SOUTH AFRICAN CIVIL AVIATION AUTHORITY

Section/division **Accident and Incident Investigations Division** Form Number: CA 12-55

LIMITED ACCIDENT INVESTIGATION REPORT

Reference Number	CA18/2/3/10037										
Classification	Accident		**Date**	9 September 2021			**Time**	1224Z			
Type of Operation	Private (Part 91)										
Location											
Place of Departure	Rand Aerodrome (FAGM), Gauteng Province		Place of Intended Landing	Rand Aerodrome (FAGM), Gauteng Province							
Place of Occurrence	Runway 11 at FAGM, Gauteng Province.										
GPS Co-ordinates	Latitude	S25º 56.' 19"	Longitude	E027º55.'34	Elevation	4520 feet					
Aircraft Information											
Registration	ZS-EFF										
Model/Make	Piper PA-24-260 Comanche (Serial No: 24-4045)										
Damage to Aircraft	Substantial		Total Aircraft Hours	2336.9							
Pilot-in-command											
Licence Valid	Yes	Gender	Male	Age	43						
Licence Type	Airline Transport Pilot Licence (ATPL)										
Total Hours on Type	65.9		Total Flying Hours	13022.5							
People On-board	1 + 1	Injuries	0	Fatalities	0	Other (On Ground)	0				
What Happened											

On 9 September 2021, a pilot accompanied by an aircraft maintenance engineer (AME) on-board a Piper PA-24-260 Comanche tricycle retractable landing gear aircraft with registration ZS-EFF took-off on a private flight from Rand Aerodrome (FAGM) Runway 11, situated in Germiston, Gauteng Province, with the intention to return to FAGM. The AME's role was to monitor the aircraft's instrumentation in-flight because the aircraft had not been flown for approximately four months and 24 days. However, during the time it was parked, regular engine run-ups were conducted to ensure that continuous airworthiness requirements were met. Visual meteorological conditions (VMC) by day prevailed on the day of the accident and no flight plan was filed. The duo conducted a pre-flight inspection on the aircraft and no abnormalities were noted. The aircraft had a total of 60 gallons of Avgas LL100 fuel in the tanks. The flight was planned to last for two hours. The duo boarded the aircraft, and the pilot started the engine. Thereafter, the pilot taxied the aircraft to Runway 11 holding point. Runway 11 is 1579 metres (m) in length.

Pre-departure checks were carried out and the pilot verified before take-off that the battery was charging by checking the ammeter indication. The pilot broadcasted his intention to FAGM control tower on frequency 118.70-Megahertz (MHz) and was cleared to take-off at 1105Z. The aircraft took off and headed north towards FAGM Traffic Zone (ATZ) at an altitude of 6500 feet (ft), cruising at 155 knots. The pilot stated that the aircraft remained in that area for approximately 15 minutes during which the AME ensured that the engine oil temperature, the oil pressure and the cylinder head temperature indications were within limits. After another 15 minutes of flight time, the aircraft climbed to 7000ft and left FAGM ATZ for Johannesburg General Flying (GF) area. After another 40 minutes of flight time, the duo noted that the aircraft's battery voltage was surging, indicating 9.2 volts (pressure that allows electrons to flow). Seconds later, it fluctuated between 9.2 and 11.4 volts, and was discharging 32.3 Amps (volume of electrons) and the red discharge indication light was illuminated. The duo discussed the situation and decided to return to FAGM to investigate the electrical system defect. During this time, the engine performance indications were within limits. The AME took a video of the engine indications on the instrumentation panel mid-air, and none of the circuit breakers (CBs) popped.

