SOUTH AFRICAN CIVIL AVIATION AUTHORITY

Section/division Accident and Incident Investigation Division Form Number: CA 12-41

AIRCRAFT SERIOUS INCIDENT SHORT REPORT

CA18/3/2/1314: The nose landing gear failed to extend during a systems evaluation flight.

Date and time	: 8 July 2020, 1202Z
Aircraft registration	: ZS-ISD
Aircraft manufacturer and model	: Piper Aircraft Company, Piper PA-34-200
Last point of departure	: Port Alfred Aerodrome (FAPA), Eastern Cape Province
Next point of intended landing	: Port Alfred Aerodrome (FAPA), Eastern Cape Province
Location of incident site with reference to easily defined geographical points (GPS readings if possible)	: Runway 10L, Port Alfred Aerodrome GPS position: 33°33'12.12" South 026°52'50.18" East
Meteorological information	: Surface wind: 100°/25kt, temperature: 21°C, CAVOK
Type of operation	: Private (Part 91)
Persons on-board	: 1 + 1
Injuries	: None
Damage to aircraft	: Minor

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 of the Investigation:

In terms of Regulation 12.03.1 of the Civil Aviation Regulations (2011), this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or accidents and ***not to apportion blame or liability.***

Disclaimer:

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1. SYNOPSIS

1.1 On Wednesday afternoon, 8 July 2020 at 1110Z, the pilot accompanied by an aircraft maintenance engineer (AME), took off from Port Alfred Aerodrome (FAPA) on an aircraft systems evaluation flight. The landing gear was selected up after take-off. The aircraft returned to FAPA for a full stop landing after being airborne for approximately 40 minutes. During landing, the pilot selected the landing gear down, but the nose landing gear indicated an “unsafe” condition. The pilot then cycled the gear a few times to no avail. He then followed the emergency gear extension procedure as contained in the Pilot’s Operating Handbook (POH). The duo conducted several low-level fly pasts over Runway 07 where several aircraft maintenance engineers (AMEs) attempted to visually inspect (the landing gear) from the ground. The AMEs later confirmed that the nose gear had failed to extend. Once the aerodrome rescue and fire-fighting (ARFF) personnel were placed in position, the pilot continued with the approach for landing and landed on Runway 10L with the aircraft coming to rest in a nose-down attitude on the grass-surface runway. This was a private flight conducted under the provisions of Part 91 of the Civil Aviation Regulations (CAR) 2011 as amended, where a landing gear system was subjected to a functional test.

1.2 The investigation revealed that the nose landing gear roller assembly exited the steering track when the landing gear was retracted after take-off. This came about after the nose gear up lock-stopper became loose during flight, causing a roller assembly out-of-track condition. This made it impossible to lower the nose gear by using both the normal and emergency gear extension systems.

2. FACTUAL INFORMATION

2.1 History of flight

2.1.1 On 12 March 2020, a Mandatory Periodic Inspection (MPI) was carried out on the aircraft ZS-ISD and, on 17 March 2020, a post-maintenance acceptance flight was conducted. The next day, the aircraft was involved in a training flight in which it was discovered that the landing gear emergency extension was sluggish. The aircraft maintenance organisation (AMO) then placed the aircraft on jacks to investigate the cause which was attributed to the lower centre bolt hole on the nose gear being elongated. This caused the nose gear to move slowly when extended. The nose gear mount, part number 95551-00, was replaced. On 26 March 2020, the aircraft was subjected to a system functional flight, and the landing gear had cycled satisfactorily.

2.1.2 Thereafter, the aircraft was grounded following the national lockdown (Level 5). Certain aircraft in the fleet were inhibited by applying Tectyl 930, which is an oil-based corrosion preventative compound, to the undercarriage. The reason the AMO opted to inhibit the landing gear was that there was insufficient hangar space for the entire fleet, and some of the aircraft, of which ZS-ISD was among them, had to be parked outside during lockdown period. At the time, no one knew how long the aircraft were to be left parked outside before training flights could resume. As lockdown restrictions were relaxed and training flights were resumed, the AMO un-inhibited the aircraft, including ZS-ISD. Each aircraft was placed on jacks and a landing gear system check was conducted by cycling the gear several times. The nose gear down lock on this aircraft had to be re-adjusted, which required a system check flight thereafter.

