



AIRCRAFT ACCIDENT INVESTIGATION BOARD

FINAL AIRCRAFT ACCIDENT REPORT FOR A CESSNA 172M, 9J – GRO THAT OCCURRED IN MKUSHI (MASEBE RANCH), ZAMBIA ON 7th SEPTEMBER, 2021

Kenneth Kaunda International
Airport
P.O. Box 310140
Lusaka, Zambia.
Mobile: +260 971232741
Tel: +260212892357

INTRODUCTION

On 7th September, 2021, an accident involving a Cessna 172 M aircraft was reported to the Director General, Civil Aviation Authority (CAA) by Niner Julliet Logistics, who immediately relayed the information to the Aircraft Accident investigation Board (AAIB). The aircraft involved was a Cessna 172 M, National Registration Marks 9J-GRO, Manufacturer's Serial Number 172-66548, belonging to Niner Julliet Logistics, which was reported to have crashed at Masebe airstrip in Central Province.

The interim Director Aircraft Accident Investigation Board immediately constituted an investigation team comprising 4 staff pertaining to the domains of operations and engineering to travel to the accident scene.

SYNOPSIS

On September 7, 2021, a Cessna 172 M operated by Niner Julliet Logistics departed from Nkamba Bay as a chartered flight for a foreign Private Pilot's Licence (PPL) holder on a Zambian Validation to build hours to convert to a Zambian PPL. On Board were 02 pilots and 01 passenger. The aircraft made a brief stop at Mulembo airstrip before making another stop at Masebe airstrip (Masebe Ranch). Around 13:45 hours local time, the aircraft took-off and lift off was slightly before the windsock. It was at this point that one pilot realized the aircraft pitch attitude was high and the aircraft was not sufficiently climbing. Unfortunately, the aircraft was already at low altitude, with low speed and losing lift. The aircraft veered to the right where it eventually went down and crashed into the trees stopping on ground, offset from the take-off path and to the right at approximately 450 meters from the threshold of runway twenty-eight (28). The pilots and passenger evacuated the aircraft with injuries and the Masebe Ranch personnel assisted in getting them medical attention at the nearest clinic. No post-crash fire broke out. The investigation team concluded that the cause of the accident was due to Human Factors. Further, other possible contributory and latent factors were identified.

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1 FACTUAL INFORMATION

1.1 History of the Flight

On 6th September 2021, a Cessna 172 belonging to Niner Julliet Logistics, registration 9J – GRO was cleared to fly from Lusaka to Nkamba Bay via Masebe ranch in Mkushi. On board was one pilot and two 20 litre jerry cans of Avgas. The aircraft was flown to Nkamba bay where it was to be used for the purpose of a foreign PPL holder on a Zambian Validation to build hours to convert to a Zambian PPL.

On 7th September 2021, the aircraft left Nkamba Bay between 08:00-09:00 hours local time and was headed for Mulembo Airstrip in the Kasanka National Park area. On Board were two (02) pilots and one (01) passenger. At Mulembo airstrip, the aircraft made a brief stop to top up on oil. The aircraft then took-off from Mulembo for Masebe airstrip. At Masebe airstrip, the aircraft refuelled with about eighty litres of Avgas. Around 13:45 hours local time, the aircraft was set to take off from Masebe to Lusaka. According to the Pilots and witness statements, the aircraft took-off and lift off was slightly before the windsock. It was at this point that the pilot on the right seat realized the aircraft pitch attitude was high and the aircraft was not sufficiently climbing. The Pilot on the right assumed control of the aircraft and made some last-minute measures to save the situation. Unfortunately, the aircraft was already at low altitude, with low speed and losing lift. The aircraft veered to the right where it eventually went down and crashed into the trees stopping on ground, offset from the take-off path and to the right at approximately 450 meters from the threshold of runway twenty-eight. The pilots and passenger evacuated the aircraft with injuries and the Masebe Ranch personnel assisted in getting them medical attention at the nearest clinic.

Meteorological flight conditions at the point of departure were forecasted as follows:

- a) Surface wind – Moderate
- b) Temperature – Unknown
- c) Weather – Cavok (Ceiling and Visibility OK)
- d) QNH – 1020 millibars

1.2 Personnel Information

The Pilot-In-Command has a Private Pilot License [PPL (A)] issued by the South African Civil Aviation Authority with a validation from the Zambian Civil Aviation Authority. He has 53.5 hours total time logged on piston single engines.

