



AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

| | | | | | | |
|--|--------------------------|---|--------------------------|-----------------------------|-------------------------|-------|
| | | | | Reference: | CA18/2/3/8179 | |
| Aircraft Registration | ZU-CYI | Date of Accident | 22 September 2006 | | Time of Accident | 1452Z |
| Type of Aircraft | L-29 Delphin (Aeroplane) | | Type of Operation | | Private | |
| Pilot-in-command Licence Type | | Commercial | Age | 42 | Licence Valid | Yes |
| Pilot-in-command Flying Experience | | Flying Hours | 2 147.3 | | Hours on Type | 469.8 |
| Last point of departure | | Air Force Base Ysterplaat, Cape Town (FAYP) | | | | |
| Next point of intended landing | | Air Force Base Ysterplaat, Cape Town (FAYP) | | | | |
| Location of the accident site with reference to easily defined geographical points (GPS readings if possible) | | | | | | |
| Offshore, near Milnerton, Cape Town (GPS position: S 33° 54.104' E 018° 28.129') | | | | | | |
| Meteorological Information | | Surface wind 134° at 18 kts gusting 28 kts, temperature 17.4°C, visibility +10 km | | | | |
| Number of people on board | 1 + 0 | No. of people injured | 0 | No. of people killed | 1 | |
| Synopsis | | | | | | |
| <p>The pilot of ZU-CYI was part of the Sasol Tigers, an aerobatic display team consisting of three L-29 Delphin jets. On the day of the accident, they joined up with the South African Air Force aerobatic team, the Silver Falcons, which consisted of four Pilatus PC-7 type aircraft. The two teams were flying in a mixed formation participating in the African Aerospace and Defence Expo 2006 (AAD 2006). An additional two aircraft accompanied the formation of seven aircraft, namely a civilian-registered L-39 jet and a fifth Pilatus PC-7 aircraft, bringing the total number of aircraft to nine. The additional two aircraft each had an aerial photographer onboard.</p> <p>After completion of the display, the formation was cleared for landing on runway 20 at Air Force Base Ysterplaat (FAYP). The formation joined on a right downwind for Runway 20 at a height of 1 500 ft above ground level (AGL). Their routing took them over the sea to the west of the aerodrome. The four Pilatus PC-7 aircraft were first to land, followed by the three L-29 jets. While the pilot of ZU-CYI positioned himself for landing, the aircraft suddenly pitched nose down and impacted with the sea in a nose-down attitude. The aircraft was equipped with an ejection seat that was armed prior to the flight, but the pilot did not eject, nor had he broadcast any distress or Mayday call prior to the accident.</p> <p>The pilot was fatally injured in the accident.</p> | | | | | | |
| Probable Cause | | | | | | |
| The aircraft departed from controlled flight, descended and struck the water. | | | | | | |
| IARC Date | | | | Release Date | | |



AIRCRAFT ACCIDENT REPORT

Name of Owner/Operator : BDS Flying Services Partnership
Manufacturer : Aero Vodochody Limited
Model : L-29 Delphin
Nationality : South African
Registration Marks : ZU-CYI
Place : Off-shore Milnerton, Cape Town
Date : 22 September 2006
Time : 1452Z

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 two hours.

Purpose of the Investigation:

*In terms of Regulation 12.03.1 of the Civil Aviation Regulations (1997), this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and **not to establish legal 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 Sasol Tigers, an aerobatic display team (consisting of three L-29 Delphin jets) in conjunction with the South African Air Force Silver Falcons aerobatic team (consisting of four Pilatus PC-7 aircraft), were flying in a mixed formation over Cape Town on the afternoon of 22 September 2006 as part of the African Aerospace and Defence Expo 2006. Following the flyby of the mixed formation at Air Force Base Ysterplaat (FAYP) in a southerly direction, they turned out to the right to join on a right-hand downwind for landing on Runway 20 at Air Force Base Ysterplaat. Accompanying the formation of seven aircraft was a civilian-registered L-39 jet (ZU-

TEE) and a Pilatus PC-7 aircraft, bringing the total number of aircraft to nine. Both these aircraft had two occupants onboard, namely a pilot and an aerial photographer.

