Australian Government

Australian Transport Safety Bureau

Piper Aircraft Corp PA-34-200, VH-CTT
Bankstown Airport, NSW
11 November 2003

INVESTIGATION REPORT
BO/200304589

CONTENTS

INTRODUCTION

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal Bureau within the Australian Government Department of Transport and Regional Services. ATSB investigations are independent of regulatory, operator or other external bodies.

In terms of aviation, the ATSB is responsible for investigating accidents, serious incidents and incidents involving civil aircraft operations in Australia, as well as participating in overseas investigations of accidents and serious incidents involving Australian registered aircraft. The ATSB also conducts investigations and studies of the aviation system to identify underlying factors and trends that have the potential to adversely affect transport safety. A primary concern is the safety of commercial air transport, with particular regard to fare-paying passenger operations.

The ATSB performs its aviation functions in accordance with the provisions of the Transport Safety Investigation Act 2003. The object of an occurrence investigation is to determine the circumstances to prevent other similar events. The results of these determinations form the basis for safety action, including recommendations where necessary. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations.

It is not the object of an investigation to determine blame or liability. However, it should be recognised that an investigation report must include factual material of sufficient weight to support the analysis and conclusions reached. That material will at times contain information reflecting on the performance of individuals and organisations, and how their actions may have contributed to the outcomes of the matter under investigation. At all times the ATSB endeavours to balance the use of material that could imply adverse comment, with the need to properly explain what happened, and why, in a fair and unbiased manner.

The 24-hour clock is used in this report to describe the local time of day, Eastern Summer Time (ESuT), as particular events occurred. Eastern Summer Time was Coordinated Universal Time (UTC) + 11 hours.

EXECUTIVE SUMMARY

On 11 November 2003, at about 1240 eastern summer time, a qualified pilot, with a flight instructor, was undertaking multi-engine aircraft training in a Piper Aircraft Corp PA-34-200 Seneca, registered VH-CTT. The training was to include flight with one engine intentionally set to produce little or no thrust. The pilot occupied the left front seat of the aircraft, and the instructor the right front seat.

The aircraft departed runway 11 centre and turned right to operate in the southern training circuit using runway 11 right (11R). They had completed three circuits and were turning onto the final approach to runway 11R, for a fourth touch and go, when the aerodrome controller (ADC) saw that the aircraft's landing gear was not extended. The ADC queried the pilots regarding the landing gear and then saw the landing gear extend as the aircraft continued the approach. Neither pilot acknowledged the ADC's radio transmission. The ADC then issued a clearance for a touch and go to runway 11R. The instructor acknowledged the transmission by reading back that clearance.

Witnesses reported that when the aircraft was almost over the threshold to runway 11R it commenced to diverge right while maintaining a low height. They reported that when the aircraft was abeam the mid length of the runway, it's nose lifted and the aircraft banked steeply to the right before impacting the ground in a near vertical nose-down attitude.

A fire ignited after the impact. The main cabin door, located on the right side, separated from the aircraft during the accident. The instructor vacated the aircraft through that opening about 30 seconds after the aircraft came to rest. The pilot was fatally injured. The instructor received severe burns and was treated in hospital for three and a half weeks before succumbing to those injuries.

The investigation found a number of anomalies in the engines, but these were considered to not have affected the circumstances of the occurrence. The witness descriptions of the aircraft during the go around and the flight profile immediately before impact suggests that it may have been operating in an asymmetric configuration during the go around. However, the investigation was unable to confirm the configuration of the aircraft immediately prior to the accident. Pilot incapacitation was unlikely to have been a factor in the accident.

It is likely that the instructor had reduced the right engine power to simulate the failure of that engine. The indications that both engines were delivering power at impact may reflect recovery actions initiated by the pilots at some stage during the go around. However, any such recovery was apparently too late to be effective.

The position of the landing gear prior to impact was most likely retracted, but could not be established by either witness information or wreckage examination. The position of the wing flaps at impact could not be conclusively determined.

The investigation found that control of the aircraft was lost at a height from which recovery was not possible. The reason for the loss of control could not be conclusively determined.

Following a number of accidents in recent years, involving twin-engine aircraft that incurred a loss of some or all engine power, the ATSB implemented a research project (B2005/0085) into power loss related accidents involving twin-engine aircraft. That report was approved for public release 27 June 2005.

On 1 December 2003, the Minister for Transport and Regional Services issued an Instrument of Direction to the Australian Transport Safety Bureau (ATSB). That instrument directed the ATSB to 'investigate the effectiveness of the fire fighting arrangements for Bankstown Airport as they affected transport safety at Bankstown Airport on 11 November 2003'. The report of that investigation was issued on 24 December 2004 (BO/200305496) and is available from the ATSB website www.atsb.gov.au or from the Bureau on request.

1 FACTUAL INFORMATION

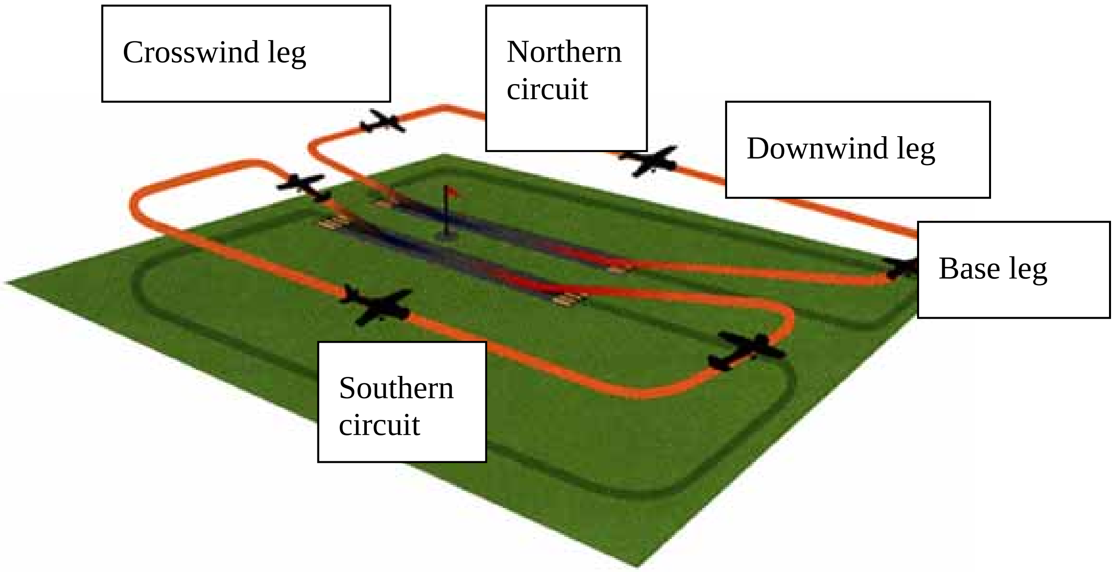
1.1 History of the flight

On 11 November 2003, at about 1240 eastern summer time at Bankstown Airport, a qualified pilot (pilot), with a flight instructor (instructor), was undertaking multi-engine aircraft training in a Piper Aircraft Corp PA-34-200 Seneca, registered VH-CTT. The flight was to be conducted in the aerodrome circuit area under visual meteorological conditions. The flight was the fifth lesson of a course consisting of a minimum of 7 hours of aircraft dual control training made up of hourly lessons. The lesson was planned, 'to teach the student to be able to handle an engine failure[1] after take-off, [in the] circuit, [during a] go-around and [when] landing'.

