ACCIDENT INVESTIGATION COMMISSION

FINAL REPORT
AIC 22-1001

Niugini Aviation Services Limited

P2-BWE

PAC 750XL

Left Main Landing Gear Collapsed during landing roll

Tekin Airstrip, Sandaun Province

Papua New Guinea

18 January 2022

About the AIC

The Accident Investigation Commission (AIC) is an independent statutory agency within Papua New Guinea (PNG). The AIC is governed by a Commission and is entirely separate from the judiciary, transport regulators, policy makers and service providers. The AIC's function is to improve safety and public confidence in the aviation mode of transport through excellence in: independent investigation of aviation accidents and other safety occurrences within the aviation system; safety data recording and analysis; and fostering safety awareness, knowledge and action.

The AIC is responsible for investigating accidents and other transport safety matters involving civil aviation in PNG, as well as participating in overseas investigations involving PNG registered aircraft. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The AIC performs its functions in accordance with the provisions of the *PNG Civil Aviation Act 2000 (As Amended),* and the *Commissions of Inquiry Act 1951,* and in accordance with *Annex 13* to the *Convention on International Civil Aviation.*

The objective of a safety investigation is to identify and reduce safety-related risk. AIC investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not a function of the AIC to apportion blame or determine liability. At the same time, an investigation report must include relevant factual material of sufficient weight to support the analysis and findings. At all times the AIC endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why it happened, in a fair and unbiased manner.

About this Report

On 18 January 2022 at 11:20 local time (01:20 UTC), the AIC was notified by NiuSky Pacific Limited via email of an accident involving a PAC 750XL aircraft, registered P2-BWE, owned and operated by Niugini Aviation Services Limited at Tekin Airstrip, Sandaun Province. The AIC immediately commenced an investigation.

This Accident Final Report has been produced by the PNG AIC pursuant to *ICAO Annex 13, Chapter 6, paragraph 6.5* and has been approved for public release.

The report is based on the investigation carried out by the AIC in accordance with the Papua New Guinea Civil Aviation Act 2000 (As Amended), Annex 13 to the Convention on International Civil Aviation, and the PNG Policy and Procedures Manual. It contains factual information, analysis of that information, finding and contributing (causal) factors, other factors, safety actions, and safety recommendations.

Capt. Aria Bouraga, MBE

Acting Chief Commissioner

5 January 2023

TABLE OF CONTENTS

About this Report ..... **v**

TABLE OF CONTENTS ..... **vii**

FIGURES ..... **xi**

TABLES ..... **xiii**

GLOSSARY OF ABBREVIATIONS ..... **xv**

INTRODUCTION ..... **xvii**

1 FACTUAL INFORMATION **1**

1.1 History of the flight 1

1.2 Injuries to Persons 3

1.3 Damage to aircraft 3

1.4 Other damage 3

1.5 Personnel information 3

1.5.1 Pilot 3

1.6 Aircraft Information 4

1.6.1 Aircraft Data 4

1.6.2 Engine Data 4

1.6.3 Propeller Data 5

1.6.4 Fuel 5

1.6.5 Weight and Balance 5

1.6.6 Minimum Equipment List 5

1.6.7 Main Landing Gear System 5

1.6.8 Aircraft Maintenance 7

1.6.9 MLG Attachment Bolts Replacement 7

1.6.10 Collision Avoidance Systems 8

1.7 Meteorological information 8

1.7.1 Papua New Guinea National Weather Service 8

1.7.2 Tekin Local Weather 8

1.8 Aids to navigation 8

1.9 Communications 8

1.10 Aerodrome information 9

1.10.1 On-site Observation of Tekin Airstrip 10

1.11 Flight recorders 11

1.12 Wreckage and impact information 11
1.12.1 Overview of the Wreckage Distribution 11
1.12.2 Aircraft Damages 13
1.12.3 Onsite Inspections 13
1.12.4 Off-site Inspection and Disassembly of the Left MLG Assembly 14
1.13 Medical and pathological information 16
1.14 Fire 16
1.15 Survival Aspects 17
1.15.1 Air Traffic Services Activities 17
1.16 Tests and Research 17
1.17 Organisational and management information 17
1.17.1 Operator: Niugini Aviation Limited 17
1.18 Additional Information 21
1.18.1 P2-BWE Previous Owner/Operator 21
1.18.2 Change Management Process 22
1.18.3 Custom Policy for MLG Attachment Bolts 22
1.18.4 Survey Report 23
1.18.5 Visual Illusions 24
1.18.6 Occurrences involving rural airstrips from 2010 to 2022 24
1.19 Useful Or Effective Investigation Techniques 25

2 ANALYSIS 27
2.1 General 27
2.1.1 Flight Operation 27
2.1.2 Tekin Airstrip 27
2.1.3 Organisational 28
2.1.4 Calibrated Tools and Equipment 29

3 CONCLUSIONS 31
3.1 Findings 31
3.1.1 Aircraft 31
3.1.2 Pilot 31
3.1.3 Flight Operations 31
3.1.4 Operator 32
3.1.5 Airstrip 32
3.1.6 Air Traffic Services 32
3.1.7 Flight Recorders 32
3.1.8 Survivability 32

3.1.9 Safety Oversight 32
3.2 Causes [Contributing Factors] 33
3.2.1 Other factors 33

4 SAFETY ACTIONS AND RECOMMENDATIONS 35
4.1 RECOMMENDATIONS 35
4.1.1 Recommendation number AIC 22-R05/22-1001 to NASL35
4.1.2 Recommendation number AIC 22-R06/22-1001 to NASL35
4.1.3 Recommendation number AIC 22-R07/22-1001 to NASL35
4.1.4 Recommendation number AIC 22-R08/22-1001 to NASL35

5 APPENDICES 37
5.1 Appendix A: Accident flight Load and Trim Sheet 37
5.2 Appendix B: Maintenance reference for Servicing MLG Oleo 38
5.3 Appendix C: MLG Oleo Struts and Tyre Pressure Inspections 39
5.4 Appendix D: Operators Procedure for tool and Equipement Calibration 40
5.5 Appendix E: Figure 19: Rural Airstrip accidents with its geological location 41

FIGURES

Figure 1: Overview of the accident flight path and the site 1

Figure 2: Arrival at Tekin Circuit Area 2

Figure 3: MLG Assembly 6

Figure 4: MLG Oleo Strut 7

Figure 5: Tekin Area Topography 9

Figure 6: Localise wind pattern at Tekin Airstrip 10

Figure 7:Tekin Airstrip with indications of onsite observation 10

Figure 8: Airstrip image taken by the drone flown along the approach path 11

Figure 9: Aircraft's wreckage distribution 12

Figure 10: Aircraft's initial touchdown points 12

Figure 11: Damages sustained by P2-BWE 13

Figure 12: Evidence of sufficient pressure in the oleo strut 13

Figure 13: Evidence of sufficient tyre pressure in the left main landing gear 14

Figure 14: MLG Laboratory Examination 15

Figure 15: Left MLG Disassembly 16

Figure 16: Tyre Inflation 20

Figure 17: Nitrogen Regulator 21

Figure 18: Upslope and downslope visual illusion (Source: FAA PHAK,17-7) 24

Figure 19: Rural Airstrip accidents per year ..... 25'

Figure 20: Accidents at rural airstrips and the geological locations of the airstrips (Refer to 5.5 Appendix E for larger version) 25

TABLES

Table 1: Injuries to persons 3

Table 2: PAC 750XL weight and balance data 5

Table 3: Left MLG defects History 7

Table 4: PNG Airstrip Guide used by NASL for Tekin during the accident 9

Table 5: RAA survey data for Tekin Airstrip 23

GLOSSARY OF ABBREVIATIONS

AFM	:	Airplane Flight Manual
AGL	:	Above Ground Level
AIC	:	Accident Investigation Commission (PNG)
AMSL	:	Above Mean Sea Level
AOC	:	Air Operator Certificate
ATC	:	Air Traffic Control
ATPL	:	Air Transport Pilot License
ATS	:	Air Traffic Service
CAR	:	Civil Aviation Rules
CPL	:	Commercial Pilot License
COM	:	Company Operation Manual
CSN	:	Cycles Since New
CVR	:	Cockpit Voice Recorder
F/O	:	First officer or Copilot
FDR	:	Flight Data Recorder
Hrs	:	Hours
ICAO	:	International Civil Aviation Organization
IFR	:	Instrument Flight Rules
IIC	:	Investigator in Charge
Kg	:	Kilogram(s)
Km	:	Kilometer(s)
Kts	:	Knots (nm/hours)
MTOW	:	Maximum Take-off Weight
NM	:	Nautical mile(s)
PIC	:	Pilot in Command
S/N	:	Serial Number
TSN	:	Time Since New
TTIS	:	Total Time in Service
UTC	:	Universal Time Coordinate
VFR	:	Visual Flight Rules

INTRODUCTION

SYNOPSIS

On 18 January 2022, at 09:26 local time (23:26 UTC) a PAC 750XL aircraft, registered P2-BWE owned and operated by Niugini Aviation Services Limited (NASL), was conducting a single pilot VFR charter flight from Kiunga Airport, Western Province to Tekin Airstrip, Sandaun Province, Papua New Guinea when during the landing roll, the aircraft sustained a left Main Landing Gear (MLG) assembly collapse and subsequent runway excursion.

There were eight persons onboard: one pilot and seven passengers. At 08:43, P2-BWE departed Kiunga Airport and arrived at Tekin Airstrip circuit at 09:18. The pilot then tracked towards the Northwest of the airstrip and made a left base turn for approach.

The pilot stated that he established the aircraft on final approach with an airspeed of 120 kts. He subsequently configured the aircraft for landing; propeller pitch set to full fine, power set to maintain nominated approach speed, and full flap. The pilot indicated that he reduced airspeed while on approach and maintained an airspeed between 85 and 90 kts. As he flared the aircraft to land, the airspeed was between 75 to 80 kts. The touchdown speed, as he recalled, was 75 kts.

The aircraft touched down two metres short of the designated landing threshold of runway18, which had an elevation of 15cm. Reviewing the flight records of the pilot, and from his interview, the AIC deduced that the pilot was not adequately familiar with Tekin Airstrip.

The investigation identified that during touchdown, the aircraft's main landing gear tyre hit the 15cm elevation at the edge of runway18, resulting in the left MLG assembly weakening. The investigation determined that due to less damping effect on the oleo or the tyre, the landing impact force could have transferred up through the structure and concurrently causing the left MLG assembly to collapse.

Following the collapse of the left MLG assembly, the left-wing assembly dropped and hit the ground, the flap detached and began to drag on the surface of the strip creating markings. The aircraft immediately began veering left, towards the edge (boundary) of the airstrip and impacted the drainage ditch adjacent to the runway where it came to rest.

The aircraft sustained substantial damaged.

All the passengers and pilot evacuated the aircraft without injuries.

1 FACTUAL INFORMATION

1.1 History of the flight

On 18 January 2022, at 09:26 local time (23:26 UTC[1]), a PAC 750XL aircraft, registered P2-BWE owned and operated by Niugini Aviation Services Limited (NASL), was conducting a single pilot VFR[2] charter flight from Kiunga Airport, Western Province to Tekin Airstrip, Sandaun Province, Papua New Guinea when during the landing roll, the aircraft sustained a left main landing gear (MLG) assembly collapse and subsequent runway excursion.

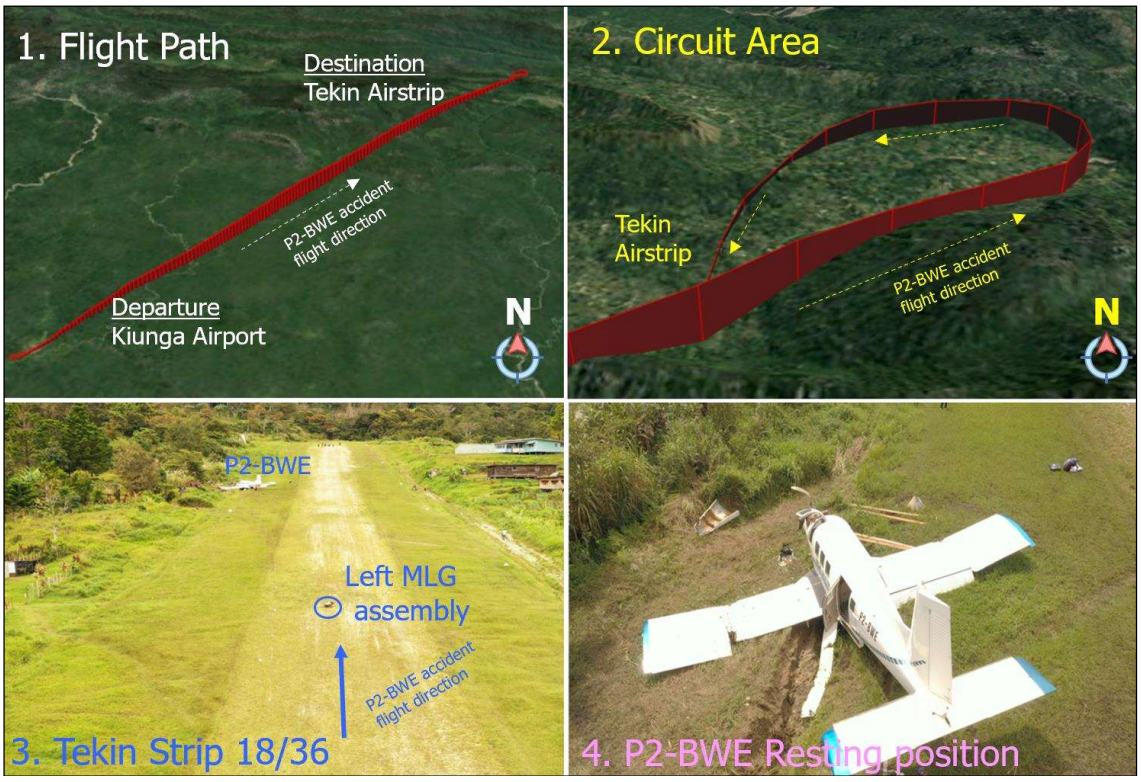


Figure 1: Overview of the accident flight path and the site

There were eight persons on board the aircraft, one pilot and seven passengers.

During an interview with the AIC, the pilot stated that he had conducted a charter flight from Kiunga to Telefomin and back to Kiunga earlier that morning. According to the flight manifest, the aircraft then departed Kiunga for Tekin with a total of seven passengers and 549 kgs of cargo.

Spidertracks[3] recorded data showed that the aircraft departed Kiunga for Tekin at about 08:43, climbed to an altitude of 11,700 ft AMSL[4] and then tracked Northeast of Kiunga direct to Tekin. The pilot recalled that there was no significant weather along the route and in the Tekin area.