2.1.3 On Wednesday afternoon, 8 July 2020, the pilot conducted a pre-flight inspection of the aircraft. Accompanied by an AME, they took off from FAPA at 1110Z for a system evaluation flight after the adjustment of the nose gear down lock. After being airborne for approximately 40 minutes, they returned to FAPA with the intention to conduct a full stop landing. The pilot selected the landing gear down but only two green “down and locked” lights for the main landing gear illuminated in the cockpit, and the light for the nose landing gear did not illuminate. The red ‘gear unsafe’ warning light remained illuminated on the instrument panel (see Figure 1), indicating that there was a problem with the nose gear (see three green lights illustrated in Figure 2). The pilot reported the situation to the aerodrome flight information service (AFIS) tower at FAPA on the very high frequency (VHF) 122.00 megahertz (MHz).

Figure 1: "Warning Gear Unsafe" light on the instrument panel of ZS-ISD. (Photograph courtesy of the AMO)

Figure 2: Gear down indication (3 greens) on the instrument panel of ZS-ISD.
(Photograph courtesy of the AMO)

2.1.4 The pilot then cycled the landing gear several times, to no avail. The duo then carried out the checklist actions for the manual/emergency extension of the landing gear, which involved activating the emergency gear extension system as called for in the POH. This action removes hydraulic pressure from the system and allows the gear to free-fall to the down and locked position, however, the cockpit indications remained unchanged.

2.1.5 The pilot then conducted several low-level fly pasts over Runway 07 where several AMEs visually inspected the nose gear from the ground. They later confirmed that the nose gear had failed to extend. The decision was made to continue with landing with the nose gear in the retracted position. Once the aerodrome rescue and fire-fighting (ARFF) personnel were in position, the pilot approached for landing on Runway 10L, which is a grass-surface runway that is 1 828 metres long. The weather was fine, with a reported surface wind from 100° at 25 knots. Full flaps were selected (40°) for landing. The pilot stated that at the threshold height of approximately 50 feet above the runway surface, he shut down both engines and the propeller levers were moved to the feather position. He allowed the aircraft to touch down on the main wheels and tried to keep the nose up for as long as possible. As the nose was lowered and made contact with the grass-surface runway, the aircraft skidded for some distance before coming to rest in a nose-down attitude. There was no fire after the incident and the pilot and the AME vacated the aircraft unassisted. The aircraft sustained damage to the lower nose cone, the nose landing gear doors and one propeller blade was bent on the number 2 engine (right) side as it was still wind-milling when the nose was lowered.

2.1.6 The incident occurred during daylight at a geographical position determined to be 33°33’12.12” South 026°52’50.18” East at an elevation of 321 feet above mean sea level (AMSL).

Figure 3: The aircraft as it came to a stop on Runway 10L. (Photograph courtesy of the ATO)

Figure 4: Damage visible to the lower nose cone and nose gear doors. (Photograph courtesy of the AMO)

Figure 5: One propeller blade was bent on the right side. (Photograph courtesy of the ATO)

2.1.7 Description of the nose landing gear

The nose landing gear on this aircraft is of the forward retracting type. When extended, it has the wheel axle forward of the oleo pivot. When retracted, the gear is held up by hydraulic pressure in the actuator and, when extended, it is held in the down position by a geometric down lock mechanism. There are no locking hooks for either position. Since the gear is held up by hydraulic pressure, gear extension can be accomplished in the event of a hydraulic failure. If the hydraulic pressure is released for whatever reason, gravity will cause the gear to extend. Aerodynamic loads and springs assist in locking the gear down. Once the nose gear starts to extend, the air flow pushes against it and assist it in moving to the down and locked position. Thus, if the hydraulic pump fails with the gear not in the down and locked position, it is necessary only to release the hydraulic pressure. An emergency gear extension knob, located near the centre of the instrument panel, is provided for this purpose. Pulling this knob releases the hydraulic pressure holding the gear in the UP position, allowing it to free fall.