The Safety Pilot has a Commercial Pilot License (CPL) issued by the Zambian Civil Aviation Authority. He has 1,231.15 hours total time logged out on single engines. He is rated on single engines.

Types in Group 1

- a) C 210
- b) C 208
- c) C 172
- d) PA 28

1.3 Aircraft Information

The Cessna 172 M, S/N 172-66548 is a single engine aircraft with Lycoming engine type O-320-E2D with a fixed pitch propeller. It has dual controls.

The aircraft was issued with a Certificate of Airworthiness (C of A) on 2nd September, 2021 and was confirmed airworthy.

This aircraft was not flown by other pilots during the period of the C of A.

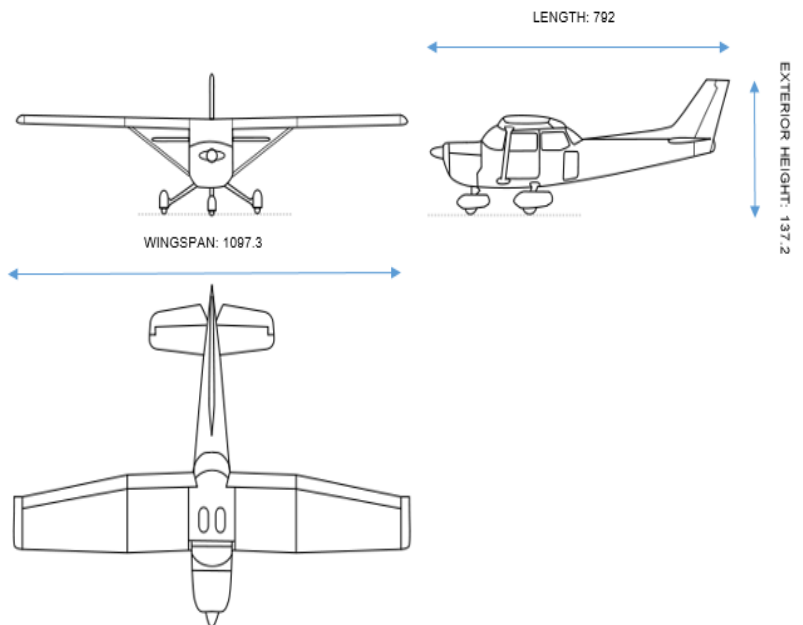
The aircraft had the following documents on board;

- | | |
|--------------------------------------|--|
| a) Certificate of Release to Service | |
| b) Flight manual | |
| c) Certificate of Reinsurance | Valid until 4 th August, 2022. |
| d) Certificate of Airworthiness | Valid until 6 th September, 2022. |
| e) Radio license | Valid |
| f) Certificate of Registration | Valid |
| g) Weight Schedule | |
| h) First Aid Kit | |
| i) Fire Extinguisher | |

The Cessna 172 M, Registration number 9J-GRO, S/N 172-66548 has the following Technical Specifications:

Exterior

- Exterior Height: 8ft 9½ in(137.2cm)
- Wing Span: 36ft (1097.3cm)
- Length: 26ft 11in (792cm)



Interior

- Cabin Height: 4ft 0In(121cm)
- Cabin Width: 3ft 6In (117cm)
- Cabin Length: 11ft10In(360cm)

Occupancy

- Crew: 1
- Passengers: 3

Operating Weights

- Max T/O Weight: 2550 Lb (1,156 kg)
- Max Landing Weight: 2550 Lb (1,156 kg)
- Operating Weight: 1666 Lb (756 kg)
- Empty Weight: 1305 Lb (592 kg)

- Fuel Capacity: 42 gal
- Payload Useful: 950 Lb (430 kg)

Range

- Max Range: 730 nm
- Service Ceiling: 13100 ft (3,993 m)

Distances

- Take off Distance: 1390 ft (424 m)
- Landing Distance: 2133 ft (650 m)

Performance

- Rate of Climb: 645 fpm (197 m/min)
- Max Speed: 123 kts (228 km/h)
- Normal Cruise: 111 kts (206 km/h)

Power Plant

Engine: 1

Type: Lycoming O-320-E2D
 Manufacturer: Lycoming
 Serial Number: L-41564-27A
 Date of Manufacture: ---
 TBO: 2000 Hrs.
 TTD: 1087 Hrs.