The recorded data showed that the aircraft arrived in the Tekin circuit area at about 09:18 and established

1 The 24-hour clock, in Coordinated Universal Time (UTC), is used in this report to describe the local time as specific events occurred. Local time in the area of the serious incident, Papua New Guinea Time (Pacific/Port Moresby Time) is UTC +10 hours.
2 Visual Flight Rules
3 A satellite tracking device for aircraft. This enables the aircraft's position to be monitored from an internet-connected device. It includes an 'SOS' button, which can be manually activated by the crew in an emergency.
4 Above Mean Sea Level

overhead the field at 2,800 ft AGL[5].The aircraft then tracked towards the northeast of the airstrip. At about 3 nautical miles (NM) Northeast of the airstrip, the pilot turned left base for approach. The aircraft established on final approach profile about 1 NM from the airstrip runway 18 designated landing threshold at a height of about 500 ft AGL. The pilot stated during interview that while positioned overhead, he conducted an aerial inspection and from his observation, the airstrip appeared suitable for landing.

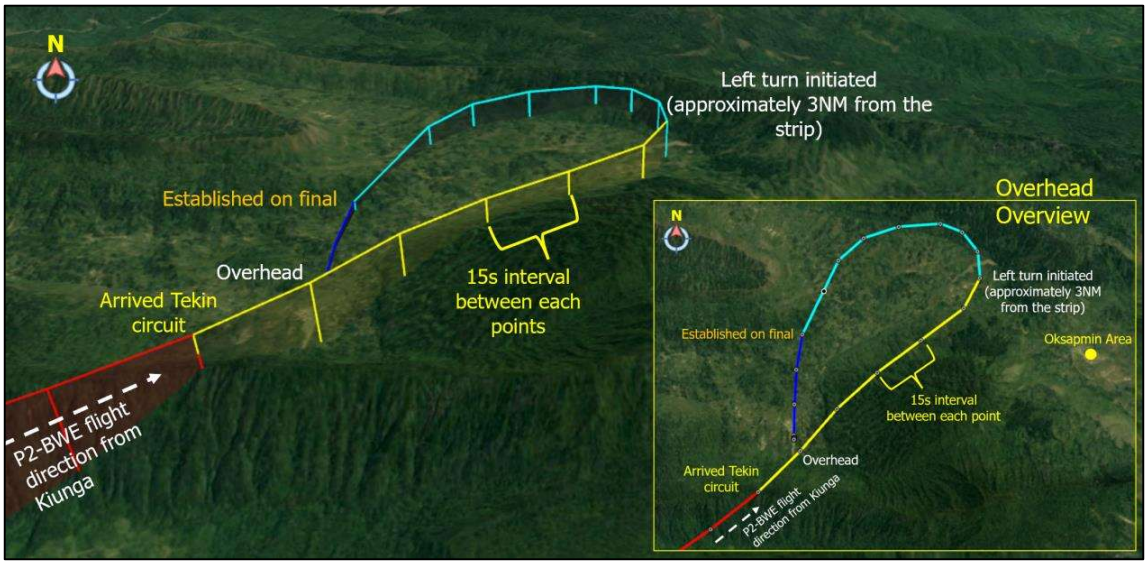


Figure 2: Arrival at Tekin Circuit Area

The pilot stated that he established the aircraft on final approach with an airspeed of 120 kts. He subsequently configured the aircraft for landing; propeller pitch set to full fine, power set to maintain nominated approach speed, and full flap. The pilot indicated that he reduced airspeed while on approach and maintained an airspeed between 85 and 90 kts. As he flared the aircraft to land, airspeed was between 75 to 80 kts. The touchdown speed, as he recalled, was 75 kts.

According to the pilot, following touchdown, the left MLG assembly collapsed. The left wing subsequently dropped and impacted the ground causing the flap to dislodge. The aircraft immediately began veering left towards the eastern edge (boundary) of the airstrip. The pilot stated that he applied full right rudder to manoeuvre the aircraft back onto the runway, but the aircraft continued dragging left towards the runway edge and subsequently impacted a drainage ditch adjacent to the runway where it came to rest.

The pilot reported that he immediately shut down the engine and evacuated the passengers from the aircraft.

[5] Above Ground Level

1.2 Injuries to Persons

Injuries	Flight crew	Passengers	Total in Aircraft	Others
Fatal	-	-	-	-
Serious	-	-	-	-
Minor	-	-	-	Not applicable
Nil Injuries	1	7	8	Not applicable
TOTAL	1	7	8	-

Table 1: Injuries to persons

1.3 Damage to aircraft

The aircraft sustained substantial damage. Refer to *Section 1.12* for detailed description of damage to relevant components of the aircraft.

1.4 Other damage

There was no other damage to property and/or the environment.

1.5 Personnel information

1.5.1 Pilot

Age	: 51 years
Gender	: Male
Nationality	: Papua New Guinean
Position	: Line Pilot
Type of licence	: ATPL[6] (Aeroplane)
Type rating	: EMB110; BN2A; DHC 6; C208B; PAC 750
Total flying time	: 9,305 hours
Total hours in command	: 1,742.5
Total hours on type	: 332.0 hours
Total on type last 90 days	: 27.4 hours
Total on type last 7 days	: 21.8 hours
Total on the type last 24 hours	: 6.5 hours
Medical class	: One
Valid to	: 03 May 2022
Medical limitation	: Spectacles

The personal records of the Pilot showed that he had about 26 years of experience as a pilot. He was employed by NASL on 01 December 2021. The pilot's training records showed that he satisfactorily

6 Air Transport Pilot Licence

completed his Emergency Procedures Proficiency and Safety Management System training on 01 December 2021. Records also showed that he had satisfactorily completed his *Company Exposition and Air Law exam (Flight Crew)* on 5 December 2021.

According to the pilot's logbook, since his employment with NASL his initial flight, conducting a single crew operation into Tekin Airstrip, was on 11 January 2022, seven days prior to his second flight which was the accident flight, on 18 January 2022.

The pilot reported that he was wearing his prescribed spectacles during the flight. According to the pilot's records, his base and line training were satisfactorily completed.

1.6 Aircraft Information

According to the Manufacturer, Pacific Aerospace Corporation, the 750XL aircraft is a turboprop driven, all metal, low wing monoplane with a fixed tricycle undercarriage. It has been developed from a proven design to meet present and future needs for an economical aircraft with high load carrying capacity. Its robust construction, wide section, and low-pressure tyres enable operations from unpaved strips to be flown as a matter of routine.

The power plant, a Pratt & Whitney PT6A-34 turbine engine, is enclosed in a 2-piece composites cowl, and drives a three, constant speed feathering and reversible pitch Hartzell propeller.

1.6.1 Aircraft Data

Aircraft Manufacturer	: Pacific Aerospace Corporation Limited
Model	: PAC 750XL
Serial number	: 161
Year of Manufacture	: 2009
Total Airframe Hours	: 7,549.4 hours
Total Airframe Cycles	: 11,178 cycles
Registration	: P2-BWE
Name of the owner	: Niugini Aviation Services Limited
Name of the operator	: Niugini Aviation Services Limited
Certificate of Registration	: 048
Certificate of Registration issued	: 18 December 2020
Valid to	: Non-Terminating
Certificate of Airworthiness	: 048
Certificate of Airworthiness issued	: 18 December 2020
Valid to	: Non-Terminating

1.6.2 Engine Data

Engine Type	: Turbo propeller
Manufacturer	: Pratt & Whitney Canada
Model	: PT6A-34
Serial Number	: PCE-RBO364
Year of Manufacture	: 2007
Total Time Since New	: 9,096.6 hours
Time Since Overhaul	: 3,851.1 hours

1.6.3 Propeller Data

Propeller Type	: Constant Speed, full feathering/reversible
Manufacturer	: Hartzell Propeller Inc
Model	: HC-B 3TN-3D
Serial Number	: BUA25600
Total Time Since New	: Unknown
Time Since Overhaul	: 818.6 hours

1.6.4 Fuel

According to information from the fuel docket, the aircraft was refuelled at Kiunga with recommended Aviation fuel Jet A1 and on-board the aircraft was about 400 kg of fuel.

During the interview, the pilot confirmed that there were no aircraft performance issues observed or experienced during the accident flight that would have been associated with the fuel.

Therefore, the investigation determined that the fuel in terms of quantity and quality were not contributing factors in the accident.

1.6.5 Weight and Balance

The accident flight Load and Trim Sheet (*Refer to 5.1 Appendix A*) showed that the aircraft departed from Kiunga with a take-off weight of 3,306 kg and landed at Tekin with a landing weight of 3,206 kg.

The Pilot Operating Handbook and Civil Aviation Authority of New Zealand Approved Flight Manual Air 2825 Section 1 has the following weight and balance data,

Weights	Structural Limitations
Max Take Off	3,402 kg
Max Landing	3,232 kg

Table 2: PAC 750XL weight and balance data

The investigation determined that the aircraft's takeoff and landing weights during the accident were within the permissible limitation.

1.6.6 Minimum Equipment List

There was no outstanding Minimum Equipment List (MEL) item at the time of the accident.

1.6.7 Main Landing Gear System

The MLG comprises of left and right gear assemblies using conventional type shock struts or oleo strut and it is attached to heavy duty castings or machined fittings forming part of the centre wing structure at the intermediate rib positions. The MLG assembly consist of the shock strut, the axle and the tire and brake assembly. The MLG is attached to the aircraft structure by four attachments 3/8 inch bolts (Part Number (PN) MS21250-06078). Two brackets attach the MLG to the structure with the bolts at the lower side.

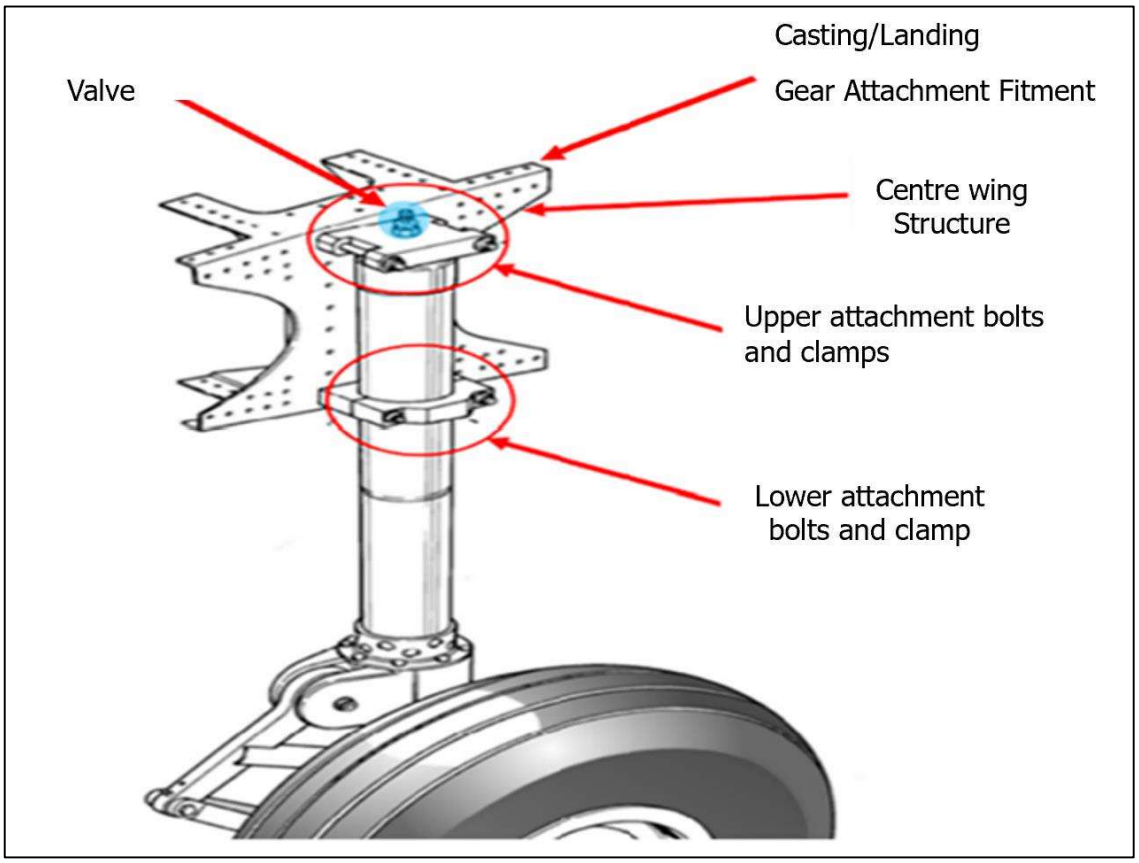


Figure 3: MLG Assembly

1.6.7.1 MLG Oleo Strut and its Servicing

The Shock struts or oleo struts are shock absorbers that cushion forces associated with aircraft landings and ground manoeuvres such as taxiing. Oleo struts are critical elements of the aircraft landing gear, connecting an aircraft's tire to the airframe to provide the main path through which load forces are transmitted from the ground to the airframe.

Shock strut is assembled with a piston and a bearing, and it is divided into two chambers by an orifice plate that allows the hydraulic fluid to travel between the lower and upper chambers. The lower part of the strut is filled with hydraulic fluid and the remaining space in the upper part of the strut is filled with nitrogen. The movement of this fluid through the orifice by the piston movement during landing and taking off reduces force and vibrations to the aircraft.

Steel sockets at the lower end of the pistons provide attachment for the wheel axles and brake anchor plates. The lower arms of the torque links are bolted by brackets to the sockets whilst the upper arms are attached to alloy lugs at the base of the cylinders.

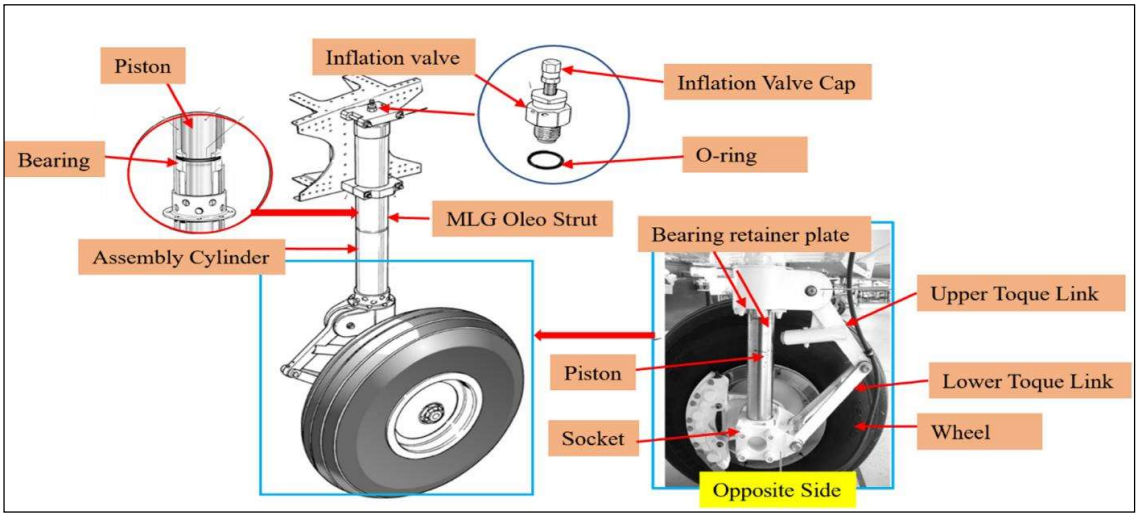


Figure 4: MLG Oleo Strut

The MLG oleo strut is serviced or replenished with fluid in accordance with *PAC 750XL Maintenance Manual (MM) Chapter 12* (*Refer to 5.2 Appendix B*).

