

No. 13

Uganda Police Airwing, De Havilland DHC-4A, 5X-AAB, accident at Entebbe, Uganda, on 28 April 1976. Report No. CAV/ACC/11/76, not dated, released by the Accident Investigation Branch, East African Community

SUMMARY

The aircraft was operating circuits, from Entebbe Airport, for the purpose of a DHC-4 Type Rating (Night) Flight Examination. The cadet pilot was flying the aircraft from the left hand seat while the check captain occupied the right hand seat. There were no passengers.

The first circuit involved a simulated hydraulic failure and was completed without incident. During the second circuit the starboard engine was intentionally feathered and the aircraft made a landing approach on one engine. Just prior to touch-down a sudden increase in engine power resulted in the aircraft yawing and rolling steeply towards the starboard side. The aircraft started skidding on its starboard wheel and wing tip. It skidded across the runway and over the adjoining grass strip, towards the aerodrome boundary. Some 220 m further down, the aircraft crossed a drainage ditch and crashed through a barbed wire fence around the aerodrome perimeter. The fuselage broke in half during the crash and the wreckage came to a halt approximately 15 m beyond the aerodrome perimeter.

The check captain suffered severe back injuries; the cadet pilot sustained no injuries. Investigations carried out after the accident revealed that the aircraft was operating satisfactorily prior to the accident. It is concluded that the probable cause of the accident was the application of considerable engine power when the aircraft was in an asymmetric landing configuration and at a speed probably below the single engine minimum control speed (V_{mc}). Lack of understanding between the two flight crew as to what each was doing immediately prior to the accident and the student/instructor relationship between the two crew members as well as the prevailing dark night conditions were contributory factors.

1.- Investigation1.1 History of the flight

The cadet pilot had been training for some time under the same check captain, and was considered ready to undertake the DHC-4 Type Rating Flight Examination. According to the requirements of the Directorate of Civil Aviation, East Africa, it was necessary that the flight test be conducted both during the hours of daylight and during official hours of darkness. The first part of the test, under daylight conditions, was conducted on Tuesday afternoon, 27 April 1976. The exercise lasted for one hour and five minutes and according to the check captain, the cadet pilot had proved his ability and aptitude to handle the aircraft under both normal and emergency conditions. It was then arranged to proceed with the night flying check on Wednesday evening, 28 April 1976.

The aircraft took off from Runway 17, Entebbe Airport at 1642 hours*, for the night flying test. Several circuits were planned around the airport to complete the exercise. The cadet pilot operated the aircraft from the left hand seat with the check captain in the right hand seat. Prior to take-off, during ground power check, the auto-feather system on the starboard engine was found not to be functioning.

* All times in this report are GMT.

During the first circuit on the "down wind" leg the check captain simulated a hydraulic failure by pulling the hydraulic pump circuit breaker. The cadet pilot used the required emergency systems, and a circuit pattern and a touch-and-go landing were completed without incident.

While on the "down wind" leg, during the second circuit, the check captain simulated starboard engine failure. The cadet pilot carried out the required emergency drills and the starboard engine was manually feathered. The pre-landing checks were completed and the aircraft continued with the landing approach in an asymmetric configuration - with only the port engine operating. The check captain advised the control tower that the aircraft was asymmetric and requested clearance for a "full stop" landing with a 20 seconds delay on the runway for restart.

Then as the aircraft was about to touch down there was a sudden increase in engine power and a gear-up selection was made. The check captain and the cadet pilot blame each other for increasing the engine power. They do not agree regarding the sequence of events leading to the accident. The approach speed had, according to the check captain, dropped to 65 kt. The cadet pilot gave a figure of 74 kt.

The high increase in engine power on the only operating engine led to strong asymmetric thrust causing the aircraft to roll and to bank steeply towards the starboard side. The aircraft made a heavy touchdown on the runway, on its starboard undercarriage and immediately started skidding on its starboard wheel and starboard wing tip. It maintained this banked attitude as it headed away from the runway lighting into the dark, and proceeded across the adjoining grass strip towards the aerodrome perimeter to the right.

The aircraft skidded for some 220 m then crashed across a deep drainage ditch and through a barbed wire fence along the aerodrome perimeter. The fuselage broke in two during the crash and ground-looped through approximately 180° on its starboard wing. The wreckage came to a halt just outside the aerodrome perimeter about 150 m from the runway. Both the check captain and the cadet pilot crawled out of the wreckage via the upper escape hatch in the flight deck.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	-	-	-
Non-fatal	1	-	-
None	1	-	

1.3 Damage to aircraft

The aircraft was substantially damaged.