Propeller: 1

Type: 1C160/DTM/7553
 Manufacturer: McCauley
 Serial Number: 83347
 Date of Manufacture: ---
 Number of Blades: 2
 TBO: ---
 TTD: ---

1.4 Injuries to Persons

There were no fatalities. All on board survived the accident but the 2 pilots sustained minor injuries. They all disembarked from the aircraft.

1.5 Damage to the Aircraft

The aircraft was extensively damaged and is beyond economic repair.

- a) The Nose Section was damaged including propellers and nose landing gear was detached from aircraft. (Fig .1) and (Fig. 2)
- b) Certain portions of the instrument panel collapsed and detached. (Fig. 3)
- c) One (01) left control yoke detached from control stick/panel. (Fig. 3)
- d) The engine controls (Throttle and Mixture lever) were bent. (Fig. 3)
- e) The wings of the aircraft were damaged especially the right side wing including secondary controls surface (flap), with detached wing tip and punctured fuel tank.(Fig. 4)
- f) Damaged tail and left wing (Fig.5)
- g) The tail section was bent. (Fig. 6)
- h) The entire fuselage section had several hard points damaged due to impact with trees and the ground (Fig. 6)
- i) Windshield broken and detached from the cockpit. (Fig.7)

1.6 Meteorological Information

The meteorological information at Masebe Airstrip were as follows:

- a) Meteorological information – Clear sky, light winds
- b) Aids to Navigation – Nil
- c) Communications – Nil

1.7 Aerodrome Information – Masebe Airstrip

- | | |
|----------------|---------------------------------|
| a) Coordinates | S13° 46' 48.3" E 029° 18' 07.0" |
| b) Elevation | 4213 FT. AMSL |
| c) Length | 1082 Meters |
| d) Width | 32 Meters |
| e) Orientation | 10/28 |
| f) Surface | Gravel |
| g) ATM | Uncontrolled |

The air field has no Navigation aids and therefore landing was purely on Visual Flight Rules (VFR).

1.8 Flight Recorders

The Cessna 172 M is not equipped with a flight data recorder and voice recorder.

1.9 Wreckage and Impact Information

After clearing the tree line, the aircraft veered to the right where it eventually went down and crashed into the trees stopping on ground, offset from the take off path and to the right at a distance of approximately 450 meters from the threshold of runway 28.

1.10 Fire

There was no evidence of post-crash fire.

1.11 Survival Aspects

All on board survived the accident with 2 pilots sustaining minor injuries and disembarked from the aircraft.

1.12 Examinations (Tests and Research)

The cockpit was critically analyzed. The levers were fully forward, and flaps deployed.

1.13 Organization and Management

The PIC is a South African citizen with Zambian permanent residence. He requested Niner Juliet Logistics, an Air Operator Certificate (AOC) holder to use their aircraft to gain experience in Zambia. He wanted to come to Lusaka for a week to do local flights, get familiar with the airspace and airfields around and eventually take his Zambian PPL validation test.

1.14 Additional Information

The Investigating Team received additional information relating to this accident from the two pilots, one passenger and three witnesses who were at the airstrip.

Pilot In-Command (PIC)

On Tuesday 7th September, 2021 the PIC (P1), a Safety pilot (P2) plus one passenger flew out of Nkamba Bay Airstrip slightly after 08:00 hours local time. For the first sector from Nkamba bay to Mulembo Airstrip, P2 was Pilot-In-Command (PIC) and on this very first sector, P1 was second pilot and another passenger. He sat on the right pilot seat to familiarize with the aircraft operation, air space procedures for radio communication before he could fly the aircraft. He recounted that take off from Nkamba Bay was normal followed by a climb out to cruising flight level 080 along a desired magnetic track to their initial destination which was maintained until top of decent for their first stop at Mulembo airfield, located in the Kasanka National Park. Following descent, a normal VFR circuit entry procedure was adhered to, and a landing was completed normally at Mulembo Airstrip. After disembarking from the aircraft, no one met them at Mulembo airstrip where they stretched a bit, topped up on oil and had something to eat. Having rested a bit at Mulembo airstrip, P1 felt confident enough to take control of the Aircraft from P2. With P1 at the controls as PIC, they later started up and taxied the aircraft to back track and took off from Mulembo airstrip normally around midday, proceeding into climb out to cruising flight level 075 which was maintained as cruising flight level along the desired magnetic track. During this second sector, he was assisted by the right seat pilot (P2) particularly over radio communication procedures, noticing radio communications procedures as expected with Lusaka area control as well as required radio check-in through the flight. At top of decent for landing into Masebe airstrip, the aircraft was descended to lower circuit altitude of about 5300ft and an approach was completed following unmanned airfield VFR procedure which required a field inspection overhead followed by a right down wind circuit pattern for runway 10. The final approach and landing was completed