The pilot occupied the left front seat while the instructor, who was the pilot in command, occupied the right front seat. The flight was the first for the day for both pilots and the aircraft.

The aircraft departed runway 11 centre (11C) and turned right to enter the southern training circuit using runway 11 right (11R). The pilot completed a touch and go[2] on runway 11R, on runway 11C, again on runway 11R and was turning onto the final approach to runway 11R for a fourth touch and go when the aerodrome controller (ADC) saw that the aircraft's landing gear was not extended. Figure 1 depicts simultaneous circuit operations for an aerodrome with two parallel runways that is similar to the circuit operations used at Bankstown Airport[3].

Figure 1: Simultaneous circuit operations[4]



[1] Asymmetric flight training is the simulation of, and response to, the failure of one engine in a twin-engine aircraft.

[2] A 'touch and go' is a practice landing during which the aircraft briefly touches the runway before taking off for a further circuit.

[3] Bankstown has three parallel runways – see Figure 3.

[4] Adapted from the Civil Aviation Safety Authority Visual Flight Guide.

The ADC queried the pilots regarding the landing gear and then saw the gear extend as the aircraft continued the approach. Neither pilot acknowledged the ADC's radio transmission. The ADC then issued a clearance for a runway 11R touch and go. The instructor acknowledged the transmission by reading back that clearance.

Witnesses reported that when the aircraft was almost over the runway 11R threshold, it commenced to diverge right while maintaining a low height. They reported that when the aircraft was abeam a position about halfway along the runway, it's nose lifted. The aircraft was then seen to bank steeply to the right before impacting the ground in a near vertical nose-down attitude.

The right wingtip hit a mound of dirt, before the right propeller and engine struck the ground, followed shortly after by the nose, left propeller and engine. The right engine separated from the aircraft. The remaining cabin and empennage fell to the ground and slid backwards for approximately 20 m before coming to rest in a level area.

A fire ignited after the impact. The main cabin door, located on the right side separated from the aircraft during the accident. The instructor vacated the aircraft through that opening about 30 seconds after the aircraft came to rest. The pilot was fatally injured. The instructor received severe burns and a broken right ankle. He was treated in hospital for three and a half weeks before succumbing to those injuries.

Figure 2: Accident site and aircraft wreckage

1.2 Injuries to persons

Injuries	Crew	Passengers	Others	Total
Fatal	2			2
Serious				
Minor				
None				

1.3 Damage

The aircraft was destroyed by impact forces and post-impact fire. No other damage was reported.

1.4 Personnel information

Flight instructor

Type of licence	Commercial pilot (Aeroplane)
Medical certificate	Class 1 renewed 7 July 2003
Flying experience (total hours)	1,623
Hours on the type	100
Hours flown in the last 24 hours	4
Hours flown in the last 7 days	9
Hours flown in the last 90 days	98

The instructor had completed aviation training at a university in New Zealand before returning to Australia to continue flying training in mid-1999 at the flying school that operated CTT. In October 1999 he gained an instructor rating and soon after commenced work as an instructor with the flying school. During late 2000, he successfully completed a multi-engine aircraft rating. The majority of that training was conducted in CTT. In late 2001, the instructor completed a number of Air Transport Pilot Licence theory subjects with a Queensland based training organisation and returned to the flying school in June 2002.

On 6 September 2002, he was rated as a Grade 1 instructor and on 9 September 2003, the instructor was assessed and subsequently issued with a multi-engine instructor rating by a CASA approved testing officer. The majority of the instructor's subsequent flying was in CTT.

The instructor held a valid Class 1 medical certificate. He was reported to have been well rested and in good health prior to the flight. He was properly qualified to undertake the flight.

Pilot under training

Type of licence	Private pilot (Aeroplane)
Medical certificate	Class 1 renewed 14 April 2003
Flying experience (total hours)	293.4
Hours on the type	15.0
Hours flown in the last 24 hours	2.4
Hours flown in the last 7 days	4.0
Hours flown in the last 90 days	15.6

The pilot was a Chinese national from Hong Kong and had spent four years studying[5] in Canada before coming to Australia. Since December 2001, he had been training with the flying school. On 26 February 2002, the pilot completed a general flying progress test and received a single-engine aircraft rating on 10 March 2002. On 25 March 2002, he was issued with a Private Pilot Licence.

Between April and July 2002, the pilot flew six times in CTT with two different instructors. None of those flights were with the instructor involved in the accident flight. It was reported that the flights were for a multi-engine aircraft rating, but that the pilot ceased that training, before completion, to concentrate on his commercial pilot licence theory subject studies.

On 20 October 2003 the pilot re-commenced multi-engine aircraft training. He had flown with the instructor in CTT on 20, 21 and 22 October and on 10 November 2003. The accident flight was the fifth flight in that aircraft since re-commencing multi-engine training and the eleventh time he had flown CTT.

The pilot held a valid Class 1 medical certificate. A friend reported that the pilot had been in good health and his associates reported that he spoke ‘excellent English’.

1.5 Aircraft information

Manufacturer	Piper Aircraft Corporation, USA
Model	PA34-200 Seneca
Serial number	34-7250261
Registration	VH-CTT
Year of manufacture	1972
Maintenance release (A24633)	Valid to (7,426.5 hours/29 Oct 2004)
Total airframe hours	7,335.6
Maximum take-off weight	1,905 kg
Actual take-off weight	1,699 kg
Weight at occurrence	1,674 kg (estimated)
Allowable centre of gravity limits	2,100 to 2,300 mm
Centre of gravity at occurrence	2,100 mm (estimated)

The Piper Seneca was a six seat, twin-engine aircraft, similar in performance and operation to other light twin-engine aircraft commonly used in flying training. It had dual flight controls and was capable of being flown from either of the two front seats.

[5] The studies were unrelated to aviation.

Unlike most light twins, the Seneca's propellers rotated in opposite directions. This was to remove the need to consider the 'critical engine', in the event of an engine failure, as failure of either engine would result in a similar performance degradation. Cabin access was via a main door on the right side and a rear door located behind the trailing edge of the left wing. The main door was the primary access to the two front seats and the rear door was the primary access to the four other seats.

The aircraft had been operated by the flying school since 1988. It was certified to be operated under the airwork operational category.

The aircraft's flight manual (AFM) was required for aircraft certification. The certification authority did not require the manual to specify how a pilot was to check that the landing gear was in the down position. That information was contained in the Pilot's Operating Manual (POM) that was issued with the AFM.

The AFM included a minimum controllability (single engine) speed of 68 kts. The POM advised that, 'Vmc[6] – Minimum Single Engine Control Speed for the Seneca had been determined to be 80 miles per hour (MPH) [69 kts]'. As a safety precaution, the manual advised that under single-engine flight conditions, either in training or emergency situations, a pilot should maintain an indicated airspeed above 90 MPH (78 kts).

The POM recommended that during the approach to a landing, the position of the landing gear should be checked on the downwind and final legs of the circuit. The landing gear position is confirmed by the three green indicator lights on the instrument panel and by the use of an external mirror for the nose gear.

The flying school's chief flying instructor reported that it was normal practice to conduct landing gear checks 'on the downwind, base and final legs of the circuit; when the aircraft crossed the aerodrome boundary and in the flare prior to landing'.

