Aviation Safety Investigation Report 199300849

Swearingen Aviation Corp Metro 2

14 April 1993

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Aviation Safety Investigation Report

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Occurrence Number: 199300849 **Occurrence Type:** Accident
Location: Mackay
State: QLD **Inv Category:** 3
Date: Wednesday 14 April 1993
Time: 0525 hours **Time Zone** EST
Highest Injury Level: Minor
Injuries:

	Fatal	Serious	Minor	None	Total
Crew	0	0	1	0	1
Ground	0	0	0	0	0
Passenger	0	0	0	0	0
Total	**0**	**0**	**1**	**0**	**1**

Aircraft Manufacturer: Swearingen Aviation Corp
Aircraft Model: SA226-TC
Aircraft Registration: VH-UZS **Serial Number:** TC-320
Type of Operation: Charter Cargo
Damage to Aircraft: Substantial
Departure Point: Archerfield Qld
Departure Time: 0331 EST
Destination: Mackay Qld

Crew Details:

Role	Class of Licence	Hours on Type	Hours Total
Pilot-In-Command	ATPL 1st Class	181.0	2670

Approved for Release: Friday, May 17, 1996

SYNOPSIS

The aircraft was operating a freight charter flight, cruising normally at an altitude of 20,000 ft (FL200), when, about 150 km south-east of Mackay, the left engine lost power and could not be restarted. During the subsequent landing on runway 14 at Mackay, the pilot attempted a single engine go-around when he suddenly had the (mistaken) impression that the landing gear was not down. He temporarily lost control of the aircraft but recovered to touch down on the flight strip to the left of the runway, some 500 m before the runway end. During the landing roll, the landing gear collapsed and the aircraft sustained substantial damage.

The report concludes that the engine power loss was caused by failure of the fuel pump high pressure relief valve.

The pilot, believing that the landing gear was still retracted, initiated action to avoid a wheels-up landing. This action was initiated too late in the landing approach for a successful outcome.

1 FACTUAL INFORMATION

1.1 History of flight

The aircraft was operating a freight charter flight from Archerfield to Mackay. The flight proceeded normally until about 150 km south-east of Mackay when, while cruising at FL200, the left engine lost power. The pilot feathered the propeller and made three unsuccessful attempts to restart the engine. At each attempt, the indicated fuel flow remained at zero. The pilot then directed his attention to conducting a single engine landing at Mackay.

The pilot reported that he positioned the aircraft to arrive abeam the upwind end of runway 14 at 2,000 ft at an airspeed of 180 kt. The descent was continued on the downwind leg, with the aircraft abeam the threshold at 1,500 ft, indicating 150-160 kt. Early in the base turn, and at an airspeed of 130-140 kt, the landing gear was selected down (with three green indicator lights illuminated) and flaps set to one quarter. The pilot recalled that the Visual Approach Slope Indicator (VASI) was indicating two to three dots high at this stage. Half flap was selected after two-thirds of the base turn had been completed. The aircraft was rolled out on final at 120-130 kt, with the VASI indicating 2-3 dots high. Three quarter flap was then selected. The pilot selected full flap when he judged that touchdown on the runway was assured and confirmed that the landing gear indicator was still showing three green lights. He noted that the airspeed was reducing towards Vref (the pilot had earlier calculated Vref to be 111 kt). The aircraft was still high on the approach so the pilot lowered the nose and pointed the aircraft at the threshold. He recalled the airspeed indicating 118 kt as the aircraft crossed the end of the runway.

The pilot flared the aircraft for landing and believed that it was settling normally as he reduced power on the right engine. As the aircraft floated, however, he felt the aircraft sinking and suddenly experienced a very strong perception that the landing gear was not down and that the propellers were about to contact the runway surface. The pilot reacted to this sensation by immediately applying full power to the right engine in an attempt to go-around. However, the aircraft pitched up and began rolling uncontrollably to the left. When he realised he could not control the aircraft, the pilot reduced power on the right engine and stabilised the aircraft which, by this stage, was above the flight strip to the left of the runway. He landed the aircraft on the flight strip, touching down about 500 m from the far end of the runway. During the landing roll, the landing gear collapsed and the aircraft skidded on its under-belly through the airport boundary fence, coming to rest at the edge of an area of mangroves about 200 m beyond the end of the runway.