Fuselage: The fuselage broke in half and separated just ahead of the front attachment to the centre wing section. The entire fuselage was cracked and distorted.

- Mainplanes: The starboard wing was twisted and crumpled particularly towards the tip end. The wing centre section was broken around its attachment fittings to the fuselage.
- Powerplants: The port propeller and reduction gear unit separated from the engine. The propeller blades were severely bent with one blade broken in half.
- Control Surfaces: The starboard ailerons were completely detached. The starboard flaps were severely distorted.
- Cockpit Controls: The engine and flight cockpit controls were broken and disconnected.

1.4 Other damage

One runway light was hit and destroyed. Approximately 9 m of the aerodrome perimeter barbed wire fence were destroyed.

1.5 Crew information

The check captain, aged 50, was born in London, England. He holds a valid East African Airline Transport Pilot's Licence (ATPL) No. 1343 (K.1218) dated 8 September 1972. This licence was granted on the strength of FAA ATPL No. 2185762 issued on 31 July 1972. The licence is rated in Group I for the following aircraft types:

Pipers: PA 12, 18, 22, 23, 24, 25, 28, 30, 31 and 32.

Cessnas: 150, 172, 180, 182, 185, 206, 207 and 210.

BN 2A Islander

DHC-4 Caribou

Captain ... is a holder of an East Africa Full Instructor's Rating Certificate No. 338 (K.157) dated 20 December 1968, in Group 'A' and 'B' Private Pilot Privileges Part I aeroplanes with professional pilot's privileges - with restrictions not to give instruction in formation flying.

His last medical examination was completed on 2 January 1976, and he was declared medically fit to fly with the provision that he has available spectacles which correct for near vision while exercising the privileges of his licence.

Experience: Available records indicate that Captain ... had 4723.35 hours total flying experience as follows:

	<u>Single-Engine</u> (Hours)	<u>Multi-Engine</u> (Hours)	<u>Total</u> (Hours)
PI Day	3325.20	1093.35	4418.55
PI Night	75.35	74.25	157.00
Dual Day	136.40	6.15	142.55
Dual Night	9.10	1.35	10.45

Captain ... is an experienced pilot and instructor. He was properly licensed on the De Havilland DHC-4 type aircraft and had 36.10 hours flying experience on the aircraft.

The cadet pilot, aged 26 was born in Mbarara, Uganda. He holds a valid East African Commercial Pilot's Licence (CPL) No. 1571 (U.58) dated 25 February 1975. The licence is rated for Cessna 150 and Piper PA 23 type aircraft.

Experience: He has a recorded total flying experience of 455.40 hours with 253 hours as commander. His flying experience on twin-engined aircraft was recorded as 180.10 hours.

Flying experience on De Havilland DHC-4 Type Aircraft: Pilot ... started training on the DHC-4 type aircraft in July 1975. From July 1975, to March 1976, he trained under two different instructors and flew a total of 69.50 hours dual and 14.40 hours solo on the aircraft. In April 1976, he began training under Captain ... and he had completed 9.30 hours flying under his supervision.

He had passed the De Havilland DHC-4 Technical Type Rating examination on 13 November 1975. His last medical check-up was completed on 21 July 1975, and was valid for 12 months.

1.6 Aircraft information

5X-AAB, a De Havilland DHC-4A 'Caribou' Serial No. 222 was manufactured by De Havilland Aircraft of Canada, Limited, Toronto, Ontario, Canada in April 1965. The aircraft was powered by two Pratt and Whitney R.2000-7M2 engines with two Hamilton Standard 43D50-651 propellers. The aircraft arrived in East Africa in possession of an Export Certificate of Airworthiness (C of A) No. Ex-763 issued on 28 April 1965, by the Department of Transportation, Canada. On arrival an East African C of A No. 14 was issued on 17 June 1965, valid until 27 April 1966. The C of A was renewed and has been kept current up to the time of the accident.

The aircraft had been operating under Private and Aerial Work Categories until 30 March 1976, when the Category was changed to Public Transport (Cargo). The aircraft had to be operated in accordance with the Department of Transportation, Canada, Approved Flight Manual dated 20 January 1961, and revised 4 January 1971.

Maintenance history

The aircraft was maintained by the Uganda Police Airwing according to the inspection requirements detailed in Appendix III of the De Havilland DHC-4 Maintenance Manual, PSM-1-4-2 revised 1 February 1972. All the inspection requirements had been complied with.