The aircraft was also fitted with a landing gear warning switch that when activated, would cause a horn to sound and a gear unsafe red light to illuminate on the aircraft's instrument panel. That switch was designed to activate when the landing gear selector was in the raised position and the engines were operating at less than 14 inches of manifold air pressure.

The AFM and POM both recommended a wing flap setting of zero degrees during takeoff and 40 degrees during landing.

1.6 Meteorological information

The air traffic control automatic terminal information service[7] recorded information India at 1242 and reported that:

- runway 11L was available for arrivals and departures on frequency 132.8 KHZ
- runway 11R was available for circuit training on frequency 123.6 KHz
- runway 11C was active; no frequency specified
- the wind direction was 140 degrees magnetic (M) at a speed of 8 kts
- the temperature was 27 degrees
- the air pressure was 1015 hectapascals

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[6] Vmc is the calibrated airspeed below which a twin-engine aircraft cannot be controlled in flight with one engine operating at take off power at sea level density altitude and the other engine windmilling.

[7] ATIS – the provision of current, routine information to pilots of arriving and departing aircraft by continuous and repetitive broadcasts. The recorded information is alphabetically coded to identify when conditions have changed.

- conditions were CAVOK[8].

Weather information recorded by the Bureau of Meteorology for the day of the accident revealed that at 1230, the:

- wind direction was from 100 degrees M at a speed of 9 kts, gusting to 13 kts
- temperature was 27 degrees C
- air pressure was 1015 hectopascals
- sky was clear below 12,500 ft
- visibility was greater than 10 km.

At 1300, the:

- wind direction was from 110 degrees M at a speed of 13 kts, gusting to 18 kts
- temperature was 27 degrees C
- air pressure was 1015 hectopascals
- sky was clear below 12,500 ft
- visibility was greater than 10 km.

A pilot operating in the runway 11R circuit reported that the weather was, 'a little bit convective with left crosswind'.

1.7 Communications

All communications between air traffic control (ATC) and the crew were recorded by ground based automatic voice recording (AVR) equipment for the duration of the flight. The quality of the recorded transmissions was good.

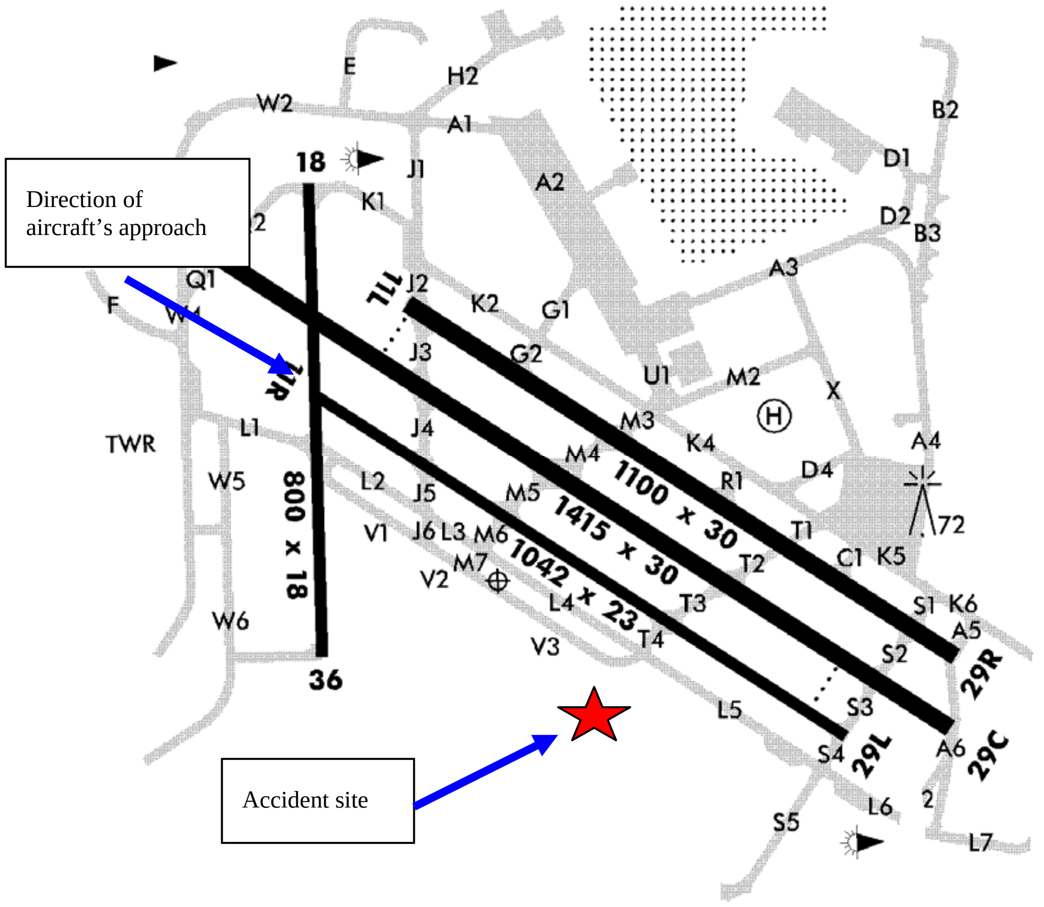
1.8 Aerodrome information

Bankstown Airport was primarily used for flying training, charter and private operations, and aircraft maintenance. It was one of six aerodromes in Australia where General Aviation Airport Procedures (GAAP) were used.

There were three parallel runways orientated 11/29 (111/291 degrees M) and one orientated 18/36 (167/347 degrees M). The northern runway (11L/29R) was primarily used for arrivals and departures, the southern runway (11R/29L) was used for circuit training and the centre runway (11C/29C) was available, for operational reasons or during busy periods.

[8] Nil cloud below 5,000 ft and visibility greater than 10 km.

Figure 3: Bankstown Airport diagram and location of accident site



Relative to the threshold of runway 11R, the accident site was on a bearing of 21 degrees to the right of the runway centreline and 610 m from the threshold. The site was located approximately 229 m south-west of the runway centreline.

Runways have a defined area, called the 'runway strip' that consists of an area either side of the runway and the stopways, if included. The runway strip was intended to reduce the risk of damage to aircraft running off a runway and to protect aircraft from obstructions when flying over it during take-off or landing operations.[9] Runway 11R was 23 m wide, 1042 m long and the required minimum width of the runway strip was 60 m.[10] The runway 11R strip was 86 m wide.

A number of dirt mounds, 1.5 m to 2 m above ground level, were located on the northern edge of an area of fill. The closest mound was about 200 m from the runway 11R centreline. The Civil Aviation Safety Authority Manual of Standards Part 139 – Aerodrome, Chapter 7: *Obstacle Restriction and Limitation* defined obstacles for aerodromes. The mounds did not infringe the obstacle limitation surfaces for runway 11R. A structure up to 26 m in height would have been permissible in the location.

