

LIMITED OCCURRENCE INVESTIGATION REPORT – FINAL

Reference Number	CA18/2/3/10291					
Classification	Accident	Date	23 April 2023	Time	1450Z	
Type of Operation	General Aviation and Operating Flight Rules (Part 91)					
Location						
Place of Departure	Wonderboom Aerodrome (FAWB), Gauteng Province		Place of Intended Landing	Wonderboom Aerodrome (FAWB), Gauteng Province		
Place of Occurrence	Runway 29 at Wonderboom Aerodrome (FAWB), Gauteng Province					
GPS Co-ordinates	Latitude	25°39'7.79" S	Longitude	028°13'16.20" E	Elevation	4 095 ft
Aircraft Information						
Registration	ZS-KJU					
Make; Model; S/N	Rockwell Commander, 112TCA (Serial Number: 13183)					
Damage to Aircraft	Substantial		Total Airframe Hours	2 395.34		
Pilot-in-command						
Licence Type	Private Pilot Licence (PPL)			Gender	Male	Age 54
Licence Valid	Yes	Total Hours on Type	63.04	Total Flying Hours	144.1	
Total Hours 90 Days	3.0		Total Hours on Type Past 90 Days	3.0		
People On-board	1 + 0	Injuries	0	Fatalities	0	Other (on ground) 0
What Happened						
<p>On Sunday afternoon, 23 April 2023, a pilot on-board a Rockwell Commander 112TCA aircraft with registration ZS-KJU was on a private flight from Wonderboom Aerodrome (FAWB) in Gauteng province to Hartbeespoort Dam in Brits, North West province, with the intention to return to FAWB. Visual meteorological conditions (VMC) by day prevailed at the time of the flight which was conducted under the provisions of Part 91 of the Civil Aviation Regulations (CAR) 2011 as amended.</p> <p>The pilot stated that upon arrival at FAWB where he kept the aircraft in his hangar, he pushed it out of the hangar and performed a pre-flight inspection. The pilot noted that the aircraft had 40.8 US gallons (154 litres "L") of Avgas 100LL fuel in the tanks. Thereafter, he communicated his intentions to the FAWB ground air traffic control (ATC) on frequency 120.60-Megahertz (MHz) and started the engine. After making sure that the engine indications were within the acceptable limits, he taxied the aircraft to the holding point of Runway 29 and performed the pre-departure run-up checks. After receiving the departure clearance, the pilot taxied the aircraft to the threshold of Runway 29. A few minutes later, he opened the throttle to 2 500 revolutions per minute (RPM) and commenced with the take-off run. The pilot rotated the aircraft and climbed to 7 000 feet (ft).</p>						

After levelling off the aircraft, he retarded the throttle to 2 400 RPM, cruising at 110 knots indicated air speed (KIAS). The aircraft headed west in the direction of Hartbeespoort Dam in Brits as planned, and the segments of the flight were uneventful. Upon his return to FAWB, the pilot performed the pre-landing checks in preparation to land on Runway 29. He selected the landing gear to the down position, however, only the green down and locked indication for the right main landing gear illuminated. Both the left main gear and the nose landing gear indicated unsafe. The pilot engaged the emergency gear extension handle mounted on the left vertical wall of the console between the two front seats, but only the down and locked indication lights for the main landing gears illuminated. The indication for the nose gear leg remained unsafe.

The pilot called the FAWB ATC and requested a low-level fly past for the ATC to verify and confirm the position of the landing gears. The ATC told the pilot that all three gears appeared to be down. The pilot then flew a circuit and, after touchdown on Runway 29, approximately beyond 100 metres (m) during the landing roll as the aircraft slowed down, the nose landing gear collapsed. The propeller blades contacted the runway surface and the aircraft skidded on the lower engine cowling for approximately 80m before it stopped in the middle of the runway. The pilot turned off the fuel selector and master and got out of the aircraft unassisted and unharmed. The Aircraft Rescue and Firefighting (ARFF) team responded swiftly to the scene; they administered foam to the aircraft to suppress sparks and to prevent any aircraft metal igniting due to friction with the runway surface. The aircraft sustained substantial damage.

The accident occurred during daylight at Global Positioning System (GPS) co-ordinates determined to be South 25°39'7.79" South, 028°13'16.20" East at an elevation of 4 095 ft.