1.6.8 Aircraft Maintenance

The maintenance records were reviewed by AIC and found that the last major scheduled maintenance on the aircraft was a Check 2 (300 hourly) carried out by the Operator's engineering team from 9 to 15 January 2022. Check 1 (150 hourly) inspections including the MLG oleo struts inflation and tire pressure were also carried out during this inspection as shown below in *5.3 Appendix C.*

The maintenance records also shows that the left MLG had defects which was recurring as detailed in the table below.

Left MLG Defects Maintenance History			
Activities	Dates		
	Sept 2021	Oct 2021	Jan 2022
Defect	LH MLG Oleo Pressure	LH MLG Wheel Assy found with slow Leak	Pilot reported left Hand Main Landing Gear Strut pressure a bit low
Maintenance/ Rectification	Strut Pressure Serviced to Normal Pressure IAW CHP 32-00-00 + 12-00-00	LH MLG Wheel Assy replaced with a serviceable wheel assy	Left Hand main landing gear strut serviced. Hydraulic Fluid replenished. Strut pressure nitrogen refilled in accordance with PAC Maintenance Manual Ch.32-00-00

Table 3: Left MLG defects History

1.6.9 MLG Attachment Bolts Replacement

The maintenance records of the aircraft showed that on 25 May 2020, during the time it was owned and operated by Central Aviation, the MLG top and bottom attachment bolts were replaced in accordance with PAC 750 XL MM as required by Central Aviation Custom Policy[7]. The policy was to replace the MLG attachments bolts every 900 hours or every three Check 2(300 hours) inspection.

7 Refer to Section 1.18.3 Additional Information of this report for more information on Custom Policy.

The AIC also looked at the hours and the landings of the aircraft since the replacement of the attachment bolts were last carried out by Central Aviation dated 25 May 2020 and identified that at the time of the accident, the MLG attachment bolts had accumulated 818.6 hours and 1,370 landings on the aircraft.

1.6.10 Collision Avoidance Systems

The aircraft was equipped with a Mode C transponder and its serviceability was not a factor in this occurrence.

1.7 Meteorological information

1.7.1 Papua New Guinea National Weather Service

The Area Forecast data obtained from PNG National Weather Service (NWS) by the investigation was effective between 17 January 2022 at 23:00 and 18 January 2022 at 11:00. The Area Forecast states:

Winds	:	2,000 ft – winds blowing at 290° at 20 kt
		5,000 ft – winds blowing at 290° at 25 kt
		7,000 ft – winds blowing at 290° at 20 kt
Cloud	:	1,500-10,000 ft – scattered cumulus clouds with broken showers.
		3,000-8,000 ft – scattered stratocumulus clouds with broken rain with drizzles.
Visibility:		500 m with fog, 3,000 m with thunderstorm and rain, 4,000 m with showers and rain or rain and drizzles (four-hourly interval from 23:00 on 17 January 2022 to 11:00 on 18 January 2022).
Weather:		fog, thunderstorm and rain; showers and rain; and rain and drizzles (four-hourly interval from 23:00 on 17 January 2022 to 11:00 on 18 Jan 2022).

1.7.2 Tekin Local Weather

The pilot stated during interview that he observed the weather in the Tekin circuit area to be good with calm wind. He also stated that the winds on approach into Tekin was very light, estimating about 2 kt.

During interview with local eyewitnesses, they stated that the weather was fine with no wind at the time of the accident.

1.8 Aids to navigation

Navigational aids and their serviceability were not a factor in this accident.

1.9 Communications

The aircraft was equipped with a High Frequency (HF) and Very High Frequency (VHF) two-way communication radio. Both communication systems were determined to be serviceable and were not a contributing factor to this accident.

1.10 Aerodrome information

Tekin Airstrip is located in Sandaun Province at an elevation of 5,632 ft and 56 NM Northeast of Kiunga Airport. According to the PNG Airstrip Guide Year 2021[8] edition used by the Operator as a route and aerodrome guide, Tekin Airstrip is a one-way airstrip with a landing direction of 180°, and a take-off direction of 360°.

The table below shows the data of Tekin Airstrip from the Airstrip Guide Year 2021.

Table 4: PNG Airstrip Guide used by NASL for Tekin during the accident

Latitude	0514.69
Longitude	14209.874
Runway	18/36
Elevation	5,500
Landing Distance Available	494
Slope	10.5 N[9]
Remarks	L 18 T/O 36 Caution turbulence in SE wind

As per the topography data, Tekin Airstrip is located in a valley surrounded with mountain ranges and is situated at the foot of Mt. Wamtakin. The mountain is 1,800m (about 5,900 ft) high and has a long ridge extending in an East-West direction and is located to the south of the airstrip. There is a river also located in the valley, to the North of the airstrip, and runs in an East-West direction as well.

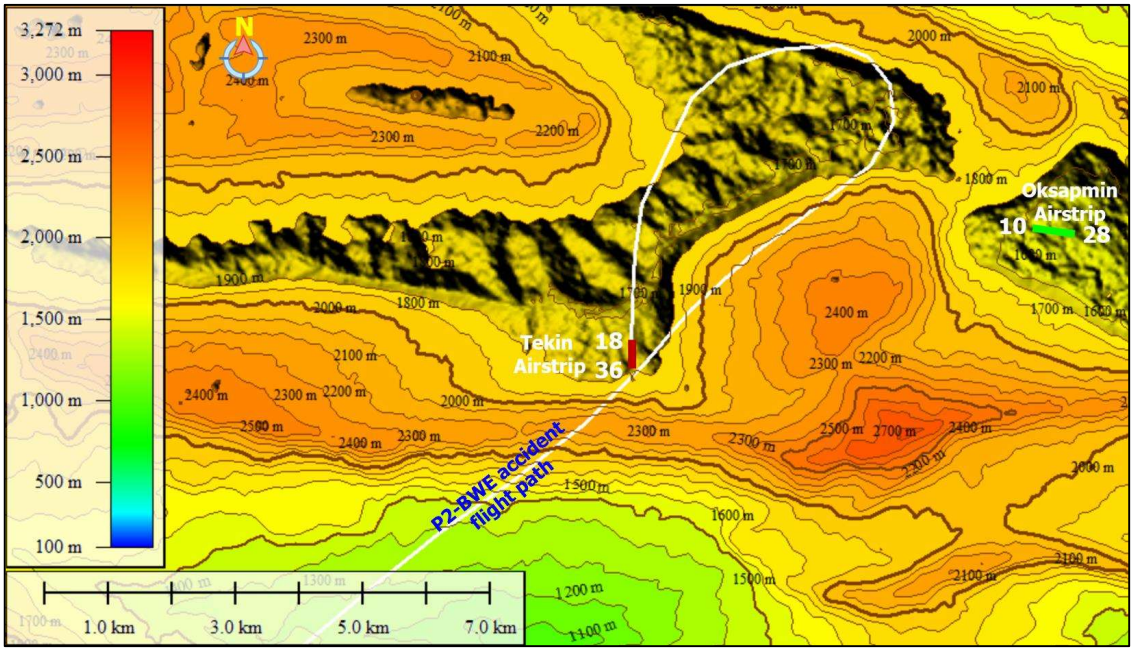


Figure 5: Tekin Area Topography

The geographical position of the airstrip and surrounding give the area its own local wind and weather patterns

8 A Guide was developed and published only as a guide to pilots in matters helpful to operations, such as GPS settings, wind characteristics, and surface conditions and it is not a PNG CASA approved guide. This guide also states that the PNG AIP-AGA is the legal document governing aviation operations. Pilots are advised to always check NOTAMS for latest information.

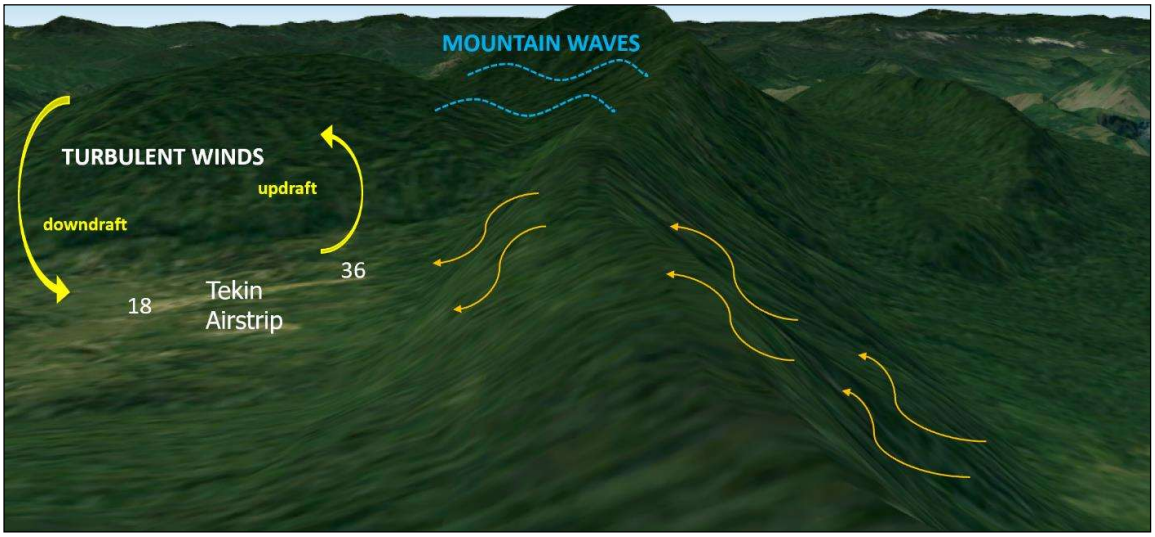


Figure 6: Localise wind pattern at Tekin Airstrip

1.10.1 On-site Observation of Tekin Airstrip

During the onsite investigation, it was observed that the runway surface was hard and comprised of unsealed gravel with light overgrowth of grass. There were several water drainage run-offs from the centre of the runway towards the grass runway.

There were two windsocks at the airstrip. One windsock was located before the start of runway18, and the other windsock was located towards the end of runway18, on the left-hand side.

There is an inclination that begins from the grass surface just before the start of runway 18 that reaches an elevation of about 15cm.

There were two cone markers to the right of runway18 about 5m up the runway from the edge of the runway. Their purpose was to indicate the designated landing threshold of the runway where the surface is levelled, however it was observed that the cone markers were not in good condition to be clearly visible. The runway surface shows evidence of a normal touchdown point 20-30m up the runway of the designated landing threshold.

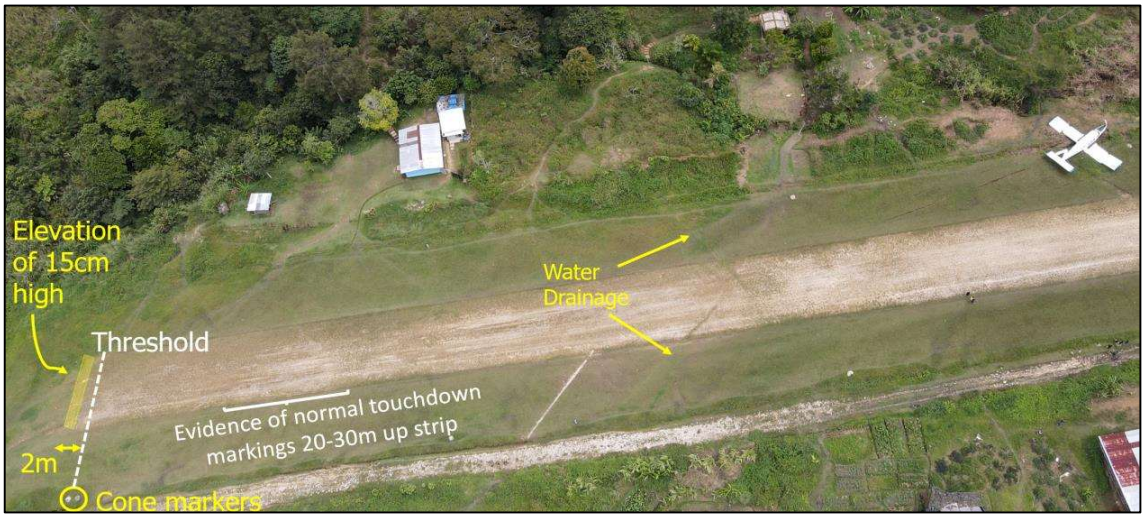


Figure 7:Tekin Airstrip with indications of onsite observation

Figure 8: Airstrip image taken by the drone flown along the approach path

1.11 Flight recorders

The aircraft was not equipped with a flight data recorder or a cockpit voice recorder, neither were they required by PNG Civil Aviation Rules.

1.12 Wreckage and impact information

1.12.1 Overview of the Wreckage Distribution

During the on-site investigation, it was established that the aircraft's initial touchdown was about 2m short of the designated landing threshold indicated by cone markers and the MLG collapsed subsequently. The investigation also established that 15m from the initial touchdown point, the aircraft's left-wing assembly dropped, hit the ground and the flap detached and began to drag on the surface creating markings. About 40m after the initial touchdown, the left MLG assembly[9] was found on the runway surface.

The tire tracking markings on the surface showed that about 61m from the initial touchdown, the aircraft began to exit the runway or veer left of the runway, onto the grass runway and continued until it impacted the drain which was adjacent to the edge of the grass runway.