Figures 1/2: The indication of the oil pressure and the oil temperature within limits (green arch), (left picture). A picture of the instruments panel showing all the CBs in pressed-in position (right picture). (Source: AME)

After joining the traffic pattern routing right base to FAGM, the pilot broadcasted to the air traffic control (ATC) requesting a full-stop landing clearance. The pilot was cleared to land on Runway 11, and he was notified that ZS-EFF aircraft would land second. About five seconds later, the ATC provided the pilot with the weather update — the surface wind was reported to be light and variable. The pilot stated that on final approach in preparation for landing, he followed the pre-landing checklist and selected the flap lever to fully extended position, and the landing gear lever to extended position. The AME stated that as a precaution, he opened the cockpit floor hatch, pulled the manual emergency gear extension lever and rotated it up to release the gear from transmission. During this time, the red discharge lights remained illuminated, and there was no green light to indicate that the landing gear was down and locked into position.

The pilot continued with the approach at 130 knots. The aircraft touched down approximately 40m

beyond Runway 11 threshold markings. During the landing roll and after approximately 60m, the landing gear collapsed and the propeller blades struck the runway surface. The aircraft slid on its belly to the right-side, exited the runway and came to a stop approximately 5m from the runway edge on the grass area just before the second taxiway. The aircraft sustained substantial damages. None of the occupants were injured during the accident sequence; they vacated the aircraft without assistance.

Figure 3: The aircraft at the accident site. (Source: Operator)

Post-accident examination of the propeller blades indicated that the engine was producing a substantial amount of power at the time of impact.

Extract from the Piper PA-24-260 Comanche Pilot's Operating Handbook (POH):

The Piper PA-24-260 Comanche aircraft uses a single electric motor to drive all three landing gears. This is connected to a transmission which converts the rotary motion into a linear movement which acts upon two large push-pull 'Bowden' type cables to move the main landing gears, and a rod which moves the nose landing gear. In the event of an electrical malfunction of the landing gear, a manual emergency gear extension lever is provided which should disconnect the transmission from the motor, allowing the landing gear to drop under gravity. To achieve that, the pilot must move the landing gear selector to the OFF position so that the electric motor does not oppose the movement of the gear mechanism when the gear is manually extended. The selector is located on the instrument panel. A mechanical guard is positioned just below the selector to guard against inadvertent movement of the landing gear selector on the ground. The warning horn will sound if the engine power is reduced below approximately 12 inches of manifold pressure and the gear has not been extended.