Figure 1: The resting position of the aircraft on Runway 29. (Source: Pilot)

Wonderboom Aerodrome (FAWB)

FAWB is a Category 2 aerodrome with licence issued in accordance with (IAW) Part 139 of the CAR 2011 as amended. The licence was renewed by the South African Civil Aviation Authority (SACAA) on 31 July 2022 with a validity period from 1 August 2022 to 31 July 2023. The aerodrome has two runways. The first runway is orientated 29/11 and is 1 828m long and 30m wide, and the second runway is orientated 24/06 and is 1 280m long and 22m wide. The aerodrome elevation is 4 095ft. The aerodrome also comprises the ARFF who responded to the accident site after the crash alarm was activated by the ATC.

Aircraft Information (Source: Aircraft Flight Manual [AFM])

The Rockwell Commander 112TCA is a four-seat, low-wing aircraft of monocoque construction with a mid-mounted stabiliser equipped with a retractable tricycle landing gear. The aircraft is powered by a horizontally opposed, four-cylinder, air cooled normally aspirated, turbocharged fuel injected Lycoming TIO-360-C1A6D engine (Serial number L-255-69A) with power output of 210 brake horsepower (BHP) at 2 700 RPM, driving a two blade Hartzell all metal fixed pitch propeller (Model DK134E).

The landing gear extension and retraction system

The hydraulic power supply is an integrated pack containing an electric motor-driven hydraulic pump, reservoir, pressure control and thermal relief valve. The power pack is in the left forward area of the fuselage tailcone. A landing selector switch mounted on the instrument panel, controls the direction of fluid flow from the pump to permit gear retraction or extension. A hydraulic manifold serves as the mounting base for attaching the power pack to the airframe. When the landing gear selector switch is pulled out slightly to clear a detent, and placed in the UP position, pressurised hydraulic fluid is directed through the manifold to the actuators. Fluid on the opposite side of the cylinder piston flows back through the manifold into the power pack.

When all three gears are retracted, a hydraulic actuating switch, located adjacent to each actuating cylinder, de-energises the hydraulic pump. Any loss of hydraulic pressure which allows any gear to partially extend is sensed by the respective uplock position switch and the hydraulic pump is energised and the gear is retracted. When all three gears are retracted, the pump is shutoff, and the gears are held up by hydraulic lock. The hydraulic pressure switch controls the pump by removing power to the pump when the pressure reaches 1 650 (± 50) pressure per square inch (psi). A loss of hydraulic pressure is sensed by the pressure switch and turns on the power pack to build up additional pressure.

When the landing gear selector switch is placed in the DOWN position, pressurised hydraulic fluid is directed through the hydraulic manifold to the downside of the actuator cylinders. When all three gears are down and locked (drag brace over centre) the power pack is turned off by a gear pressure switch set at 400 to 800 psi. Hydraulic pressure is maintained in the gear down system by a pilot operated check valve. The emergency dump valve bypasses fluid from the upside of the hydraulic actuators (which form the hydraulic uplock) directly to the reservoir, the gear then drop by gravity, assisted by down springs. When the emergency dump valve is in the down position, the gear will not retract because the pressure is being relieved through the dump valve back to the reservoir and not to the hydraulic cylinders.

