AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

			Reference:	CA18/2/3/9622	
Aircraft registration	**ZS-IGY**	**Date of accident**	26 May 2017	**Time of accident**	1000Z
Type of aircraft	Beagle B121 (Aeroplane)		**Type of operation**	Private (Part 91)	
Pilot-in-command licence type	Airline Transport	**Age**	29	**Licence valid**	Yes
Pilot-in-command flying experience	Total flying hours	3 144.1		Hours on type	157.1
Last point of departure	Springs Aerodrome (FASI), Gauteng province				
Next point of intended landing	Springs Aerodrome (FASI), Gauteng province				
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)					
Tafelkop Mountain near Wakkerstroom (GPS position; 27°16'30.63" South 030°16'24.31" East); elevation of 6 920 feet (2 110m) above mean sea level (AMSL).					
Meteorological information	Wind; 250°/28 knots, Temperature; 20°C, Visibility; + 10km				
Number of people on board	1 + 1	**No. of people injured**	2	**No. of people killed**	0

Synopsis

The pilot, accompanied by a navigator participated in the Presidents Trophy Air Race (PTAR). They took off from Springs aerodrome (FASI) on day one of the race with the intention to land back at FASI. The first turning point in the race was at the Piet Retief aerodrome (FAPF) when they flew over the marked location (brightly coloured gazebo) seven minutes ahead of their calculated time. They then turned right onto a heading of 259° towards the town of Wakkerstroom, where the second turning point of the race was. Due to mountainous terrain ahead they opted to fly to the right of the map track (direct line between the two points). The official weather forecast for the area was strong winds from the southwest, which they did encounter. As they approached Tafelkop Mountain, the pilot decided to climb and fly over the mountain but the airspeed started to decay rapidly as they got closer to the mountain. The aircraft was unable to maintain altitude and the pilot took evasive action by turning left, but the aircraft impacted with the mountain side. Both occupants were airlifted from the accident site via two air ambulance helicopters and were taken to a private hospital in Gauteng. The pilot was seriously injured, and the navigator sustained minor injuries.

Probable cause

The climb performance of the aircraft was not able to overcome the strong downdraught on the leeward side of the mountain, and during an attempted evasive manoeuvre by the pilot the aircraft impacted with terrain.

SRP date	12 September 2017	Release date	19 September 2017

AIRCRAFT ACCIDENT REPORT

Name of Owner	: DM Finch
Name of Operator	: Private (Part 91)
Manufacturer	: Beagle Aircraft Ltd
Model	: B121
Nationality	: South African
Registration markings	: ZS-IGY
Place	: Tafelkop Mountain near Wakkerstroom
Date	: 26 May 2017
Time	: 1000Z

All times given in this report are Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.

Purpose of the Investigation:

In terms of Regulation 12.03.1 of the Civil Aviation Regulations (2011) the purpose of investigation of an aircraft accident or incident is to determine, in terms of the provisions of this Part, the facts of an accident or incident in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents, and ***not to establish blame or liability****.*

Disclaimer:

This report is produced without prejudice to the rights of the CAA, which are reserved.

1. FACTUAL INFORMATION

1.1 History of flight

1.1.1 The pilot, accompanied by a navigator took off from Springs aerodrome (FASI) at 0826Z on Friday morning, 26 May 2017, in order to participate in the Presidents Trophy Air Race (PTAR). The first turning point was at Piet Retief aerodrome (FAPF). They flew at 7 000 feet where after they commenced with their descent 10 minutes prior to Piet Retief at 200 feet per minute in order to cross overhead at 5 000 feet as required by the race rules. The navigator indicated that they arrived over FAPF seven minutes ahead of their planned time, which indicated that they had a substantial tail wind component on the sector. Their planned time for the sector was calculated to be 64 minutes.

1.1.2 Once they arrived overhead FAPF, they turned right onto a heading of 259° towards Wakkerstroom, which would have been their second turning point. The pilot and navigator then made a decision to go to the right of their planned route in order to avoid the mountainous terrain ahead. They also discussed the possibility of turbulence as strong winds were coming over the mountains, as the forecast winds in the area being from the west. It was at this stage, that they opted to tighten their seatbelts (four point safety harness) in anticipation of the turbulence to be encountered. The navigator indicated that he also removed his sunglasses at this stage in order to avoid any possible injury it might cause.