The aircraft was not operated from 16 November 1971 up to 7 May 1975, during which period the C of A expired. To bring the aircraft back to C of A standards a major repair and inspection programme was undertaken by BALAIR Ltd. of Basel, Switzerland. The C of A was then renewed on 31 October 1975, at 1 711 airframe hours.

During the last 30 days preceding the accident the aircraft flew for 36 hours mostly for training purposes. There were no technical defects recorded during that period.

On the material date, the aircraft suffered a lightning strike in the morning, while being cleaned. This resulted in minor damage to both starboard wheels. The affected wheels were replaced and the electrical and compass systems checked and found serviceable. Prior to the flight, during engine power checks, the auto-feather system on the starboard engine was found not to be functioning. The engine could, however, be feathered manually.

At the time of the accident, the following hours had been recorded:

Airframe total hours since manufacture	1 953.36
" " " " last major check	242.36
" " " " 50 hours inspection	36.00
Port engine hours since overhaul	303.10
Starboard engine hours since overhaul	439.05
Port propeller hours since inspection	36.00
Starboard propeller hours since inspection	36.00

All additional mandatory modifications and inspections and DCA Notices applicable to the aircraft, its engines, propellers and equipment had been complied with.

1.7 Meteorological information

The accident occurred at night. The weather conditions at Entebbe Airport at approximately 1659 hours, were recorded by the control tower as follows:

Wind	Calm
Visibility	Better than 10 km
Clouds	1/8 Stratocumulus at 2 000 ft.
	1/8 Cumulonimbus at 2 500 ft.
	7/8 Cirrostratus at 30 000 ft.
QNH	1015.8
Temperature and Dew Point	21°C/18
Lightning conditions to the east.	

1.8 Aids to navigation

The aircraft was operating in a circuit pattern around the airport. The approach lights and runway lights were switched on.

1.9 Communications

The aircraft was in radio contact with the ground control unit until just prior to the accident.

1.10 Aerodrome and ground facilities

Entebbe Airport has three tarmac runways designated as 12/30, 17/35, 18/36 - at a field elevation of 3 782 ft. The aircraft had taken off from Runway 17 and was again landing on the same runway.

Runway 17 is 3 658 m long by 45 m wide. It has a Precision Approach CAT II Lighting System, Visual Approach Slope Indicator (VASI), and runway lighting along the edge, threshold, centre line and touchdown zone. There are marking aids indicating threshold touchdown area and the centre line. There are no obstructions along the approach to Runway 17.

The aerodrome is served by two fire stations - the main fire station and the Kigungu fire sub-station, situated towards the left side end of Runway 17. The Kigungu fire sub-station responded immediately after one of the fire officers had observed the crash. Two fire vehicles reached the wreckage within a few minutes after the accident, carried out rescue operations and put out smoke that was reported to be

coming from the port engine. Soon after, the emergency vehicle arrived and was used to transport the two crew members to the hospital. A few minutes later more fire vehicles reached the wreckage from the main fire station.

The aerodrome fire services conducted the rescue operations promptly. The early stages of the rescue operations were, however, not well co-ordinated. The recorded communications indicate some degree of confusion between the aerodrome fire services and the duty Air Traffic Control Officer immediately following the accident. The fire services had apparently initiated the rescue operation before the duty Air Traffic Control Officer was aware of their action. This led to the confusion.

1.11 Flight recorder

Not fitted and none required.

1.12 Wreckage

The wreckage was inspected, at the crash site, two days after the accident. It was observed from the skid marks that the aircraft first touched the ground on Runway 17, towards the right-hand side, and approximately 700 m from the runway threshold. The starboard wheel contacted the ground, immediately followed by the starboard wing tip. The aircraft then started grounding on its starboard wheel and wing tip, gradually turning towards the adjoining grass area to the right. The starboard wheel skid marks extended for approximately 35 m along the runway then crossed over to the adjacent pavement along the runway covering some 24 m before getting into the soft grass area. The skid marks continued for a further 55 m over the grass-covered soft ground then disappeared.

The starboard wing tip skid marks appeared initially outside the runway boundary but within the adjoining right-hand side shoulder. As it skidded, the wing tip apparently hit and destroyed one runway edge light. The skid marks disappeared shortly after crossing into the grass area then reappeared some 55 m further down, continuing steadily up to the crash site.

The aircraft covered a distance of approximately 220 m before it struck against the steep wall of a drainage ditch along the aerodrome perimeter. Thereafter it crashed through a boundary barbed wire fence. The force of the impact broke the fuselage into two and caused the aircraft to ground loop through approximately 180°. The wreckage came to a halt approximately 15 m beyond the aerodrome perimeter.