normally after which the aircraft was brought to a stop from a landing roll. The aircraft was then parked on middle section of the airstrip reserved for parking aircraft.

At Masebe airstrip they stopped for about 30-45 minutes and filled the aircraft fuel tanks with about eighty litres of Avgas fuel. He stated that both P2 and himself physically checked the fuel tanks by finger dipping and determined they had fuel level above half in both tanks as confirmed by the fuel gauges. He also stated that he did a pre-flight inspection and at his request also asked P2 to do an extensive pre-flight inspection. They boarded the aircraft, started up and taxied down towards the western side of the airstrip to the very end of runway 28 to position at threshold and turned back around to line up for a runway 10 departure. He also observed the windsock that there was a moderate wind blowing down the runway. He further said, "I remember taking specific care to be dead centre on the runway." Once there, he held the aircraft on brakes, with no flaps, released the brakes and advanced the throttle gradually fully forward proceeding into a take-off run down on runway 10. He remembered that at about 60 knots, he rotated the aircraft normally and the lift off was normal, although a short while after lift-off, the aircraft seemed to be climbing out normally although it appeared as though the aircraft was not climbing out sufficiently as he noticed that they were below the treetops at the end of the runway which were fast approaching. During this initial climb out, P2 asked for control as was discussed at Nkamba Bay airstrip between the two pilots. When the aircraft approached close to the tree line, P1 realised that they were too close and slightly below the tree line tops. As the aircraft was about to clear the tree line P2 said that they were not going to make it and likely going down. P1 looked back at the passenger and screamed "we are going down, hold on!" He then turned forward to observe what was going on and remembers that P2 mentioned something about flaps. According to P1 the aircraft narrowly cleared the trees, but it was apparent that the aircraft was not gaining sufficient altitude. He remembers hearing the stall warning as the aircraft hit the treetops, impacting with trees and the aircraft finally came to a stop on the ground beneath the trees. He quickly realized that they had crashed and instinctively checked if everyone was okay. He could smell avgas and the engine was off. At this point himself and other occupants struggled a bit but managed to evacuate using the left side door of the aircraft. As he egressed the aircraft wreckage, he realized that he had sustained injuries to his right hand and right leg causing an extensive loss of blood which was slowly affecting his consciousness. The passenger helped him control the bleeding by bandaging the open wounds with cloth.

Safety Pilot (P2)

On Tuesday 7th September, 2021 himself, another pilot (P1) plus one passenger flew out of Nkamba Bay Airstrip slightly after 08:00 hours local time. P2 was Pilot-In-Command (PIC), P1 was second pilot and a passenger. He sat on the left pilot seat as PIC to assist P1 seated on the right pilot seat to familiarize with the aircraft operation, air space and radio communication before P1 could fly it. Take off from Nkamba Bay was normal followed by a climb out to cruising flight level 080 which he

maintained along the planned track until top of decent for their first stop at Mulembo airfield located in the Kasanka National Park, following the unmanned airstrip VFR procedure, a landing was completed normally. They found no one at Mulembo airstrip, stretched a bit, topped up on oil and had something to eat. At Mulembo airstrip, P1 told P2 that he was confident enough to take control of the aircraft. P1 was the PIC, while P2 was the safety pilot when the aircraft was manoeuvred for take-off. P1 operated the aircraft after lining up into a take-off run, lift off, initial climb out to cruising flight level 075 which was maintained throughout along the planned desired track. During this flight, P2 was not on the aircraft controls but gave advice to P1 over radio communication, interpretation of the navigation scenario and radio communications with Lusaka control where it was a requirement as normal Lusaka area control check-in. At top of decent for landing into Masebe, a descent was completed, and an unmanned VFR airstrip inspection procedure was completed observing a circuit altitude of 5300ft using area QNH of 1020mbs, an approach was executed by P1 as per VFR procedure which required airfield inspection overhead at an altitude of about 5300ft. A right down wind circuit pattern for runway 10 was observed. P1 operated the aircraft into final approach and a landing completed normally. The aircraft was brought to a stop from a landing roll and later parked on middle portion near the windsock of the airstrip reserved for parking aircraft.