1.1.3 Not flying via the planned route, the navigator was most of the time with his head down on this sector in order to map read. En route, the navigator could see Tafelkop Mountain ahead as their track took them directly towards the mountain, he was unsure if they were going to fly around it to the left, or the right at that point in time. The pilot then started to climb but as they got closer to the mountain, it was decided that the saddle between Tafelkop and the peak to the right would put them on track for Wakkerstroom. They decided on an escape path, in case they were not going to clear the high ground, which was a left turn down the valley to the north of Tafelkop Mountain. The navigator then proceeded to look at the map for navigation points on the southern side of the mountain. He recalled that he looked up with some distance before they had to clear the mountain and noted the saddle some distance away. As he looked at the instrument panel the airspeed indicator showed 110 miles per hour (mph) with a zero vertical speed indication (VSI). He then proceeded with map reading, but when he looked up again, he noticed the saddle was above them and the airspeed indication showed 80 mph with the VSI displayed a rate of descent of between 300 to 400 feet per minute, *"it was apparent we were in a very strong downdraught."*

1.1.4 The pilot ~~the~~ then raised the nose of the aircraft in an attempt to clear the saddle ahead, but the aircraft continued to descend~~t~~. He then executed a left turn down the valley, as discussed but it became apparent that a ridge ahead on the mountain was now sticking out, which was an obstacle. The pilot then opted to turn the wings level before the aircraft impacted with the side of the mountain. The aircraft came to rest in an upright position in a substantial left wing low attitude. The left door unlatched during the impact sequence and both occupants were able to evacuate the aircraft via the open door.

The pilot sustained serious injuries (spinal injury) and also suffered from a laceration to his chin. He managed to get his cell phone which was in a sealed bag as per the race rules. Once clear of the aircraft wreckage he phoned the air traffic controller (ATC) that was on duty at FASI and advised him of the accident. The ATC in turn advised the aeronautical rescue coordination centre (ARCC) who activated the necessary resources to rescue the two occupants. The first person to locate them was a paramedic from the local emergency services who climbed up the mountain. Two emergency medical services (EMS) helicopters were also dispatched to the scene, and both occupants were airlifted to a private hospital in Alberton.

1.1.5 Both occupants that were on board the aircraft at the time of the accident were interviewed. A mechanical malfunction as a probable cause or contributed factor to this accident was ruled out as they indicated that the engine functioned normally throughout the flight.

1.1.6 The accident occurred during daylight conditions at a geographical position that was determined to be 27°16'30.63" South 030°16'24.31" East at an elevation of 6 920 feet (2 110m) above mean sea level (AMSL). The highest point of the Tafelkop Mountain was approximately 7 242 feet (2 208m).

1.2 Injuries to persons

Injuries	Pilot	Crew	Pass.	Other
Fatal	-	-	-	-
Serious	1	-	-	-
Minor	-	1	-	-
None	-	-	-	-

1.3 Damage to aircraft

1.3.1 The aircraft was destroyed.

Figure 1: The aircraft as it came to rest on the side of the mountain

1.4 Other damage

1.4.1 No other damage was caused.

1.5 Personnel information

1.5.1 Pilot-in-command

Nationality	South African	Gender	Male		Age	29
Licence number	0272276312	Licence type	Airline Transport			
Licence valid	Yes	Type endorsed	Yes			
Ratings	Instrument rating					
Medical expiry date	31 December 2017					
Restrictions	None					
Previous accidents	None on record					

Flying experience:

Total hours	3 144.1
Total past 90-days	195.2
Total on type past 90-days	4.6
Total on type	157.1

1.6 Aircraft information

1.6.1 The Beagle B121 is a single-engine low-wing aircraft and was manufactured in the United Kingdom and first flew in 1967. According to available information only 175 of these aircraft were manufactured.

Figure 2: A photograph of the aircraft ZS-IGY (sources from the internet)

Airframe:

Type	Beagle B121 (Pup)	
Serial number	B121-112	
Manufacturer	Beagle Aircraft Ltd	
Year of manufacture	1968	
Total airframe hours (at time of accident)	1 759.7	
Last MPI (hours & date)	1 756.8	21 April 2017
Hours since last MPI	2.9	
C of A (issue date)	23 April 1979	
C of A (expiry date)	22 April 2018	
C of R (issue date) (present owner)	14 May 2015	
Operating categories	Standard Part 91	

Engine:

Type	Lycoming O-320-A2B
Serial number	L-23972-27A
Hours since new	1 759.7
Hours since overhaul	TBO not yet reached
Engine power	150 horse power (HP)

Propeller:

Type	Sensenich 74DM6S5-D-60
Serial number	K29557
Hours since new	1 759.7
Hours since overhaul	TBO not yet reached

1.6.1 Weight and balance

The pilot was accompanied by a passenger/navigator on this flight. A weight and balance calculation was conducted prior to take-off from FASI and the maximum take-off weight was determined to be 867 kg, which was 6 kg below the maximum take-off weight for the aircraft according to the approved flight manual page 2-1. At the time of the accident they had been airborne for approximately one hour and twenty minutes. At the time of the accident a substantial amount of fuel had been burnt off since they became airborne.