The fuselage was broken into two pieces, separated just ahead of the front attachments to the wing centre section. The front section was resting sideways on its port side and at a slight angle to the rest of the fuselage. The nose undercarriage appeared almost retracted and the fuselage underside severely distorted. The escape hatch in the flight deck was found open. The centre and aft fuselage sections and the mainplanes maintained their normal attitude and rested on the centre fuselage underside. The main undercarriage was almost fully retracted. There was extensive distortion and cracking along the entire centre fuselage section. The cargo door was found detached and lying under the starboard wing. The wing centre section was broken around the area of attachment to the fuselage. The starboard wing was severely twisted and crumpled with the ailerons torn loose and lying underneath the wing. The starboard flaps were in the full down position but distorted and loosely attached to the wing structure.

There was relatively little damage to the port wing.

The port powerplant appeared severely damaged. The propeller and reduction gear unit were found torn off the engine and resting on the opposite side just ahead of the starboard engine. One of the blades had broken in half. All the blades were severely bent and appeared to have rotated approximately 180° within the hub.

The starboard powerplant appeared to have suffered less serious damage. The engine was reported to have been feathered prior to the accident. The propeller blades were found feathered and had sustained relatively less damage.

The engine and flight controls in the cockpit were found to be no longer functional. Their settings had probably changed during the crash. Several control cables and rods had broken. Nevertheless the following positions of the cockpit controls were observed.

Engine throttles: both throttles were found in maximum open position.

Propeller Control Levers: both levers in medium pitch position.

Mixture Control Levers: right-hand lever in Auto Lean, left hand lever slightly forward of Auto Lean.

Flap Control Lever: 25° position.

Flap Position Indicator: 15°.

Undercarriage Selector Lever: up position.

Magneto Switches: left switches ON.
right switches OFF.

Generator Switches: ON

The Emergency Fuel and Oil Shut-off switches were found in the OFF position.

1.13 Pathological aspects

The check captain was admitted to hospital with a serious back injury. He remained hospitalized for 3 weeks. The cadet pilot sustained no injuries.

1.14 Fire

Fire did not break out. There were, however, reports of smoke coming from the port engine. The smoke was immediately put out by the Fire Crew Unit.

1.15 Survival aspects

The cockpit area remained relatively undamaged, although the entire front section of the fuselage had broken opened and was lying sideways on its port side. The two flight crew members were strapped in their respective seats during the accident. The seats structure and the safety belt systems suffered no breakage and completely supported the occupants during the crash.

The two crew members crawled out of the wreckage via the upper escape hatch in the flight deck.

1.16 Tests and research

Both the check captain and the cadet pilot stated that the aircraft was operating satisfactorily and that they observed no systems failure or malfunction prior to the accident. Investigations after the accident have revealed no systems defects that could have led to the accident. It appears that the accident occurred probably due to operational reasons.

The prescribed exercises for the Type Rating Flight Examination on multi-engined aircraft are detailed in the relevant requirements of the Directorate of Civil Aviation, East Africa. Among other things, the exercises include making an approach and landing under emergency conditions resulting from loss of power from one engine. The examination must be conducted in two parts, first in daylight and then after darkness. The flight in question was being conducted at night following completion, a day before, of the required day-time flight test.

The procedure for landing the aircraft with one engine inoperative are spelled out in the Flight Manual as follows:

- i) Down Wing Leg: The landing check-list should be completed except for flaps. Maintain speed at 95 kt.
- ii) Final approach

	<u>Aircraft weight up to 26 000 lb</u>	<u>Aircraft weight over 26 000 lb</u>
Wing Flaps	19°	14°
Airspeed (IAS)	76 kt	77 kt
Propeller lever	Full Increase	
Flaps	40°	30°

When a safe landing is assured and power is no longer required on the live engine.
- iii) Touchdown:

At approximately 69 kt (IAS) for aircraft weights up to 26 000 lb; and approximately 74 kt (IAS) for aircraft weights above 26 000 lb.
- iv) Go-around

The decision to go-around on one engine must be made while the flaps are still at the approach setting (19° up to 26 000 lb, 14° over 26 000 lb).

Take-off power should be applied and the landing gear retracted after which the flaps should be selected up.

1.17 Loading

The aircraft was properly loaded. There were two people on board and no baggage. The aircraft had a fuel load endurance of approximately 6 hours. The gross weight and centre of gravity were within the prescribed limits.