P2 described the landing at Masebe as "a little bit sketchy." Whilst on ground, he suggested that they refuel based on his knowledge of the Cessna 172 endurance of 5 hours bearing in mind that they had already flown 4 hours. Personnel from Masebe ranch arrived with fuel to top up the aircraft. They then proceeded to refuel with 40 litres in each tank. He stated that he could not find the dip stick to measure the fuel level and hence decided to use a method he learned in flight school by dipping a finger to touch the fuel. He stated that before take-off he had mentioned the need to consider their current weight considering his analysis that the aircraft was underpowered.

Upon completion of refueling procedure, they were ready to depart. P1 boarded the aircraft, and taxied down towards the western side broadcasting their intentions. At the very end of runway 10 the aircraft was turned around. He had also noticed that there was a moderate wind blowing down the runway.

Once positioned at threshold of runway 10 for take-off, he said that it was moderately windy with a slight crosswind. Before the take-off he had brief discussion with P1 about abort procedure during take-off when appropriate. P2 also said that he felt uncomfortable assuming control of the aircraft mid-way because of the obstacles. He also stated that "P1 put full power on brakes, short field technique" and they started rolling with flaps selected at 10 degrees. During the take-off run the aircraft was rotated at about 65 knots and about the same time he looked out and waved at the farm worker who had remained behind to watch them take-off. It was at this point that he noticed the "pitch attitude of the aircraft was a bit high." He immediately looked at the airspeed indicator which registered an airspeed of about 60 knots. P2 reminded P1 about their emergency briefing at Nkamba Bay. Upon observing P1's take-off path ahead, he

realized that P1's forward perception was causing him to pull back more on the control yoke. Looking ahead at the tree line, he felt the aircraft was underpowered by this high pitch attitude. They immediately adopted a low aircraft pitch attitude to gain some forward air speed, but the tree line was fast approaching, and it was at this point that P1 handed over the controls, more or less letting go of the control column. Seeing the tree line coming up fast ahead, he looked at the airspeed indicator which registered about 55 knots which compelled him to extend flaps fully down and this action was followed by the aircraft ballooning over the tree tops. He knew that it was a temporal measure as the aircraft eventually lost altitude going down but was hoping to see a clear spot to drift down into a forced landing. Looking around, he noticed one tree that stood out and turned the aircraft towards the right and let the airplane descend below the treetops into the woods. He states that the stall warning came on for a few seconds before the aircraft eventually impacted onto the trees and finally coming to rest on the ground in the wooded area. He realised that they had crashed and at the same time got the smell of avgas and heard the fuel leaking from tanks. He also noticed that his adjacent right-side door was jammed. He also observed that the engine and propeller were not running. He also realized that he had sustained injuries on his nose and left leg causing an extensive loss of blood. Even though he bled profusely, he remained conscious being aware of his environment and after crash actions. Having successfully evacuated from the aircraft wreckage with the other two (02) occupants, he remembers seeing a helper from the farm who appeared from the woods and lead him and others towards the road to catch a vehicle arranged to take them to the clinic. Upon reaching the vehicle on the roadside, one of the farm workers reported that the aircraft was still producing some sound. P2 went back to the crash site and turned off the master switch and removed the keys from the ignition switch. He left with others to seek medication from nearest clinic which was about 40 minutes away.