1.7 Meteorological information

1.7.1 The weather information entered in the table below was obtained from the pilot questionnaire.

Wind direction	240-270°	Wind speed	26 knots	Visibility	Good
Temperature	20°C	Cloud cover	Nil	Cloud base	Nil
Dew point	unknown				

1.7.2 An official weather report was obtained from the South African Weather Services (SAWS).

A special weather forecasts was made available for the Presidential Trophy Air Race on the 26 May 2017 by the SAWS.

Weather Forecast

This is an official aviation forecast for 26 May 2017 over the route (Springs-Piet Retief-Wakkerstroom-Springs). The forecast is provided by Aviation Weather Centre at the South African Weather Service (situated at OR Tambo International Airport):

A cool to cold morning with minimum surface temperatures expected to reach 3-4°C at 05:00 over the Springs Airfield. There is a low level inversion sitting at around FL058-060 (5800-6000 feet), with wind at and above this level expected to reach speeds of 15-18 knots and mostly have a direction of 270°.

Over the southern Mpumalanga Highveld, the early morning minimum temperatures will be around 5-6°C, with the low level inversion being much stronger in this area. Relatively weak surface winds (6-7 knots) early morning will gradually pick up to 10-15 knots over Piet Retief and 15-20 knots at Wakkerstroom from 08:00 UTC until 15:00. The main winds directions would be from the west/southwest. The general winds above FL065 up to FL100 will be above 20 knots, reaching even 30-35 knots over the south-eastern Mpumalanga Highveld.

Severe low level turbulence up to FL075 over Springs and moderate up to FL090; severe turbulence up to FL090 over the rest of southern Mpumalanga until 11:00. After 11:00 the winds calms down a bit and the turbulence become light to moderate until 16:00 UTC, after which severe turbulence into the evening.

NO CLOUDS for the day.

	WAKKERSTROOM
Temperature (surface)	Min: 05°C Max: 19°C
Surface Winds (until 08:00)	260° / 10kts
Surface Winds (from 08:00)	260° / 15 kts Gust: 18 - 25 knots
Weather (until 11:00)	Severe turbulence below FL090
Weather (until 16:00)	Moderate turbulence below FL090.
Weather (after 16:00)	Moderate-Severe turbulence below FL095
Clouds	None

Wind Forecast

*This was an official wind forecast for **26 May 2017** over Wakkerstroom. The forecast was provided by the Aviation Weather Centre of the South African Weather Service (situated at OR Tambo International Airport):*

Wakkerstroom

Time	Surface	FL060	FL070	FL080	FL090	FL100
08:00	26012KT	29015KT	25032KT	26035KT	28034KT	28032KT
09:00	25015KT	28020KT	25030KT	26034KT	27032KT	27028KT
10:00	25018KT	27025KT	25028KT	26028KT	27026KT	27023KT
11:00	25018KT	27028KT	26027KT	26025KT	26023KT	26022KT
12:00	25018KT	27028KT	26026KT	26023KT	26024KT	26026KT
13:00	25015KT	27027KT	26028KT	26022KT	26024KT	26026KT
14:00	24013KT	27025KT	27028KT	27025KT	26027KT	26027KT

1.8 Aids to navigation

1.8.1 The aircraft was equipped with standard navigational equipment for the aircraft type as approved by the regulating authority.

1.8.2 The passenger/navigator had an aeronautical map with him that he used for the navigational route they had to fly. This map was recovered from the accident site during the on-site investigation.

1.9 Communication

1.9.1 The aircraft was equipped with standard communication equipment for the aircraft type as approved by the regulating authority.

1.9.2 The PTAR race rules allowed the pilot to take his cell phone with on the flight, however he was not allowed to use this device as a navigation tool during the race. The pilot cell phone was sealed in a bag by the race organisers and he was allowed to take it with him in the aircraft. The navigator did not opt to take his cell phone with on the flight. Following the accident the pilot managed to get hold of the sealed bag. After the managed to disembark from the wreckage he was able to switch the cell phone on, which was undamaged in the accident. He managed to obtain a signal from the cell phone network and he called the air traffic controller (ATC) that was on duty at FASI for this race advising them of the accident. The ATC at FASI intern informed the Aeronautical Rescue Coordination Centre (ARCC), which was accordingly activated. The pilot was able to provide them with a GPS position he obtained from his cell phone. The ARCC dispatched the necessary emergency services as well as the police in the area to the accident site.

1.10 Aerodrome information

1.10.1 The accident did not occur at or close to an aerodrome but on the northern side of the Tafelkop Mountain near Wakkerstroom (GPS position; 27°16'30.63" South 030°16'24.31" East); an elevation of 6 920 feet (2 110m) above mean sea level (AMSL).

