AUSTRALIA

Aircraft Accident Investigation

Beech 200 VH-AAV
Sydney (Kingsford Smith) Airport
21 February 1980

DEPARTMENT OF Transport Australia

Report 802-1017

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Advance Airlines of Australia Beech Super King Air 200 VH–AAV Sydney (Kingsford Smith) Airport, New South Wales 21 February 1980.

The Secretary to the Department of Transport authorised the investigation of this accident and the publication of this report pursuant to the powers conferred by Air Navigation Regulations 278 and 283 respectively.

Prepared by Air Safety Investigation Branch

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Note 1: All times are Australian Eastern Summer Time (Greenwich Mean Time plus 11 hours) and are based on the 24-hour clock. Where applicable, seconds are shown using a six figure time group.

Note 2: Metric units are used except for airspeed and wind speed which are given in knots; and for elevation, height and altitude which are given in feet. Unless otherwise noted, all elevations and altitudes are above mean sea level.

Fig. 1. Beech Super King Air 200 VH-AAV

The Accident

At 1909:22 hours on 21 February 1980, Beech 200 aircraft, registered VH-AAV, collided with the western sea wall enclosing the extension of Runway 16/34, abeam the Runway 34 threshold, at Sydney (Kingsford Smith) Airport, New South Wales. The aircraft broke apart on impact and there was an explosive fire. The pilot and all twelve passengers were killed.

The accident occurred approximately 106 seconds after the aircraft had commenced take-off from Runway 25, on a scheduled flight to Temora, New South Wales.

1 Factual Information

1.1 HISTORY OF THE FLIGHT

Beech Super King Air 200 aircraft, VH-AAV, was operated by Advance Aviation Pty Ltd, trading as Advance Airlines of Australia. The operator held a current exemption, under Air Navigation Regulation 203, to operate a regular public transport service without holding an airline licence. The holder of the certificate of registration for the aircraft was Landura Pty Ltd. At the time of the accident the aircraft was engaged in a scheduled service, designated Flight DR 4210, from Sydney to Temora and Condobolin, within the State of New South Wales. The scheduled departure time was 1845 hours.

At 1844 hours the pilot of VH-AAV contacted Sydney Airport Clearance Delivery by radio and requested his airways clearance. The airways clearance issued was a Standard Instrument Departure (SID), titled '25 Katoomba Two'. That SID specified that radar headings would be assigned after take-off from Runway 25. The pilot correctly acknowledged the airways clearance.

At 1848 hours the pilot contacted Sydney Ground Control and requested clearance to taxi. This was granted and the aircraft was taxied to the holding point for Runway 25. The pilot reported to Sydney Aerodrome Control at 1858 hours that he was ready for take-off. Due to other traffic, the aircraft was not cleared to line up until 1906 hours. VH-AAV then entered Runway 25 and stopped about 50 metres from the threshold. At 1907 hours VH-AAV was cleared to 'maintain runway heading, maintain 3000 (feet), clear for take-off'. This was correctly acknowledged and VH-AAV commenced take-off.

The aircraft became airborne and crossed the intersection with Runway 16/34, at a height of about 100 feet above ground level (AGL) at 1908:19 hours. The landing gear was retracted. Observers then noted the aircraft level off at about 150 feet AGL and commence a shallow banked turn to the left. As this was contrary to the departure instructions, Aerodrome Control was about to query the pilot when, at 1908:33 hours, he advised: '. . . we've lost er, the left engine. Request landing, ah, landing on runway three four immediately please.' This was acknowledged and Aerodrome Control cleared VH-AAV for a visual approach to a left base for Runway 34.

During these transmissions, VH-AAV continued its left turn through approximately 90 degrees, onto a southerly heading. It had maintained a height of about 150 feet AGL and the left propeller was probably in the process of feathering.

At 1908:44 hours, Aerodrome Control queried '. . . do you have the seven two seven in sight on short final.' At 1908:49 hours, the pilot of VH-AAV replied, 'Affirmative'.

The other aircraft referred to by Aerodrome Control was an Ansett Airlines of Australia Boeing 727, VH-RMO, which was on approach for Runway 34.

Shortly after passing over the shore of Botany Bay, VH-AAV entered a steady descent and then levelled off just above the water. The left turn was continued and the aircraft converged towards the western side of the sea wall enclosing the extension of Runway 16/34.

At 1908:50 hours, Aerodrome Control asked, '. . . will your approach and landing be normal.' The reply, eight seconds later, was 'Alpha Alpha Victor negative'.

At 1909:08 hours, Aerodrome Control activated the crash alarm system. In addition, VH-RMO was directed '. . . go around, correction, st . . . stay on the runway and expedite. We have a landing, er, right behind you . . . one engine out.' The initial direction was made prior to visually assessing the Boeing 727's situation, but when, during the transmission, it was noted that the aircraft was on the ground and well established in its landing roll sequence, the 'expedite' instruction was substituted.

At 1909:20 hours, Aerodrome Control cleared VH-AAV to land. This was not acknowledged.

The final segment of the flight was at an extremely low altitude and in a nose-high attitude. The right propeller, on at least one occasion, probably contacted the water and the tail either furrowed the water or induced a wake.

VH-AAV struck the sea wall in a nose-up attitude, banking to the left and skidding to the right. The left wing of the aircraft disintegrated. The resultant fuel spillage ignited and a 'fire ball' explosion occurred. The right engine and the outboard section of the right wing both separated and were thrown across the ground adjacent to the runway. The remainder of the aircraft bounced over the sea wall, landed inverted on a taxiway and slid backwards.

The accident occurred in daylight at 1909:22 hours. The elevation of the point of initial impact was 6 feet and the location was Latitude 33°58′ South, Longitude 151°10′ East.

1.2 INJURIES TO PERSONS

Injuries	*Crew*	*Passengers*	*Others*
Fatal	1	12	—
Serious	—	—	—
Minor/None	—	—	—

1.3 DAMAGE TO AIRCRAFT

The aircraft was destroyed by impact forces and fire.

1.4 OTHER DAMAGE

There was no other damage.