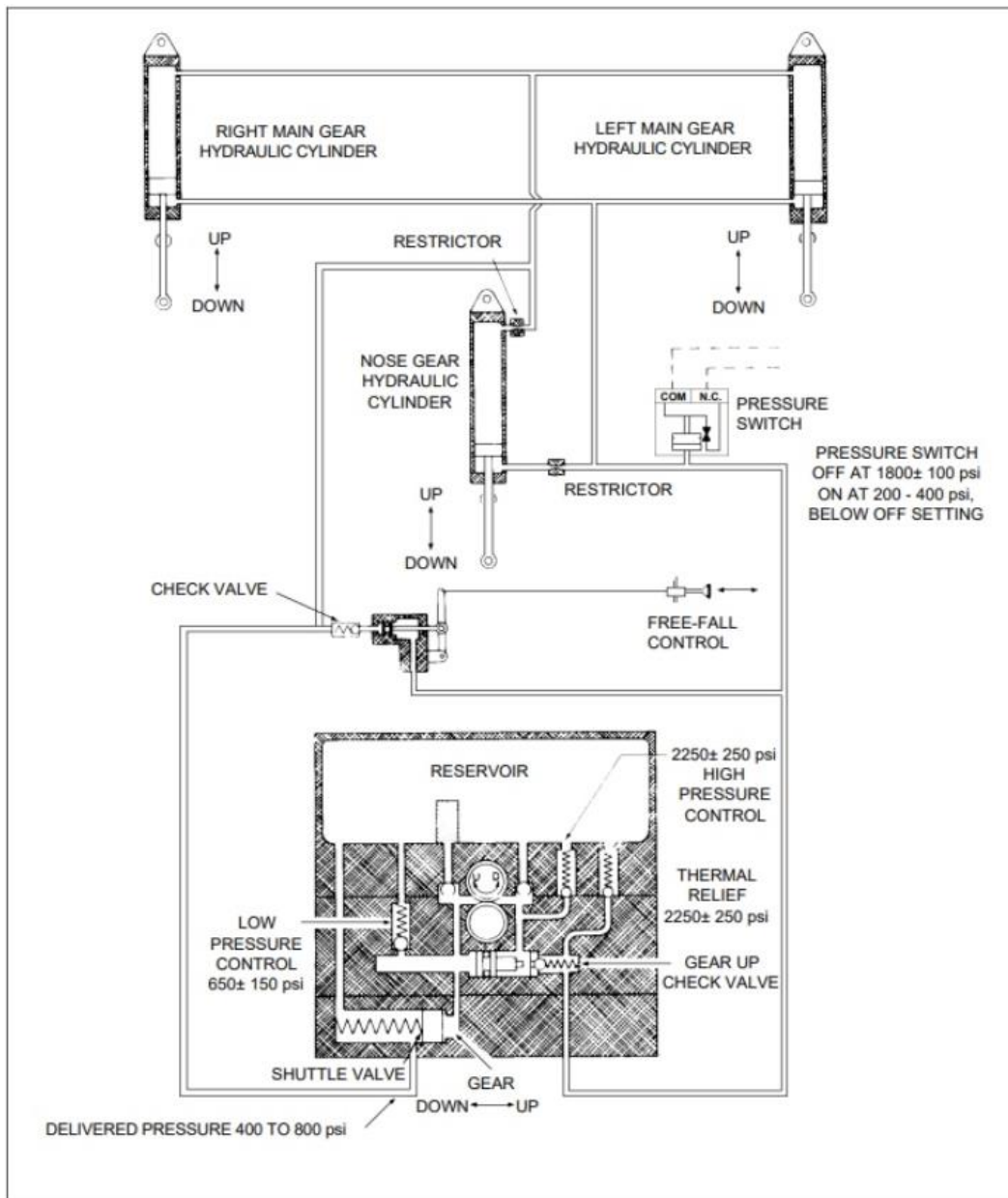


Diagram 1: The aircraft hydraulic system schematic. (Source: AFM)



Figures 2 and 3: The gear selector switch/position indicator lights (left). The gear emergency extension (right).

Scrutiny into the aircraft maintenance job card number 11738, dated 17 May 2022, revealed that a 100-hour Mandatory Periodic Inspection (MPI) on the aircraft was conducted by the SACAA approved aircraft maintenance organisation (AMO) at 2 386.3 total airframe hours. The MPI could not be completed because of corrosion that was detected on the aircraft's forward wing spars on 9 June 2022 after the aircraft maintenance engineers (AMEs) conducted an eddy current inspection IAW the RSA Airworthiness Directive (AD) 97-02. The corrosion defect was captured in the maintenance job card and the pilot, who is also the owner of the aircraft, was made aware of the deficiency that rendered the aircraft unserviceable or unairworthy.

The pilot took the aircraft from the AMO in FAWB to his hangar, also in FAWB, with a known outstanding corrosion defect on the forward wing spars (incomplete MPI). The flight folio page serial number 0023 revealed an entry dated 5 November 2022 which showed what was referred to by the pilot as the first test flight flown by him at 2 386.3 airframe hours, with a duration of 1.9 hours during which three gear retractions and landings were conducted. Another entry in the flight folio dated 23 April 2023 revealed what was referred to by the pilot as the eighth (8th) test flight at 2 394.24 airframe hours with a duration of 1.1 hours (2 395.34 total airframe hours logged post the accident flight). According to the flight folio, about 10 retractions and landings were conducted and recorded from 5 November 2022 to 23 April 2023.