9 The position of the left main landing gear assembly in Figure 9 was indicated to the on-site team by the locals during the on-site investigation

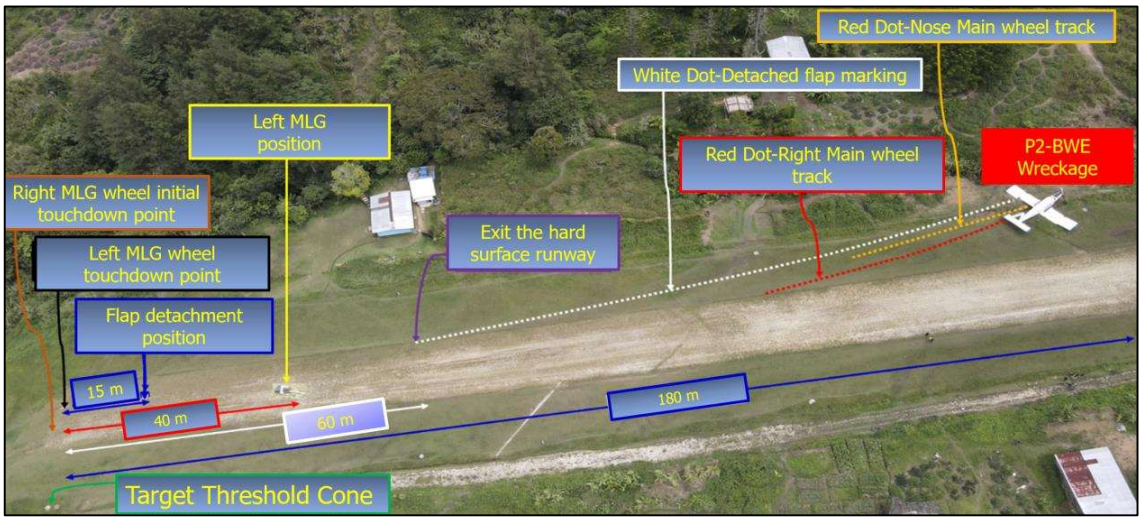


Figure 9: Aircraft's wreckage distribution

The on-site investigation team also established from the tire track markings that during the initial touchdown, the aircraft's left main landing tire hit the elevation of about 15cm high at the edge of runway18 and penetrated through the ground at a depth of 10cm.

The evidence also showed that the aircraft's right main tyre initially touched down a few centimetres prior to the left main tyre touchdown point, however, there was no sign of heavy ground penetration as a result.

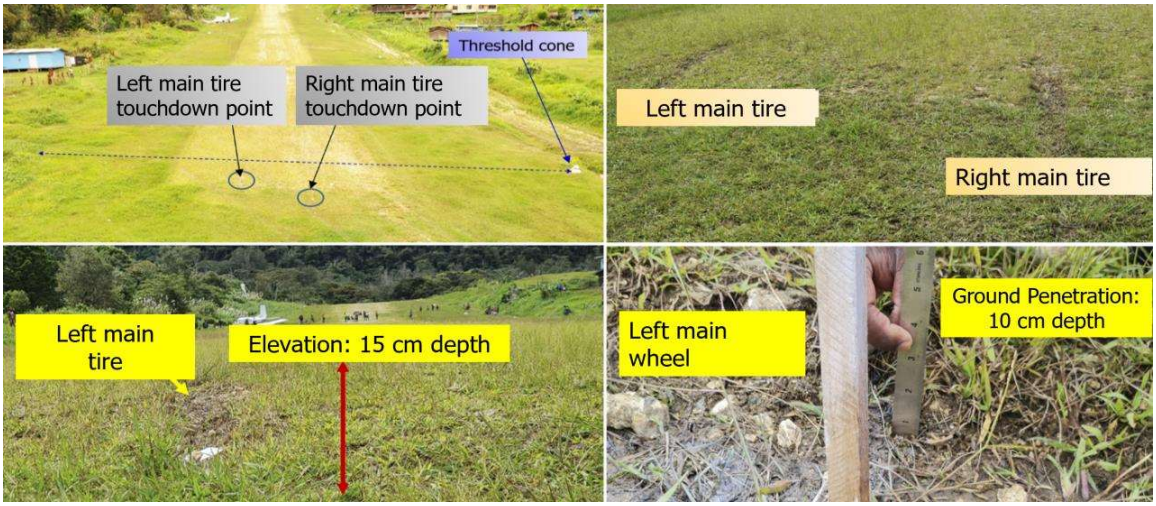


Figure 10: Aircraft's initial touchdown points

1.12.2 Aircraft Damages

The aircraft sustained significant structural damages to the left MLG assembly, left wing assembly, nose landing gear assembly, the propeller blades, and the engine exhaust section.

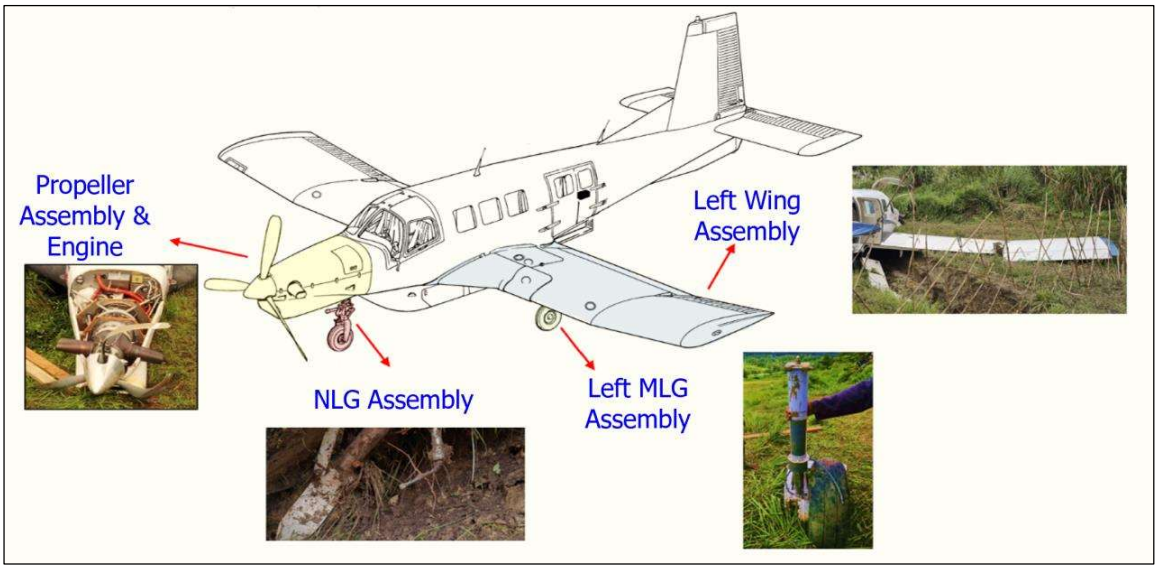


Figure 11: Damages sustained by P2-BWE

1.12.3 Onsite Inspections

The on-site investigation team also identified that the left MLG oleo strut that had detached from the aircraft was extended and there was also evidence of fluid coming out of the valve cap. This indicated that there was sufficient pressure in the oleo strut allowing it to extend.

Figure 12: Evidence of sufficient pressure in the oleo strut

The on-site investigation team also measured the pressure of the left main tire at Tekin Airstrip and identified that the pressure was 38 psi.

Figure 13: Evidence of sufficient pressure in the left main landing tire

1.12.4 Off-site Inspection and Disassembly of the Left MLG Assembly

The left MLG assembly was brought to AIC's Engineering Laboratory for further examination as shown below. The evidence on the stone deflector assembly showed that there was a bend of about 40°. The impact force was also sustained at the inflation valve enclosed with the valve cap where a bend of about 20° was measured.

Examination also showed that all four attachment bolts, two upper and two lower attachment bolts, locking the strut together to the fuselage attachment structure, broke off from the bolt head side. Evidence showed that the upper attachment bolts sheared upon impact due to the hard landing. However, one of the lower attachment bolts had bent significantly while still inserted in the clamp half indicating that stress was applied to it momentarily before it had snapped.

Other observations made from the Laboratory examination are as follows:

- tire assembly was intact with no damage
- Strut oleo with the allowable amount of fluid and pressure with valve core cap intact
- Torque link was intact and had castellated nut with safety split pin missing
- Brake assembly unit was intact with hose supplying fluid snapped off from the top; and
- Both strut upper attachment bolts sheared off at the head side

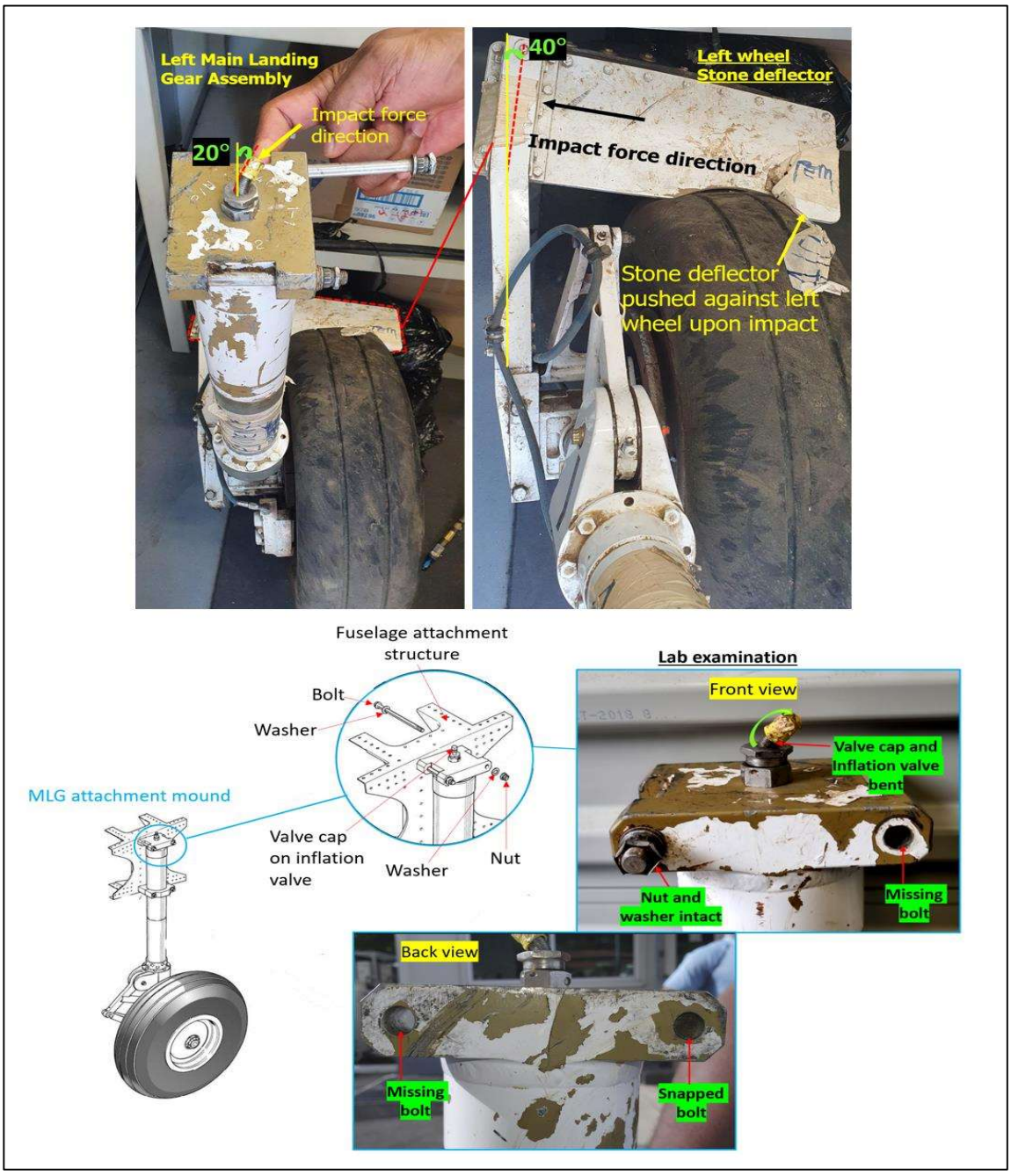


Figure 14: MLG Laboratory Examination

The MLG was disassembled by AIC and observed that all internal and external parts of the MLG strut assembly were intact including O ring had no visible damage. There was also no evidence of fluid leakage.

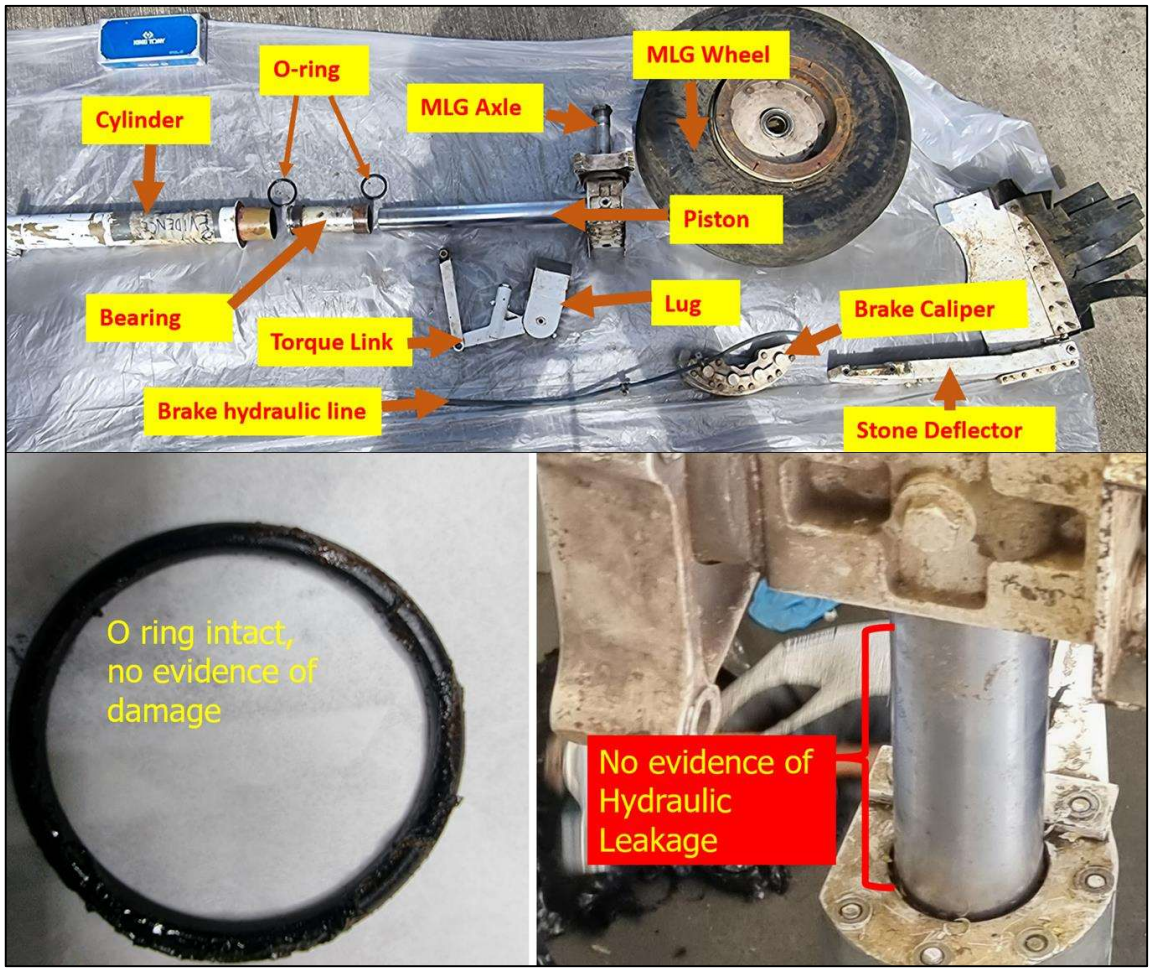


Figure 15: Left MLG Disassembly

1.13 Medical and pathological information

No medical or pathological investigations were conducted as a result of this occurrence, nor were they required.