1.5 PERSONNEL INFORMATION

1.5.1 Flight crew

VH-AAV was certified for single-pilot operation.

, aged 44 years, was the pilot-in-command. He held a senior commercial pilot licence which was valid until 30 April 1980. His licence endorsements authorised him to fly Beech 200 aircraft and he held a class one instrument rating endorsed for ADF, VOR, VAR, DME, ILS and Localiser radio navigation aids.

He had last completed a licence medical examination on 5 October 1979 and the records of the eyesight test indicated visual acuity of right eye 6/5 and left eye 6/12. The minimum visual acuity standard for commercial pilots was 6/9 and accordingly his licence was endorsed with a requirement that he must wear a correcting lens.

The pilot's total flying experience at the time of the accident was 6384 hours, of which 448 hours had been gained in Beech 200 aircraft. His most recent proficiency check was on 13 February 1980, when he satisfactorily passed a test by a company check and training pilot.

The various check and training records on . consistently indicated that he was a conscientious pilot with a high standard of personal discipline. He was noted for a well developed sense of responsibility and his aircraft handling was rated average to above average.

had not been previously involved in an accident. It was established that, on at least three occasions he had experienced an engine failure in a multi-engine aircraft during the take-off/initial climb phase of flight. He had successfully handled these emergency situations and safely terminated the flights.

was off duty for the period 16 to 18 February 1980, inclusive. He flew four hours on 19 February 1980. He was again off duty on 20 February 1980, played golf in the afternoon and retired at a normal time that evening.

The pilot reported for duty at approximately 1030 hours on 21 February 1980. He operated an apparently normal flight in another Beech 200 aircraft to Lord Howe Island, returning at 1603 hours. He spent the period between that flight and the accident flight relaxing in the vicinity of the operator's office. A light meal was eaten during this period.

was not subject to any known personal or work related problems at the time. He appeared to be healthy, relaxed and in good spirits.

Although the pilot position in VH–AAV was equipped with a headset/boom microphone, activated by a switch on the left arm of the control wheel, Mr elected not to use this equipment. Instead he used a personal headset and hand-held microphone. As there was no suitable mounting for the microphone he normally placed it on his seat, adjacent to his left thigh.

1.5.2 Air Traffic Control

An air traffic control unit was established in the Sydney Airport Tower, with provision for six operating positions: Senior Tower Control, Aerodrome Control I and II, Co-ordination, Surface Movement Control and Flight Data. There were, however, eight controllers on duty at the time of the accident. Two of these were trainees, under supervision, manning the Aerodrome Control I and Flight Data positions.

aged 34 years, was at the Aerodrome Control I position. He was under supervision as he did not hold any current ratings on his licence. Mr did, however, have 12 years experience in air traffic control but his Australian ratings had lapsed whilst he had been serving overseas. Subsequent to his return, on 14 February 1980, he was undergoing renewal training.

Mr had completed his most recent licence medical examination on 25 May 1978. There were no medical restrictions upon his licence. He commenced duty on 21 February 1980 at 1318 hours.

aged 33 years, was the controller directly supervising Mr He had eight years experience in air traffic control and held a valid air traffic controller licence. His current ratings included Aerodrome Control and this had last been revalidated on 23 October 1979.

M had completed his most recent licence medical examination on 23 May 1978. There were no medical restrictions upon his licence. He commenced duty on 21 February 1980 at 1400 hours.

The remaining personnel, who were not involved with the accident flight, were appropriately licensed for the positions they manned.

1.6 AIRCRAFT INFORMATION

1.6.1 History

VH-AAV was manufactured in the United States of America by the Beech Aircraft Corporation, in 1977, and allotted Serial No. BB-245. It had been entered on the Australian register of aircraft on 22 September 1978. A certificate of airworthiness was issued six days later.

At the time of the accident VH-AAV had flown a total of 5061 hours since new.

1.6.2 Maintenance

VH-AAV was maintained in accordance with a continuous inspection cycle, whereby all necessary servicing, up to and including major inspections, was carried out over a progressive schedule rather than at a number of set dates or operating hours. This system was contained in a maintenance system manual, produced by Advance Aviation Pty Ltd and approved by the Department of Transport. The bulk of the maintenance was carried out by the operator, but radio maintenance was performed by Amalgamated Wireless (A'asia) Ltd.

In respect of each element of the servicing cycle, the maintenance system provided printed schedules to be used by the technical staff for check and certification purposes. When work in each category (engines, airframe, electrical, etc.) was completed, a category certification was to be entered in the aircraft log books. When all work was completed, the servicing co-ordinator would sign and issue a maintenance release, returning the aircraft to operations. A maintenance release would be valid for 80 hours flying or four calendar months, whichever was the earlier.

For some time prior to the accident VH-AAV had been scheduled for maintenance each Monday and Thursday. On each of these days a Routine Inspection would be carried out and on each Thursday one of three Detailed Inspections would also be completed. In addition, on any servicing day, any necessary unscheduled maintenance or maintenance required under a different schedule, such as component time–life, would also be performed.

On 21 February 1980, after its return from Condobolin and Temora at about 0800 hours, a period of servicing was commenced on VH-AAV. This consisted of a Routine Inspection, a No. 2 Detailed Inspection, time-scheduled replacement of the left engine fuel nozzles and the cabin windows, and a number of unscheduled items. These consisted of re-rivetting a broken top cowl bracket on the right engine, replacing a right engine starter generator, repair of a leaking fuel drain on the right engine, replacement of a stretched oil filter 'O' ring on the left engine and fitment of glare shields to the left engine fire detection system. All of this work was reported to have been completed, except that only six windows had been replaced because of lack of time and the engine fuel drain pump screens, an item on the No. 2 Detailed Inspection, had not been cleaned.