1.2 Injuries to persons

The pilot, the only occupant of the aircraft, received minor injuries in the accident.

1.3 Damage to aircraft

All three landing gears had failed rearwards. The nose landing gear became wedged beneath the cockpit, causing distortion to the lower fuselage around the nose landing gear attachment point and at the rear cockpit bulkhead. There was substantial damage to the engine nacelles, propellers, and engine mounts.

1.4 Personnel information

The pilot in command was 29 years old. He held a current First Class Airline Transport Pilots Licence and was appropriately endorsed on Swearingen SA226 aircraft. His total flying experience at the time of the accident was 2,670 hours, of which 181 were on type. The pilot had 2,350 hours flying experience on multi-engined aircraft and 1,500 hours experience on turbine engined aircraft.

1.5 Aircraft information

The aircraft was a Swearingen Aviation Corporation SA226-TC, Serial Number TC-330, manufactured in the USA in 1979. It was powered by two Garrett Airesearch TPE-331-10 turboprop engines.

1.6 Meteorological information

The weather at Mackay at the time of the accident was reported to have been fine with a light south-easterly wind. The beginning of daylight on the day of the accident was 0550 hours EST.

1.7 Communications

Satisfactory radio communications existed between the aircraft and Brisbane Flight Service. The pilot did not declare an emergency or advise Flight Service of the engine failure.

1.8 Aerodrome information

Runway 14/32 at Mackay is 1981 m in length. It is 45 m wide and has a surface of grooved asphalt. The runway is equipped with T-VASIS approach slope indicator system, set for a 3 degree glide slope.

1.9 Flight recorders

The aircraft was equipped with a Collins 642C-1 cockpit voice recorder. The unit was removed from the aircraft and replayed following the accident. The quality of the recording was satisfactory and the contents of the tape supported the pilot's account of the sequence of events.

1.10 Wreckage information

The aircraft's weight and centre of gravity at the time of the accident were within limits.

Examination of the left engine revealed a failure of the threaded section of the fuel pump assembly high pressure relief valve body. When the part was disassembled, the packing washer that fits between the threaded section and the hexagon portion of the valve body was missing. The face of the hexagon portion of the valve body contained marks consistent with the cap having been tightened against this face. The fracture surface was indicative of overload failure.

No reason could be determined for the packing washer not being fitted, nor could it be determined who might have tightened the valve cap.

1.11 Survival aspects

The aircraft was equipped with full safety harnesses for both cockpit seats. The pilot reported that his habit was to fly with the lap strap secured and the shoulder straps undone during the cruise. On this occasion, he forgot to reconnect the shoulder straps before landing. He recalled that, during the impact sequence, he braced himself with his hands against the instrument panel coaming.

The pilot did not advise any air traffic services agency of the emergency. Mackay Tower was not manned at the time of the accident, nor were any emergency services in attendance at the airport.

1.12 Human performance aspects

1.12.1 Pilot's recent history

The accident flight was the pilot's first duty period following a three day break. He had worked on three of the four days before the break, commencing duty not earlier than 0500 hours and finishing not later than 2300 hours on each occasion.

On the night of the accident, the pilot rested from about 2300 hours to 0200 hours. This was his normal practice. The pilot said that he routinely felt tired during early morning flights and this occasion was no different.

1.12.2 Stress

In unexpected and unusual situations, an individual's stress level increases. In high stress situations, performance can degrade as the individual tends to restrict or focus attention on that which is perceived to be the primary demand (an effect often termed narrowing of attention).