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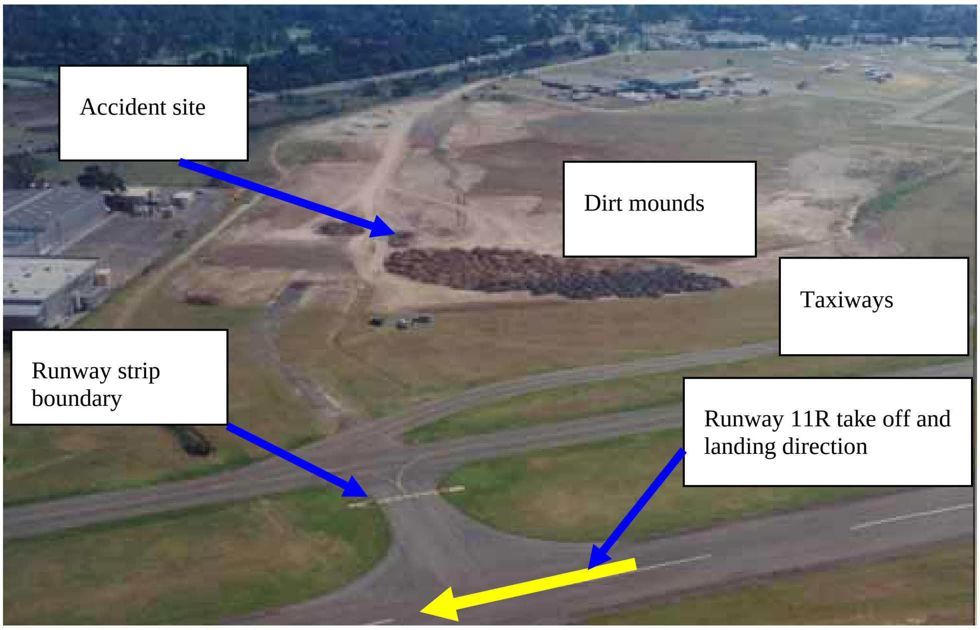
9 CASR Part 139 Aerodromes - Manual of Standards (MOS).

10 MOS Chapter 6.2.18 - Aeroplanes not exceeding 5,700 kg by day, the runway strip width may be 60 m.

Figure 4: Location of wreckage and dirt mounds on the aerodrome



The En Route Supplement Australia (ERSA) is a compilation of aerodrome information provided by aerodrome operators. Information on the category of aerodrome rescue fire fighting services (ARFFS) at an aerodrome is included in the ERSA if a service is provided. The absence of such information from ERSA indicates that a service is not provided. There was no ARFFS information for Bankstown in the ERSA (see Section 1.15.3 for further discussion on the ARFFS).

1.9 Flight recorders

The aircraft was not fitted with a flight recorder or a cockpit voice recorder, nor was there any legislated requirement to do so.

1.10 Wreckage and impact information

Ground marks indicated that the aircraft's right wing tip had struck one of the dirt mounds. The outer third of the right wing, including the outboard fuel tank and wing tip fairing was torn from the aircraft during the initial impact with the mound. That impact breached the fuel tank. The investigation estimated that, at impact, the fuselage was approximately 45 degrees nose down, with 60 to 90 degrees of right bank. Soot deposits were found on dirt mounds south of the mound impacted by the right wing tip.

The aircraft cartwheeled in a southerly direction, crushing the nose of the fuselage and both propeller domes into the ground before rotating approximately 90 degrees clockwise about its longitudinal axis, falling to the ground and sliding backwards.

The aircraft's forward fuselage had been crushed back to the cabin. Parts of the fibreglass nose section were scattered along the wreckage trail and the right aileron was located about 11 m beyond the initial impact point.

There were ground contact marks from the impact of the nose of the aircraft, the leading edge of the left wing, and from both propeller domes and propeller blades. The right engine separated from the wing during the impact and came to rest east of the main wreckage. The left propeller impacted the ground then separated from the engine leaving the propeller dome buried vertically in the ground. The left crankshaft propeller attachment flange had fractured in bending overload and remained attached to the propeller hub. The ground contact marks from both propellers and the angle of the impression made by the domes indicated that they impacted in a near vertical attitude.

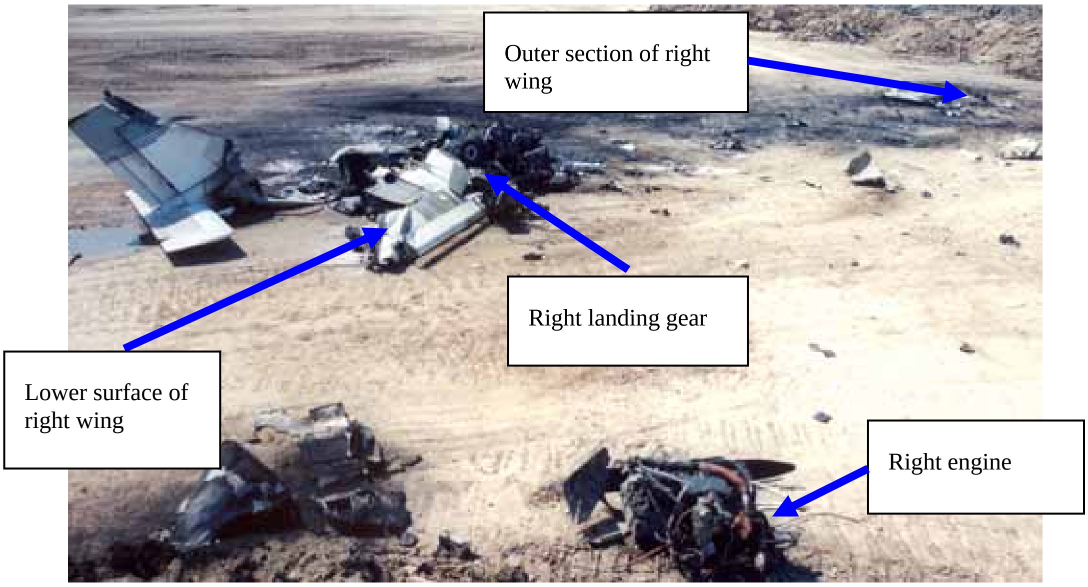
Figure 5: Left propeller as found at the accident site

The damage to the propellers indicated that the engines were delivering comparable and substantial levels of power at impact, with chord-wise blade bending and rotation marks on the blade faces and domes.

The aircraft came to rest upright and facing approximately north. The left wing remained attached to the fuselage and was destroyed in the fire. The left engine remained attached to that wing. The dual stall warning switches fitted to the left wing were destroyed by fire. The right wing had detached at the wing root and had rotated upside down. That wing remained connected to the fuselage by cables and wires.

The right main landing gear leg was extended, the left main landing gear had partially melted in the fire and the nose landing gear had been extensively damaged during the impact. The position of the landing gear, at the time of impact, could not be confirmed.

Figure 6: Aircraft wreckage components that were upwind of the fire



Examination of the flight control systems found no evidence of pre-existing damage. The stabilator and rudder control cables were intact, but had sustained impact damage.

The impact forces and fire sustained by aircraft structures in occurrences of this type can result in erroneous control position indications and generally the position of the flight controls after impact cannot be relied upon as evidence of the aircraft's pre-impact configuration. Examination of the damage to the wing flap control lever was unable to conclusively determine their position at impact.

The horizontal tail surface was of the stabilator type and was fitted with an anti-servo tab that acted as a longitudinal trim tab. Similarly, the rudder had an anti-servo tab mounted on the trailing edge that also acted as a trim tab.