The records of this servicing were incomplete in that four of the 13 pages of the No. 2 Detailed Inspection schedule had not been available when the inspection was carried out. Stocks of these pages had run out. As an alternative, four pages from a No. 3 Detailed Inspection, three dealing with radio equipment checks and one covering category certifications, had been completed. This substitution did not, however, cover all items on the missing No. 2 Detailed Inspection pages. In particular, there was no provision on the substitute pages to record the results of post-maintenance engine ground runs. The ground runs were carried out and the performance of each engine was reported as satisfactory but no details were recorded.

There was a number of deficiencies noted in the maintenance records. These were not considered relevant to the accident.

There was no evidence that VH-AAV had any significant mechanical defect prior to the accident flight.

1.6.3 Loading

Advance Airlines passenger and freight handling at Sydney Airport was undertaken by an agent, Flight Facilities (Merimbula) Pty Ltd. The agent prepared a passenger/baggage manifest which listed the passengers by name and sex and itemised the baggage by both number and weight. A freight manifest was also prepared and contained the number and weight of items of freight. Both baggage and freight were weighed to obtain accurate figures.

These manifests indicated that VH-AAV carried 12 passengers, consisting of eight men, three women and an infant, plus seven items of baggage weighing 69.5 kg and three items of freight weighing 9 kg.

The aircraft was refuelled to full main tanks (1461 litres usable) and 100 litres in each auxiliary tank. At a specific gravity of 0.795, the usable fuel weight was 1320 kg.

An approved practice of the operator was to deduct 40 kg of fuel, used during start-up and taxi, to determine take-off weight. It was calculated that the probable fuel usage by VH-AAV prior to take-off was 41 kg.

Safety equipment carried in the aircraft, but not included in the empty weight, consisted of a large life raft, a small life raft, two emergency radio beacons and 13 life jackets. These weighed a total of 47 kg.

The weights of VH-AAV have therefore been calculated as:

	kg
Aircraft empty weight (including oil, unusable fuel, toilet charge and oxygen)	3468.6
Pilot and passengers (derived)	925
Baggage	69.5
Freight	9
Fuel (usable)	1320
Safety equipment	47
Weight at start-up	5839.1
Taxying fuel used	41
Weight at take-off	5798.1

The maximum allowable take-off weight for VH-AAV was not limited by the ambient conditions and was 5670 kg.

There were 11 seats in the cabin and the right-hand seat in the cockpit available for passengers. As it was not the practice to allocate passengers to specific seats, a precise centre of gravity could not be calculated. To assess the likely centre of gravity, three sets of circumstances were considered: the most forward, the most aft and the 'most probable'. In the first case, the passengers were assumed to be located in reducing order of weight from front to rear in the aircraft. In the second case, the reverse order was assumed. In the third case, all available sources of information as to passenger location were used to derive a 'most probable' seating plan.

The three cases gave the following results:

Most forward	4868 mm aft of datum
Most aft	4934 mm aft of datum
Most probable	4927 mm aft of datum

The approved range of centre of gravity at maximum take-off weight was 4700 mm to 4989 mm aft of datum.

The pilot of VH-AAV prepared an aircraft Weight Sheet for the proposed flight which indicated the aircraft start-up and take-off weights would be 5703 kg and 5663 kg, respectively. The variation from actual weights was due to a number of factors which introduced errors into his calculations.

Firstly, an aircraft operating weight (aircraft empty weight plus one pilot plus standard equipment) of 3555 kg was used. This figure was low as it only allowed some 10 kg for equipment and the safety equipment alone weighed 47 kg.

Secondly, the passenger load was assumed to be five men, five women and one child. It was a common practice, followed by a number of company pilots, to make such an assumption so that the Weight Sheet could be compiled at an early stage of pre-flight preparation, before all the passengers checked in.

Passenger sex is not a factor in the use of standard weights as prescribed in Air Navigation Order 20.16.1. This requires that all adult passengers be considered to weigh 78 kg. The approved standard weight for children varies, dependent upon the operator's 'half fare' age range. For Advance Airlines, this is between 3 and 14 years and hence the appropriate standard weight is 46 kg.

The Weight Sheet for VH-AAV indicated weights of 77 kg, 67 kg and 48 kg for men, women and children, respectively. The basis for these weights was practical experience: for a period of more than 12 months in 1975–6, a record of actual passenger weights had been maintained and the results averaged. The resultant figures had been employed in all subsequent operations by Advance Airlines. The figures had not, however, been incorporated in the company Operations Manual nor had formal Department of Transport approval been sought.

Company personnel expressed the opinion that relevant Department of Transport surveillance officers were aware of the practice and had accepted it.

The third variation in the Weight Sheet figures was that baggage and freight had been recorded as 110 kg. The reason for using this figure, instead of the 78.5 kg indicated on the manifests, could not be established.

Finally, the 1661 litres of usable fuel was recorded as weighing 1270 kg. The reason for this 50 kg variation also could not be established.

1.7 METEOROLOGICAL INFORMATION

At 1900 hours a meteorological observation was taken at Sydney Airport. This recorded the surface wind as 310° magnetic at 9 knots, visibility 50 km, cloud two oktas (eighths) cumulus at 8000 feet and five oktas altocumulus at 10 000 feet, temperature 39°C and QNH (altimeter sub-scale setting) at 997 millibars.

Shortly after the accident, at 1911 hours, a further observation was taken. The only changes to the above were that the surface wind was 320° magnetic at 4 knots and the cumulus had increased to three oktas.

A significant meteorological (SIGMET) advice was current for the Sydney Flight Information Region south of Latitude 32° South. This indicated occasional severe turbulence below 10 000 feet. There was, however, no reported turbulence at low altitude in the immediate vicinity of Sydney Airport.

At the time of the accident the sun was some six degrees above the horizon on a bearing of 249° magnetic. It was behind the thin, middle level cloud but still created a strong, diffuse glare.

1.8 AIDS TO NAVIGATION

Not applicable.

1.9 COMMUNICATIONS

Communications relevant to the accident were recorded on continuously-running magnetic tape and a transcript is at Appendix B. Communications were normal in all respects.

1.10 AERODROME INFORMATION

Sydney (Kingsford-Smith) Airport is located on the northern shore of Botany Bay and has two intersecting runways. Runway 07/25 is 2530 metres long by 45 metres wide. Runway 16/34 is 3962 metres long by 45 metres wide and extends into the bay for some 2000 metres.