Mounted on the upper end of the nose leg is a tiller assembly, which is attached to a roller assembly. This roller sits within a curved track which it follows as the gear leg is raised. The track assembly itself is made up of two sections. The lower section is fixed to the aircraft structure, whilst the upper section is attached to a hinged quadrant casting to allow for nose-wheel steering. This quadrant is attached by cables to the steering arm. With the gear locked down, the roller assembly remains within the upper hinged section of the track, movement of which is transmitted to the nose wheel from the quadrant via the tiller. As the nose gear starts to retract, the nose wheel and tiller is centred automatically, and the hinged and fixed sections of track line up, allowing the roller assembly to follow the track as the nose leg retracts.

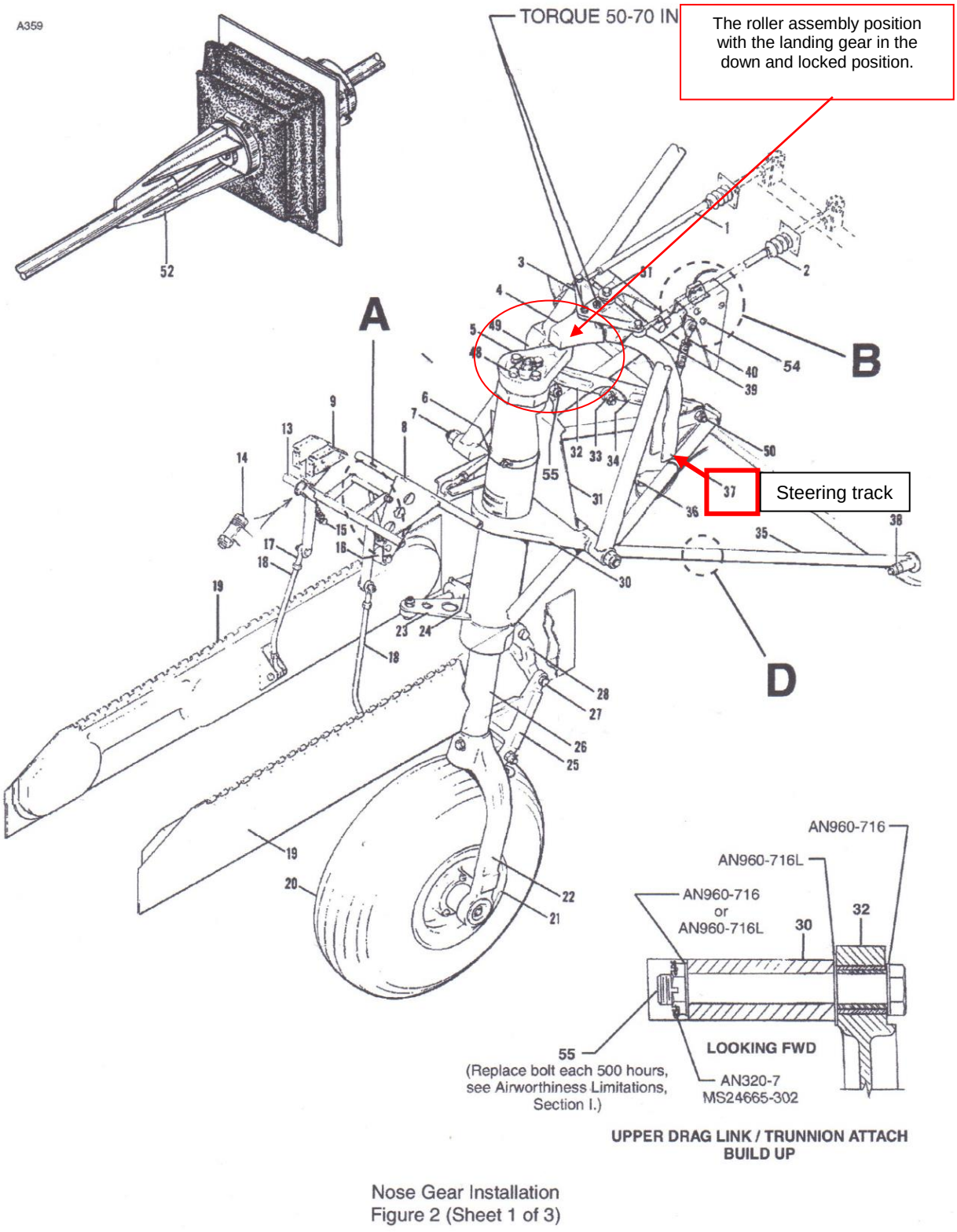

Figure 6: Schematic of the nose landing gear installation.