Passenger

On that morning, they took off from Nkamba Airstrip at sometime between 08:00-09:00 hours local time. Everything was normal and she took a nap as she listened to music through her headsets. Between 12:00 hours and 13:00 hours local time, they landed at Mulembo airstrip for a brief time. They found nobody there, took a bathroom break and took off again. Later, they came in to land at Masebe airstrip at around 13:30 hours local time with everything seemingly very normal. They were then met by a car with two (02) people in it who helped them refuel. She sat somewhere under the wing and had a snack as this was being done. They then got back into the aircraft where she put on her headsets before take-off. After take-off everything seemed normal except, they were not climbing fast. They turned to the right and climbed over the tree line but were not going any higher. She thought they were having a look around the farm until she saw P1 turn around, look at her and saw the panic in his eyes. It was seconds later that she saw the trees coming fast towards them as the aircraft was not sufficiently high enough. The aircraft then hit the trees, at which she heard a lot of noise and in no time, they were nose down on the ground. She then heard P2 say,

“everyone out of the plane.” She quickly unclipped her seatbelt, abandoned her things, got out after P1 and P2 followed. She noticed that fuel was leaking out of the right wing. After evacuating the aircraft, they all sat down to catch their breath, she stated that she was worried about P1’s bleeding. P2 went back to the aircraft to collect the first aid kit. When they heard the sound of vehicles, they began to shout for help. It took about thirty (30) minutes for one of the farm workers to locate them. After being found, she went back to the aircraft to collect her things. They were then taken to the nearest clinic which was 45 minutes away.

Witness Statements

Witness (01)

The Aircraft landed on 7th September 2021 slightly after 13:00 hours local time at Masebe Ranch, where he was expecting it in order to refuel the aircraft for its departure to Lusaka. In the aircraft were 3 people. After arrival of the aircraft, it was refueled with about 80 litres which filled both the tanks. He waited as they inspected the aircraft before its departure. At approximately 13:45 hours local time, the aircraft began to move down the runway in order to line up for take-off. The wind at the time was calm. He then stood at the windsock waiting for the aircraft to depart. About 5 minutes later, he heard the sound of the aircraft as it was moving along the runway. The aircraft took off slightly after the pine trees but before the windsock. The aircraft looked as though “it was climbing slowly.” After passing the windsock “it was a little bit low but began to climb out slowly until it was almost a meter above the trees.” A few minutes later he heard a big sound and could no longer see the aircraft. He immediately called the farm manager on radio to inform him of what had happened. He then went toward where the aircraft could have been thinking that he could have by passed it being in a wooded area. On his way back he met the farm manager on a motorbike who decided to go into the wooded area to look for the aircraft.

Witness (02)

On that day, he states that he received a report that an aircraft had crashed from his friend Witness (01), who was at the airstrip. He immediately contacted Witness (03) who had a motorbike. When he arrived, he found both Witness (01) and Witness (03) trying to locate the accident scene. He initially by passed it but without delay turned back towards the area thought to have been the accident scene within the woods. Upon arrival, he found one (1) woman and (2) men being escorted out of the wooded area. After seeing their condition, he quickly instructed Witness (01) to go and pick up a vehicle that could easily ferry the 3 persons to a nearby clinic. After the victims were taken to the clinic he kept communicating with Witness (01) for updates on their condition.

Witness (03)

On Tuesday at around 13:50 hours local time, he received a call from Witness (02) that an aircraft which came for refueling had crashed. He quickly got on his motorbike and rushed toward the airstrip. He then called Witness (02) to find a precise location of where the aircraft could be and was told around Dam 4 or Mpongo road area. He then went to Dam 4, parked his motorbike, and began to search the wooded area. Not before long, he heard cries for help. He then picked up his radio and contacted Witness (02) to quickly organise people to patrol the area and find the distressed persons. He continued to move in the wooded area until he saw the aircraft from a few meters away. Upon arrival at the accident scene, he found all 3 victims. They had evacuated the aircraft and had carried out a few first aid measures with 1 person bleeding profusely from the nose area. He took hold of the victim bleeding from the nose first and led him to the roadside where a vehicle was awaiting to ferry all victims to the nearest clinic. He came back and helped the other 2 passengers and carried off their luggage. About 15 – 20 minutes later, he went back to the aircraft to collect the remaining luggage and noticed that the aircraft was still producing some sound from running components. The victim who was bleeding from the nose then returned to the aircraft to turn off the power. Himself, the other farm worker, and the bleeding victim then went back to the roadside and all the victims were taken to the clinic.