At the time of the accident both Runway 25 and Runway 34 were in use. However, the majority of aircraft were being allocated Runway 25 for take-off.

The Sydney Control Tower is located on the shore of Botany Bay, some 650 metres to the west of Runway 34 and 600 metres south of Runway 25. An unobstructed view of both runways and their associated taxiways is available to tower controllers. Services provided to VH-AAV by the tower consisted of Surface Movement Control, responsible for aircraft and vehicular traffic on all parts of the airport movement area other than the runways, and Aerodrome Control, responsible for aircraft taking off and landing.

Clearance Delivery, from which the pilot of VH-AAV obtained an airways clearance, is an element of the Sydney Area Approach Control Centre. This centre is located in a building at the base of the tower.

Sydney Tower is equipped with a combined crash alarm system which provides, via a single button, simultaneous alerting of emergency services. This alarm was activated just prior to VH-AAV striking the sea wall.

The tower is also equipped with an Aerodrome Terminal Information Service (ATIS) system, whereby certain information concerning conditions and operations at the airport is continuously transmitted on set radio frequencies, for the use of arriving and departing aircraft. The ATIS is updated as circumstances change and each message is sequentially identified by use of the international phonetic alphabet.

The ATIS current at the time VH-AAV taxied was information 'Romeo' and was as follows:

> 'Runway three four. Wind two seven zero to three zero zero degrees, one zero (knots) to one five (knots). Crosswind, mean of eight (knots) maximum one five (knots). QNH nine nine seven (millibars). Temperature, four zero (degrees). CAVOK. On first contact with Sydney Ground or Approach, notify receipt of Romeo.'

At 1900 hours the information was changed to 'Sierra' and was as follows:—

> 'Runway two five. Wind two nine zero degrees, ten (knots) to fifteen (knots). Crosswind, maximum eleven (knots). QNH nine nine eight (millibars). Temperature, three nine (degrees). CAVOK. On first contact with Sydney Ground or Approach, notify receipt of Sierra.'

The term CAVOK is an acronym of 'ceiling (cloud) and visibility okay', and means, in general terms, that there is no cloud lower than 5000 feet and visibility is 10 km or greater.

1.11 FLIGHT RECORDERS

Flight recorders were not installed on the aircraft and there was no requirement for such equipment to be carried.

1.12 WRECKAGE AND IMPACT INFORMATION

The aircraft struck the sea wall in a nose-high attitude, banked approximately 5 degrees to the left and skidding 19 degrees to the right.