2.1.8 Landing Gear Unsafe Warning (Source: POH, Limitations)

The red landing gear light will illuminate when the landing gear is in transition between the full up position and the down and locked position. The pilot should recycle the landing gear if continued illumination of the light occurs. Additionally, on aircraft with serial numbers 34-72500046 and up, the light will illuminate when the gear warning horn sounds. The gear warning horn will sound at low throttle settings with the gear in the up and locked position. The light is off when the landing gear is in either the full down and locked or full up positions.

2.1.9 Manual Extension of Landing Gear (Source: POH, Emergency Procedures)

Check the following before extending the gear manually:

a. Circuit breakers - Check

b. Master switch - On

c. Alternator - Check

d. Navigation lights - OFF (daytime)

To extend the gear, reposition the clip covering the emergency disengage control downward, clear of the knob, and proceed as listed below:

a. Reduce power; airspeed not to exceed 100 miles per hour (MPH)

b. Place Landing Gear Selector Switch in "GEAR DOWN LOCKED" position

c. Pull emergency gear extension knob

d. Check for 3 green lights

e. Leave emergency gear extension knob out.

WARNING

If the emergency gear extension knob has been pulled out to lower the gear due to a gear system malfunction, leave the control in its extended position until the airplane has been put on jacks to check the proper function of the landing gears hydraulic and electrical systems.

2.1.10 Aircraft examination

The aircraft was recovered from the runway by lifting the nose section and extending the nose landing gear manually, however, no photographs were taken prior to these actions. A technical report was obtained from the AMO that conducted the recovery. It was found that the roller assembly, which would normally be captive within the steering track assembly (see Figure 7), had left (exited) the track at the lower end and was pushing against the outer side (left side) of the steering track channelling (see Figure 9). This came about after the up lock-stopper (illustrated in Figure 10) became loose during flight. The lock nut was most probably not properly secured, which caused the roller assembly out-of-track condition, and it got jammed against the U-channelling when the landing gear was retracted after take-off, making it impossible to lower the nose gear.

According to the AMO, there was no procedure available in the Aircraft Maintenance Manual (AMM) that dealt with how and when landing gear needs to be inhibited. This was an initiative that the AMO implemented to preserve the aircraft that would be standing outside during the lockdown (Level 5) period in which no flight training was allowed.