2. ANALYSIS

2.1 Crew Resource Management

The Crew Resource Management (CRM) component reveals that the cockpit gradient was slightly steeper with P1 on the lower side and P2 on the higher point.

Clearly due to lack of experience P1 exhibited less authority over the conduct of the flight as PIC.

P2 was equally not authoritative enough as Safety Pilot in that he was equally only expecting to be Safety Pilot from Nkamba bay all the way to their planned final destination in Lusaka.

Even though P2 was relatively experienced on Cessna 172, his CRM abilities were challenged by stress of helping an inexperienced pilot.

2.2 Flight Planning

The interview revealed that one pilot (P2) had completed adequate route and trip planning for this entire exercise with all flight plans having being properly filed with Zambia Airports Corporation Limited (ZACL) Air Traffic Navigation Services (ATNS).

The fuel planning by P2 was ideal for bush flying requirements and the rule of thumb estimates is accepted where the aircraft is normally operated within the range cruise settings.

2.3 Safety

It was also revealed that P2 accepted to fly two (02) containers amounting to 40 litres of Avgas on the back seat of the aircraft flown from Lusaka to Nkamba Bay not conforming to ZCARs Part 9, ICAO Doc 9282 Technical Instructions for the Safe

Transport of Dangerous Goods by Air and IATA Dangerous Goods Regulations. Both P2 and P1 accepted to fly with dangerous goods from Nkamba bay to Masebe airstrip.

2.4 Maintenance

The aircraft was fully serviceable with a valid C of A, except P2 noticed that the aircraft was slightly underpowered compared to other Cessna 172s that he had previously operated in the past.

2.5 Weather

The weather was relatively clear skies in Haze through with moderate westerly winds and nearest area QNH being 1020mbs.

The temperature was not recorded but it was normal daytime temperature ranges for September 2021.

2.6 Observations by the Investigation Team

Accident causalities.

The accident scene was at Masebe Airstrip and following the account of the two Pilots we deduced the following:-

- a) Take off run – The take-off run at Masebe airstrip runway 10 was executed in the proper runway direction as per observed wind from the windsock.
- b) Flap Setting as mentioned by P2 could have been selected at 10 degrees setting.
- c) The lift off point for the aircraft was way ahead before the location of the windsock which was closer to the threshold of runway 28.
- d) The description of the aircraft not sufficiently climbing out after liftoff could have been as a result of :-
 - flap setting at 10 degrees which caused an early lift off at low speed
 - aircraft lift off was early but high pitch attitude as observed by P2 prevented an advantage of accelerating within the ground effect, by account of both pilots, aircraft attitude was not sufficiently low to allow air speed build up in ground effect (Principles of flight).
- e) As the aircraft approached the tree line with insufficient speed reported to be about 55kts, flap was extended to full flap setting. This action resulted in the wings extending the boundary layer upwards, pushing the lift vector higher and also moving the centre of pressure back away from the centre of gravity. This action caused an increase in drag corresponding to a high angle of attack. The thrust component remained more or less constant creating unequal forces on the aircraft wings. The lift vector was at the point acting in equilibrium with the weight vectors but drag was greatly higher than thrust. The resultant was a twist on the wing centre of gravity downwards as result of moments between the Centre of Pressure (CP) and pointing upward and forward along the chord against the centre of gravity pointing downwards and backwards along the chord.

The high downwash caused by a full flap setting then further increases the angle of attack in reference to the relative airflow towards the critical angle of attack. The final result is boundary layer separation as the CP further moves up on the chord.

This scenario explains why the aircraft balloons after selection of full flaps followed by sound of the stall warning leading into a loss of lift as the wings stall just above the tree top. At this point the aircraft state was undesirable for a stall recovery technique.

The aircraft acceleration into the trees was increased by a running engine at take-off thrust. The impact with trees caused a pitch down attitude, with the propeller assisting the acceleration of motion towards the ground. The impact of this acceleration was cushioned by wings and tail which resulted in the aircraft impacting the ground at reduced speed. This resulted in the bending of both wings backwards especially the right wing, break up of right wing fuel cell and bending of aircraft nose.

Furthermore, this resulted in the bending of propeller, separation of nose wheel from aircraft fuselage, bending and curling of main landing gear, brake up of windshield, separation of control yoke, bending of instrument panel and curling out of firewall, jamming of right door on impact, bending of fuselage in many sections including curling to the left of tail plane.