- 1.1.2 The formation was cleared for landing on runway 20 with the four Pilatus PC-7 aircraft taking the lead and the Sasol Tigers team falling back. Aircraft No. 1 and No. 2 of the Sasol Tigers team were already in formation while aircraft No. 3 was being positioned to join the formation when aircraft No. 2 (ZU-CYI) was seen by several eye-witnesses to suddenly pitch nose-down and crash into the sea in a nose-down attitude of approximately 30°.
- 1.1.3 According to eye-witness' accounts, at no time did they observe any smoke emanating from the aircraft, anything falling from the aircraft, or the pilot ejecting from the aircraft. Prior to the aircraft pitching down, the formation was at a height of approximately 1 500 ft above mean sea level (AMSL). The aircraft was equipped with an ejection seat, which was active at the time –one of the team members confirmed that he had pulled the safety pins prior to the flight and handed them to the pilot to keep in his flying overall pocket, which was the standard procedure. At no time prior to the accident was there any indication via radio of a distress call or Mayday call that indicated that the pilot was experiencing a problem or difficulty with the aircraft or physically.
- 1.1.4 Several eye-witnesses to this accident were interviewed and their observations concurred. The pilot was flying in the formation, positioned for landing with the other aircraft flying line astern (one behind the other) when suddenly the aircraft pitched nose-down and remained in that attitude until it impacted with the water. All witnesses concur that they could still hear the engine noise as the aircraft pitched nose-down towards the sea.
- 1.1.5 Following the accident, several emergency response teams were activated and dispatched in search of the pilot and the aircraft. These included rescue boats from the South African Police, South African Navy, National Sea Rescue Institute (NSRI) as well as a rescue helicopter. The pilot was found fatally injured.
- 1.1.6 The accident occurred during daylight conditions at a geographical position determined as S 33° 54.104' E 018° 28.129' where the aircraft crashed into the sea.

1.2 Injuries to Persons:

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

1.3 Damage to Aircraft:

1.3.1 The aircraft was destroyed during the impact with the sea.

1.4 Other Damage:

1.4.1 There was no other damage caused.

1.5 Personnel Information:

| | | | | | |
|---------------------|---|---------------|------------|-----|----|
| Nationality | South African | Gender | Male | Age | 42 |
| Licence Number | ***** | Licence Type | Commercial | | |
| Licence valid | Yes | Type Endorsed | Yes | | |
| Ratings | Instrument; Night | | | | |
| Medical Expiry Date | 30 March 2007 | | | | |
| Restrictions | Pilot was required to wear corrective lenses while flying | | | | |
| Previous Accident | None | | | | |

Flying Experience:

| | |
|----------------------------|---------|
| Total Hours | 2 147.3 |
| Total Past 90 Days | 45.9 |
| Total on Type Past 90 Days | 22.4 |
| Total on Type | 469.8 |

*NOTE: The flying hours reflected in this report were obtained from the pilot's flying logbook, which was completed until 16 September 2006. According to the Flight Folio document of ZU-CYI, the pilot had conducted an additional five flights in this aircraft after 16 September 2006. These flying hours were added to the table reflected above. The accident flight was his second flight for the day in this aircraft.

1.6 Aircraft Information:

Airframe:

| | | |
|--|------------------------|---------------|
| Type | L-29 Delphin | |
| Serial Number | 294682 | |
| Manufacturer | Aero Vodochody Limited | |
| Year of Manufacture | 1972 | |
| Total Airframe Hours (At Time of Accident) | 3 686.8 | |
| Last MPI (Hours & Date) | 3 640.1 | 30 March 2006 |
| Hours Since Last MPI | 46.7 | |
| Authority to Fly (Issue Date) | 17 March 2006 | |
| C of R (Issue Date) (Present owner) | 26 March 2003 | |
| Operating Categories | Commercial | |

Engine:

| | |
|----------------------|-------------------|
| Type | Walter M701-C-500 |
| Serial Number | C881005 |
| Hours since New | 1 304.8 |
| Hours since Overhaul | 340.8 |