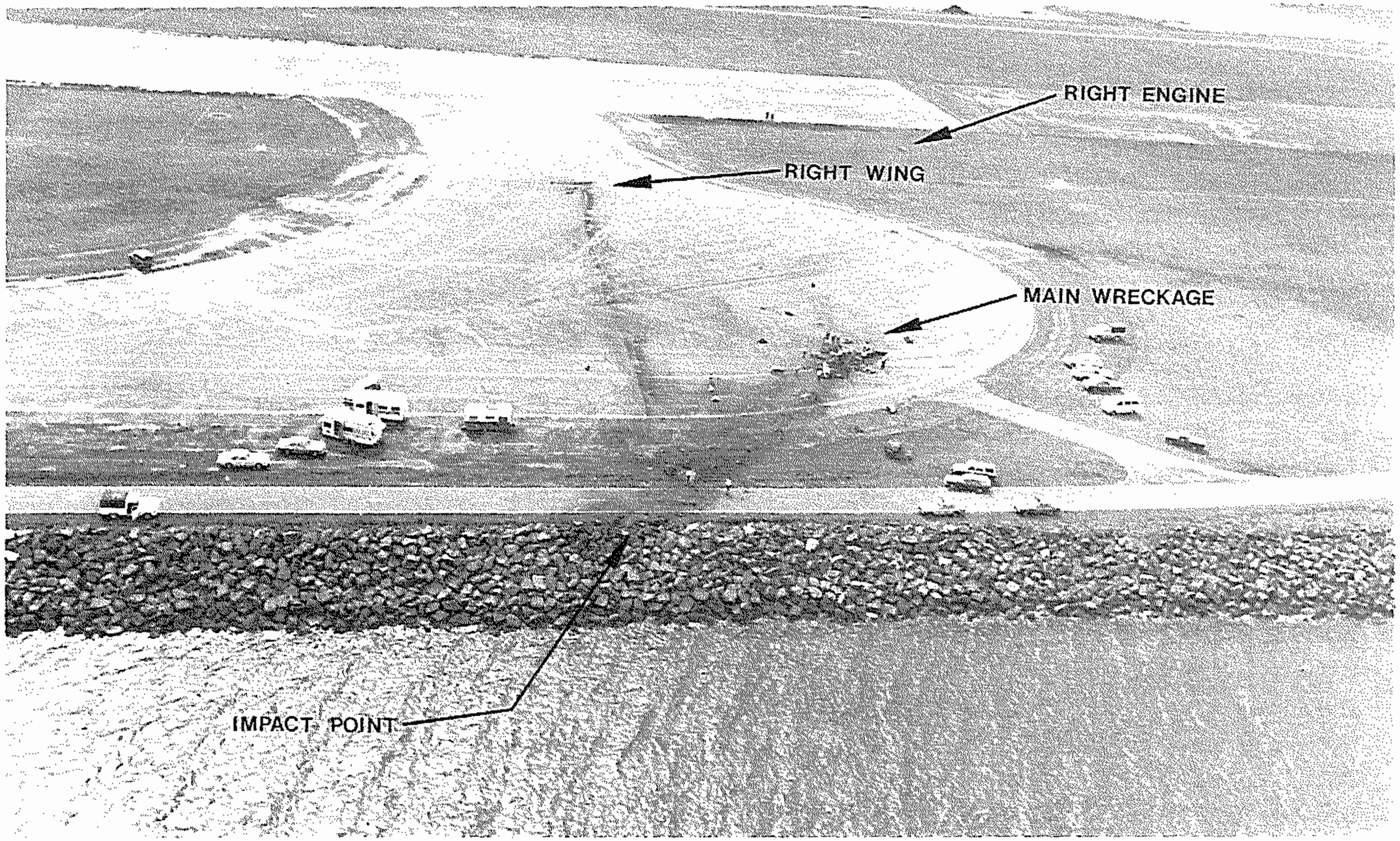


Fig. 2. The accident site

As the lower fuselage was destroyed by fire, it was not possible to establish an accurate pitch attitude at impact. However, the nose section, as far aft as Station 77, had cleared the wall and there was ample evidence that the fuselage had been subjected to high vertical deceleration at impact. Because of the large angle of yaw and nose-high attitude, it is considered likely that the collision with the sea wall was not the first impact. It is probable that the aircraft struck the water first and then ricocheted into the sea wall. Damage to the right propeller supports this hypothesis. There was forward bending of all blades, consistent with contacting a medium such as water.

On impact with the wall the left outboard wing disintegrated and the released fuel exploded in a fire ball which enveloped the aircraft. The right engine and right outboard wing both separated and were thrown across the ground for some 190 metres and 125 metres, respectively. The fuselage, inboard wing sections and left engine bounced over the sea wall and landed, inverted, on the adjacent taxiway and then slid backwards, on a bearing of 104° magnetic, for some 55 metres.

Fire destroyed the centre fuselage section and both inboard wing sections. Portions of the aircraft nose and tail were heat affected but not destroyed.

Continuity of flight control systems could not be confirmed due to impact and fire damage. No evidence of pre-existing fault was found with those control systems components which had not been destroyed. The landing gear and flaps were in the retracted position at impact. The elevator, aileron and rudder trim actuators were all in positions that equated to approximately neutral settings.

The cockpit instrument panel suffered virtually no impact damage and very little heat damage. The centre pedestal was extensively damaged by fire and was disturbed in the course of rescue operations. All engine instruments were reading zero, except for the two torque gauges. These read 1900 ft lb and 2450 ft lb, for left and right engines, respectively. When electrical power is removed from the engine instruments all except the torque gauges return to zero. The torque gauges normally remain on the reading shown at the time of power removal. In this case, the readings as found were considered not to be representative of the pre-impact values because of needle movement resulting from impact forces.

Switch positions of significance were found as follows. Both engines were selected to their respective nacelle fuel tanks. Both engine bleed air systems were on and the air conditioning compressor driven by the right engine was on. The auto-ignition switch for the left engine was on whilst the right was off. The auto-feather system switch was off. The battery, generator 1 and generator 2 switches were all off. There was a gang bar associated with these three switches so that they could all be turned off simultaneously.

It was established that the fire extinguisher systems had not been discharged.

A hand-held microphone, which was identified as the pilot's personal property, was found connected to the pilot position microphone jack.

The aircraft was fitted with three warning annunciator panels, master warning and master caution flashers and warning lights in the gear selector lever. These units sustained very little impact and fire damage.

The left engine came to rest inverted, adjacent to the nose of the aircraft. It had separated from its mounts and the propeller had separated at the drive shaft mounting flange. The cowls and exhaust units had also broken away during the ground slide. Although adjacent to a fire area, the engine had sustained little heat damage, only sooting and charring of some electrical wiring.

The right engine came to rest 135 metres beyond the main wreckage. It had separated at the firewall attachment of the engine mounting truss. The propeller and front engine cowls were still attached. As it was outside the area of post-crash fire, there was no fire damage sustained.

1.13 MEDICAL AND PATHOLOGICAL INFORMATION

Post-mortem examinations were undertaken of all the victims. There was no evidence of any pre-existing abnormality or condition that could have contributed to the accident.

The pilot's medical history showed a deficiency in his left eye visual acuity. As a result, he was required to wear a correcting lens. It was not positively established that he was complying with this requirement at the time of the accident but evidence indicated he was in the habit of wearing spectacles whilst flying. In the event that he had not been wearing his spectacles, it is considered that, given the excellent vision in his right eye, the pilot's ability to see both inside and outside the aircraft would not have been significantly affected.

Traumatic injuries sustained by all occupants of the aircraft were considered consistent with their having been seated at the time of the accident. There was not sufficient evidence to determine whether all safety harnesses had been secured at the time.

1.14 FIRE

There was no evidence of pre-impact fire.

On impact with the sea wall the aircraft's left wing disintegrated and the fuel contained therein ignited in a 'fire ball' explosion that engulfed the fuselage. The detached right wing spilled burning fuel as it was thrown across the ground. The fire zone was therefore some 125 metres long, with main centres at the fuselage and right wing.

The Sydney Airport Rescue and Fire Fighting Unit is located in two stations; on the southwest (No. 1 Station) and northeast (No. 2 Station) sides of the airport. No. 1 Station was some 2000 metres from the accident site whilst No. 2 Station was about 2700 metres away.

The crash alarm was sounded a few seconds before the accident. Simultaneously the duty fire observer, who had noted the abnormal flight path of the aircraft, broadcast an alert over the Unit's public address system.

No. 1 Station was equipped with a Rescue Tender and two Ultra Large Fire Tenders. No. 2 Station had one Ultra Large Fire Tender and one Large Fire Tender. All five vehicles proceeded to the accident site. They travelled along the airport taxiways and runways and did not experience any delay. The first vehicle arrived approximately two minutes after the accident.

Two Ultra Large Fire Tenders were used to control the fire in the fuselage. Foam was dispersed and the fire was under control in some 30 seconds. The third Ultra Large Fire Tender dealt with the burning right wing. Handlines were used to extinguish small patches of burning fuel. The fire was extinguished within approximately 10 minutes of the arrival of the vehicles.

Units from the New South Wales Fire Brigade also attended and assisted in the final stages.

1.15 SURVIVAL ASPECTS

This was not a survivable accident.