1.11 Flight recorders

1.11.1 The aircraft was not equipped with a flight data recorder (FDR) or a cockpit voice recorder (CVR), nor was it required to be fitted to this type of aircraft.

1.12 Wreckage and impact information

1.12.1 The aircraft impacted on the southern side of the Tafelkop Mountain on a heading of 170°M at an altitude of 6 920 feet above mean sea level (AMSL). The aircraft came to rest in a left wing low attitude against a steep slope. In Figure 3 the wreckage could be seen as it came to rest in relation to the highest point of the Tafelkop Mountain. The aircraft impacted hard with terrain, which caused the aft fuselage to severe partially and the nose gear broke off and came to rest next to the left wing as can be seen in Figure 4. The ground impact markings indicate that the aircraft came to rest within 3m after impact.

Both wings display impact damage, and flight control continuity was assessed and was found to be compromised. The left front door unlatched during the impact sequence according to the pilot and both occupants were able to disembark from the cockpit via the open door. The cockpit/cabin area remained intact. Both the control stick grips broke off during the impact sequence as can be seen in Figures 7 and 8. The four-point safety harnesses of both front seats remained intact and were unlatched by the occupants.

Figure 3: The wreckage in relation to the highest point of the Tafelkop Mountain

Figure 4: Side view of the wreckage as it came to rest, nose gear broken off

Figure 5: A front view of the wreckage

Figure 6: A view of the main landing gear that collapsed and folded backwards

Figure 7: Arrow shows a view of the broken control grip on the navigator side.

Figure 8: A view of the broken control grip on the pilot side

In Figure 9 below the saddle area that was identified by the pilot can be seen.

Figure 9: A view of the wreckage with the saddle area visible to the right behind it

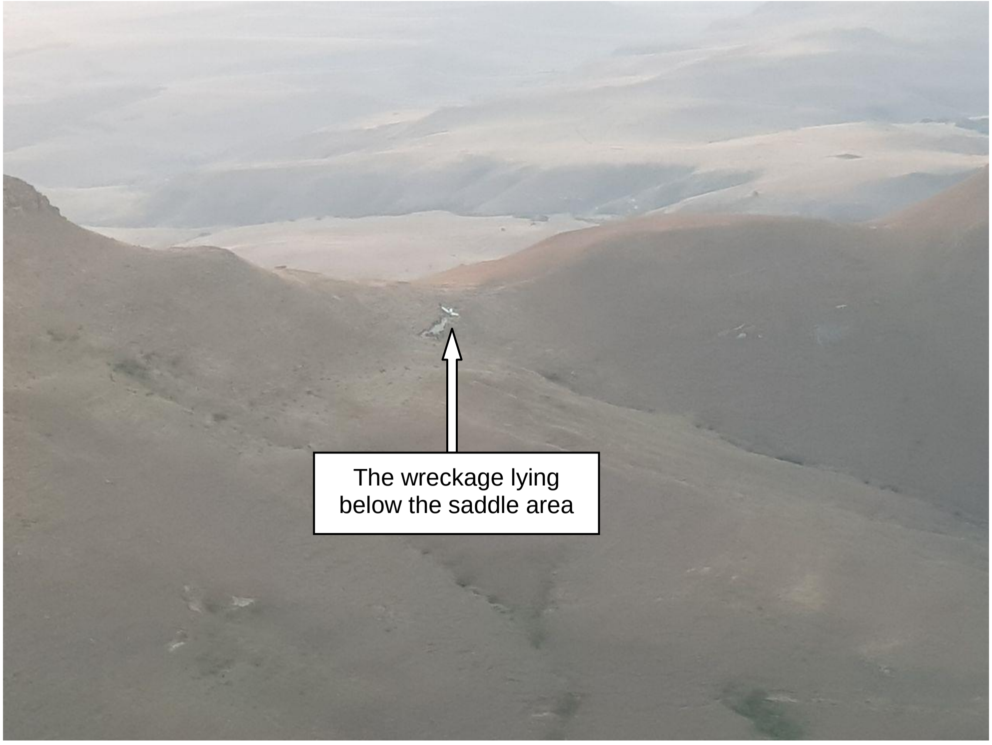


Figure 10: Aerial view of the wreckage below the saddle area (photograph courtesy of BP Greyling)

1.13 Medical and pathological information

1.13.1 The pilot incurred a serious spinal cord injury and was airlifted from the scene by an air ambulance and underwent spinal surgery in a private hospital in Johannesburg on Tuesday, 30 May 2017. He also suffered from a laceration to his chin during the impact sequence, which needed to be surgically treated.