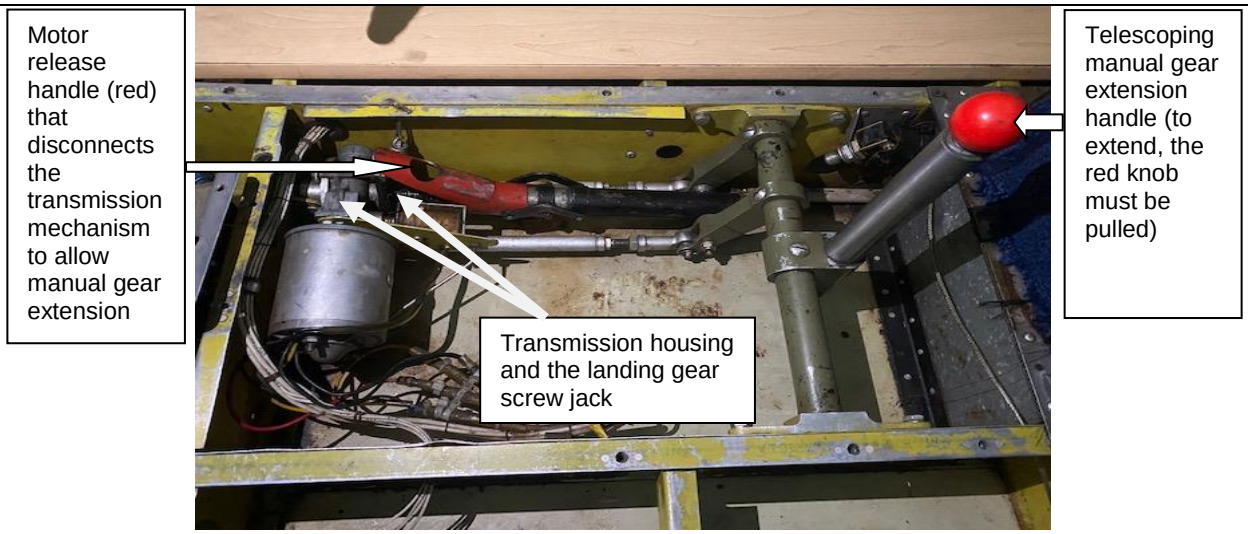
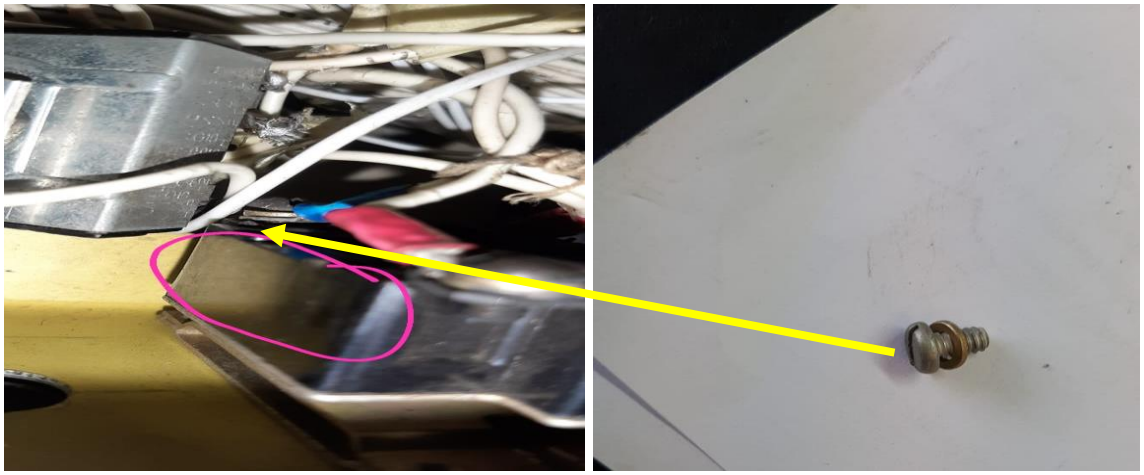


Figure 4: The landing gear manual extension lever in an extended position.

The aircraft was recovered on a trailer to the hangar at FAGM and was placed on jacks for further investigation. The cockpit floor panels were opened to allow inspection. Examination of the motor and transmission assembly revealed that all components were intact and exhibited no external damage. The landing gear screw jack was normal and well lubricated. The flaps sustained substantial damage because they were extended, while the main landing gear doors were not damaged. Post-accident landing gear retraction and extension tests could not be carried out because the nose gear actuating rod was damaged. During the investigation, the operator shared a video footage of the landing gear retraction and extension tests conducted during the 100-hour mandatory periodic inspection (MPI) before the accident. Tests were carried out and all three landing gears moved freely and in unison between their retracted and extended positions with the green down and locked position indication light illuminating. All three landing gears extended fully and the stops and microswitches reached their respective overcentre links, which indicated normal rigging. An additional test was carried out using the emergency gear extension lever and all three landing gears moved freely and in unison to the extended position with the green down and locked position indication light illuminating.

On 13 September 2021, the aircraft maintenance organisation (AMO) with a valid approval certificate was contracted by the operator to assist with the electrical system defect investigation. The engineer who assisted with the investigation had both Category W and X ratings. Inspection was carried out on the battery and connection to the master solenoid, making sure that the fasteners were properly secured; nothing abnormal was noted. The wiring under the floor panels was inspected and found undisturbed. After the AMO's engineer had opened a panel situated on the left of the pilot's side, he noticed that the screw securing the cable ring lug to the master switch was loose. The cable was found to have detached from the master switch body. The cable in question controls the aircraft's charging system and the defect was directly linked to electronic failure as the charging system was not sufficiently keeping buss and battery voltage at operating levels. The buss voltage dropped too low that the master solenoid switched off.

All connections to the landing gear were tugged and inspected, including the motor function check, and all was found to be satisfactory. Examination of the aircraft flight folio showed no outstanding defects relating to the electrical system at the time of the accident. The logbooks also did not reveal defects or maintenance task entry that might be relevant to the cause of the electrical failure.