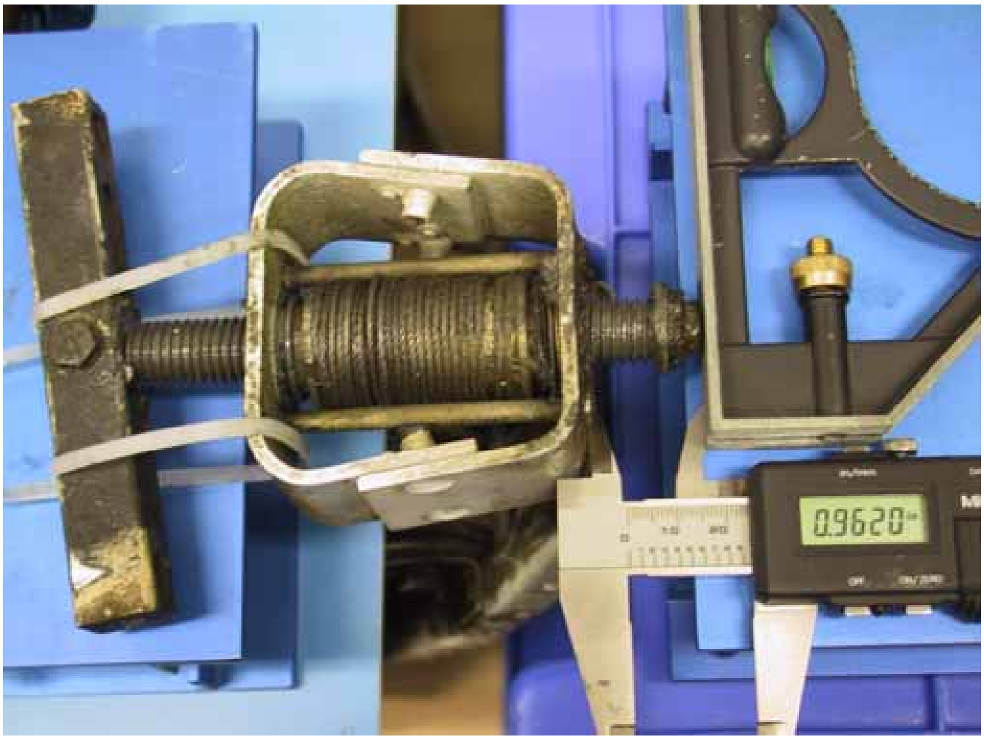
The trim systems enabled a pilot to reduce the effect, on the flight control system, of the aerodynamic forces acting on the control surfaces. The trim systems could be manually operated via two rotating wheels located between the pilots' seats, or the stabilator could be trimmed via an electric servo. That electric servo was operated by a switch on the pilots' control yokes. The system could be disconnected in the event of failure, by a switch on the instrument panel.

On 21 January 2003, the stabilator electric trim was reported unserviceable. An entry was made in the endorsements section of the maintenance release (MR) previous to that being used at the time of the accident. That unserviceability had remained open after the MR ceased to be in force. The investigation could not establish whether a subsequent entry had been made in any maintenance documents to clear the unserviceability. The maintenance organisation that conducted the aircraft's last 100-hour servicing, advised that they would have transferred the electric trim unserviceability to the new MR. They also indicated that they would have placed a placard on the aircraft instrument panel to highlight the problem to pilots. Due to the damage to the instrument panel, the investigation was unable to confirm the annotation in the MR, or the use of a placard on the panel. The unserviceable electric trim did not prevent the manual operation of the stabilator trim by pilots during flight.

The position of the stabilator trim jack assembly screw was measured as 0.962 inches. The aircraft's full nose up trim position equated to a screw position of 0.45 inches and the neutral trim position 1.35 inches. It suggested that the pilot may have set the trim to about half the aircraft's nose-up trim range, consistent with an approach setting. [11]

The position of the rudder trim jack assembly screw was measured as 0.853 inches. The rudder's full right trim deflection equated to a screw position of 0.4 inches and the neutral trim position 1.0 inch. It suggested that the pilot may have set the trim to about one-quarter of the available right trim tab deflection. That position was consistent with the observed position of the rudder trim tab following impact. The rudder may have been trimmed to counteract right yaw. Right yaw can be due to an increase in drag on the right of an aircraft or from a difference in thrust from the propellers.[12]

Figure 7: Measurement of stabilator trim screw jack position



The right fuel system selector was positioned to OFF and the left selector to CROSSFEED. Examination of both fuel control valves found that the right valve was positioned at about 45 degrees beyond the ON position and the left valve was positioned at ON. The cables connecting the right selector and valve were intact, but twisted and stretched. The cables connecting the left selector and valve were encased in solidified molten metal. The normal position for the fuel control selector valves during both landing and take off was ON.

Insufficient aviation gasoline (Avgas) was available from the aircraft to enable analysis. A water contamination test of the small amount of fuel recovered indicated that there was no water present in that sample. A sample of Avgas, taken from the refuelling

[11] During an approach to land, it was normal practice for pilots to apply nose up trim, particularly when an aircraft's centre of gravity was near the forward limit, as reducing power during that phase of flight would cause the nose to drop. Conversely, the application of power, for example during a go around, would cause the aircraft's nose to rise.

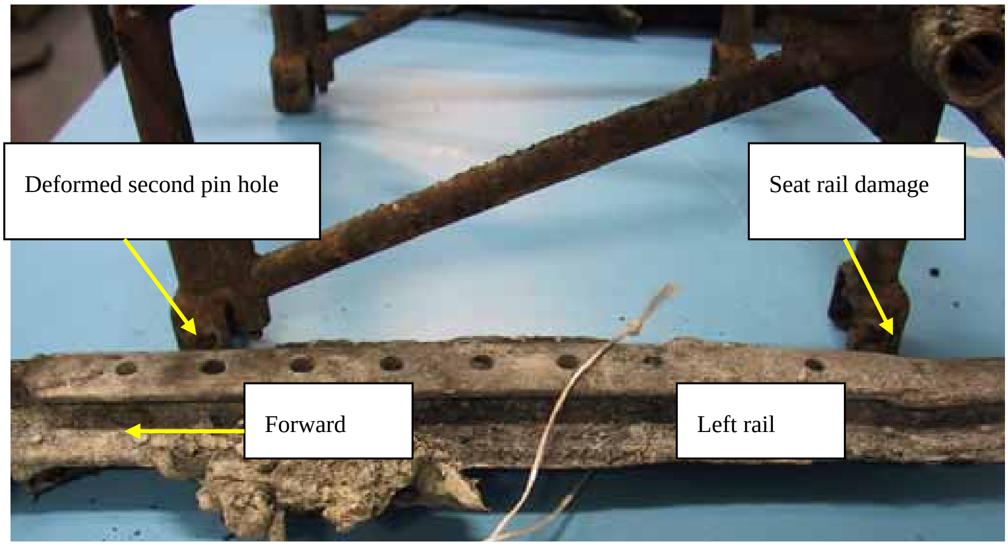
[12] For example, from a windmilling right propeller or a left propeller delivering greater thrust compared to the right propeller.

tanker that was used to refuel the aircraft prior to the accident, was analysed[13] and was found to be the correct grade and type.

The dual manifold pressure (MAP) gauge had impact and fire damage. However, there was evidence of damage on the face of the instrument consistent with a reading of 27 inches MAP for the left engine. The damage to the right pointer indicated that it was within the operating range, but the exact position at impact could not be determined.

The left pilot's seat was separated from both seat rails and was inclined to the rear. Examination of the seat and rails revealed that three of the four seat runners were splayed. The left front runner was the only one not deformed. The second rearward hole of the left rail was deformed and there was damage at the rear attachment point. The deformation of the seat rail fittings and the damage near the rear attachment point was consistent with the seat being positioned at the second hole from the front. The seat locking pins were in-situ. The right rail seat stop was undamaged. The left rail seat stop was destroyed by fire.