1.16 TEST AND RESEARCH

1.16.1 Engines and propellers

Inspection and disassembly established mechanical integrity in the power and accessory gear trains of both engines. Those components that had not been too damaged for testing, and for which test facilities were available locally, were functionally checked against manufacturer's specifications.

On flow testing, four of the right engine set of 14 fuel injection nozzles did not meet the manufacturer's test limitations for 'streaking' (characteristics of atomisation). In addition, one of these four had a flow rate of 16.2 pounds per hour, slightly lower than the minimum specified 16.5 pounds per hour. However, this set was tested in the 'as found' state and the results were considered consistent with normal usage deterioration.

On pre-test inspection of the left engine set of nozzles, two abnormal conditions were noted. Firstly, they all contained traces of water. Secondly, nozzles Nos 1 to 7 and No. 10 contained a soot or carbonaceous deposit. Accordingly, No. 1 nozzle was set aside for more detailed inspection. The remaining nozzles, with the exception of No. 8, which had sustained impact damage, were then flow tested. Only three nozzles, Nos 11, 12 and 14, met manufacturer's limitations. Incorrect spray cone angle, asymmetry of spray cone and abnormal streaking were evident.

If these conditions had existed in an operating engine then combustion inefficiency could have caused burning of the fuel further down the combustion chamber, leading to higher than normal inter-turbine temperature (ITT) readings. Attendant defects, such as localised burning or overheating of the combustion liner, nozzle guide vanes and turbine assembly, could also have occurred. No such defects were found.

During normal engine shutdown, fuel is shut off from the nozzle system at the fuel control unit and unburned fuel, remaining in the nozzles and transfer tubes, is purged into a collector box by high pressure air from the combustion chamber. The nozzles are thus prevented from dribbling and becoming fouled with soot. If the condition lever was not placed to cut-off during the emergency shutdown of the left engine, then fuel would have continued to dribble from the nozzles. The nozzles are set tangentially in the combustion chamber, hence any residual fuel in those which were facing upwards could be expected to form soot, when burned. The relevant nozzles, Nos 1 to 7, did contain soot and hence it was concluded that this contamination had occurred post-impact.

The compressor bleed valves for both engines were tested for control pressure and leaking. All four valves controlled at lower internal pressure settings than prescribed by the manufacturer but all did fully close. Therefore, high-power operation would not have been affected.

Because of impact damage to the left propeller governor, a check of the beta valve was not carried out. Also, the pneumatic maximum adjusting screw and stop had been broken off. When functional testing was carried out, the governor was found to be within specifications, except that the feather stop was at 69 degrees instead of 75 degrees.

The right propeller governor was functionally tested and was within specifications, except for an abnormally high air leak through the air bleed orifice at the underspeed setting. This may have had an effect upon fuel control unit fuel scheduling. This possibility was tested on an engine in a test cell. (Refer Section 1.16.4)

Due to a fractured housing, it was not possible to test the left propeller overspeed governor. The right propeller overspeed governor was found to be out of calibration, on the low side. Because the low setting may have interfered with the operation of the normal governor, the effect was tested on an engine in a test cell. (Refer Section 1.16.4)

The auto-feather/auto-ignition switches from both engines were functionally tested. The high pressure switch on the left engine operated at a lower-than-normal pressure. The effect of this would have been for auto-ignition, presuming it had been selected on at the time of engine failure, to have not commenced until engine power decayed to about 215 ft lb instead of about 370 ft lb. If, as seems more likely, auto-ignition was not

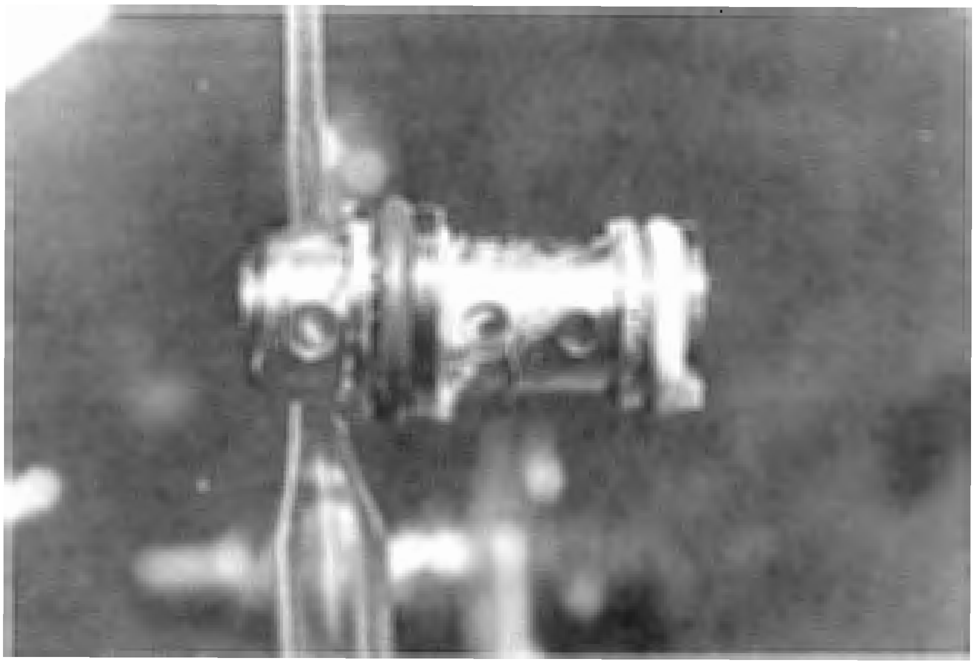


Fig. 3. Gelatinous deposit on left engine FCU bypass valve sleeve assembly.