1.7 Meteorological Information:

1.7.1 An official weather report was obtained from the South African Weather Services (SAWS) following the accident, indicating that fine weather conditions prevailed in the area, with clear sky conditions.

| | | | | | |
|----------------|---------|-------------|--------------------------|------------|----------|
| Wind direction | 134° TN | Wind speed | 28 kts 18 kts gusting | Visibility | +10 km |
| Temperature | 17.4°C | Cloud cover | No cloud | Cloud base | No cloud |
| Dew point | Unknown | | | | |

1.8 Aids to Navigation:

1.8.1 The aircraft was equipped with the following navigational aids, which, according to available information (aircraft documentation) were serviceable prior to the flight:

magnetic compass

transponder

automatic direction finder (ADF)

variable omni-range finder (VOR)

GPS/navigation/communication system (Garmin GNS 430)

1.9 Communications:

1.9.1 The aircraft was equipped with a VHF radio receiver and transmitter. The pilot did not broadcast any distress or Mayday call prior to the accident.

1.10 Aerodrome Information:

1.10.1 Not relevant to the cause of the accident.

1.11 Flight Recorders:

1.11.1 The aircraft was not equipped with a flight data recorder (FDR) nor a cockpit voice recorder (CVR), nor were these required by regulation to be fitted to this aircraft type.

1.12 Wreckage and Impact Information:

1.12.1 The aircraft was observed by a number of eye-witnesses to impact with the sea in an estimated 30° nose-down attitude, on a heading of approximately 040° M.



Figure 1: Artificial horizon indicator that was recovered from the sea.

1.12.2 Following impact with the water, the aircraft broke up into a considerable number of pieces. The debris field was scattered over a large area underneath the water. A considerable number of light-weight debris washed-up on shore and the assistance of the military police was obtained in collecting most of this debris. Several pieces of debris were picked up by the public and were handed into local police stations in the surrounding area. Several pieces of floating debris were collected by police and navy vessels that were in the area where the aircraft impacted with the sea shortly after the accident occurred. All the debris that was collected was taken to a secure location in the Cape Town harbour, which was made available by the South African Police.

The only piece of video footage that was gathered in this investigation displaying the impact was obtained from a security surveillance camera, which recorded low-resolution colour images in a timed sequence. The camera was located on top of a building in Milnerton, which was a considerable distance away. Apart from the actual impact with the sea, seen as a massive water splash, it was not possible to draw any conclusions from the footage.



Figure 2: A surveillance video camera located on top of a building in Milnerton recorded the impact.



Figure 3: A Google Earth map displaying the location of the accident site.

1.12.3 The pilot's ejection seat was armed for the flight, which imposed a hazard for any person who might have wanted to disturb the seat following impact, as the pilot did not eject from the aircraft prior to impact. The assistance of a special dive unit from the South African Navy was acquired to disarm both ejection seats prior to the continuation of any underwater recovery work.



Figure 4: Underwater photo of the aft cockpit ejection seat with some of the pins still secure.

1.12.4 The South African Police dive unit, assisted by a civilian dive company, proceeded with the debris collection from the sea. The recovery took them fifteen (15) days to collect all the debris that was visible from the surface of the sea. Underwater photos were taken as they proceeded; however, this process was dependent on water conditions and adequate visibility underneath the water. Several of the larger pieces, including the empennage and engine, required the assistance of a crane to be lifted from the sea – for this, the assistance of a special vessel was obtained. It was possible to transport the wing sections and all other debris recovered on some of the smaller craft.



Figure 5: Divers preparing the empennage section for recovery.



Figure 6: Recovery of the empennage section from the water onto the support vessel.

1.12.5 Following recovery of the debris, everything was rinsed with fresh water and allowed to dry properly before it was secured in a demarcated area. Approximately 90% of the aircraft was recovered, with the majority of missing pieces originating from the nose and cockpit areas. All the flight control surfaces as well the dive breaks/spoilers were accounted for, although they were severely distorted and compressed due to impact and subsequent corrosion.



Figure 7: The outer section of the left elevator distorted by corrosion.