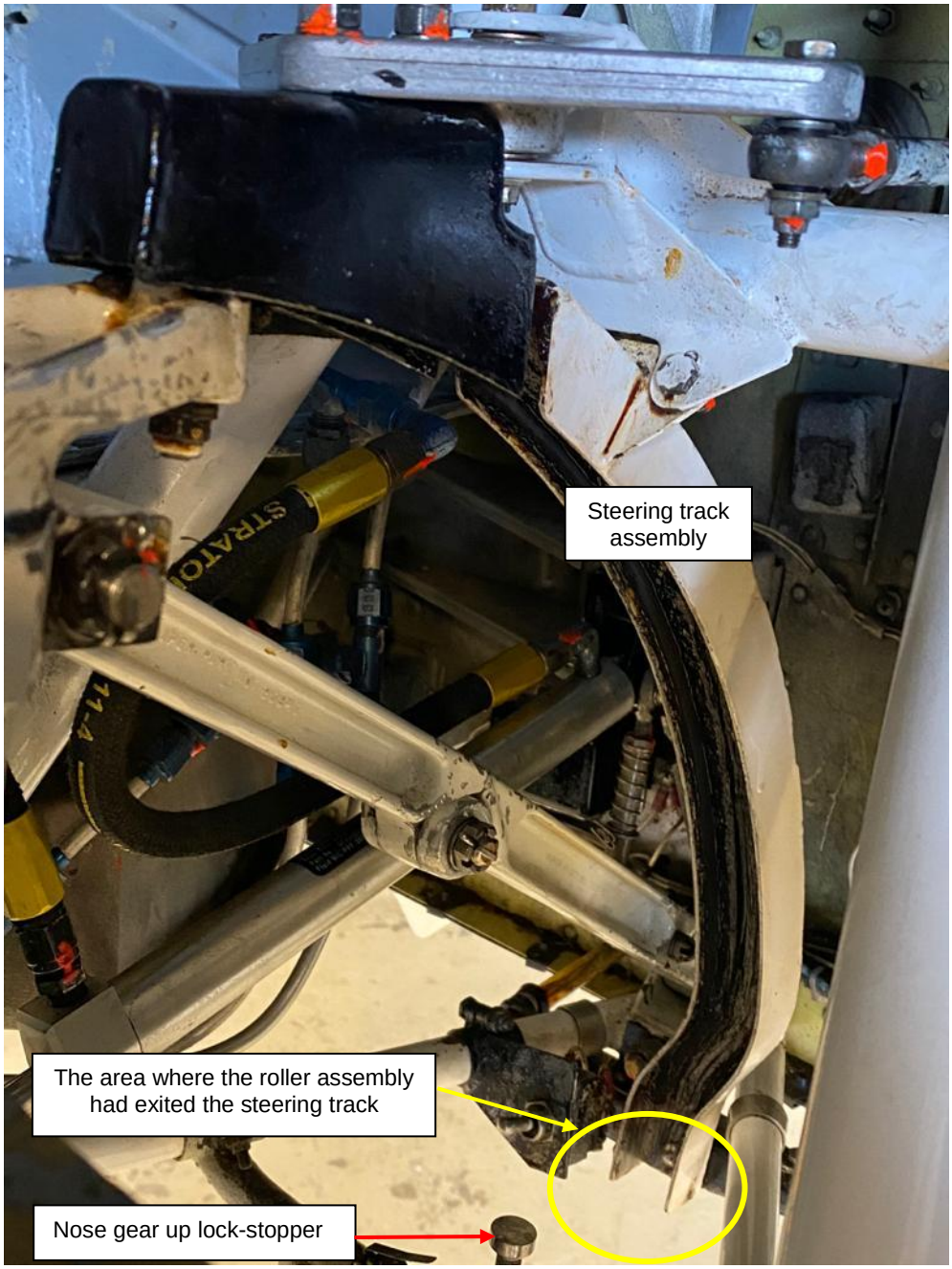

Figure 7: A view of the steering track and the nose gear up lock-stopper (gear in down position).