The aircraft Certificate of Airworthiness (C of A) was invalid. It was initially issued on 19 October 1978. The latest C of A had an expiry date of 31 July 2022. The aircraft was not airworthy when it dispatched for the private flight on 23 April 2023. Therefore, the provision of Part 91.02.7 of the CAR 2011 as amended was not complied with.

Duties of PIC regarding flight preparation:

91.02.7 (1) *The PIC of an aircraft shall not commence a flight unless he or she is satisfied that—*

- (a) the aircraft is airworthy;*
- (b) the instruments and navigation, communication and other equipment required for the particular type of operation to be undertaken, are installed and are serviceable and functioning correctly, except as provided for in the MEL, if any;*
- (c) the aircraft has been released to service in accordance with Part 43;*

Meteorological Information

The weather information in the table below was obtained from the South African Weather Service (SAWS).

Wind Direction	225°	Wind Speed	04 kt	Visibility	9999 m
Temperature	26.4°C	Cloud Cover	Nil	Cloud Base	CAVOK
Dew Point	0.4°C	QNH	848.6hPa		

Engineering Examination

On-site investigation was not conducted; however, a follow up inspection was carried out by the investigators on 10 May 2023 following the recovery of the aircraft from the active Runway 29. None of the circuit breakers (CBs) tripped. All three “press-to-test” gear position indication lights were tested and were found to be serviceable. Post-accident examination of the aircraft revealed that the nose landing gear had collapsed, and the wheel well doors and the exhaust pipe were damaged. Interviews with the AMEs who recovered the aircraft from the runway revealed that the nose gear fell off due to the force of gravity, a conclusion made after the aircraft’s nose was lifted and locked into position with all three lights illuminated.

Visual inspection of the individual components of the nose gear revealed no anomalies other than an impact damaged hydraulic actuator. Plans were made to acquire a replacement (loaned) nose gear model hydraulic actuator, but without success. The landing gear could, therefore, not be tested post-accident. Examination of the landing gear Prestolite model hydraulic power pack (Diagram 1) was carried out, and no evidence of MIL-H-5606 hydraulic fluid leak or improper installation was observed. No evidence of failure of the main and nose landing gear down lock safety mechanisms and switches were observed.

The power pack was removed from the aircraft and taken to Rand Aerodrome (FAGM) for examination and testing. The AME who performed the task had a Category “W” rating. The power pack was placed on a test bench and it contained adequate hydraulic fluid. Gauges were fitted to test the hydraulic pump and the applicable voltage (12 volts) was applied to the motor with no indication of the gear movement.

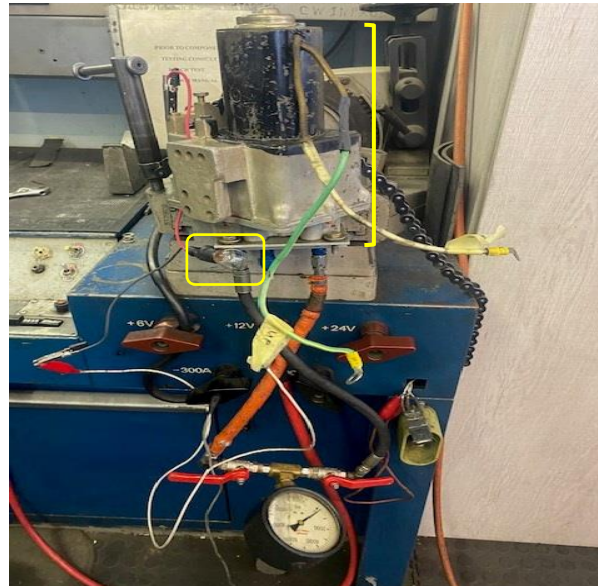


Figure 4: The power pack indicating no sign of gear movement when tested (globe not lit as shown in the yellow window).

The landing gear power pack motor cover was opened, and the electrical carbon brush which transmits electrical current was found disconnected and the spring was destroyed due to excessive heat. Signs of hydraulic weep were observed inside the motor which indicated hydraulic fluid push up into the electrical parts that appeared to have contributed to the failure of the landing gear power pack.