1.12.3 Workload

The ability of the human to process information is limited. Influences such as stress and fatigue can increase the perception of the demands of the task and therefore increase workload. In work overload conditions, the human responds in one of the following ways:

1. Omission - Ignoring some aspect of or responsibility associated with the task.

2. Error - Information is processed incorrectly.

3. Queueing - Responses are delayed until lulls occur in workload.

4. Filtering - Certain categories of information are omitted according to some priority scheme.

5. Approximation - Responses become less precise.

6. Regression - Responses are in accordance with previous overlearned behaviour.

7. Escape - Giving up.

1.12.4 Information processing

When making decisions, an individual will search the environment for critical cues. Evidence is available which suggests that the decision maker's cue seeking behaviour is heavily influenced by any hypothesis which may have already been chosen. Information which is consistent with the hypothesis is used in the decision making process while information which is inconsistent is ignored. Such a scenario is particularly relevant in high stress situations. Equally, when there is pressure to make a decision quickly, the chance of making an error increases - a phenomenon which is known as the speed-accuracy trade-off. This trade-off often occurs when the consequences of making an error are most unforgiving, such as when landing an aircraft.

1.13 Additional information

1.13.1 Asymmetric flight training

The pilot had completed the required training for his endorsement on the SA226-TC aircraft. This training included asymmetric flight training and involved circuits and landings with an engine set at zero thrust. The accepted standard technique for asymmetric circuit training is for the pilot to fly as close to a normal circuit as possible, using power as required on the live engine to achieve the required performance.

The pilot indicated that the conversion training he undertook on the aircraft included a number of practice asymmetric circuits and landings with the failed engine set at zero thrust, not shut down. These circuits were flown using the height and speed parameters for a normal circuit with the aircraft carrying no load other than the pilot and check pilot.

CAO 40.1.0 Appendix III specifies the flying training syllabus applicable for a type conversion on to SA226-TC aircraft. Paragraph 1(d) of the CAO refers to asymmetric flight and lists, as one requirement, approach and landing with one or more engines inoperative (at least twice). The CAA advised that there was no requirement for landings to be conducted with one propeller feathered and it was acceptable for an engine to be set at zero thrust for landing.

1.13.2 Single engine operations aspects

The pilot said that, for the arrival at Mackay, his aim was to maintain aircraft speed close to, but not below, normal and to remain slightly high compared to a normal powered approach. He was very conscious of the need not to let the aircraft get too low or slow and felt that, in flying the type of circuit described, he had achieved his aim.

The pilot provided a comparison between the parameters he used for a normal powered circuit and those flown for the single engine approach into Mackay.
When abeam the upwind end of the runway, the aircraft should be at 1,000 ft, 210 kt and with 1/4 flap lowered. The pilot reported that his aircraft was at 2,000 ft and 180 kt, with the flap still up.

By mid-downwind, the aircraft should be maintaining 1,000 ft, airspeed 180 kt with 1/2 flap lowered. The pilot stated that the descent was still continuing at this point.

By abeam the runway threshold the aircraft should still be at 1,000 ft with the speed reduced to 170 kt and the gear down. Abeam the threshold, the aircraft was passing 1,500 ft at 150 to 160 kt.

One third of the way around base, the aircraft should be at 140 to 150 kt. The pilot reported that it was at 130 to 140 kt with the gear down, 1/4 flap lowered and three dots high on the VASI.

Two thirds of the way around base, the aircraft should have been at 130 kt. At this point the pilot lowered half flap.

The aircraft should be lined up on final approach not below 500 ft when full flap can be selected. The pilot reported that the aircraft was at 120 to 130 kt when lined up on final approach with 3/4 flap selected and two to three dots high on the VASI.

Mid to late final approach, the pilot should have been flying to achieve a Vref airspeed of 111 kt at 50 ft. At this stage, the aircraft was configured with full flap, airspeed decreasing towards Vref and still above the desired glide slope. The pilot then lowered the nose and "aimed the aircraft" at the threshold.

2. ANALYSIS

The Specialist Report details the cause of the failure of the fuel pump assembly high pressure relief valve. Failure of this valve interrupted the flow of fuel to the engine. This not only caused the engine failure, but also prevented a restart.