1.14 Fire

There was no evidence of fire in flight or after the impact.

1.15 Survival Aspects

1.15.1 Air Traffic Services Activities

The Air Traffic Services (ATS) audio recordings revealed that the Flight Information Service (FIS) officer started calling P2-BWE on High Frequency (HF) 5565 and 8861 kHz at 09:27 several times for about two minutes with no response from the pilot.

The COSPAS SARSAT[10] distress message provided to the AIC indicated that P2-BWE's Emergency Locator Transmitter (ELT)[11] activated at 09:30. ATS audio recordings indicated that at around the same time, the pilot responded to FIS and advised that they were on the ground at Tekin and reported that the aircraft had crashed after landing. The pilot reported that the aircraft had run over a ditch, but all passengers including himself were safe. The FIS officer acknowledged by cancelling SAR watch.

According to the interview conducted by the AIC, the pilot stated that all passengers were safely evacuated through the main passenger door and there were no injuries to the passengers.

ATS audio recordings indicated that at 09:35, they declared a Distress Phase upon receipt of the COSPAS SARSAT message on P2-BWE.

The ATS Centre Supervisor (CS) Journal entries indicated that the Distress Phase was cancelled at 10:49 and the Operator was subsequently asked to advise ATS when the ELT was isolated. The Operator advised that they were yet to get in touch with the pilot of P2-BWE to instruct him to isolate the ELT.

At 11:50, Australian Mission Control Centre (AUMCC)12 advised ATS that the ELT for P2-BWE was suppressed.

The pilot stated during interview, that he was flown back to Kiunga on the same day, on an aircraft belonging to another airline that had landed at Tekin after the accident.

1.16 Tests and Research

No test and research conducted in this investigation

1.17 Organisational and management information

1.17.1 Operator: Niugini Aviation Limited

NASL is an aircraft Operator which conducts charter and regular Fares & Freight (F&F) operations under the VFR category, within PNG. Most of its operations are into remote areas servicing rural communities.

NASL holds an Air Operator's Certificate, or AOC number 119/063 issued under CAR 119 for fixed wing air operations in accordance with CAR Part 135 on 15 December 2021 and expires on 30 December 2023.

The Operator also holds a current Maintenance Organisation Certificate, or MOC number: 145/063 issued on 1 November 2021, and expires on 31 October 2023. The NASL Maintenance Organisation is based at Mt. Hagen (Kagamuga) Airport, Western Highlands Province.

---

[10] Satellite system that detects distress ELTs, emergency Position-Indicating Radio Beacons and Portable Locator Beacons operating in the 406 MHz frequency.

[11] P2-BWE was fitted with an Artex ME-406 ELT.

[12] Local User Terminal that processes data that is received from COSPAS SARSAT, and transmits to the appropriate Search and Rescue authority, in this case, ATS.

1.17.1.1 Training and Competency

1.17.1.1.1 Route and Aerodrome Training

Training and Competency Manual, section 6.1 (A) (1) (2) requires each pilot acting as pilot-in-command to within the immediately preceding 12 months, pass a check of route and aerodrome proficiency that is administered by a flight examiner and that;

> (i) *consists of at least one flight over one route segment and one or more landings at aerodromes representative of the operations to be flown; and*
> *(ii) establishes that the pilot can satisfactorily perform the duties and responsibilities of a pilot-in-command in air operations appropriate to this Part.*

This Section is in compliance to *PNG CAR Part 135.607(a)(1)(i), Flight Crew Competency Checks* which states;

> *a) A holder of an air operator certificate must ensure that —*
>
> *(1) for each pilot acting as pilot-in-command has, within the immediately preceding 12 months, passed a check of route and aerodrome proficiency that is administered by a flight examiner and that*
>
> *(i) consists of at least one flight over one route segment and one or more landings at aerodromes representative of the operations to be flown*

According to the Training and Competency Manual, section 5.3.3 '*Training at Special Characteristics Aerodromes,'*, a Special Characteristics Aerodrome is identified with the following features;

1. *One-way landing strip*
2. *One-way take-off strip*
3. *Longitudinal surface gradient of more than 1:50 (2.0 %)*
4. *Uneven longitudinal surface gradient*
5. *Is subject to wind conditions conducive to the formation of subsidence or wind shear*
6. *Is subject to excessive cross wind conditions for the aeroplane type in use*
7. *Is subject to excessive tail wind conditions for the aeroplane type in use.*
8. *Special knowledge required to execute a baulked approach*

For the Special Characteristics Aerodrome, a pilot is required to demonstrate to a Check Captain or Line Training Captain the ability to land and take off an aeroplane with an operating weight equivalent to the maximum permissible weight for an aerodrome.

The investigation identified that Tekin Airstrip falls under a Special Characteristic Aerodrome.

There is variation to the route and aerodrome qualification training as stated in section 5.3.5 (3) of the Operator's Training and Competency Manual as;

> *At the discretion of the Flight Operations Manager, the training for route and aerodrome qualification may be reduced when;*
> 1. *the pilot requiring qualification has in excess of 500 Hours experience of flying in Papua New Guinea;*
> 2. *the aerodrome concerned is not one that would come under the description of having special characteristics;*
> 3. *the aerodrome is listed in the Route Intelligence Manual and the pilot has studied the details relevant to it and in AIP AGA.*

Therefore, the pilot had to be checked into the Aerodrome before operating into Tekin Airstrip, however, during the interview, the Operator informed the investigation that the Flight Operations Manager used

his discretion to allow the pilot to not undergo the aerodrome check into Tekin Airstrip. The Operator also informed the investigation that the FOM's decision was based on the pilots previous flying experience.

1.17.1.1.2 Route and Aerodrome Guide

According to *PNG CAR 135.77 Use of aerodromes;*

> *(C) The certificate holder shall, where its aeroplanes use an aerodrome not promulgated in the PNGAIP, maintain a register containing—*
>
> *(1) the aerodrome data; and*
> *(2) procedures for ensuring that the condition of the aerodrome is safe for that operation; and*
> *(3) procedures for ensuring that the condition of any required equipment, including safety*
> *equipment, is safe for that operation; and*
> *(4) any limitations on the use of the aerodrome*

During the investigation, the Operator informed AIC that they were using PNG Airstrip Guide Year 2021 edition as their route and aerodrome guide.

A review of the PNG Airstrip Guide, Year 2021 edition by AIC identified that the guide did not contain information as required under *CAR Part 135.77(C)(2), (3) and (4)* requirements.

1.17.1.2 Safety and Quality Management

NASL has an integrated Safety and Quality Management System (SQMS) which is a formal organisational system to manage safety and quality. It defines the safety and Quality management process that encompasses all the functions of the organisation clearly showing how the safety and quality management activities integrate with all operational activities and how the organisation's desired outcomes are attained. It comprises the structure, responsibilities, processes, and procedures of an organisation that taken together, promote and establish an environment and culture of continuing improvement and thus enhance the safety of aircraft operations.

The Safety Management Systems manage safety through a continuing process of hazard identification and risk management. The Quality Management System systemically assesses the level of compliance and continuous improvement process with *CAR Part 100* and any applicable CASA regulations. The Quality Management System and Safety Management System responsibilities are assumed by the same senior person.

The Hazard Management Process which included hazard identification and reporting for assessment and correction was captured in the Operator's Safety and Quality Manual, *section 7.2 pursuant to PNG CAR Part 100.59 'Hazard identification'*

During the investigation, the Operator provided AIC with the Hazard and Occurrence Register on 23 May 2022. A review identified that the 2021 Register only contained hazards and risk assessments records for reported occurrences for other airstrips, excluding Tekin. There were no other records of hazards.

1.17.1.3 Calibration of Tools and Equipment

The Operator's approved Maintenance Organisation Manual Section 4 requires the Operator to carry out the Calibration of Tools and Equipment pursuant to *CAR Part 145.107 Equipment, tools, and material.*

The Engineering Manager is responsible for ensuring the equipment and tools that need calibration are removed from service, tagged as unserviceable and quarantined prior to their expiration date. *Refer to 5.5 Appendix D.*

AIC requested NASL to provide evidence of calibrated tools and equipment such as strut oleo servicing nitrogen gauge and Tyre Inflator-TDR for performing aircraft maintenance.

According to the manufacturers,

- *the details of the Nitrogen regulator is found to be, Maximum Outlet pressure 3,000(kPa), flow rate of 1,600 (l/min) and the pressure gauge range as 30,000 kPa for inlet and 4,000 kPa for outlet gauge*
- *the Tire Inflator-TDR 2000 has a maximum supply of 200 psi and maximum inflation of 138 psi. It has an accuracy tolerance of 2 plus or minus for the reading ranges between 25 psi to 75psi*

The Operator provided evidence of an existing Nitrogen regulator fitted with two gauges that connected to the Nitrogen bottle and Tyre Inflator-TDR, however, the evidence did not show the calibration date and expiration date.

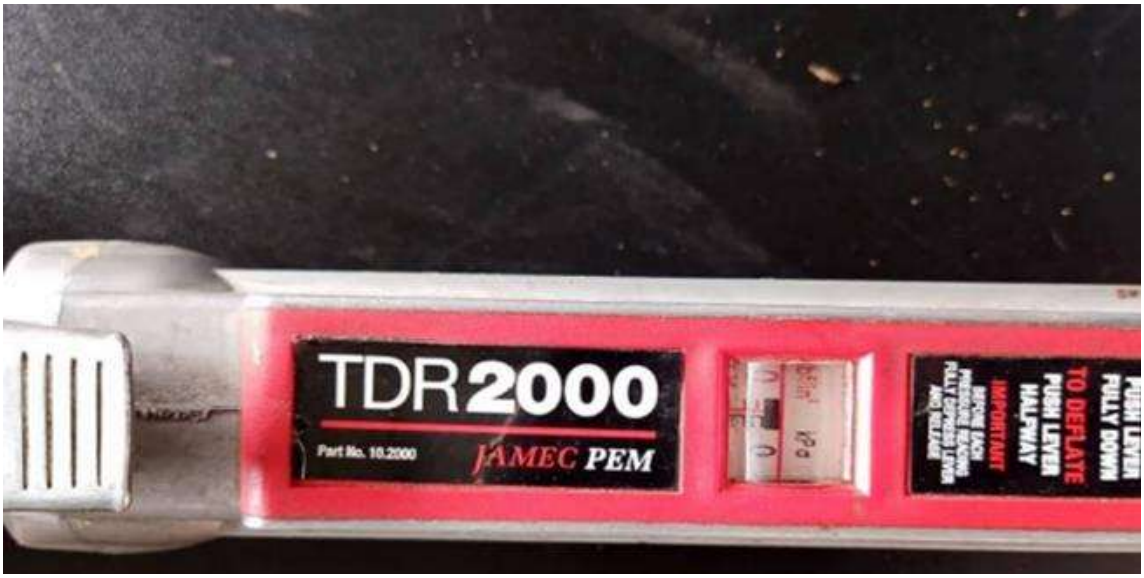


Figure 16: Tire Inflation

Figure 17: Nitrogen Regulator

Therefore, AIC requested the Operator to provide records of calibrated tools. The Operator provided a tool and equipment calibration register which did not include the records of the Nitrogen regulator gauges and tire pressure gauge. Upon further query regarding the calibration records of the two gauges, the Operator stated that they were sent to PNG National Institute of Standards and Industrial Technology (PNG NISIT) for calibration. After the calibration, the Operator provided the gauges, without their calibration records.

The investigation then requested NISIT for tool calibration records of the concerned gauges. PNG NISIT provided the records for 2019 to 2021. In these records, the two concerned gauges were not included.

1.18 Additional Information

1.18.1 P2-BWE Previous Owner/Operator

Niugini Aviation Services Limited had undergone internal changes to the company in 2020 with the acquisition of Central Aviation, Mt Hagen which included two PAC 750XL aircraft (now registered P2-BWE and P2-BWC). Following the acquisition of Central Aviation, the CoR and CoA was issued to the NASL on the 18 December 2020.The Civil Aviation Safety Authority of PNG (CASA PNG) accepted Niugini Aviation Services Ltd Maintenance Organization MOC 145/063 application and issuance of the initial MOC was on the 12 February 2021.

1.18.2 Change Management Process

According to PNG CAR Part 100.65 (a) (b),

> *(a) An applicant for the grant of an organisational certificate must establish and maintain documented procedures for managing changes to the certificate holder's organisation and operation.*
> *(b) The procedures required by paragraph (a) must—*
> *(1) define the operation in sufficient detail to provide a baseline for evaluating change; and*
> *(2) include processes for identifying changes to the organisation and to the operation; and*
> *(3) procedures for applying risk analysis and risk mitigation to changes; and*
> *(4) describe the safety management arrangements for implementing changes and on-going safety monitoring; and*
> *(5) identify the means by which all person affected by a change are notified during the*
> *development and implementation of the change*

A thorough review of the specific contents about management of change in the Operator's Safety and Quality Management System Manual showed that the Operator had established procedures for managing changes to the organisation and operation in their Safety and Quality Manual, Section 15.

Acquisition of Central Aviation included introduction of two additional aircraft. This meant introduction of new equipment and procedure, etc. When changes happen, the system has to be amended to include changes to the organisation and the knowledge and expertise to keep the system running.

There was no evidence of change process carried out by Niugini Aviation Services Limited before the acquisition of Central Aviation.

1.18.3 Custom Policy for MLG Attachment Bolts

According to Pacific Aerospace, the PAC 750 XL Maintenance Manual does not define a schedule for replacing the MLG attachment bolts, but it is common practice for operators to replace these bolts based on their internal Company Policy in conjunction with normal scheduled maintenance. Operators normally refer to this Policy as a Custom Policy.

The Central Aviation developed a Custom Policy after they noticed that the attachment bolts were deteriorating at 1000 hours. With that, a policy was established to replace the MLG attachment bolts every 900 hours or every third Check 2 and was tracked on the system by Air Fleet Management, the organisation who was engaged for their Maintenance Control.