- f) Both Pilots accepted to fly two (02) containers of 20 litres of Avgas on the back seat of the aircraft flown from Lusaka to Nkamba Bay not conforming ZCARs Part 9 9.6.1.2 (a), ICAO Doc 9282 Technical instructions for the Safe Transport of Dangerous Goods and IATA Dangerous Goods Regulations.

3. CONCLUSION

The cause of this accident from submitted reports and all related documentation gathered, indicate that this aircraft was mishandled on entire take off process out of Masebe airstrip. The aircraft was operated by inexperienced pilots whose actions caused a loss of critical airspeed after liftoff. This critical airspeed required after liftoff was not achieved as a result of flap 10 degrees for take-off. This flap setting caused the aircraft to fail to gain sufficient airspeed required to generate sufficient lift for a safe climb attitude to safely clear the tree line at Masebe airstrip. As the aircraft was struggling to climb sufficiently, the selection of full flaps sealed the fate of this aircraft.

Human Factors is the cause of this accident mainly due to both organizational arrangements put in place prior to the flight on pilot currency requirements and unfamiliarity with unpaved runway take off procedures as exhibited in both pilot written submissions.

The investigations team notes that both pilots were not current as clearly there is no record of supervised training by a CAA authorized instructor as prescribed by ZCARS 1.1.3.6 (b)(3)(i)(ii) and ZCARS 1.1.3.6 (b)(4).

4. SAFETY RECOMMENDATIONS

The Investigation Team recommends the following;

4.1 To Niner Juliet Logistics

AAIB/SR/2022/009

Niner Juliet Logistics management is recommended to ensure that for future operations on Cessna 172 aircraft or similar aircraft class ratings, both pilots to

undergo minimum flight training skills test with a qualified instructor to include take off and landings from unpaved air strips in accordance with ZCARS part 2.

AAIB/SR/2022/010

Niner Juliet Logistics management is recommended to put in place adequate quality control measures to ensure that training programs conform to ZCARS Part 1.

4.2 To the Civil Aviation Authority

AAIB/SR/2022/011

The Civil Aviation Authority is recommended to carry out an ad-hoc audit of Niner Juliet Logistics quality control measures to ensure that training programs conform to ZCARS Part 1.

AAIB/SR/2022/012

The Civil Aviation Authority is recommended to promote awareness and continue enforcement of Dangerous Goods regulations (onboard the aircraft) to Pilots and Operators.

AAIB/SR/2022/013

The Civil Aviation Authority is recommended to engage the Government and fuel marketing companies to work out modalities on fuel accessibility to Operators in remote areas not covered by the fuel marketing companies as a long term measure.



Fig .1: Nose Section and Propellers Damaged



Fig. 2: Nose Landing Gear Detached from Aircraft



Fig .3: Instrument Panels Collapsed and Detached, One (01) Left Control Yoke Detached from Control Stick/Panel, The Engine Controls (Throttle and Mixture Lever) Bent



Fig. 4: Wings and Secondary Control Surface (Flap) Damaged, Detached Wing Tip and Punctured Fuel Tank



Fig. 5: Damaged Tail and Left Wing



Fig. 6: Tail Section Bent



Fig. 7: Broken Windshield

APPENDIX A – GLOSSARY

AAIB – Aircraft Accident Investigation Board
AOC – Air Operator Certificate
ATNS – Air Traffic Navigation Services
ATPL – Airline Transport Pilot Licence
CAA – Zambia Civil Aviation Authority
CAVOK – Ceiling and Visibility OK
CPL – Commercial Pilot Licence
CRM – Crew Resource Management
Ft – Feet
Ft/m – Feet per minute
Hrs – hours
IATA – International Air Transport Association
IAS – Indicated Air Speed
Kg – kilograms
KKIA – Kenneth Kaunda International Airport
Kts – Knots
Lb – Pounds
M – Meters
MTOW – Maximum Take Off Weight
NM – Nautical Miles
PIC – Pilot in Command
PPL – Private Pilot Licence
TBO – Time Before Overhaul
TTD – Total Time Done
UTC – Universal Time Coordinated
VFR – Visual Flight Rules
ZACL – Zambia Airports Corporation Limited
ZCARs – Zambia Civil Aviation Regulations