A key issue in this accident was the pilot's decision to fly a non-standard approach. The aircraft was carrying about 650 kg of freight at the time of the occurrence. Thus, the pilot was operating the aircraft at a considerably higher weight than that at which he had conducted asymmetric training. The pilot was also conscious of not allowing the aircraft to get too low or too slow at any stage of the approach. It is probable that these two aspects led him to adopt a continuously descending approach from 2,000 ft abeam the upwind end of the runway instead of flying a standard 1,000 ft circuit.

The effect of flying the modified circuit was to place the pilot in a situation involving judgements and assessments with which he was not familiar as he had not previously flown such an approach. The aircraft was higher than normal for the complete circuit and, according to the pilot, crossed the end of the runway at an airspeed of 118 kt. The calculated Vref was 111 kt. The less than normal propeller drag (due to the left propeller being feathered) would have reduced the rate of deceleration of the aircraft after the pilot closed the throttles and flared the aircraft for landing. The pilot had not previously conducted a landing in the aircraft type with one propeller feathered. He therefore had no reference upon which to base his expectations concerning the rate of deceleration in this configuration. The pilot also indicated that after flaring the aircraft for landing, he held it off the runway rather than flying it on. These three elements - the high speed, the lower drag, and the pilots landing technique - would all have contributed to prolonging the float before the wheels contacted the runway.

The pilot described experiencing a sinking feeling which led him to believe that the landing gear was not down. This feeling most probably resulted from the float during the flare. Although he indicated otherwise during interview, the pilot's stress level was probably elevated during the arrival at Mackay. The higher the stress level, the less likely it would have been for the pilot to recall the "three greens" landing gear check he had completed on base and final approach and to assess this against the sinking feeling.

In most situations in which an aircraft is close to the ground and uncertainty arises as to whether a safe landing can be made, the familiar pattern of behaviour would be for the pilot to remove the aircraft from the immediate threat by increasing power and climbing away. In this instance, the pilot seems to have done this almost as an unconscious automatic reaction to the sudden (misconceived) impression that the landing gear was not extended. It is perhaps indicative of the level of stress he was under at that instant, that he reacted in the manner he did.

As soon as the aircraft began rolling left after power had been increased on the right engine (the airspeed would almost certainly have been below Vmca by this time), the pilot quickly recognised the situation and reacted correctly by closing the throttle and landing the aircraft.

The pilot was fortunate that the deceleration forces experienced during the off-runway landing were relatively low, as he had not secured his shoulder harness (this omission may be another indication of his stress level). The pilot was also fortunate that assistance after the landing was not required from any of the emergency services. The aerodrome was unmanned at the time of the accident and no emergency services had been activated because the pilot had not advised any agency (other than his company) of the abnormal situation.

3. CONCLUSIONS

3.1 Findings

1. The pilot was appropriately licensed and qualified, and medically fit, to undertake the flight.

2. The aircraft weight and centre of gravity were within limits.

3. The left engine failed, and could not be restarted, following failure of the fuel pump high pressure relief valve for that engine.

4. The pilot did not notify any agency, other than his company, of the emergency situation prior to the approach.

5. The pilot conducted a non-standard, single-engine approach into Mackay.

6. The pilot had not previously conducted a landing in the aircraft with one propeller feathered.

7. The pilot was probably experiencing some stress during the approach and landing.

8. The aircraft speed across the threshold was about 7 kt above the reference threshold speed.

9. A combination of reduced propeller drag, high threshold speed, and the landing technique of the pilot resulted in the aircraft floating for a substantial distance along the runway.

10. The pilot formed a false hypothesis that the landing gear was not extended.

11. The pilot initiated and then discontinued a single-engine go-around at a speed below Vmca.

12. The aircraft subsequently landed on unsuitable terrain adjacent to the runway.

13. The pilot did not have his shoulder harness secure for the landing.

3.2 Significant Factors

1. Failure of the fuel pump high pressure relief valve interrupted fuel flow to the engine.

2. During the subsequent single-engine landing, a combination of reduced propeller drag, high threshold speed, and the landing technique of the pilot resulted in the aircraft floating for a substantial distance along the runway.

3. The pilot perceived that the landing gear was not extended and attempted a single-engine go-around at a speed below Vmca.