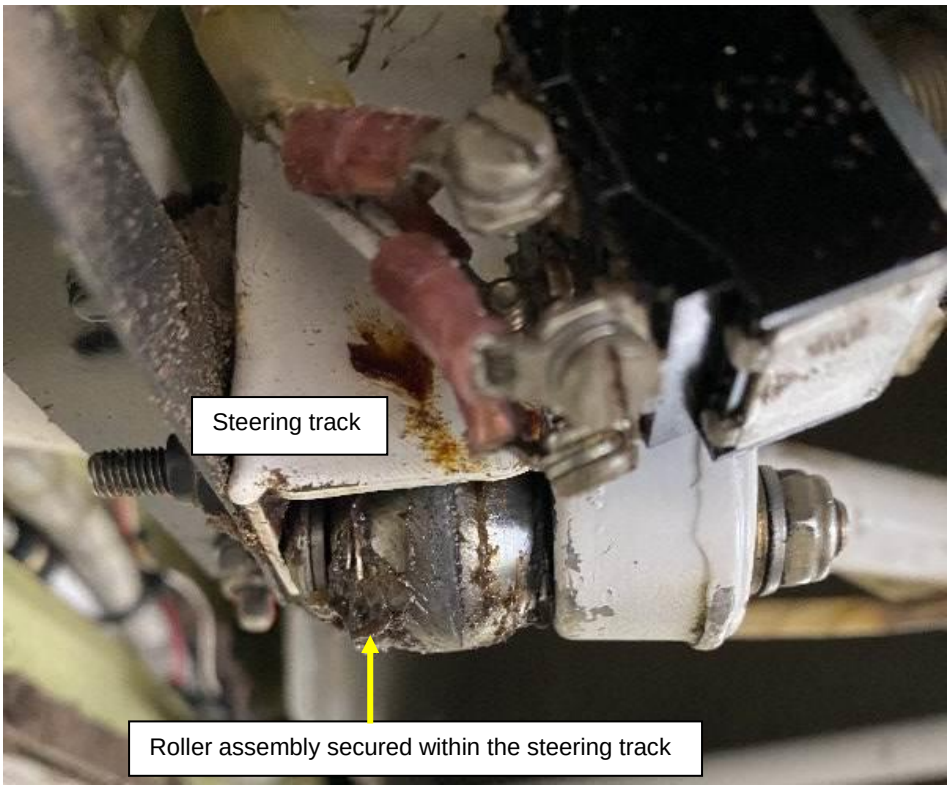

Figure 8: The roller assembly secured within the steering track (nose gear in the up position).

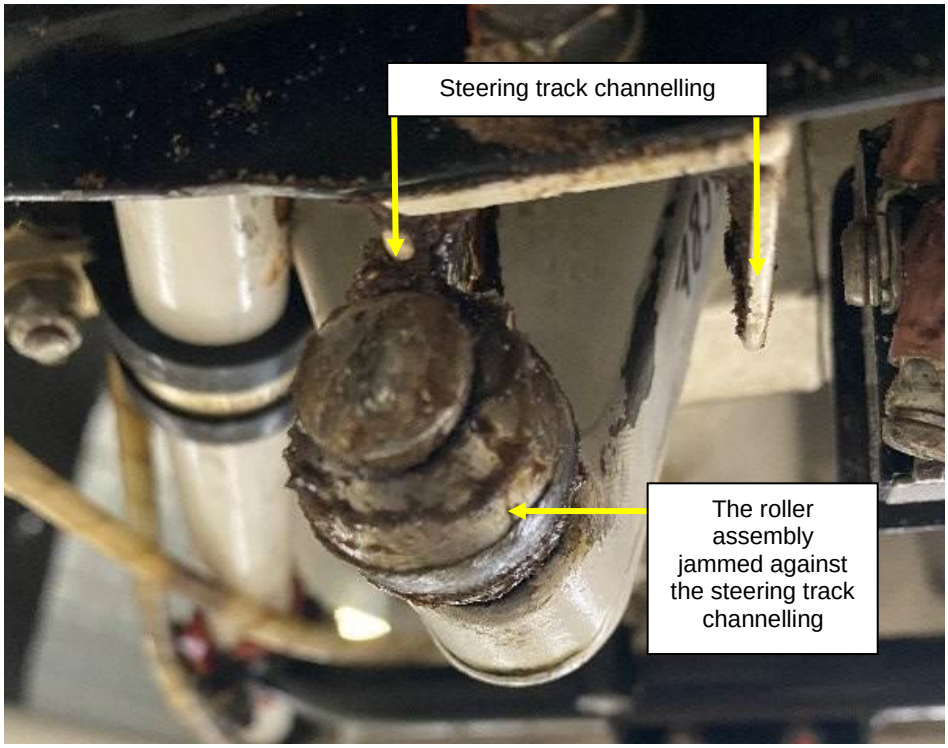

Figure 9: The roller assembly where it had exited the steering track and jammed the nose gear.

Figure 10: Nose gear up lock-stopper and the lock nut (nose gear in the up position).

3. FINDINGS

3.1 The pilot was initially issued a Commercial Pilot Licence on 16 October 2014; the reissued CPL had an expiry date of 31 October 2020. He had accumulated a total of 884.9 flight hours of which 125.7 were on the aircraft type.

3.2 The pilot was issued an aviation medical certificate (Class 1) on 1 October 2019 with an expiry date of 31 October 2020.

3.3 This was a private flight conducted under Part 91 of the Civil Aviation Regulations (CAR) 2011 as amended, where the landing gear was subjected to a system check.

3.4 The aircraft, with serial number 34-7250147, was manufactured in 1972 and was first registered in South Africa on 25 April 1972 to the (same) owner.

3.5 The aircraft was issued a Certificate of Airworthiness on 9 May 2019 with an expiry date of 31 May 2021.

3.6 The aircraft was issued a Certificate of Release to Service on 12 March 2020, which would lapse at 15 578 airframe hours or on 11 March 2021, whichever comes first.