1.13.2 The passenger/navigator was also airlifted from the scene by an air ambulance and was taken to a private hospital in Alberton where he underwent a medical check-up. He did not suffer from any serious injuries and was accordingly discharged from hospital.

1.14 Fire

1.14.1 There was no evidence of a pre- or a post-impact fire.

1.15 Survival aspects

1.15.1 The accident was survivable. Both occupants were restrained by making use of the aircraft equipped four point safety harness at the time of impact with terrain.

1.15.2 The aircraft was equipped with dual flight controls and it was found that the control yoke/stick (similar to that of a helicopter) broke off on both sides. The passenger indicated that he was not injured by this failure. A substantial amount of blood was noted on the left side of the aircraft as well as the upper surface of the left wing, according to the passenger/navigator the pilot suffered from a blow to his head which was bleeding.

1.15.3 The emergency person that first arrived on the scene did so by foot and the rest of his team followed. Both occupants were stabilised on the scene by paramedics and the decision was made to air lift both of them via air ambulance (EMS helicopters) due to the difficult terrain and the severe spinal injury suffered by the pilot.

1.15.4 The pilot was first air lifted and both occupants were flown to a private hospital in Alberton. On Sunday, 28 May 2017, two days after the accident the pilot was transported by road ambulance to a private hospital in Johannesburg where he underwent spinal surgery on Tuesday, 30 May 2017.

1.16 Tests and research

1.16.1 None considered necessary as there was no technical malfunction reported with the aircraft that could have contributed or have caused the accident.

1.17 Organizational and management information

1.17.1 This was a private flight, the two occupants on board where participating in the President Trophy Air Race. They took-off from FASI with the intention to land back at FASI.

1.17.2 The last maintenance inspection that was carried out on the aircraft was certified on 21 April 2017 by an aircraft maintenance organisation (AMO) that was in possession of a valid AMO approval certificate number 1217.