Figures 5/6: The area where a loose screw was found (left picture). The screw in question (right picture).

*NOTE: The Piper PA-24-260 Comanche aircraft electrical system includes a 12-volt Amp alternator, providing power at all engine speeds, a transistorised voltage regulator, an over voltage relay and a 35-Ampere hour battery.

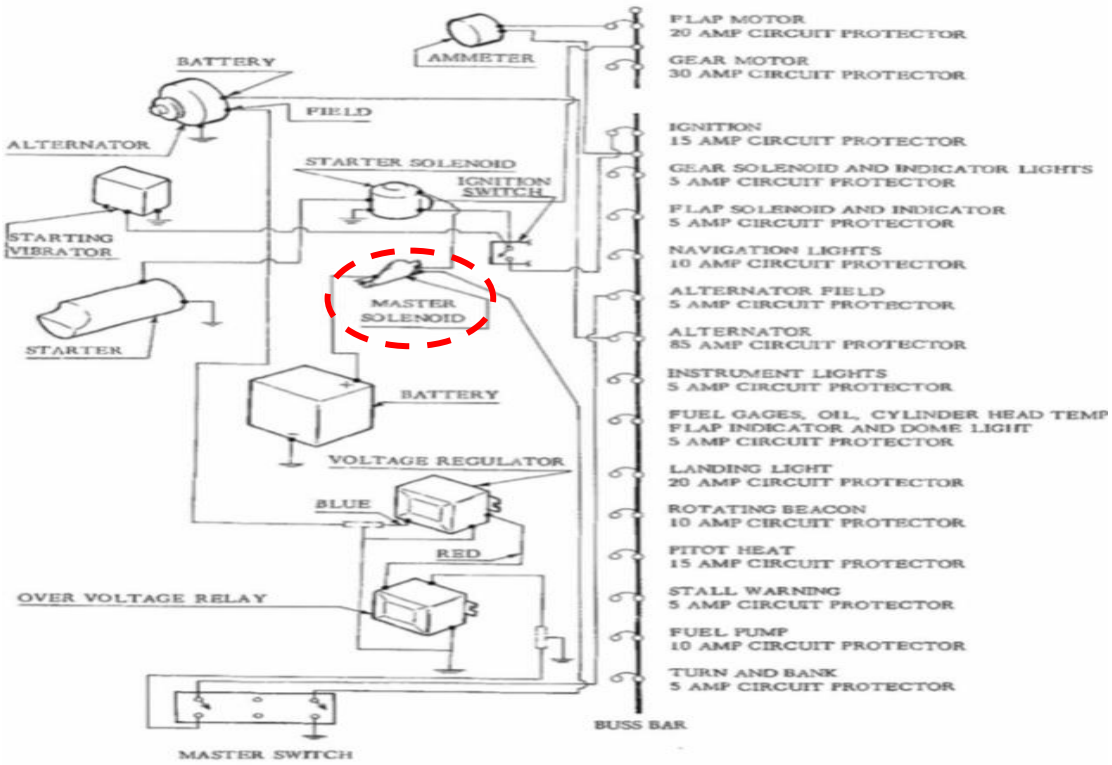


Figure 7: The wiring diagram of a PA-25-260 Comanche aircraft. (Source: AMM)

Examination of the pilot's file held at the South African Civil Aviation Authority's (SACAA) facility showed that the pilot had an Airline Transport Pilot Licence (ATPL) initially issued on 4 May 2004. The pilot was properly licensed and had the aircraft type endorsement in his pilot licence. The pilot had a valid Class 1 aviation medical certificate issued on 31 March 2020 with an expiry date of 31 March 2022, with a restriction to wear hearing protection.

Post-accident examination of the aircraft maintenance records and other documentation revealed no anomalies, and showed that the aircraft was certificated, equipped and maintained in accordance with existing regulations and approved maintenance procedures.