Due to the severity of the impact and the distortion of both the forward and aft cockpit, it was not possible to determine any cockpit settings with regard to the

throttle, elevator trim or useable cockpit instrument settings/readings. It was determined that most of the instrumentation that was recovered originated from the aft cockpit.

1.13 Medical and Pathological Information:

1.13.1 Due to the fact that the body of the pilot had been severely mutilated and fragmented, it was not possible to conduct any meaningful post-mortem, histology or toxicology examination. The cause of death according to the post mortem report was attributed to multiple injuries and the consequences thereof.

1.14 Fire:

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

1.15 Survival Aspects:

1.15.1 The pilot was flying an aircraft that was equipped with an ejection seat, which was armed prior to the flight. He was wearing all the required protective gear available, including a helmet and flying suit. He was properly strapped in by ground support personnel prior to the flight, whereupon all the ejection seat pins was removed as required.

1.15.2 The aircraft was being flown at a height of approximately 1 500 ft above mean sea level when it was observed by eye-witnesses to suddenly pitch nose-down. The pilot did not eject from the aircraft, even though he had sufficient altitude available to do so. The aircraft remained in a nose-down attitude until it impacted with the sea at a considerable speed. Due to the severe impact forces associated with this accident, this was considered a non-survivable accident.

1.16 Tests and Research:

1.16.1 CrashLab Report:

A limited number of cockpit instruments were recovered from the sea. Two of these instruments displaying engine parameters were subjected to a detailed examination by a metallurgist. The purpose of the examination was to ascertain the operational status of the engine prior to impact.

Discussion and Conclusion:

Both indicators suffered severe damage on impact as well as from seawater submersion for a period of time. This resulted in severe corrosion damage inflicted to all internal parts, therefore only faceplate analysis was completed with the following results:

- (i) Fuel Pressure Indicator: The faceplate indentation corresponds with an indication of 22 kl/cm² or 22 bar.
- (ii) Oil Pressure Indicator: The faceplate indentation corresponds with an indication of approximately 2.2 kl/cm² or 2.2 bar.
- (iii) Oil Temperature Indicator: The faceplate indentation corresponds with an indication of -20°C. Two other intention marks correspond with 70°C and 110°C. The negative value is highly unlikely, taking into account the other indications from the same instrument. Due to the damages inflicted to the internal parts, the actual position could not be determined conclusively.
- (iv) Exhaust Gas Temperature Indicator (EGT): No clear faceplate needle indication was detected. The needle mechanism was lodged in a position that correlates with an indication of 560°C.

The complete report can be found attached to this report as Annexure A.

1.17 Organisational and Management Information:

1.17.1 The aircraft was registered in the name of a partnership, consisting of two persons.

The pilot that was flying the aircraft at the time of the accident was one of the

partners. The aerobatic team displayed the colours of a South African petroleum company and had obtained a sponsorship from the company, but was privately owned.

1.17.2 The last maintenance inspection that was carried out on the aircraft prior to the accident flight was certified by an aircraft maintenance organisation (AMO), no. 932. The AMO was in possession of a valid AMO Approval Certificate to perform the required maintenance.

1.18 Additional Information:

1.18.1 Engine Teardown Inspection:

The engine, a Walter M701-C-500, serial no. C881005, was recovered from the sea by means of a special vessel that was equipped with an adequate crane.



Figure 8: The engine being lifted by crane from the sea onto a special recovery vessel (ZTUG).

Once recovered, the engine was taken to an aircraft maintenance organisation (AMO) that was able to assist the investigation team with a teardown inspection. The effect of corrosion on the majority of the parts/components was found to be severe. The engine was rinsed down with fresh water immediately after it was recovered.

The engine teardown procedure did not reveal any mechanical defect that could be

associated with an engine malfunction inflight that would result in this accident.

1.19 Useful or Effective Investigation Techniques:

1.19.1 None.

2. ANALYSIS

2.1 General:

The pilot, who was appropriately licensed, was part of an aerobatic display team for several years. This was his second flight of the day. This particular flight was somewhat different in that the display team was part of a military display team of four aircraft – the two teams flew in a mixed formation as part of a large aerospace display. An additional two aircraft joined the formation, bringing the total of aircraft flying together to nine. The additional two aircraft each had an aerial photographer onboard.