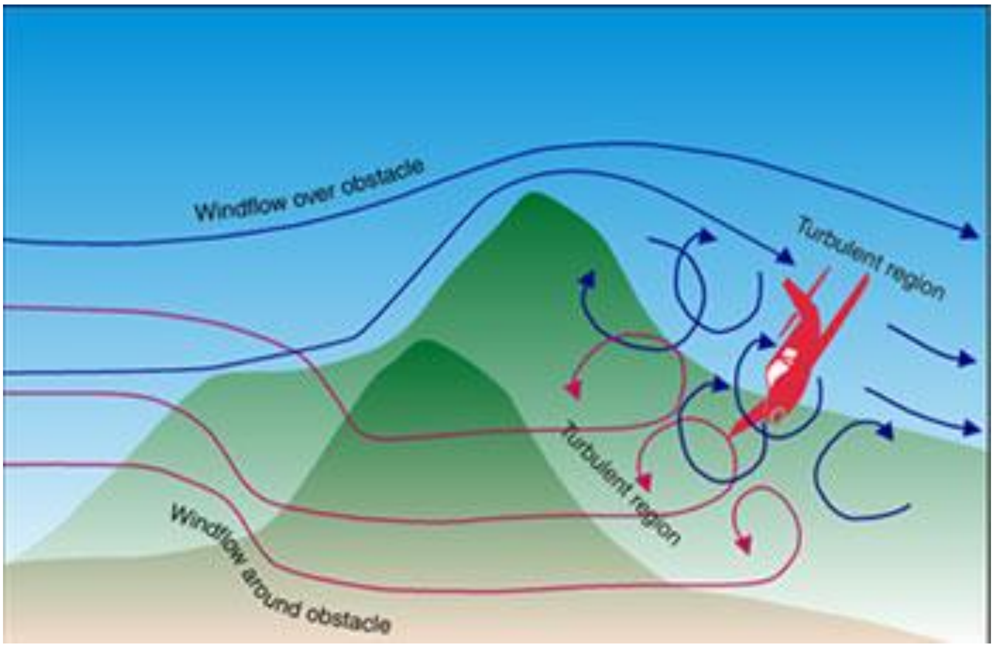
1.18 Additional information

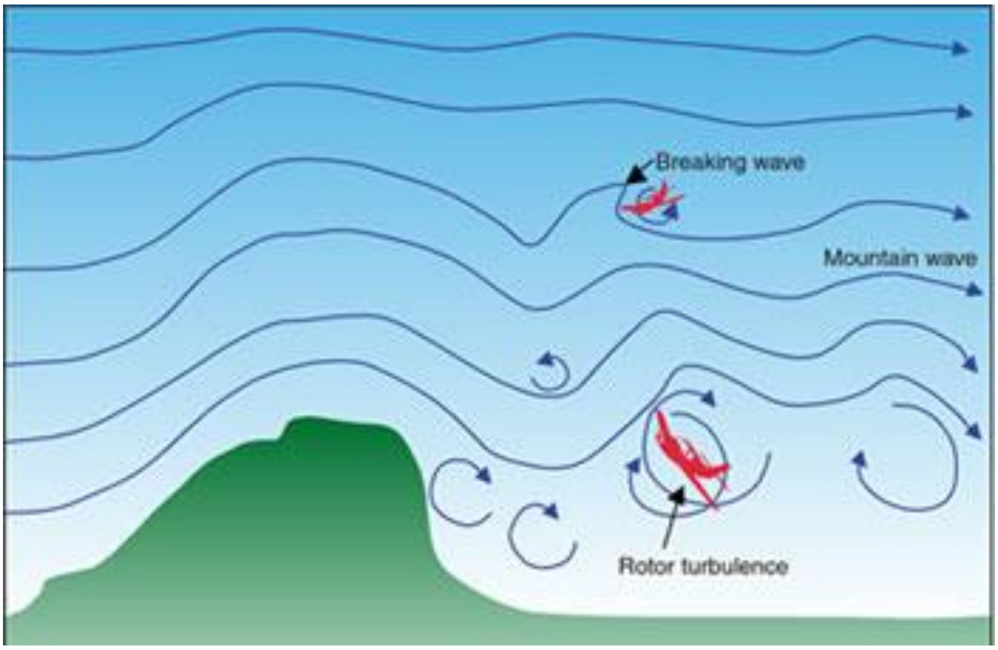
1.18.1 Mountain wave turbulence

Source: www.atsb.gov.au/publications/2005/mountain_wave_turbulence/

"Mountain waves are a different phenomena to the mechanical turbulence found in the lee of mountain ranges, and can exist as a smooth undulating airflow or may contain clear air turbulence in the form of breaking waves and 'rotors'. Mountain waves are defined as 'severe' when the associated downdrafts exceed 600 feet/min and/or severe turbulence is observed or forecast.

'Breaking waves' and 'rotors' associated with mountain waves are among the more hazardous phenomenon that pilots can experience. Understanding the dynamics of the wind is important in improving aviation safety.





Glider pilots learn to use these mountain waves to their advantage; typically to gain altitude. However, some aircraft have come to grief in those conditions. Encounters have been described as similar to hitting a wall.

Mountain waves are the result of flowing air being forced to rise up the windward side of a mountain barrier, then as a result of certain atmospheric conditions, sinking down the leeward side. This perturbation develops into a series of standing waves downstream from the barrier, and may extend for hundreds of kilometres over clear areas of land and open water.

Mountain waves are likely to form when the following atmospheric conditions are present:

- *the wind flow at around ridge height is nearly perpendicular to the ridge line and at least 25 knots;*
- *the wind speed increases with height;*
- *there is a stable layer at around ridge height.*

If the wave amplitude is large enough, then the waves become unstable and break, similar to the breaking waves seen in the surf. Within these 'breaking waves', the atmospheric flow becomes turbulent.

The crests of the waves may be identified by the formation of lenticular clouds (lens-shaped), if the air is sufficiently moist. Mountain waves may extend into the stratosphere and become more pronounced as height increases. Some pilots have *reported mountain waves at 60,000 feet. The vertical airflow component of a standing wave may exceed 8,000 feet/min.*

Rotors or eddies can also be found embedded in mountain waves. Formation of rotors can also occur as a result of down slope winds. Their formation usually occurs where wind speeds change in a wave or where friction slows the wind near to the ground. Often these rotors will be experienced as gusts or windshear. Clouds may also form on the up-flow side of a rotor and dissipate on the down-flow side if the air is sufficiently moist.

Many dangers lie in the effects of mountain waves and associated turbulence on aircraft performance and control. In addition to generating turbulence that has demonstrated sufficient ferocity to significantly damage aircraft or lead to loss of aircraft control, the more prevailing danger to aircraft seems to be the effect on the climb rate of an aircraft. General aviation aircraft rarely have performance capability sufficient to enable the pilot to overcome the effects of a severe downdraft generated by a mountain wave or the turbulence or windshear generated by a rotor.

Crossing a mountain barrier into wind also reduces the groundspeed of an aircraft and has the effect of keeping the aircraft in the area of downdraft for longer, while an aircraft flying downwind on the upwind side of a mountain range is likely to initially encounter updrafts as it approaches rising ground. Rotors and turbulence may also affect low level flying operations near hills or trees.