During the investigation, the Air Fleet Management informed AIC that there is no procedure behind a particular task if it will be requested to be treated under customs policy since it is a single task setup in the Maintenance Control tracking system. Therefore, once tracking hours or landing of a particular task is established, the task is automatically set into the tracking software for monitoring and tracking purposes.

Air Fleet Management also informed the investigation that they had verbally passed the Custom Policy regarding the MLG attachment bolt replacement to the new Central Aviation Maintenance Controller at that time. Since Central Aviation is no longer in operation, the evidence to show that this information was passed from Air Fleet Management to Central Aviation could not be verified.

The AIC also requested NASL to provide any Custom Policy that they used for the MLG attachment bolt

replacement or maintenance, however, NASL informed the investigation that they did not have a Custom Policy to cater for MLG attachment bolts replacement

The investigation determined that the Custom Policy was not passed to NASL by neither of the Air Fleet Management or Central Aviation.

1.18.4 Survey Report

A survey of Tekin Airstrip was carried out on 21 May 2020 by Mission Aviation Fellows (MAF) PNG in accordance with Advisory Circular 139-6 (AC139-6). The survey information was reviewed, approved, and provided to the investigation by the Rural Airstrip Agency (RAA). The airstrip information provided is as follows:

Elevation	5,632 ft (at threshold)
Coordinates	Latitude: 05°14'41.64"
	Longitude: 142°9'52.56"
Runway length	531 m (1,742 ft)
Runway width	24 m (79 ft)
Slope	9.6% North[13]
Surface conditions	Short grass, fine-grain soil (silt, clay), rough with some undulations

Table 5: RAA survey data for Tekin Airstrip

According to the survey that was carried out, in contrast to Section 3.2 *Take-off Climb/ Approach Surface* of *AC139-6,* the Take-off Climb/Approach surface at Tekin Airstrip did not have –

a) 5% rise from the horizontal; and
b) 5% side splay (left and right); and
c) Clear for 600m horizontally.

Five obstacles (trees) were found to be within 600m of the Take-Off Climb/Approach horizontal surface, and four were penetrating the obstruction limitation surface (OLS).

The survey determined that with the prevailing conditions regarding the airstrip's OLS, the threshold is required to be displaced further up-strip to ensure that the take-off climb/approach OLS is clear. However, as it is, the airstrip was deemed not compliant with AC139-6 and was determined to not be safe for aircraft use.

The investigation also reviewed the PNG Airstrip Guide Year 2021 used by NASL during the accident and the RAA survey data and found variations in the data.

1.18.4.1 Rural Airstrip Agency (RAA)

RURAL AIRSTRIP AGENCY (RAA) OF PNG LIMITED (CN 1-87723) is a not-for-profit company. RAA, a wholly owned subsidiary of Mission Aviation Fellowship (MAF PNG Holding Limited) with a widely representative board including members from the National and Provincial Governments, airstrips owners, Aircraft operators and donor organisations.

RAA has been established for the primary purpose of facilitating and conducting maintenance and restoration of rural airstrips in Papua New Guinea. These activities are aimed at improving aviation safety and providing greater access by remote communities to essential services such health, education, community development and commercial markets for cash crops. RAA has been created as an interim to the establishment of the Rural Airstrip Authority, a PNG Government statutory body.

The RAA maintenance program is based on a continuous maintenance model. This program is for airstrips that are currently usable and require the minimum amount of work to keep them open, such as cutting grass, checking and repairing surfaces etc. Recently restored airstrips are added to the program after restoration work is complete.

Training of airstrip maintenance officers (AMO) is part of program. The AMOs are from the airstrip community. They are trained to cut grass using a industrialised lawn mower, provide daily reports on conditions of airstrip, cleaning drainages, placing of cone marker, reporting wind sock conditions and more. This enables airstrips to meet the maintenance standard (CASA AC Part 139-6 revision2) and remain operational.

1.18.5 Visual Illusions

According to the Federal Aviation Administration of the United States in its Pilot's Handbook of Aeronautical Knowledge (PHAK), Chapter17. Aeromedical Factors, pg. 17-11:

> *An upsloping runway, upsloping terrain, or both can create an illusion that the aircraft is at a higher altitude than it actually is. The pilot who does not recognize this illusion will fly a lower approach. Downsloping runways and downsloping approach terrain can have the opposite effect.*

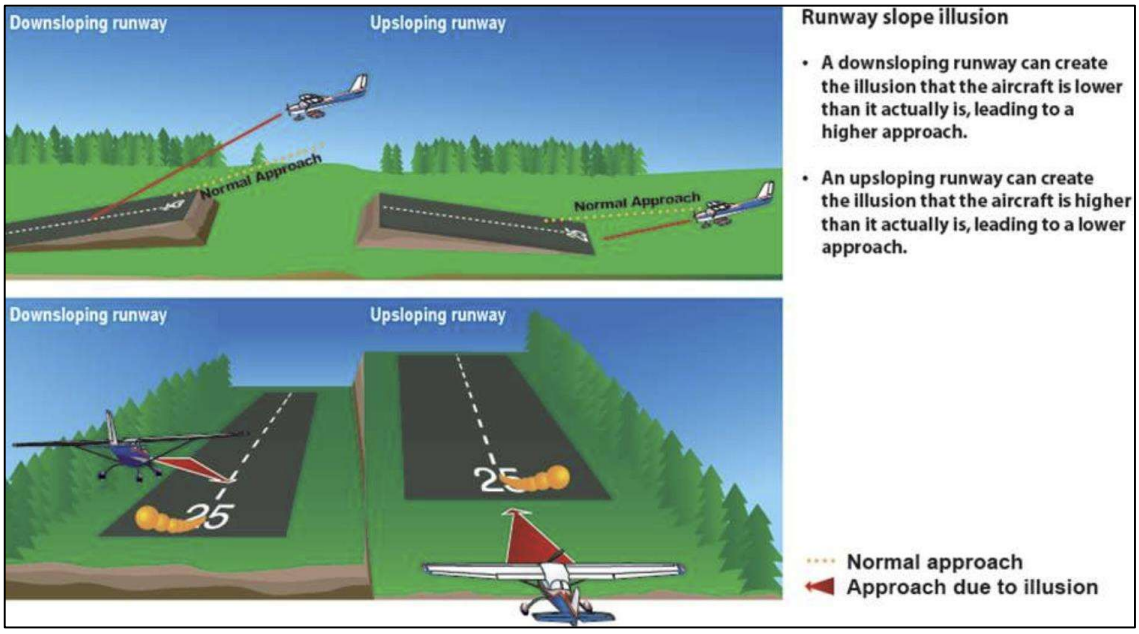


Figure 18: Upslope and downslope visual illusion (Source: FAA PHAK,17-7)

1.18.6 Occurrences involving rural airstrips from 2010 to 2022

During the investigation, AIC used the accident data from 2010 to 2022 and generated a graph showing the number of rural aircraft accidents in airstrip involving Operators operating under *CAR Part 135* and *CAR Part 125*. Also, a google earth display was generated from the data to show the rural airstrips and their respective locations.

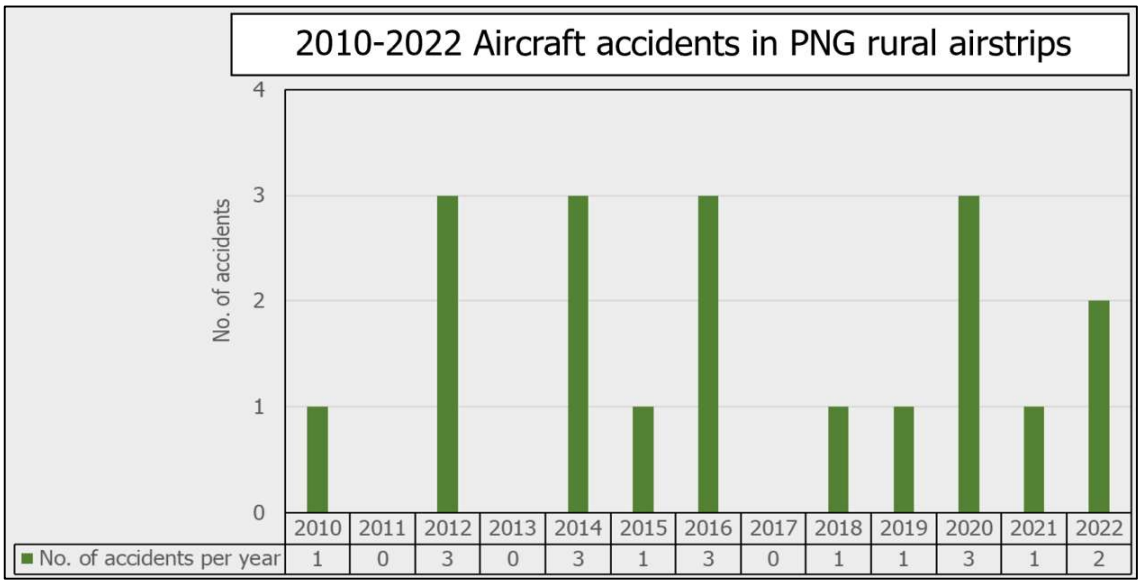


Figure 19: Rural Airstrip accidents per year

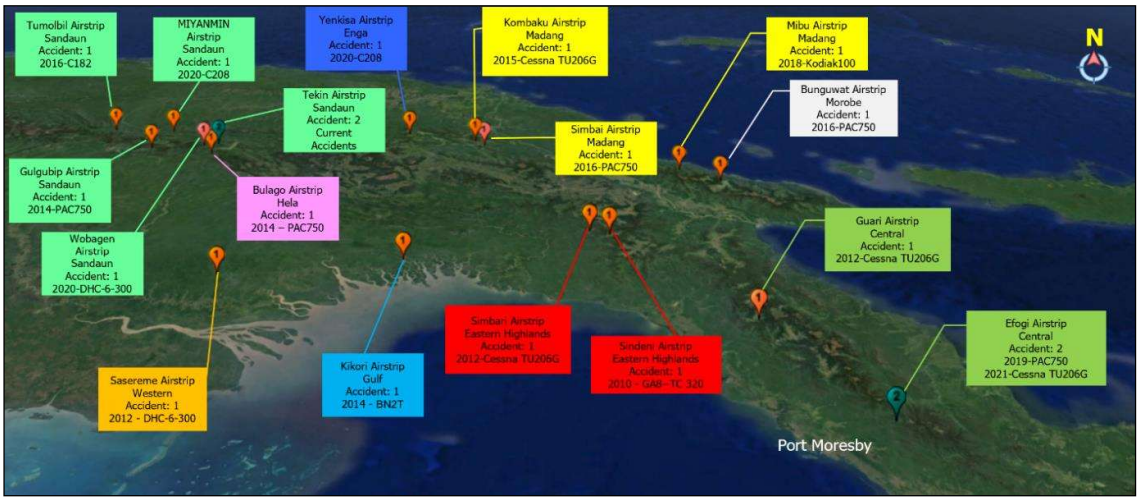


Figure 20: Accidents at rural airstrips and the geological locations of the airstrips (Refer to 5.5 Appendix E for larger version)

The AIC found that with an average of about two accidents per year has been a aviation safety concern for the travelling public into rural airstrips.

1.19 Useful Or Effective Investigation Techniques

The investigation was conducted in accordance with the Papua New Guinea *Civil Aviation Act 2000* (*As Amended)*, and the Accident Investigation Commission's approved policies and procedures, and in accordance with the Standards and Recommended Practices of *Annex 13* to the Chicago Convention on International Civil Aviation.

2 ANALYSIS

2.1 General

The analysis of this report will discuss the relevant issues and circumstances resulting in the P2-BWE aircraft that experienced a landing roll accident at Tekin Airstrip, Sandaun Province.

The analysis will therefore focus on the following issues.

- Flight Operations
- Tekin Airstrip Conditions
- Organisational
- Maintenance and Tooling

2.1.1 Flight Operation

The pilot recalled maintaining an airspeed between 85 and 90 kts while on approach and as he flared the aircraft to land, he reduced the airspeed to 75 knots and maintained this speed to touchdown. The investigation observed that the aircraft was appropriately configured for landing. The pilot stated that the approach appeared normal. However, the investigation found that the aircraft touched down at the edge of runway 18, which is about 2m from the designated landing threshold. Reviewing the flight records of the pilot, and from interview, the AIC deduced that the pilot was not adequately familiar with Tekin Airstrip.

Conducting a safe approach and landing requires the pilot to recognize and mitigate certain risks associated with operating into those special characteristic airstrips. As there are no approach aids on the ground at Tekin and most other special characteristic airstrips in PNG, pilots rely on their experience and training into special characteristic airstrips for conducting safe flights into those airstrips. To verify that the aircraft is on profile, pilots constantly monitor and adjust the approach profile relying on visual queues and estimations. These are developed through training, experience, and familiarization.

The AIC noted that the Operators Training and Competency Manual did not have a provision allowing the Operator exempting a pilot from aerodrome checks for special characteristic airstrips. However, the Operator's pilots were operating into those airstrips without aerodrome checks. The Operator stated that the pilot had significant experience in PNG rural airstrip operations and therefore did not need to be checked into the airstrips. The investigation believes that recruiting an experienced pilot does not take away the obligation of the Operator to verify that the pilot can conduct safe operations into airstrips. Furthermore, the Operators own manual did not give discretion to anyone to exempt a pilot from checks into special characteristics airstrips.

2.1.2 Tekin Airstrip

The AIC identified that although the runway surface conditions at Tekin Airstrip was suitable for the aircraft to land at the time of the accident, there were some existing hazards such as the two cone markers that did not clearly indicate the designated landing threshold for the normal touch down point, 20-30m up runway from the edge of runway 18. The AIC determines that this hazard most likely contributed to the pilot landing the aircraft short of the designated landing threshold.

The investigation also identified in accordance with the topography information of the Tekin airstrip area, downdraft is likely to be presented which may become another hazard for the pilot to consider.

From the observations of Tekin Airstrip made by the AIC during the investigation, which is also supported by the PNG CASA AC139-6, and the survey data provided by RAA that was never made available, nor was it required by any documents for dissemination, it revealed that there were existing hazards at the time of the accident but were never identified by the Operator. It would have been beneficial for the Operator to have access to reliable airstrip survey information from such organisations with technical expertise and for the Operator to develop a guidance tool for safe operation into Tekin airstrip.

2.1.3 Organisational

2.1.3.1 Aerodrome Checks

The AIC found that the Operator's procedure for route and aerodrome check was in accordance with *PNG CAR Part 135.607(a)(1)(i)*. However, there were no records to show that the pilot had undergone a route and aerodrome check since he had been employed by the Operator. The investigation determined that the pilot was not appropriately familiar with the operation into the aerodrome and the hazards associated with the airstrip.

