aviation Authority

Republic of South Africa