Figure 8: Left front seat left rail



The right front seat was secure on both rails and the locking pins were engaged on the seventh hole from the front of the rail. None of the seat runners was deformed.

The seatbelt buckles for the two front seats were found locked. The seatbelt webbing was destroyed by fire.

The left and right pilot control yokes were damaged by impact forces and fire. Both the vertical arms on the left pilot's control yoke were broken. The right pilot's yoke was intact.

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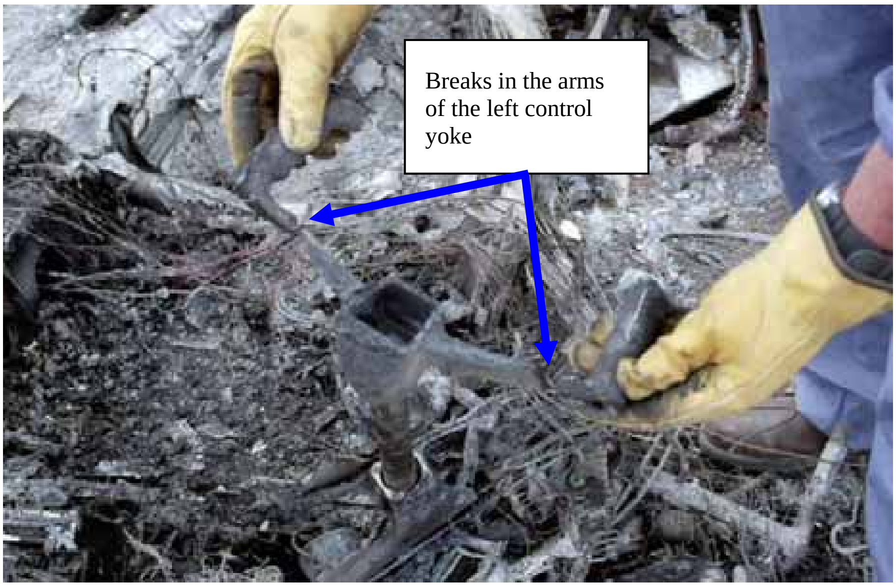
[13] By an approved National Association of Testing Authorities facility.

Figure 9: Broken left pilot's control yoke



1.11 Medical information

Post-mortem examination of the pilot revealed extensive burns and multiple rib fractures. There were no fractures of the hands or arms.

The instructor died three and half weeks after the accident as result of burns sustained in the post-impact fire.

There was no evidence that psychological factors or incapacitation affected the performance of the pilots.

1.12 Fire

There was no evidence of an in-flight fire. During the impact sequence, the aircraft's right fuel tank was ruptured and fuel spilled and ignited. Fire had consumed most of the aircraft's structure before being extinguished by persons working near the accident site and the attending emergency services.[14] The ignition source for the fire could not be confirmed.

1.13 Survival aspects

The ignition of the fire following the initial impact with the mounds reduced the possibility for survival. Although the instructor was able to vacate the aircraft with a broken ankle, he received significant burn injuries that ultimately caused his death.

The pilot received fatal chest injuries during the impact.

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[14] See section 1.15.3.

1.14 Organisational information

The flying school operated three single-engine aircraft and the twin-engine Seneca. The school's operations manual detailed procedures for simulated asymmetric flight. The procedures required flight instructors to ensure that trainees clearly understood that an engine failure would be simulated and the method to simulate that failure. The manual stated that the procedures to be used would vary according to the engine type. If the aircraft manufacturer's pilot operating handbook specified a procedure then it should be used, otherwise, for non-turbo-charged engines, as fitted to CTT, an engine failure would be simulated by the retardation of either the throttle or the mixture control. The chief flying instructor and trainees who had flown with the instructor reported that his normal practice to simulate one engine inoperative performance was to adjust the engine controls to establish zero thrust after the trainee had identified the failed engine.

The section of the manual covering multi-engine training outlined the minimum training for pilots undergoing an initial multi-engine aircraft rating. There was no external theory testing required, but pilots were required to complete an aircraft type engineering examination to demonstrate an adequate understanding of the aircraft's systems and operating parameters, including emergency procedures. The pilot under instruction during the accident flight had successfully completed that examination, including correctly nominating the single engine minimum control speed (Vmc) for the aircraft.

An instructor will normally progressively introduce a trainee to simulated emergency situations, such as an engine failure, by pre-flight briefings followed by their in-flight sequences. It is not unusual for a trainee, when initially responding to a simulated engine failure in a critical situation, to experience difficulty preventing the aircraft from drifting off line while establishing it in a climb. An instructor would normally prompt the pilot to make any corrections, or may demonstrate the required corrections if necessary.

The chief flying instructor reported that it was flying school practice not to conduct or simulate single-engine operation in a multi-engine aircraft below 350 ft above ground level.

About a week prior to the accident flight, the aircraft's right engine was reported to have been difficult to start. To reduce the possibility of that problem delaying flying training, the school elected to operate the aircraft with full fuel tanks and not shut down the engine when changing pilots. Previously, the aircraft had been operated in the circuit with the fuel tanks half full. The maximum fuel capacity of the aircraft was 360 L.

The investigation estimated that at the time of the accident the aircraft's fuel tanks contained 325 L of Avgas 100/130. The flight was conducted with the aircraft within weight and centre of gravity (CG) limits, but close to the forward CG limit.

1.15 Additional information

1.15.1 Notification of asymmetric training

The Aeronautical Information Publication (AIP) detailed specific operations that may be conducted at GAAP aerodromes by day with the prior approval of air traffic control (ATC). Asymmetric training in multi-engine aircraft involving operations with a propeller feathered was one of the operations that required prior approval. A pilot was also required, at the earliest opportunity, to advise ATC when conducting simulated engine failures and asymmetric training in multi-engine aircraft. Pilots that had previously flown with the instructor reported that he normally advised ATC when conducting asymmetric flying training in the circuit. The automatic voice recording (AVR) indicated that the instructor did not notify ATC that they were conducting asymmetric flight training.

1.15.2 Witnesses

There were 15 people located either on, or near the aerodrome who witnessed the aircraft's approach and subsequent go-around. They included; a pilot in an aircraft operating in the runway 11R circuit behind CTT, a pilot in an aircraft waiting to depart from runway 11C, a pilot near the south-western boundary of the aerodrome, a pilot near the western access gate and a pilot in an office on the northern side of the aerodrome. There were a similar number of witnesses who did not see the approach and go-around, but who saw the aircraft just prior to or shortly after the impact with the ground. The majority of witnesses were familiar with the aviation industry as a pilot or an engineer, or were involved in some aspect of aircraft or aerodrome operations.

The witnesses reported that the aircraft was on short final at about 200 ft with the landing gear retracted. The landing gear was extended as the aircraft passed over the aerodrome perimeter road.

Either just before, or as it passed over the threshold to runway 11R, the approach was discontinued and the aircraft was seen to commence a go-around. The aircraft's wheels did not touch the runway. Reports about the aircraft's height above ground level during the go-around varied from 5 ft to 50 ft.