2.2 Overview:

On completion of the formation flight, the formation was cleared for landing on runway 20 at Air Force Base Ysterplaat. In order to prepare for landing, the formation joined on a right downwind for runway 20, which took them over the sea. The four aircraft in the military display team were the first to land, to be followed by the three aircraft in the Sasol Tigers team. The Sasol Tigers aircraft were being positioned for landing flying behind one another (line astern) at a circuit height of approximately 1 500 ft above mean sea level. At no stage during the flight did the pilot indicate to the formation or to his lead aircraft that he was feeling ill, tired or having concentration problems. According to several eye-witnesses that watched the formation flying over the sea, the accident aircraft deviated from straight and level flight by suddenly pitching nose-down. The aircraft remained in that attitude until it impacted with the sea. Not one of the eye-witnesses that were interviewed observed anything falling from the aircraft, any smoke emanating from it, nor the pilot ejecting from the aircraft.

Not one of the pilots flying in the formation was aware of any problem as the pilot

did not broadcast any distress or Mayday call prior to the occurrence.

2.3 Impact Trail:

The aircraft impacted the sea in a nose-down attitude of approximately 30°. The impact was captured on a video surveillance camera, which was a considerable distance away. The wreckage was scattered over a large area underneath the sea. With the assistance of the police, a private dive company, and a special recovery vessel (Smit Amandla, ZTUG) approximately 80% to 90% of the wreckage was recovered from the sea bed over a period of 15 days and was taken to a secure location where a wreckage layout was performed. All flight control surfaces were accounted for although severe corrosion had consumed almost entire sections of the flight controls.

2.4 Engine:

The engine was recovered from the sea, but displayed evidence of severe corrosion, especially to the accessory components attached to it. It was subjected to a teardown inspection, which did not reveal any mechanical defect. Due to water contamination and the deterioration of the engine filters due to corrosion, it was not possible to analyse the filters. According to eye-witnesses, they could hear the engine, which appeared to function normally, as the aircraft went down. The engine instruments that were recovered from the sea were subjected to metallurgical examination, and indicated that all operating temperatures and pressures were within the normal operating range for the engine at the time of impact. The engine indications obtained from these instruments were as follows:

Fuel pressure indicator: Faceplate indentation – 22 kl/cm² = 22 bar

Oil pressure indicator: Faceplate indentation – 2.2kl/cm² = 2.2 bar

Oil temperature indicator: Faceplate indentation – 70 °C and 110 °C

Exhaust gas temperature: Needle mechanism lodged at 560 °C

When these readings are used in conjunction with the other evidence, namely the results of the engine teardown and the statements of the witnesses on the ground, it substantiates that the engine was functioning satisfactorarily for the power demand required at the time.

2.5 Height:

Following an interview with the military display team as well as the two remaining members of the Sasol Tigers after the accident, they concur that the circuit height at the time of the occurrence was 1 500 ft above mean sea level. According to the two pilots from the Sasol Tigers team as well as ground support personnel this would have allowed the pilot sufficient height to eject from the aircraft. The aircraft was positioned over the sea on a heading away from the shoreline, reducing the risk to people and property on the ground.

2.6 Weather:

Visual meteorological conditions (VMC) prevailed over the Cape Town area at the time of the flight. Weather information, both meteorological and the witnesses' reports, indicate that the prevailing weather at the time was fine with some high cloud about and the surface wind from the south-west at 18 kts gusting 28 kts. Therefore, the prevailing weather conditions were not considered to have had any bearing on this accident.

2.7 Pilot:

The pilot was well experienced in aerobatic flying, being a member of the Sasol Tigers team for a considerable period. The team flew on a regular basis and participated in many air shows around the country. The pilot was properly licensed to perform the flight and was the holder of a valid aviation medical certificate that was issued on 2 May 2006 by an approved CAA medical examiner, with the only restriction being to wear corrective lenses while flying.