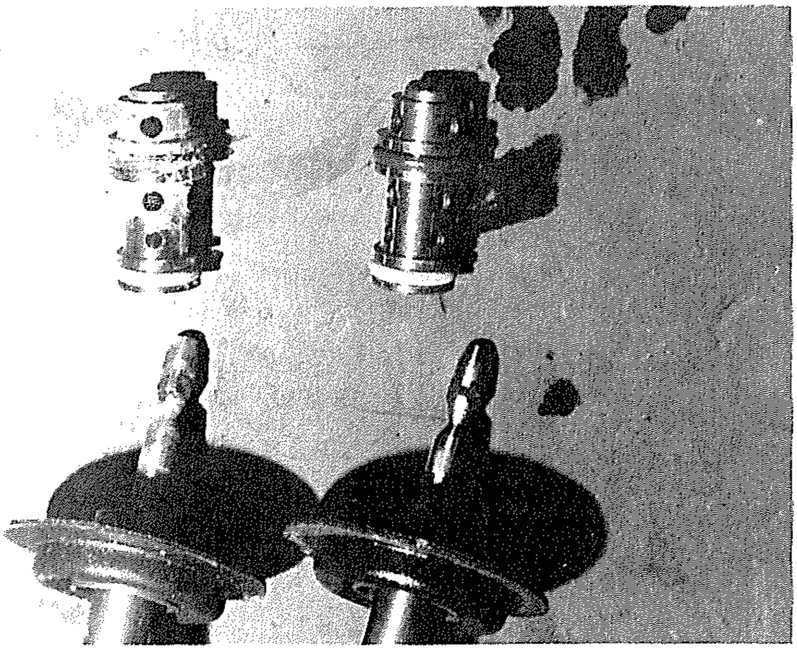


Fig. 4. Bypass valve and sleeve assemblies of left and right engine FCUs. The left engine components show considerable rusting and deposits. The gelatinous deposit on the left engine sleeve assembly has dried to a white powdery material.

turned on until some time following engine failure, then the low setting would not have mattered. All the other switches functioned within specifications.

The left engine fuel control unit (FCU) did not sustain significant impact damage and could have been functionally tested. However, when it was removed from the engine water droplets were noted in the fuel nozzles, transfer tubes, flow divider and FCU outlet line. The unit was disassembled to determine the extent of contamination and samples were collected by syringe for further investigation. (Refer Section 1.16.5)

Water was found throughout the various chambers of the FCU and its associated fuel pump. In addition, many of the components, such as valves, were found to be coated with a translucent material, resembling petroleum jelly. On drying, these became white powdery deposits. The deposits varied from thin films to quite thick coatings, and were sometimes associated with rust-like deposits. (Refer Figs. 3 and 4)

Rusting was evident on the fuel pump gear teeth, over a section of approximately three teeth on each gear. As there was no disturbance of the staining on the gear teeth working surfaces, it was concluded that rusting had occurred subsequent to the accident.

The right engine FCU was also capable of being flow tested but, in view of the findings in the left FCU, the unit was also strip examined. No contamination of any nature was present. The FCU was in good condition and was considered capable of normal operation at the time of the accident.

Each engine had a fuel collector system which, as mentioned previously in this section, collected unburnt fuel from the nozzles and transfer tubes following normal engine shutdown. The fuel was collected in a tank, of some 480 mL capacity, until a float switch in the tank activated a small electric pump. This pump transferred the contents of the collector tank to the engine nacelle tank. The collector tank was vented to atmosphere.

Examination of both engine return pumps revealed that they contained heavy deposits of rust-like sludge in the pump fuel cavities and rusty deposits on the filter screens inside the cavities. By visual observation of the nature and location of the deposits, it was assessed that water, possibly as much as 20 mL, had at some time been present in the pump cavity. The pump housing was manufactured from cadmium plated mild steel. Despite the plating, considerable corrosion had occurred. It was considered that the water entered the collector system through the tank vent line and was a condensation of atmospheric moisture during cooling cycles between engine operations. On transfer of fuel/water to the nacelle tank, the collector tank would be emptied, but a non-transferable volume of about 20 mL would remain in the horizontally mounted pump housing, below the level of the pump outlet line.

The left engine collector tank had sustained both impact and heat damage. It was of stainless steel construction and there was no evidence of rusting. The right engine collector tank was not significantly damaged and was found to contain a pink emulsion. (Refer Section 1.16.5)

The propellers were Hartzell, model HC-B3TN-3G, three bladed, constant speed, fully feathering and hydraulically actuated.

Examination of the propellers revealed no evidence of pre-impact defect. They had been in good condition and appeared to be capable of normal operation prior to impact.

Impact marks in the left propeller pitch change mechanism and the blade roots were consistent with the left propeller having been feathered prior to impact.

The right propeller remained attached to the engine and sustained considerable damage after separation from the aircraft. No clear evidence was found which could establish a pre-impact blade angle. Score marks within the pitch change mechanism, however, were consistent with the propeller being at a low pitch setting at initial impact and being driven by impact forces towards a coarse angle. The propeller blades had not struck the sea wall. All three blades had sustained substantial forward bending which was consistent with their striking the water, prior to the aircraft striking the sea wall.

1.16.2 Warning lights

The various light bulbs recovered from the wreckage were closely examined with the aid of a low-power, binocular microscope. The purpose was to determine whether any of the filaments showed evidence, by stretching, of having been illuminated at the time of impact. In addition, as a serviceability check, electrical power was applied to each unbroken bulb.

The inspection started with the three annunciator panels. Many of the bulbs had sustained an impact load sufficient to break their filament, but no filaments exhibited evidence of stretching. This included those bulbs, such as the left D.C. generator and left fuel pressure, that could be expected to be illuminated because the left engine had been shut down. This evidence, in combination with the position of the electrical power switches, supported a hypothesis that the pilot had turned off all electrical power, as part of a pre-impact emergency drill.

The master warning and master caution bulbs were also examined. Again the filaments were broken but unstretched. These lights would not necessarily have been illuminated. Prior to impact, the pilot could have extinguished these lights by depressing them. This capability did not extend to the annunciator panels lights.

Subsequently, however, the two warning light bulbs which were built into the landing gear selector lever were examined. Both filaments showed evidence of stretching. In the event that the pilot had retarded the left power lever as part of his left engine shutdown procedure, and as the landing gear was retracted, it would be normal for the selector lever lights to be illuminated.