Examination of the flight folio indicated no open or deferred maintenance items listed before the flight. The flight folio page serial number 11 indicated that the aircraft was subjected to a 100-hour MPI on 26 March 2021 at 2332.6 airframe hours. The Certificate of Release to Service was issued on 26 March 2021. The aircraft manufacturer's 100-hour MPI checklist page serial number 11 (Bullet 5) dictates that all electrical cables be inspected for condition and security. On the right-side of the instruction block were signatures of the AME who carried out the inspection and a certifying engineer.

Page serial number 11 of the flight folio revealed that post-maintenance acceptance flight was flown on 15 April 2021 and no defects were reported. The accident occurred on 9 September 2021 at 2336.9 airframe hours. This indicated that the aircraft flew a total of 4.3 hours since the 100-hour MPI was completed. The aircraft manufacturer's maintenance instruction as outlined in the 100-hour MPI checklist, page serial number 11 (Bullet 5), dictates that all electrical cables be inspected for condition and security. The master switch cable was not checked for condition and security during the 100-hour MPI inspection as outlined in the manufacturer's 100-hour MPI checklist, which was not in accordance with (IAW) Part 43.02.3 of the South African (SA) Civil Aviation Regulations (CAR) 2011 as amended. The AME who certified the 100-hour MPI inspection was interviewed by the investigator-in-charge (IIC) in which he stated that at no time was the master switch area inspected for condition and security of electrical cables. The AME's aircraft maintenance credentials were examined and it was found that he was appropriately qualified with the aircraft type ratings endorsed on his AME licence.

Probable cause:

The aircraft's landing gears collapsed during the landing roll because they did not lock into position prior to landing, probably due to the landing gear manual extension being performed while the electrical motor was still operative. This appeared to have prevented the movement of the gear mechanism.

Contributing factor:

The electrical failure on the aircraft was caused by a disconnected master switch cable which controls the charging system, and the defect was directly linked to the electrical failure as the charging system was not sufficiently keeping buss and battery voltage at operating levels.

Safety Action/s

None.

Safety Message

Maintenance personnel are cautioned to comply with all maintenance requirements as this will ensure that aircraft are not operated with undetected defects that may result in major damage/loss of aircraft and injuries/death due to incomplete maintenance inspection being carried out.

The following regulation was extracted from the SA-CAR, 2011 as amended

43.02.3 Any person who carries out maintenance on an aircraft or aircraft component shall—

(a) have available adequate accommodation and facilities for the necessary disassembly, proper inspection and re-assembly of the aircraft or aircraft component;

(b) use methods, techniques and practices which are—

(i) prescribed in the current manufacturer's maintenance manual or in any instructions for safe operation and continued airworthiness;

(ii) in accordance with the approved maintenance programmed for the aircraft;

(iii) in accordance with Document SA-CATS 43; or

(iv) approved by the Director;

(c) use the tools, equipment and test apparatus necessary to ensure that the maintenance is carried out in accordance with the appropriate manufacturer's requirements or standard practices approved by the Director;

(d) on completion of the maintenance, ensure that the condition of the aircraft or aircraft component is satisfactory for release to service and is at least equal to its original or properly modified condition with regard to—

(i) aerodynamic function;

(ii) structural strength;

(iii) resistance to vibration and deterioration; and

(iv) other qualities affecting airworthiness;

(e) use any special or test equipment recommended by the manufacturer, or equivalent equipment approved by the Director; and

(f) if maintenance is carried out on an aircraft operated under an aircraft operating certificate, carry out such maintenance in accordance with the operator's approved maintenance control manual. The format and requirements for a maintenance control manual are prescribed in Document SA-CATS 43.

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****.*

About this Report

Decisions regarding whether to investigate, and the scope of an investigation are based on many factors, including the level of safety benefit likely to be obtained from an investigation. For this occurrence, no 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 brief report. The report has been compiled using information supplied in the initial notification, as well as follow-up information 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 accident.

This report provides an opportunity to share safety message/s in the absence of an investigation.

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.

Disclaimer

This report is issued by:

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