The flight in question was nothing out of the ordinary. The formation part of the flight had been concluded and aircraft was flying straight and level in a line astern formation to allow adequate spacing between each aircraft for landing. This was the pilot's second flight for the day, as he had flown a 25 minute flight earlier in the day.

At no stage prior to or during the flight was there any indication from the pilot that he was feeling ill or unwell. He continued with the flight as per normal and at no stage did his flying skills reflect anything suspicious that was picked up by his fellow aviators.

It was not possible to perform a detailed post-mortem report on the deceased due to the fragmentation of the body associated with the impact forces. Most of the vital organs were absent during the procedure, concluding that the cause of death was multiple injuries and the consequences thereof.

2.8 Rescue Response:

Following notification of the accident, a military rescue helicopter that was on standby at AFB Ysterplaat was dispatched within minutes (5 – 10 minutes) to the scene. Police and navy patrol boats that were at sea at the time of the accident responded quickly to where the aircraft impacted with the sea. The helicopter orbited the area while the patrol boats moved into position and started searching the area for the missing pilot, who was found to be fatally injured.



Figure 9: View from the rescue helicopter with a navy patrol boat visible, searching the area.

2.9 Summary:

A number of factors were taken into consideration that could have contributed to or have caused the accident.

Environment/Weather:

Fine weather conditions prevailed at the time of the accident and were not considered to have had any bearing on this accident.

Mission:

The pilot was well experienced in aerobatic flying and this was considered to be a straightforward phase of flight for him, as they had concluded the formation flying phase of the flight and were positioning for landing on runway 20. The aircraft was flying straight and level prior to pitching nose-down.

Aircraft:

It took the underwater recovery team a considerable period of time to recover all possible wreckage debris visible at the bottom of the sea. The debris, which was shattered over a considerable area, was recovered to a secure location where it was properly rinsed with fresh water and allowed to dry before the wreckage layout was performed. All flight control surfaces were accounted for although they were severely damaged by the impact forces and corrosion that eroded most of the metal to near destruction. The engine displayed evidence of normal operation. No evidence of a mechanical defect or malfunction were detected that could have contributed to or have caused the sudden nose-down pitch event.

Pilot:

At no stage during the final phase of the flight, or as the aircraft pitched nose-down, did the pilot communicate with any of his fellow team members, nor had he broadcast a distress or Mayday call.

The aircraft was equipped with an ejection seat that was armed, but the pilot did not eject from the aircraft.

Failure by the pilot to communicate with anyone, accompanied by the absence of an attempt to recover from the nose-down pitch attitude, as well as the pilot not ejecting from the aircraft, indicate that the pilot might have suffered from a sudden in-flight medical condition. However, it was not possible for the forensic pathology team to obtain any medical evidence to substantiate the possibility due to the mutilation of the pilot's body, associated with the high impact forces.

3. CONCLUSION

3.1 Findings

- (i) The pilot was the holder of a valid commercial pilot's licence and had the aircraft type endorsed in his logbook.
- (ii) The pilot was the holder of a valid aviation medical certificate that was issued by an approved CAA medical examiner.
- (iii) The pilot had no record of a medical condition and was flying on a regular basis.
- (iv) The aircraft was properly maintained and held a valid Authority to Fly.
- (v) The maintenance release for the aircraft was valid and the investigation found no technical fault with the aircraft.
- (vi) The flight was operated as a general aviation flight under VFR rules.
- (vii) Fine weather conditions prevailed at the time, and were not considered to have had any bearing on the accident.
- (viii) Circuit height was approximately 1 500 ft AMSL when the aircraft suddenly pitched nose-down and impacted with the sea.
- (ix) The pilot did not broadcast a distress or Mayday call at any given time.
- (x) The pilot made no attempt to eject from the aircraft, with the seat being armed prior to flight.
- (xi) The pilot was fatally injured in the accident.

3.2 Probable Cause/s

- (i) The aircraft departed controlled flight, descended and struck the water.

4. SAFETY RECOMMENDATIONS

4.1 None

5. APPENDICES

5.1 Annexure A (CrashLab Report, Engine Instruments)

Report reviewed and amended by Advisory Safety Panel: 28 July 2009.

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