2.- Analysis and conclusions

2.1 Analysis

During the flight, the cadet pilot was expected to handle the aircraft under both normal and emergency conditions. The check captain as commander was responsible for the safety of the flight and was expected to carry out corrective action in case the cadet was unable to deal with any situation.

It should be noted that the cadet pilot had, for some time, been training under the same check captain and a strong student/instructor relationship most likely existed between the two crew members. This may have had a bearing on the cause of the accident.

Investigations have not been able to establish the sequence of events that occurred at the material time. The check captain and the cadet pilot blame each other for increasing the engine power at the critical time. According to the check captain, he made the 'GEAR-UP' call after the engine power had been increased and the aircraft had already banked and was heading into the dark towards possible obstructions. The cadet pilot on the other hand stated that the captain made the 'GEAR-UP' call and then increased the engine power while the aircraft was still lined up with the runway. The aircraft was by then reported to have attained a speed of 65 kt (IAS) by the check captain. The cadet pilot reported a speed of 74 kt (IAS).

Each of the two crew members stuck to his version of the story and in the absence of a flight recorder and/or a cockpit voice recorder, the investigation has not been able to establish the correct sequence of events prior to the accident.

From the communications with the control tower just before the accident, the check captain had indicated that they intended to do a "full stop" landing with a 20 seconds delay on the runway for re-start. It would appear, therefore, that the aircraft was by then in a touchdown configuration and any attempt to go-around would have been unsuccessful as the aircraft was by then too low, had full flaps and had a speed below V_{mc} . Under these conditions, the increase in engine power would introduce adverse asymmetric thrust causing the aircraft to roll steeply in the direction of the feathered engine. This would lead to the starboard wing tip coming into contact with the ground.

The position of the engine cockpit controls, as found, and the nature and extent of damage suggest that the live engine was still under considerable power when the aircraft finally crashed. Up to the last moment, therefore, it would appear that efforts were apparently still being made to get the aircraft airborne again.

The statements by both the check captain and the cadet pilot indicate that each did not know what the other was doing immediately prior to the accident. There should have been a common understanding between the two considering that they had been training together for some time.

When the aircraft rolled and banked towards the starboard side, it headed in the dark, away from the runway lighting. The crew, as stated by the check captain, probably lost all orientation and were in no position to carry out the necessary recovery manoeuvres.

2.2 Conclusions

a) Findings:

- 1) The aircraft had been properly maintained and its documentation was in order.
- 2) The check captain was properly licensed and the cadet pilot qualified to undertake the flight test.
- 3) The aircraft was properly loaded and its centre of gravity was within the prescribed limits.
- 4) The aircraft was about to touch down in an asymmetric configuration when engine power on the live engine was suddenly increased.
- 5) The aircraft banked, struck the ground and finally crashed.
- 6) Both the check captain and the cadet pilot blame each other for increasing the engine power.
- 7) Investigations have revealed no evidence of any in-flight failure or malfunction of the aircraft structures, systems or powerplants, prior to the accident.
- 8) The check captain and the cadet pilot had been training together in the preceding weeks.
- 9) The cadet pilot had on the previous day completed the day-time flight test with the same check captain.
- 10) The cadet pilot was making the landing approach from the left seat.
- 11) The check captain was responsible for the safety of the flight.
- 12) The check captain may have relaxed his supervision of the flight immediately prior to the accident.
- 13) There was lack of common understanding between the two crew members of what each other was doing at the critical time.
- 14) The crew became disoriented once the aircraft rolled and headed away from the runway lighting into the darkness.
- 15) It was too late for the aircraft to execute go-around under the prevailing conditions.
- 16) The investigation has not been able to establish the correct sequence of events at the critical time immediately prior to the accident.

b) Cause

The accident occurred most probably due to strong asymmetric thrust caused by increasing engine power on the operative engine when the aircraft was about to touch down with one engine feathered. Contributory factors were:

- i) the lack of understanding between the two flight crew members of what each other was doing immediately prior to the accident.
- ii) the student/instructor relationship between the two and the prevailing dark night-time conditions.

3.- Recommendations

It is recommended that:

- 1) Consideration be given to the possible adverse consequences when a student/instructor relationship exists while conducting a flight examination.
- 2) Check captains be reminded of the importance of continually supervising the flight tests they are conducting.
- 3) Consideration be given to having on board a third properly rated supernumary member of the flight crew, apart from cadet pilots, when conducting training or check-out flights.
- 4) Flight instructors be required to attain a specified minimum flying experience on a given aircraft type before they can conduct training flights or examination checks on that type of aircraft.
- 5) Consideration be given to the possible consequences when rescue operations are initiated at airports without proper communication with the control tower.