Research into 'braking waves' and 'rotors' or eddies continues but there is no doubt that pilots need to be aware of the phenomenon and take appropriate precautions. Although mountain wave activity is usually forecast reasonably well by the Weather Services, many local factors may affect the formation of 'breaking waves' and 'rotors'. When planning a flight a pilot should take note of the winds and the terrain to assess the likelihood of waves and rotors. There may be telltale signs in flight, including the disturbances on water or wheat fields and the formation of clouds, provided there is sufficient moisture for cloud to form.

Prudent flight planning may include allowing for the possibility of significant variations in the aircrafts altitude if updrafts and downdraughts are encountered. A margin of at least the height of the hill or mountain from the surface should be allowed, and consideration given to the need to adopt a manoeuvring airspeed appropriate to the circumstances.

Ultimately, it may be preferable for pilots to consider diverting or not flying, rather than risk flying near or over mountainous terrain in strong wind conditions conducive to mountain waves containing 'breaking waves' and 'rotors'."

1.18.2 Examination of aviation accidents associated with turbulence, wind shear, thunderstorms

Source: NASA/CR-2013-217989

The purpose of this analysis was to compare the characteristics of accidents associated with seven categories of atmospheric hazard (mostly turbulence, thunderstorm and windshear). Eight hundred sixty-four accidents from 1987-2008 were selected from the NTSB accident database. All are considered US-based accidents, and were operating under FAR Part 121, 135 or 91 flight rules at the time. The seven categories were as follows:

1. Wake Turbulence (WAKE): Wake turbulence is a by-product of lift and is present behind every aircraft in flight. Once the aircraft is airborne, two counter rotating cylindrical vortices are created, which are hazardous to any trailing aircraft. This is particularly true during take-off, initial climb, final approach and landing, when the high angle of attack at which the aircraft operates maximizes the formation of strong vortices.

2. Mountain Wave Turbulence (MTN): Mountain wave turbulence occurs when air flows are forced to rise up the windward side of a mountain barrier, then as a result of certain atmospheric conditions, sink down the leeward side. This perturbation develops into a series of waves which may extend for hundreds of miles. Sixty-six percent of mountain wave accidents resulted in fatality as well as the destruction of the aircraft

3. Clear Air Turbulence (CAT): Clear air turbulence typically occurs in cloud-free regions at higher altitude, widely separated from mountains, and often is associated with wind shear, particularly between the core of a jet stream and the surrounding air.

4. Cloud Turbulence (CLD): This turbulence phenomenon occurs in cloud covered regions without the requirements of convection or precipitation reaching the ground.

5. Convective Turbulence (CONV): An air mass which absorbs heat from the earth's surface will rise. As the air rises, it cools, and eventually the cooler air mass descends. This cycle of rising and falling air is known as convection. Convective turbulence occurs within, or in close proximity to, convective storms, particularly thunderstorms, which result in strong updrafts and downdrafts.

6. Thunderstorm, with no turbulence (TRW): This hazard category is restricted to thunderstorms, with or without microbursts or wind shear, but with no mention of turbulence.

7. Low Altitude Wind Shear, Microburst or Turbulence (LAWMT): This category consists of wind shear, microbursts or turbulence occurring at low altitude, with no mention of thunderstorms.

Flight Operations Category

Although wake turbulence is caused primarily by large jets, its effects are felt most among Part 91 flights (83%). **Similarly, Part 91 flights account for nearly all accidents attributed to mountain wave turbulence (90%),** thunderstorms with no turbulence (91%) and low altitude wind shear, turbulence or microburst (92%). Clear air turbulence primarily affects Part 121 (75%), while both cloud and convective turbulence are split more evenly between Part 121 and Part 91. Part 135 accidents accounted for between 2% and 10% of the atmospheric hazards which were examined here (5% overall), and roughly 5% of all accidents in this time frame.

Aircraft Engine Type

Aircraft engine types correlate strongly (although not perfectly) with flight operations categories, so it is not surprising that the distribution of atmospheric hazard by engine type is very similar. Sixty-eight accidents were attributed to mountain wave turbulence, aircraft that was equipped with reciprocating engines accounted for nearly all accidents attributed to mountain wave turbulence (88%).

1.19 Useful or effective investigation techniques

1.19.1 None.

2. ANALYSIS

2.1 Man (Pilot)

2.1.1 The pilot was appropriately qualified and type rated to conduct the flight as per the provisions contained in the Civil Aviation Regulations (CARs) of 2011. He held a valid airline transport pilot licence and the aircraft type were endorsed in it.

2.1.2 All participants in the PTAR had access to a detailed weather forecast prior to departure from FASI. Strong wind conditions were forecast in the Wakkerstroom area from the southwest. En route to their first turning point the pilot and navigator became aware of the prevailing wind conditions and the decision was made at the turning point to deviate to the right of the direct track to Wakkerstroom due to mountainous terrain en route.