Most witnesses could not recall the position of the aircraft's flaps during the approach. One witness reported that the aircraft, 'looked clean'[15] while another witness 'thought the flaps were down'. The aircraft's approved flight manual nominated 40 degrees of flap for landing and zero for take-off.[16]

Soon after the go-around commenced, the aircraft diverged steadily right by 'about 30 degrees' and maintained that heading. The witnesses reported that during and after the go-around, both propellers were rotating and that both engines 'sounded normal'. One witness reported that, 'the approach was slow and waffly and looked asymmetrical'[17], while two witnesses reported that 'the engines [propellers] did not appear to be feathered'. As the aircraft diverged from the runway centreline, the landing gear retracted and it commenced a shallow climb. The witnesses reported that the aircraft was in a flat attitude with little or no bank. Witnesses also described the aircraft as conducting 'a number of step climbs' and it 'appeared to stall three or four times'.

Witness reports indicated that the aircraft climbed to between 100 and 200 ft before the right wing dropped, it turned right and then impacted the ground. None of the witnesses could recall the position of the aircraft's landing gear at impact. They also reported that immediately after the aircraft impacted the ground in a cartwheel motion, a fire commenced. Two witnesses reported seeing a person moving away from the burning aircraft prior to an explosion and the aircraft being engulfed in fire.

A witness in a factory adjacent to the aerodrome saw the instructor escape through the right main door as the aircraft was burning. After the instructor had vacated the aircraft, that witness saw the pilot in the aircraft in a prone position on his back. He was not moving and the witness lost sight of him shortly after as the fire intensified.

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[15] An aircraft is normally considered to be in a clean configuration when the landing gear and wing flaps are retracted.

[16] There were four possible flap positions – zero, 10 degrees, 25 degrees and 40 degrees.

[17] Asymmetrical – the aircraft was operating with one engine inoperative or at reduced power.

Some pilot witnesses suggested that the accident was likely the result of the aircraft operating at, or near, the minimum control speed, Vmc.

The attending ambulance crew reported that the instructor said that the pilot was flying the aircraft and that he did not know what had happened. The instructor was unable to provide any other information in relation to the accident.

1.15.3 Effectiveness of fire fighting services

On 1 December 2003, the Minister for Transport and Regional Services signed an Instrument of Direction to the Australian Transport Safety Bureau (ATSB). That instrument directed the ATSB to 'investigate the effectiveness of the fire fighting arrangements for Bankstown Airport, as they affected transport safety at Bankstown Airport on 11 November 2003'. The instrument was issued to the ATSB on 15 December 2003.

That investigation found that the fire fighting arrangements for Bankstown Airport on 11 November 2003 complied with national policy. The response to the accident by the NSW Fire Brigade (NSW Brigades) produced the expected result, in that resources to fight the fire were available within the expected time. Despite the loss of life, the arrangements were deemed to be effective in terms of producing the intended or expected result for which they had been established. The response to the accident was enhanced by the efforts of personnel located on, and adjacent to the aerodrome. The report of that investigation (BO/200305496) was issued on 24 December 2004 and is available from the ATSB website www.atsb.gov.au.

1.15.4 Technical disassembly and examination

Examination of both propeller mechanisms indicated that the propeller blades were at an approximate angle of 22 degrees at impact. That blade angle was consistent with both propellers being at a blade pitch angle consistent with the take-off, go-around or early climbing phase of flight.

The examination of the propellers also revealed that the supporting washers, positioned under the blade latches for both propellers were inverted. The washers normally had a rebate that was positioned below the latches to ensure free latch movement. Analysis determined that this anomaly did not influence the circumstances of the occurrence.

Examination of the left engine revealed damage to the number-2 cylinder exhaust valve and valve actuation train. The two retaining keys for the valve spring on the number-2 cylinder exhaust valve were found to be broken into several small pieces. Despite the damage to the keys, the valve had remained in place. A hardness test of the pieces of the key found that the metal complied with the manufacturer's specifications. The valve head had evidence of radial cracking, and had burnt through the part of the outside circumference that created a seal with the valve seat. The valve's sealing surface and the matching surface on the valve seat were abnormally worn.

Figure 10: Burnt and worn left engine number-2 cylinder exhaust valve

The valve rotator cap and the face of the tappet body evidenced uneven wear, indicating that neither item had been rotating, as intended, during engine operation. The operation of the exhaust valve hydraulic lifter could not be determined. The engine manufacturer advised that the damage to the valve and valve keys was consistent with an improperly operating hydraulic lifter.

The investigation assessed that the valve damage would have resulted in some degradation of power from the left engine, such that it would not have produced rated power. However, the extent of that degradation could not be quantified.

1.15.5 Air traffic control

When the aircraft was on final approach, the aerodrome controller (ADC) saw that the landing gear was not extended and queried the pilots by using the phraseology, 'Charlie Tango Tango have you forgotten something'. A pilot is responsible for ensuring that an aircraft is configured appropriately for landing. There is no requirement for a controller to ensure that an aircraft's landing gear is down during an approach to a landing. However, one of the objectives of air traffic control is the provision of advice useful for the safe and efficient conduct of flights. The ADC saw the aircraft's landing gear extend shortly after making the radio transmission to the pilot.

The AIP GEN 3.4 - 11 states that the use of standard phrases for radiotelephony communication between pilots and ground stations (including air traffic control) is essential to avoid misunderstanding of the intent of messages and to reduce the time required for communication. Where circumstances warrant, and no phraseology is available, clear and concise plain language should be used to indicate intentions. For example, a controller might instruct a pilot to either 'check wheels' or advise that there was ‘no landing gear/wheels’ or to, ‘go-around’ if there was insufficient time for the pilot to comprehend and react to the situation.

A pilot who is issued a clearance to land by air traffic control is not required to continue with the landing if it is unsafe to do so, or it is contrary to aircraft or operator procedures. A clearance issued by an air traffic service unit (ATS)[18] is only an authorisation for a pilot in command to proceed in accordance with the terms of the clearance. The clearance does not authorise a pilot to deviate from any regulation, order, operating standard or procedure, minimum altitude, or to conduct unsafe operations in his/her aircraft. Further, the issuance and acceptance of a clearance in no way abrogates or transfers to an air traffic service unit responsibilities of the pilot in command.[19]

After seeing the landing gear extend, the controller issued a clearance for a touch and go. That clearance was acknowledged and read back by the instructor. The provision of the clearance to the pilots signified that the runway was available for use and that the pilots could continue for the touch and go, or go-around if required.

1.15.6 Pilot response during stressful situations

When placed in an unusual and/or stressful situation requiring an immediate response, an individual may be unable to mentally and physically respond. The situation is compounded if the individual is operating an aircraft, as they may then effectively ‘freeze’[20] the controls, preventing or delaying vital corrective action by others.

No information is available to suggest that either the pilot or instructor experienced any such condition.

1.15.7 ATSB accident database

A search of the ATSB database for accidents involving Piper PA-34-200 revealed 23 accidents since 1980. Of those accidents, there were two that occurred during asymmetric flight. While the outcome of these accidents (ATSB investigation BO/198902592 and BO/199500988) were similar to CTT’s accident the related factors involved were different.

1.15.8 Other investigation

Following the investigation into a fatal accident at Toowoomba, Qld on 27 November 2001, involving a Beech Aircraft Corporation C90, which had an engine failure during take off, the ATSB report (BO/200105618) addressed aspects of asymmetric flight, aircraft performance, factors that can influence a pilot’s response time and inappropriate pilot responses to engine failures. It also included extracts from Federal Aviation Administration H-8083-3 *Airplane Handbook* and an article from the Civil Aviation Safety Authority’s *Flight Safety Australia* magazine about aircraft operation during asymmetric flight.