Figures 5 and 6: The landing gear power pack motor showing heat damage (left picture). Wetness on the wiring is caused by hydraulic fluid weep (right picture).

Examination of the landing gear did not show any sign/s of improper rigging. The investigation could not determine the reason the nose gear leg did not lock into position after the emergency gear extension procedure was followed during the pre-landing checks. *Note: the overall geometry of the landing gear is such that aircraft's weight on the nose-wheel applies a compressive load to the drag link assembly which tends to drive it more firmly into the safe 'over-centre' condition when the gear is properly extended.*

A review of the maintenance records indicated that on 1 June 2022, the landing gear power pack (Serial number 105921) was removed from the ZS-KJU aircraft at the time the MPI was in progress; it was taken to another AMO situated in FAWB for a 500-hour inspection. The AMO had a Category "W" maintenance rating as detailed on the operations specification certificate issued by the SACAA.

The AME who performed the maintenance task was appropriately rated IAW Part 66.01.5 of the SACAA regulation. The maintenance scope as stipulated on the job card number 1242-07 included the replacement of the brushes, inspection of the saddle and windings, lubrication of gears and general cleaning IAW the Aircraft Maintenance Manual (MM) AC43.13.1B. The power pack was bench-tested and was certified serviceable on 6 June 2022. A release to service certificate for the power pack was issued on 6 June 2022 and the component was returned to the AMO assigned to perform the MPI.

The power pack was fitted back to the ZS-KJU aircraft on 6 June 2022 and was filled with sufficient hydraulic fluid as required. Page 8 on bullet 5 of the aircraft inspection checklist at the AMO that was assigned to perform the MPI revealed that the landing operational check was not conducted after the power pack installation because of the corrosion defect maintenance task on the forward wing spars which remained outstanding. The reason was that the aircraft's wings needed to be removed from the aircraft fuselage to allow for the corrosion treatment and repair process. It was also a requirement that the landing gear retraction and extension tests, including the rigging of the flight controls and the landing gear, be conducted after the wings were fitted back to the fuselage post-maintenance because of the moving parts that would have been disturbed or disconnected.

Findings

1. The pilot was initially issued a Private Pilot Licence (PPL) on 18 February 2020. The last renewal of the pilot's licence was on 10 November 2022 with an expiry date of 30 November 2023. The pilot had flown a total of 144.1 hours of which 63.04 hours were on the aircraft type.
2. The pilot had a Class 2 aviation medical certificate that was issued on 21 February 2023 with an expiry date of 29 February 2024 and with a restriction to wear suitable corrective lenses.
3. The pilot was properly licensed and medically fit to conduct the flight. The aircraft type was endorsed on the pilot's licence, however, the pilot had no test flight rating endorsement.

<p>4. The MPI on the aircraft was not completed because of the extensive corrosion detected on the aircraft's forward wing spars on 9 June 2022 after the engineers had conducted an eddy current inspection in accordance with the RSA AD 97-02.</p> <p>5. The aircraft was flown for 9.04 hours since it was taken from the AMO in an unairworthy condition.</p> <p>6. The aircraft Certificate of Airworthiness (C of A) was invalid at the time of the flight.</p> <p>7. The aircraft Certificate of Registration (C of R) was issued to the current owner on 31 July 2017.</p>
<p>Probable Cause</p>
<p>For undetermined reason/s, the nose gear leg did not lock down or reach the over-centre position following emergency extension of the landing gear and it collapsed during the landing roll.</p>
<p>Contributing Factor</p>
<p>1) The aircraft was not airworthy when it dispatched which was a violation of Part 91.02.7 of the CAR 2011 as amended.</p> <p>2) Poor airmanship.</p>
<p>Safety Action</p>
<p>Pilots are advised to adhere to established regulations, the manufacturer's limitations and maintenance schedule to avoid unnecessary accidents.</p>
<p>Safety Recommendation/Message</p>
<p>None.</p>
<p>About this Report</p>
<p><i>The decision 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, a limited scope, fact gathering investigation was conducted to compile this limited report and allow for greater industry awareness of potential safety issues as well as possible safety action/s that the industry might want to consider in preventing a reoccurrence.</i></p> <p><i>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.</i></p> <p><i>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.</i></p>
<p>Disclaimer</p>
<p><i>This report is produced without prejudice to the rights of the AIID, which are reserved.</i></p>

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