During interview, the Operator informed the AIC that the pilot had been exempted from an aerodrome check because he had significant experience operating into rural airstrips within PNG. The investigation found that the Operator's SOP does not give the Operator the discretion to exempt pilots from undergoing aerodrome checks into Special Characteristics airstrip.

Tekin Airstrip met the condition of a Special Characteristics airstrip as per the Operator's manual. Conducting aerodrome Check for Special Aerodrome Airstrip is significant for the safe operation of aircraft into those airstrips. It helps the pilot to become more familiar with special conditions of operation, hazards, landing, and takeoff techniques which help pilots complete flights safely in challenging conditions.

2.1.3.2 Hazard Identification and Risk Management

Evidence showed that the Operator had established procedures for Safety Management System which included hazard identification, reporting, risk assessment and management. However, there were no records to show that hazard identification and risk assessments had been conducted for the aerodromes and airstrips the Operator's aircraft were operating into, including Tekin.

Although there were certain known hazards identified by the onsite investigation, the Operators hazard register did not contain those hazards. The only records shown in the hazard register were logs of occurrences (incidents/accidents). The investigation concluded that the SMS was not being adequately implemented to the intended extent.

This has been identified as a risk to the continued operations of the Operator as its pilots are operating into certain airstrips, including Tekin, for which the existing risks are not being managed by the Operator.

2.1.3.3 Custom Policy

Air Fleet Management informed the AIC that they had verbally informed the new Central Aviation Maintenance Controller of the Custom Policy relating to the MLG attachment bolts. However, there was no evidence to verify this information. The investigation determines that even if it was verified to have been passed verbally, this would not have been the appropriate method to use for transferring such vital maintenance information.

The Operator did not have a custom policy, nor were there any provisions in their maintenance documentation that referred to a custom policy requirement. The investigation determined that the tracking system was not handed over to the Maintenance Controller of Central Aviation, subsequently, C

did not transfer any information regarding the Custom Policy to NASL

The investigation determined that due to the lack of provision in the Operator's maintenance documentation in relation to a custom policy requirement, the Operator was unaware of the Custom Policy, especially for the MLG attachment bolts replacement.

2.1.4 Calibrated Tools and Equipment

The investigation determined that maintenance was not a direct cause of this accident. However, the maintenance practice for the Operator was of a safety concern.The aircraft came out from a scheduled maintenance three days before the accident. The MLGs were also subject for inspection, servicing, and maintenance as per the schedule.

The investigation found that the Operator did not have any calibration records for the tire inflation gauge and the oleo charging gauge. This finding was supported by the fact that there were no records available to show that these tools were calibrated. The Operators equipment/tools calibration register, or list did not contain the tire inflation gauge and the nitrogen oleo charging gauge.

The investigation determined that these components' accuracy levels were unknown to the Operator. Nevertheless, they continued to use the equipment for servicing and maintenance. On 27 July 2022, six months after this accident, the Operator removed all their uncalibrated pressure gauges and then sent to the NISIT with unserviceable tags on them for calibration.

The accuracy of these two pressure gauges was unknown. This presented a risk that the readings may appear at specified values but the actual pressure may be outside the tolerances. For landing gear components that dampen landing forces, it is crucial that actual pressure in those components is maintained within the manufacturer approved tolerances. Overpressurising or underpressurising the oleo and or the tire could lessen the intended dampening effect of the oleo and/or tire causing the landing impact forces to be transferred up through the structure, compromising the structural integrity of components which are not designed to sustain such a large amount of force.

Although there was no way of determining the actual pressure of the tire and oleo with certainty, the investigation believes it is likely that the pressure of either or both the tires were outside of the specified tolerances. The investigation also believes that any pressure outside of tolerance pressure would have been induced by the uncalibrated pressurization and recharging equipment

3 CONCLUSIONS

3.1 Findings

3.1.1 Aircraft

a) The aircraft was certified, equipped, and maintained in accordance with existing Civil Aviation Rules and Operator's approved procedures.

b) The aircraft had a valid Certificate of Airworthiness, Certificate of Registration and had been maintained in compliance with the Civil Aviation Rules.

c) The aircraft was certified as being airworthy and serviceable when dispatched for the accident flight.

d) The takeoff weight of the accident flight was within the prescribed limits.

e) The landing weight of the accident flight was within the prescribed limits.

f) The center of gravity of the accident flight was within limits.

g) There was no evidence of any defect or malfunction in the aircraft that could have contributed to the accident.

h) There was no evidence of airframe failure or system malfunction prior to the aircraft initial touchdown.

i) There was no MEL item pending at the time of the accident.

j) The aircraft was structurally intact prior to impact.

k) All control surfaces were accounted for, and all damage to the aircraft was attributable to the severe impact forces.

l) The aircraft was substantially damage by impact forces.

m) There was evidence of sufficient fuel in the tank when the aircraft was inspected.

n) Propeller blade damage and twist were consistent with the engine producing power at impact.

o) There was no evidence of pre- or post-impact fire.

3.1.2 Pilot

a) The pilot was licensed and qualified for the flight in accordance with existing regulations.

b) The pilot was properly licensed and medically fit to operate the flight.

c) The pilot was in compliance with the flight and duty time required under Civil Aviation Rules.

d) The pilot did not undergo the route and aerodrome checks as per the Operator's Procedure and the *PNG CAR Part 135.607.*

3.1.3 Flight Operations

a) The flight was conducted in accordance with the procedures in the company Operations Manual.

b) The flight crew carried out normal radio communications with the relevant ATC units.

3.1.4 Operator

a) The Operator had a valid Air Operating Certificate at the time of the accident.

b) The Operator also had Maintenance Organisation Certificate at the time of the accident.

c) The Operator's Operating Procedures were in compliance with PNG CARs

d) The Operator did not implement some of its Operating Procedures

e) The Operator used its discretion to exempt the pilot not to undergo the route and aerodrome checks

f) The Operator was using the PNG Airstrip Guide Year 2021, which did not contain information as required under CAR Part 135.77 (c)(2)(3) and (4).

g) The Operator did not fully implement its Hazard Management Process which included hazard identification and reporting for assessment and correction was captured in the Operator's Safety and Quality Manual

h) The Operator did not calibrate its pressure gauges which were used for servicing the aircraft prior to the accident

3.1.5 Airstrip

a) The airstrip was suitable for normal take-off and Landing.

b) The airstrip's cone marker for the designated landing threshold was not clearly visible

c) The airstrip's number of cones and how they were positioned as the designated landing threshold cone were not in accordance with *CAR PNG AC139-6*

3.1.6 Air Traffic Services

a) ATS provided prompt and effective assistance to the pilot.

3.1.7 Flight Recorders

a) The aircraft was not equipped with a flight data recorder (FDR) or a cockpit voice recorder (CVR); neither was required by regulation.

3.1.8 Survivability

a) The accident was survivable due to the low-level severity of impact.

b) The pilot and passengers survived the crash landing and disembark after the aircraft came to a stop.

c) The ELT unit was automatically activated

3.1.9 Safety Oversight

a) The Civil Aviation Safety Authority's safety oversight of the Operator's procedures and operations was adequate.

3.2 Causes [Contributing Factors]

During the landing at Tekin Airstrip, the pilot touched down about 2m short of the designated landing threshold and subsequently the main landing tires of the aircraft hit the elevated edge of runway18, 15cm high, resulting in the left MLG assembly to weaken.

The investigation determined that due to less damping effect on the oleo or the tire, the landing impact force could have transferred up through the structure and concurrently causing the left MLG to collapse.

Following the collapsing of the left MLG assembly, the left-wing assembly dropped and hit the ground, the flap detached and began to drag on the surface creating markings. The aircraft immediately began veering left, towards the eastern edge (boundary) of the airstrip and impacted the drainage ditch adjacent to the runway where it came to rest.

3.2.1 Other factors

The investigation found noncontributing safety deficiencies. These are addressed in the factual and safety recommendations.

4 SAFETY ACTIONS AND RECOMMENDATIONS

4.1 RECOMMENDATIONS

As a result of the investigation into the accident involving P2-BWE, the Papua New Guinea Accident Investigation Commission issued the following recommendations to address safety concerns identified in this report.

4.1.1 Recommendation number AIC 22-R05/22-1001 to NASL

The PNG Accident Investigation Commission recommends that Niugini Aviation Services Limited, should ensure that an aerodrome register/guide is developed in accordance with *CAR Part 135.77 (c)* that includes the following:

1) *the aerodrome data; and*
2) *procedures for ensuring that the condition of the aerodrome is safe for that operation; and*
3) *procedures for ensuring that the condition of any required equipment, including safety equipment, is safe for that operation; and*
4) *any limitations on the use of the aerodrome.*

4.1.2 Recommendation number AIC 22-R06/22-1001 to NASL

The PNG Accident Investigation Commission recommends that Niugini Aviation Services Limited should ensure that as part of the Change Management process required in *CAR Part 100.65,* the responsible persons should identify potential safety hazards associated with new business activities or changes or introduction of new aircraft and complete a risk assessment process whenever a change in conditions or environment is planned to include projects, tasks, and events.

4.1.3 Recommendation number AIC 22-R07/22-1001 to NASL

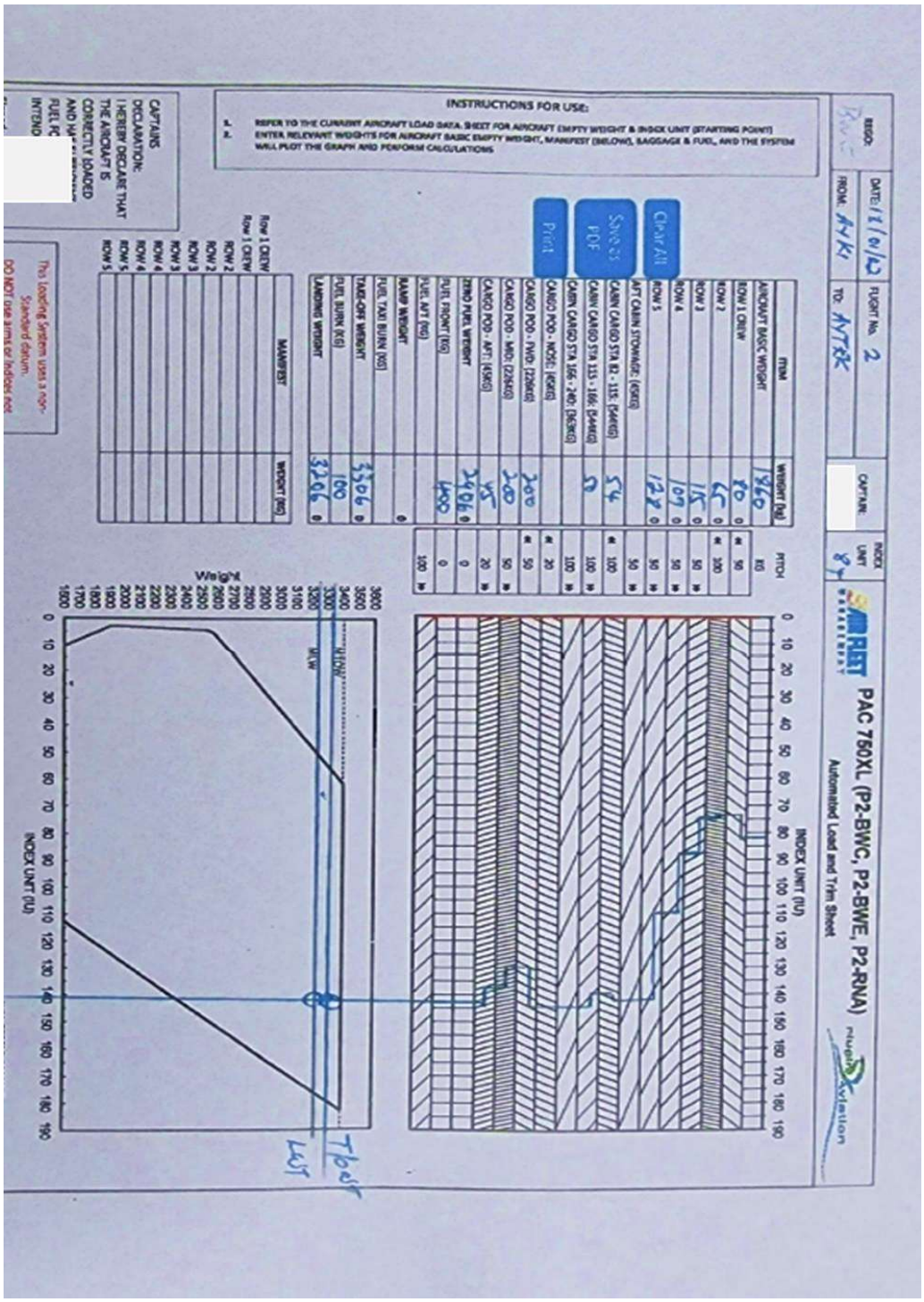
The PNG Accident Investigation Commission recommends that Niugini Aviation Services Limited should ensure that the staff are made aware of their Hazard identification and Risk Management process required by *CAR Part 100.59 and 100.61* in order to enforce implementation.

4.1.4 Recommendation number AIC 22-R08/22-1001 to NASL

The PNG Accident Investigation Commission recommends that Niugini Aviation Services Limited, should ensure that all flight crew to undergo and complete Route and Aerodrome checks to comply with their Standard Operating Procedures (SOP) and *PNG CAR Part 135.607(a)(1)(i)*.

5 APPENDICES

5.1 Appendix A: Accident flight Load and Trim Sheet



5.2 Appendix B: Maintenance reference for Servicing MLG Oleo

LANDING GEAR **12-60-00**

1. MAIN LANDING GEAR OLEO SERVICING

(1) Place aircraft on jacks

(2) Remove valve cap from inflation and place a length of plastic tubing over the threaded portion of the valve and place the free end into a container.

(3) Reduce the gas pressure in the oleo by slowly slackening the locking nut until no pressure remains.

NOTE: Some oil will exit with the gas. Repeat he process for the opposite undercarriage.

(4) If available, place a spacer 3.75" in length between the bearing retainer plate and the socket.

(5) Simultaneously lower the jacks until the MLG have compressed onto the spacers. Without spacers, compress legs until a dimension of 3.75" is achieved between bearing retainer plate and the socket.

(6) Remove the inflation valve.

(7) Place a standpipe into the aperture where the valve was removed and fill with Mil-H-5606 fluid.

(8) Replace the inflation valve with new "O" ring and torque.

(9) Connect Dry Nitrogen source to inflation valve and carefully inflate to a pressure of 100PSI (repeat for opposite side).

(10) Jack the aircraft until both main wheels are clear of the ground and inflate with dry nitrogen to 350 – 450 PSI torque locking nut, disconnect inflater and refit valve cap.