2.1.3 During the initial phase of the flight they avoided flying over mountainous terrain as conditions had become very turbulent, these conditions did not change as the flight progressed towards the second turning point. As they approached Tafelkop Mountain they had to make a decision if they were going to fly around it to the left or the right or if they were going to climb and fly over it. The latter was decided on and a 'saddle area' within the contour of the mountain was identified to overfly the mountain as it was at a substantial lower altitude then the rest of the mountain.

2.1.4 The pilot did brief the navigator on what evasive action he was going to take should they encounter mountain wave conditions as they approach the saddle area. They were well aware that they were on the leeward side of the mountain and that there was a strong probability they were going to encounter mountain waves/rotors, which they did. Following a sudden decay in airspeed, accompanied by a negative rate of climb indication on the VSI the pilot decided to took evasive action and he turned left. He waited however too long before he initiated the evasive action and was unable to fly the aircraft down the valley as he had two factors against him, a substantial decay in airspeed as he turned and he did not keep cognisance of the contour of the mountain to his left, he was therefore unable to clear the terrain safely and opted to turn the wings level before the aircraft impacted heavily with the side of the mountain.

2.2 Machine (Aircraft)

2.2.1 The aircraft was maintained in accordance with the approved maintenance schedule and there was no reported defects documented prior to the flight that could have contributed or have caused the accident. During an interview with both the occupants that were on board the aircraft they indicated that the aircraft was mechanically sound and that the engine was functioning normal during the flight. It should be noted that the aircraft was equipped with a 150 hp engine and at that altitude and mountain wave conditions they experienced the power required to climb and avoid the mountain wave conditions by far exceeded the power that was available.

2.3 Mission

2.3.1 The occupants were participating in the PTAR, the pilot had flown in several of these races before, it was therefore nothing new to him, nor something that was out of the norm. From a flying perspective the pilot did not have to meet any special requirement, nor perform any special flying manoeuvres.

2.4 Environment

2.4.1 An official weather forecast was made available to the PTAR participants by the SAWS. Strong winds from the west to the southwest were forecast in the Wakkerstroom area, these winds had a direct influence on this accident. The pilot made the decision to fly over the Tafelkop Mountain but as they approached the leeward side of the mountain they encountered strong turbulence associated with mountain waves. The airspeed rapidly decayed and the aircraft encountered a substantial rate of descent, which required evasive action by the pilot and the aircraft impacted with terrain.

3. CONCLUSION

3.1 Findings

3.1.1 The pilot was the holder of a valid airline transport pilot licence and he had the aircraft type endorsed in his licence.

3.1.2 The pilot was the holder of a valid aviation medical certificate that was issued by a CAA designated medical examiner.

3.1.3 The pilot sustained serious spinal injuries and was airlifted from the accident site via an air ambulance and was transported to a private hospital in Gauteng. He underwent spinal surgery in a private hospital in Johannesburg four days after the accident.

3.1.4 The passenger/navigator were also airlifted from the accident site via an air ambulance to a private hospital in Alberton, he sustained minor injuries.

3.1.5 The aircraft was in possession of a valid certificate of airworthiness.

3.1.6 The aircraft was maintained in accordance with regulatory requirements by an approved aircraft maintenance organisation (AMO).

3.1.7 There aircraft was mechanically sound and normal engine performance parameters were met.

3.1.8 The aircraft was operated within its weight and balance limitations at the time of the accident.

3.1.9 The aircraft impacted with terrain on the leeward side of the mountain and came to rest in an upright, left wing low attitude.

3.1.10 The prevailing winds in the area of the Tafelkop Mountain were strong from the southwest and had a direct influence on the accident.

3.2 Probable cause:

3.2.1 The climb performance of the aircraft was not able to overcome the strong downdraught on the leeward side of the mountain, and during an attempted evasive manoeuvre by the pilot the aircraft impacted with terrain.

3.3 Contributory factors:

3.3.1 The lack of sufficient height as they approached Tafelkop Mountain to overcome the effects of wind rotors and turbulence was a factor in the accident.

3.3.2 The pilot made the decision to fly over the mountain and was at a too low altitude to clear it at a safe margin.

4. SAFETY RECOMMENDATIONS

4.1 Safety Message: The pilot had his cell phone with him, which was in a sealed bag. He was able to obtain cell phone network coverage from where he was lying on the side of the mountain. There survivability in this accident was greatly dependant on this cell phone network coverage as certain service providers did not had any cell phone coverage in the area. It is recommended that pilot's be made aware that they cannot depend solely on cell phone coverage throughout the country as an essential tool in the case of an accident/emergency as network limitations are a reality. Aircraft should be equipped with a serviceable ELT and pilot should consider carrying with them a personal locator beacon (PLB).

5. APPENDICES

5.1 None.