3.7 The last mandatory inspection that was carried out on the aircraft prior to the incident flight was certified on 12 March 2020 at 15 478 airframe hours. A further 4.3 hours were flown with the aircraft since its last inspection.

3.8 The aircraft maintenance organisation (AMO) that conducted the last maintenance inspection on the aircraft prior to the incident flight, as well as having performed the inhibiting and un-inhibiting of the landing gear, was in possession of an AMO approval certificate number 46, which was issued by the SACAA on 1 October 2019 with an expiry date of 30 September 2020.

3.9 The aircraft maintenance engineer (AME) who certified the maintenance that was performed on the landing gear prior to the serious incident flight was the holder of an AME licence, which was initially issued on 1 July 2004; and the reissued licence had an expiry date of 31 October 2020. The AME had the aircraft type Piper PA-34-200 Series (Airframe) endorsed on his licence.

3.10 The last flight with the aircraft prior to the incident flight was on 26 March 2020 due to the SARS-Cov-2 (Covid-19) virus, resulting in the country entering lockdown (Level 5) phase, which restricted flights.

3.11 During the lockdown period, the undercarriages of several aircraft in the fleet were inhibited with an oil-based corrosion preventative compound. The reason for this arrangement was that the hangar space was insufficient for all aircraft in the fleet, and thus, some of the aircraft had to be parked outside for several months, of which ZS-ISD, was among those.

3.12 The AMO had made the decision to inhibit the landing gear of the aircraft that were going to be parked outside. The time frame of how long the aircraft were to be parked was unknown when Level 5 lockdown came into effect. The Aircraft Maintenance Manual (AMM) does not provide guidance on inhibiting the landing gear.

3.13 During a flight on 18 March 2020, the emergency landing gear system was found to be sluggish. Following maintenance intervention, a system functional flight was conducted on 26 March 2020 and the system was found to function satisfactorily. The aircraft was then parked due to Covid-19 lockdown.

3.14 The pilot and the AME were not injured during landing, and the aircraft sustained minor damage.

3.15 The prevailing wind at the time of the flight was from the south-east (100°) at 25 knots, and the temperature was 21°C, according to the pilot questionnaire.

3.16 The investigation was conducted off site by AIID.

3.17 The investigation revealed that the nose landing gear roller assembly exited the steering track when the landing gear was retracted after take-off. This came about after the nose gear up lock-stopper became loose during flight, causing a roller out-of-track condition. This made it impossible to lower the nose landing gear by using both the normal and the emergency extension systems.

4. PROBABLE CAUSE

4.1 The nose landing gear roller assembly exited the steering track when the landing gear was retracted after take-off. This came about after the nose gear up lock-stopper became loose during flight. This made it impossible to lower the nose landing gear by using both the normal and emergency extension systems.

5. CONTRIBUTING FACTOR

5.1 None.

6. REFERENCES USED IN THE REPORT

6.1 Pilot questionnaire (form CA 12-03)
6.2 Owner questionnaire (form CA 12-04)
6.3 Aircraft maintenance documents

6.4 Technical report from the Aircraft Maintenance Organisation (AMO)

6.5 Pilot Operating Handbook (POH) of the Piper PA-34-200

6.6 Extracts from the Aircraft Maintenance Manual (AMM)

6.7 Extracts from the Illustrated Parts Catalogue (IPC)

7. SAFETY RECOMMENDATION

7.1 Safety message: It is recommended that the maintenance organisations establish procedures such as dual inspections to ensure that critical aircraft/engine components do not fail, as well as ensure that their maintenance engineers adhere to established procedures.

8. ORGANISATION

8.1 This was a private flight.

8.2 The aviation training organisation (ATO) has a substantial number of aircraft in its fleet, which are used for training.

8.3 The aircraft maintenance organisation that maintained the aircraft was in possession of an AMO approval certificate No. 46 that was issued by the SACAA on 1 October 2019 with an expiry date of 30 September 2020.

8.4 The AMO was established in 1988 and, since then, had maintained the entire ATO fleet of aircraft that is based at FAPA.

9. APPENDICES

9.1 None.

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