2. NOSE LANDING GEAR OLEO SERVICING

(1) Place aircraft on jacks.

(2) Remove engine cowls.

(3) Remove valve cap from inflation valve and place a length of plastic tubing over the threaded portion of the valve and place the free end into a container.

(4) Reduce the gas pressure in the oleo by slowly slackening the locking nut until no pressure remains.

NOTE: Some oil will exit with the gas.

(5) Place a spacer 5.25" in length between the bearing retainer plate and the socket.

(6) Simultaneously lower the jack until the nose undercarriage has compressed unto the spacer.

(7) Remove the lock-wire from the inflation valve and remove the valve assembly.

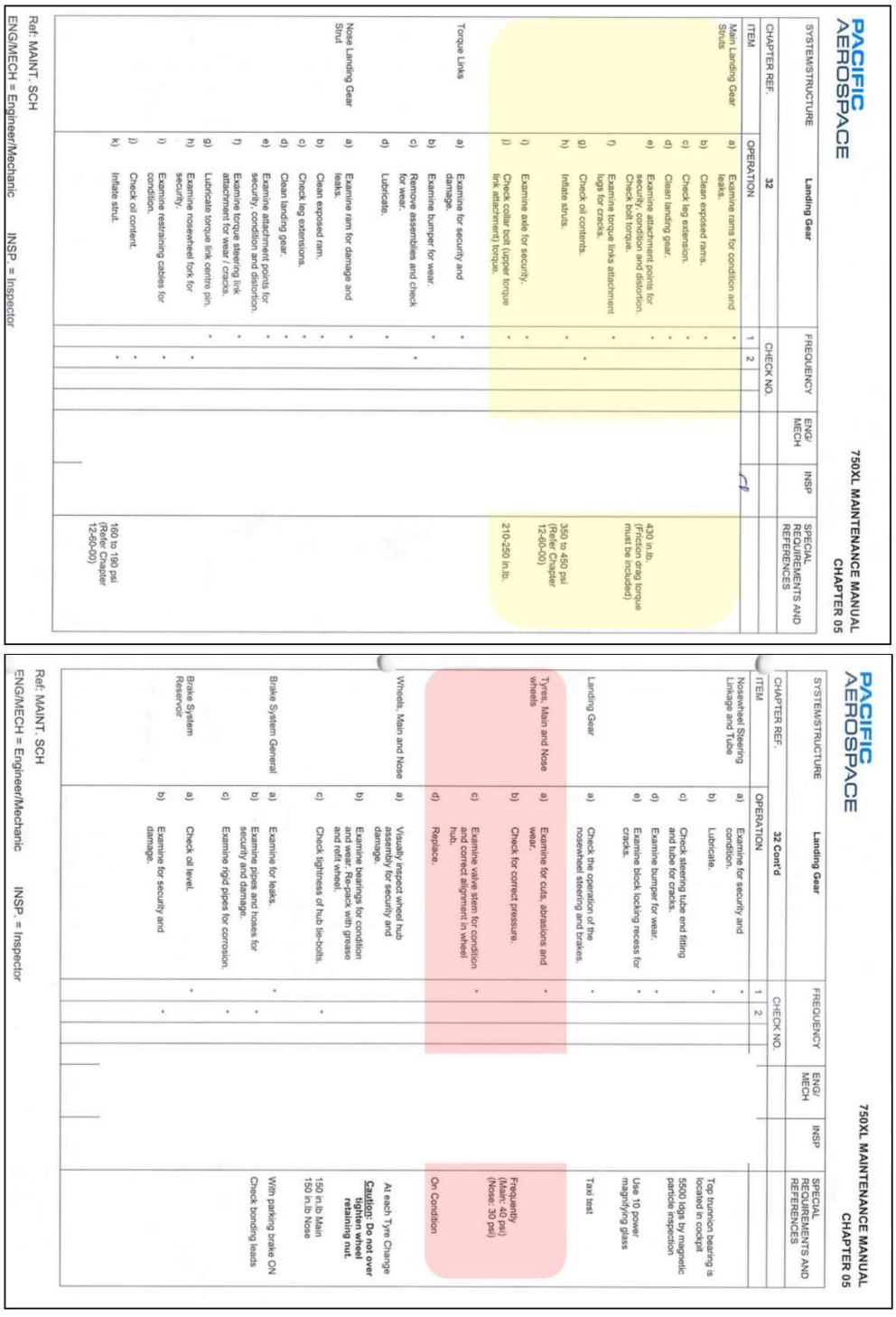
(8) Place a standpipe into the aperture where the valve was removed and fill with Mil-H-5056 fluid.

(9) Replace the inflation valve with new "O" ring, torque and lock-wire.

(10) Connect Dry Nitrogen source to inflation valve and carefully inflate to a pressure of 100PSI.

(11) Jack the aircraft until nose wheel is clear of the ground and inflate with dry nitrogen to 160 - 190 psi, until steering block is approximately parallel with the ground. Torque locking nut, disconnect inflater and refit valve cap.

5.3 Appendix C: MLG Oleo Struts and Tire Pressure Inspections



PACIFIC AEROSPACE

750XL MAINTENANCE MANUAL
CHAPTER 05

SYSTEM/STRUCTURE	Landing Gear		FREQUENCY		ENG/ MECH	INSP	SPECIAL REQUIREMENTS AND REFERENCES
CHAPTER REF.	32		CHECK NO.				
ITEM	OPERATION		1	2			
Main Landing Gear Struts	a)	Examine rams for condition and leaks.	*				
	b)	Clean exposed rams.	*				
	c)	Check leg extension.	*				
	d)	Clean landing gear.	*				
	e)	Examine attachment points for security, condition and distortion. Check bolt torque.	*				430 in.lb. (Friction drag torque must be included)
	f)	Examine torque links attachment lugs for cracks.	*				
	g)	Check oil contents.		*			
	h)	Inflate struts.	*				350 to 450 psi (Refer Chapter 12-60-00)
	i)	Examine axle for security.	*				
	j)	Check collar bolt (upper torque link attachment) torque.	*				210-250 in.lb.
Torque Links	a)	Examine for security and damage.	*				
	b)	Examine bumper for wear.	*				
	c)	Remove assemblies and check for wear.		*			
	d)	Lubricate.	*				
Nose Landing Gear Strut	a)	Examine ram for damage and leaks.	*				
	b)	Clean exposed ram.	*				
	c)	Check leg extensions.	*				
	d)	Clean landing gear.	*				
	e)	Examine attachment points for security, condition and distortion.	*				
	f)	Examine torque steering link attachment for wear / cracks.	*				
	g)	Lubricate torque link centre pin.		*			
	h)	Examine nosewheel fork for security.	*				
	i)	Examine restraining cables for condition.	*				
	j)	Check oil content.	*				
	k)	Inflate strut.	*				160 to 190 psi (Refer Chapter 12-60-00)

Ref: MAINT. SCH

ENG/MECH = Engineer/Mechanic INSP = Inspector

PACIFIC AEROSPACE

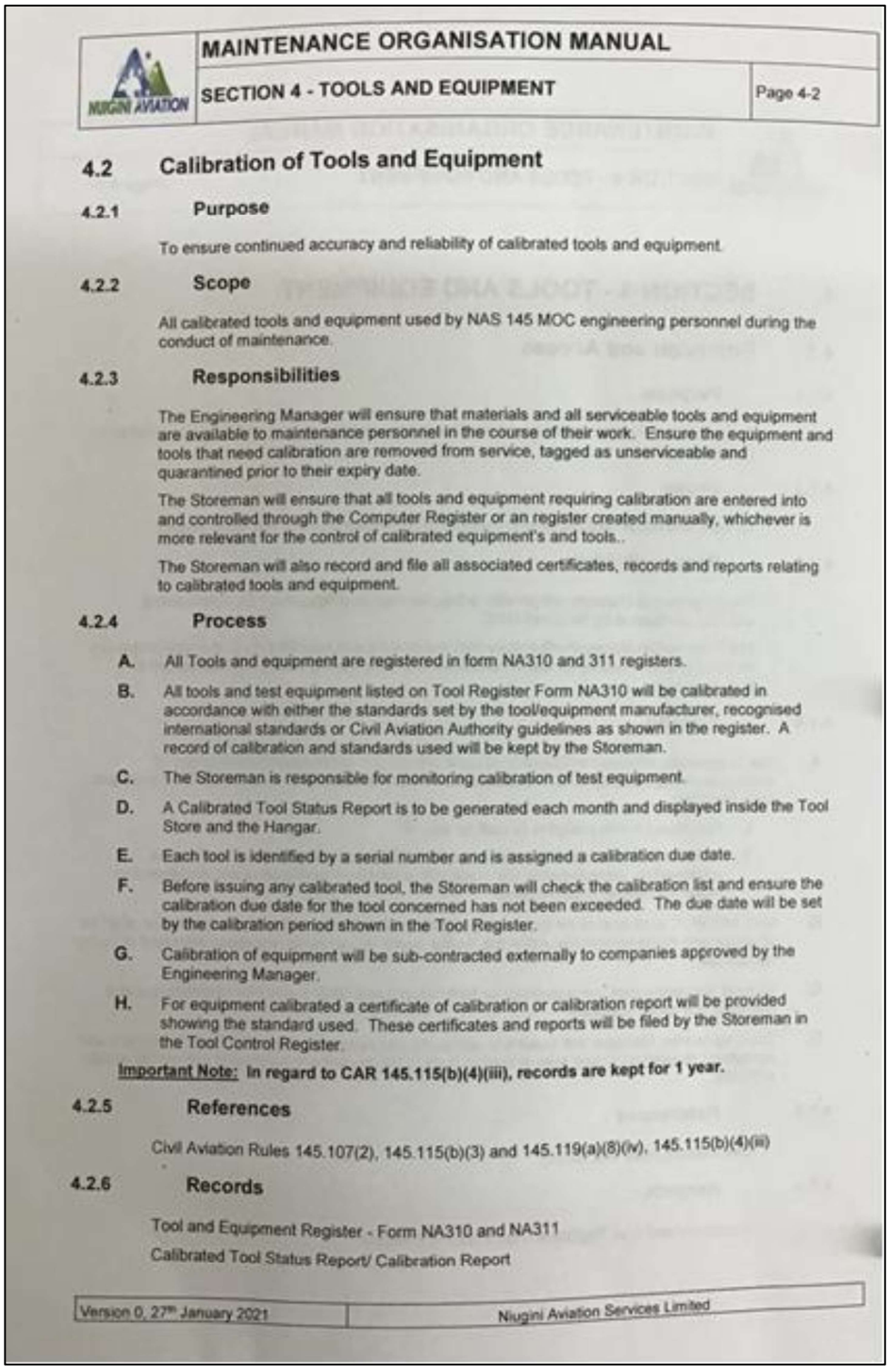
750XL MAINTENANCE MANUAL
CHAPTER 05

SYSTEM/STRUCTURE	Landing Gear		FREQUENCY		ENG/ MECH	INSP	SPECIAL REQUIREMENTS AND REFERENCES
CHAPTER REF.	32 Cont'd		CHECK NO.				
ITEM	OPERATION		1	2			
Nosewheel Steering Linkage and Tube	a)	Examine for security and condition.	*				
	b)	Lubricate.	*				
	c)	Check steering tube end fitting and tube for cracks.					
	d)	Examine bumper for wear.	*				
	e)	Examine block locking recess for cracks.	*				
Landing Gear	a)	Check the operation of the nosewheel steering and brakes.	*				
Tyres, Main and Nose wheels	a)	Examine for cuts, abrasions and wear.	*				
	b)	Check for correct pressure.					Frequently (Main: 40 psi) (Nose: 30 psi)
	c)	Examine valve stem for condition and correct alignment in wheel hub.	*				
	d)	Replace.					On Condition
Wheels, Main and Nose	a)	Visually inspect wheel hub assembly for security and damage.					At each Tyre Change **Caution: Do not over tighten wheel retaining nut.**
	b)	Examine bearings for condition and wear. Re-pack with grease and refit wheel.					150 in.lb Main 150 in.lb Nose
	c)	Check tightness of hub tie-bolts.	*				
Brake System General	a)	Examine for leaks.	*				With parking brake ON
	b)	Examine pipes and hoses for security and damage.	*				Check bonding leads
	c)	Examine rigid pipes for corrosion.	*				
Brake System Reservoir	a)	Check oil level.		*			
	b)	Examine for security and damage.	*				

Ref: MAINT. SCH

ENG/MECH = Engineer/Mechanic INSP. = Inspector

5.4 Appendix D: Operators Procedure for tool and Equipement Calibration



4.2 Calibration of Tools and Equipment

4.2.1 Purpose

To ensure continued accuracy and reliability of calibrated tools and equipment.

4.2.2 Scope

All calibrated tools and equipment used by NAS 145 MOC engineering personnel during the conduct of maintenance.

4.2.3 Responsibilities

The Engineering Manager will ensure that materials and all serviceable tools and equipment are available to maintenance personnel in the course of their work. Ensure the equipment and tools that need calibration are removed from service, tagged as unserviceable and quarantined prior to their expiry date.

The Storeman will ensure that all tools and equipment requiring calibration are entered into and controlled through the Computer Register or an register created manually, whichever is more relevant for the control of calibrated equipment's and tools..

The Storeman will also record and file all associated certificates, records and reports relating to calibrated tools and equipment.

4.2.4 Process

A. All Tools and equipment are registered in form NA310 and 311 registers.

B. All tools and test equipment listed on Tool Register Form NA310 will be calibrated in accordance with either the standards set by the tool/equipment manufacturer, recognised international standards or Civil Aviation Authority guidelines as shown in the register. A record of calibration and standards used will be kept by the Storeman.

C. The Storeman is responsible for monitoring calibration of test equipment.

D. A Calibrated Tool Status Report is to be generated each month and displayed inside the Tool Store and the Hangar.

E. Each tool is identified by a serial number and is assigned a calibration due date.

F. Before issuing any calibrated tool, the Storeman will check the calibration list and ensure the calibration due date for the tool concerned has not been exceeded. The due date will be set by the calibration period shown in the Tool Register.

G. Calibration of equipment will be sub-contracted externally to companies approved by the Engineering Manager.

H. For equipment calibrated a certificate of calibration or calibration report will be provided showing the standard used. These certificates and reports will be filed by the Storeman in the Tool Control Register.

Important Note: In regard to CAR 145.115(b)(4)(iii), records are kept for 1 year.

4.2.5 References

Civil Aviation Rules 145.107(2), 145.115(b)(3) and 145.119(a)(8)(iv), 145.115(b)(4)(iii)

4.2.6 Records

Tool and Equipment Register - Form NA310 and NA311

Calibrated Tool Status Report/ Calibration Report

5.5 Appendix E: Figure 19: Rural Airstrip accidents with its geological location