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18 Aerodrome control is an air traffic service unit.

19 Aeronautical Information Publication ENR 1.1 – 99.

20 Leach J (2005). Why people ‘freeze’ in an emergency: Temporal and cognitive constraints on survival responses. *Aviation, Space, and Environmental Medicine*, 75, 539-542.

2 ANALYSIS

2.1 Introduction

The analysis of the circumstances of the loss of control of the aircraft during an apparently routine training exercise will focus primarily on aircraft performance, the management of the flight and indications of the type of sequence being conducted.

2.2 Aircraft performance

Examination of the aircraft wreckage and components indicated that, other than the effect of the damaged valve in the left engine, the aircraft should have been capable of normal operation. It is unlikely that the left engine would have produced rated power, but the degree of power loss could not be determined. The aircraft's deviation from the runway indicated that at the time of the deviation, significant power was being produced by the left engine and that the power on the right engine had been reduced. It is likely that the instructor had reduced the right engine power to simulate the failure of that engine. However, the wreckage examination confirmed that both engines were producing similar levels of significant power at impact. There is no indication that the pilots had been aware of any aircraft serviceability or performance deficiency prior to the attempted go-around.

In the event of an actual failure of the right engine during the go around, the condition of the left engine may have limited the options available to the pilots. However, the aircraft began to yaw to the right when almost the full length of the runway and adjacent strip was available. It is unlikely that the instructor would have continued with the go-around if the right yaw had been due to an unexpected problem.

The indications that both engines were delivering power at impact may reflect recovery actions initiated by the pilots at some stage during the go-around. However, any such recovery was apparently too late to be effective.

2.3 Aircraft configuration

Reports from witnesses, including those familiar with general aviation operations, were inconclusive regarding the configuration of the aircraft and whether it was operating under asymmetric power.

The position of the landing gear prior to impact was most likely retracted, but could not be established by either witness information or wreckage examination.

The investigation determined that the damage to the left pilot seat and its fittings was consistent with impact forces and fire.

Although the stabilator trim jack screw and the rudder trim positions may have reflected their pre-impact settings the extent of the disruption to the aircraft structure and particularly the right wing prevented confirmation of the position of the right fuel system control valve, and elements of the flight control systems. The position of the wing flaps at impact could not be conclusively determined.

During the impact sequence, as the right wing was torn from the aircraft, the cable attached to the arm of the right fuel valve may have pulled that arm beyond the ON position. However, it could not be relied upon to establish the pre-impact configuration.

2.4 Divergence of the aircraft from the runway centreline

As discussed at 2.2, aircraft performance, the divergence from the centreline was unlikely to have been due to an unexpected problem. The divergence was consistent with the pilot under instruction experiencing difficulty countering the tendency of the aircraft to turn to the right in response to an asymmetric power situation. In that situation, the instructor would normally prompt the pilot to make any necessary corrections or else assume control of the aircraft to maintain controlled flight.

The investigation was unable to establish why the aircraft was permitted to continue to drift to the right until it stalled.

2.5 Pilot flying the aircraft

The instructor, after leaving the aircraft, indicated that the pilot was flying the aircraft during the loss of control sequence. Although the vertical arms of the left control yoke were broken, suggesting that the pilot may have been holding the yoke at impact, his injuries did not include typical damage to the hands. Consequently, it was not possible to confirm which pilot was flying the aircraft at the time of impact.

Incapacitation of either pilot was unlikely to have been a factor in the accident. The instructor was able to vacate the aircraft unassisted. There is no indication that he would have been unable to assume control of the aircraft had the pilot become incapacitated. Similarly, it is considered unlikely that there was a communication problem between the instructor and pilot.

Had the pilot 'frozen' on the controls, the instructor may have been prevented from taking full control in time to restore the aircraft to stable flight. However, there was no supporting evidence to indicate that was the case.

2.6 Oversight of operations

While the instructor had only received his multi-engine aircraft instructor rating two months before the accident, he should have been very familiar with the aircraft, having conducted most of his recent flying in it.

The late extension of the landing gear when the aircraft was on final approach may indicate that the pilot was distracted or was becoming over-loaded. The instructor's familiarity with the aircraft may have led him to believe that he could cope with any possible problems that may be encountered as a result of the circumstances of the training sequence. However, he was subsequently unable to respond effectively to prevent the unstable flight rapidly developing into a loss of control.

2.7 Air traffic control communication

While there is no specific phrase for a controller to use to notify a pilot of an aircraft approaching for a landing without the landing gear extended, the aerodrome controller (ADC) could have used less ambiguous alternatives. However, when the aircraft was on short final the ADC saw the landing gear extend following his query and the instructor acknowledged the subsequent clearance for a touch and go. Those actions suggest that the pilots understood the query.

2.8 Summary

The circumstances of this occurrence are consistent with a loss of aircraft directional control during an attempted go-around manoeuvre with reduced right engine power. This is supported by the intention to include asymmetric flight in the training session, and by information related to the go-around. That information included:

- the three previous circuits were concluded by touch and go landings, but on this occasion the pilots initiated a go-around
- the pilots did not conduct a landing as would be expected if they had concerns about any aspect of the aircraft's serviceability or performance
- the aircraft began to diverge right soon after commencing the go-around and that divergence was not corrected
- the aircraft's performance deteriorated until it stalled at a height from which recovery was not possible
- at impact both engines were producing significant and comparable power.

However, because the investigation was unable to confirm the configuration of the aircraft during the approach and go-around, the reason the aircraft was not landed or restored to stable flight before control was lost could not be determined.

3 CONCLUSIONS

3.1 Findings

Aircraft

1. The aircraft had been fully fuelled with the correct fuel for normal engine operation before the flight.
2. The damage to the propellers indicates that the engines were producing significant and comparable power at impact.
3. Both propellers were assessed as being at their correct relative blade pitch angle for the take-off, go-around or early climb phase of flight.
4. The position of the wing flaps at impact could not be conclusively determined.
5. The position of the landing gear at impact could not be confirmed.

Flight Crew

6. The instructor was appropriately qualified to conduct the flight.

Air traffic control

7. The aerodrome controller saw the landing gear extend and issued a clearance for the pilots to conduct a touch and go landing.

3.2 Significant factors

1. The aircraft was not landed, or power restored to the right engine in sufficient time to regain stable flight.
2. The aircraft departed from controlled flight at a height from which recovery was not possible.

4 SAFETY ACTION

ATSB safety action

Following a number of accidents in recent years, involving twin-engine aircraft that incurred a loss of some or all engine power, the ATSB implemented a research project (B2005/0085) into power loss related accidents involving twin-engine aircraft. That report was approved for public release 27 June 2005 and concluded that:

- Power loss accident rates in twin-engine aircraft are almost half the rate in single-engine aircraft. However, a power loss accident in a twin-engine aircraft is more likely to be fatal than a power loss accident in a single-engine aircraft.
- Fatal accidents subsequent to a power loss in twin-engine aircraft are overwhelmingly a result of in-flight loss of control events.
- Just over one-third of power loss accidents in twin-engine aircraft occurred during a non-asymmetric power loss. The majority of these were related to fuel management, and no benefit was derived from the presence of a second engine.
- More accidents (46 per cent) occurred following an asymmetric power loss in the take-off phase than in any other phase of flight.

The research report is available on the Bureau's website www.atsb.gov.au or from the Bureau on request.