The evidence therefore indicated that electrical power failed between the time the gear selector lever sustained a significant impact load and when the annunciator panels were similarly loaded. There were certainly two distinct impacts; one against the sea wall and another as the aircraft dropped inverted to the taxiway. There would not need to be a significant period between these impacts. Once an electrical current is removed, it only requires a fraction of a second for filaments to cool below a temperature where stretching will occur.

1.16.3 Engine exhaust stubs

The pairs of damaged exhaust stubs from the two engines were submitted to metallurgical examination. The purpose was to determine engine operating status from the knowledge that if exhaust stub material is bent when cold, strain hardening will cause an appreciable increase in hardness. Also, the microstructure of the stub at the bend will exhibit extensive slip lines when examined with a scanning electron microscope. If the stub is hot when bent, there is little, if any, increase in hardness and very few slip lines occur in the microstructure.

Test samples were cut from the exhaust stubs, at positions that had not been distorted. One sample was bent at room temperature and the other whilst heated to approximately 400°C.

Both in hardness and microstructure, bends in the left engine exhaust stubs had similar properties to the cold-bent sample. The right exhaust stubs compared to the hot-bent sample.

1.16.4 Engine manufacturer's tests

As suitable facilities were not available in Australia, the two torque limiters were referred for functional testing at the premises of engine manufacturer, Pratt and Whitney Aircraft, in Montreal, Canada. The left engine torque limiter was found to be too damaged for testing. The right engine unit was found to function within specifications.

The propeller governor and propeller overspeed governor from the right engine, which had been found to operate outside specifications, were re-tested using the facilities of the engine manufacturer to confirm the initial findings and then installed on an engine in a test cell. The engine operated normally, without any reduction in performance due to the slightly out of adjustment governors.

1.16.5 Fuel

On the evening of the accident fuel samples were taken from both the underground storage at Flight Facilities and the tanker which had completed the fuelling of VH-AAV. Both sources had been subject to routine testing prior to the accident and there was no history of any abnormality. On visual inspection, the post-accident samples also appeared to be normal aviation turbine fuel, with no observable contaminants.

In addition, a number of the pilots of those aircraft which had been fuelled from the tanker before and after VH-AAV were contacted. They all reported that post-fuelling drain checks and subsequent aircraft operations had been normal.

A third fuel sample was collected at Sydney Airport from the storage facility from which the tanker had been filled. All three were then submitted to analysis. The results indicated all three were within specifications for aviation turbine fuel Jet-A1, with no indication of any contamination.

Subsequent to the discovery of water in the left engine of VH-AAV, it was established that the aircraft had been refuelled at Lord Howe Island on 20 February 1980. Fuel is transported to that island in drums and then decanted, as necessary, into a tanker trailer for aircraft supply. The drum stock and tanker trailer were inspected and no evidence of water contamination was found. Two samples were taken from the tanker trailer sump and filter drains and, together with the trailer's stripper cartridge and coalescer filter element, were submitted to analysis.

The samples were uncontaminated and within aviation turbine fuel Jet-A1 specifications. Light contamination, with solids such as tank scale, was evident in the coalescer element and a small quantity of a white paste-like material, possibly a lubricant grease, was found in the stripper cartridge. The purpose of the filters was, of course, to trap such contamination and it was evident that they had fulfilled this function.

As noted in Section 1.16.1, many of the components of the left FCU were coated in a translucent material that, on drying, became a white powder. Electron probe micro analysis of a sample was carried out. The results indicated that the sample contained the elements aluminium, oxygen, chlorine and potassium. The former two were present in considerable quantity whilst chlorine was estimated at 5 to 10 per cent and potassium as a strong trace. No other elements, above the atomic number of carbon, were evident. It was noted that the sample displayed slight volatility and charring under the conditions of the electron beam and vacuum, a situation typically associated with the presence of an organic material.

Quantitative atomic absorption spectroscopy analysis was applied to another sample of the white powder, to confirm the presence of potassium and the apparent absence of sodium. Analysis of a 0.7 mg sample yielded 0.2 per cent potassium and concluded that sodium, if present, was less than 0.05 per cent. This was unusual in that both sodium and potassium are normally present in either reticulated water systems or sea water.

An attempt was made to identify a possible source of the high-potassium/nil-or-low sodium contaminant. As it was established that VH-AAV had been partly washed just prior to the accident flight, a sample of the detergent used was analysed. It was found to contain both sodium and potassium, in a 6:1 ratio. As the detergent had been decanted from a bulk stock into a bottle that had previously contained a different brand of detergent, the formula for the original detergent was obtained from the manufacturer. This also contained both elements, with sodium being predominant.

As the left engine had been in the crash fire zone, and thus possibly affected by fire fighting foam, a sample of foam was analysed. Both sodium and potassium were present, in an approximate ratio of 3:1.

Three fuel samples were recovered from the FCUs of VH-AAV prior to the units being strip examined. Two samples were from the left FCU: one from a broken fuel line and the other from the high pressure filter housing. The third sample was from the right engine high pressure filter housing. Both left FCU samples contained visible water and were light amber in colour. The sample from the right FCU did not contain visible water and was yellow in colour.

Gas liquid chromatography of the samples established that all three were within the specifications for aviation turbine fuel Jet-A1, except that they were slightly 'weathered', having lost some of the more volatile components. Such weathering was considered normal, bearing in mind the history of the samples. The bright yellow colouration of the starboard sample was not considered as cause for concern. The sample faded to an almost water white colour after several days exposure in the ambient laboratory light. This can be a normal phenomenon caused by the inter-reaction of fuel antioxidants and ultra-violet light.

The pink emulsion recovered from the right engine fuel collector tank was not analysed for a few days. During this period the emulsion partially separated into a clear red layer over a milky white aqueous phase. The clear red liquid was subjected to gas liquid chromatography and determined to be consistent with aviation turbine fuel Jet-A1. No irregular peaks were detected in the chromatograph to account for the red colouration and no explanation of its origin was apparent.

Analyses were carried out on a number of water samples, for purposes of elemental comparison. The samples included water from the normal supply at Sydney Airport, two samples from the left FCU of VH-AAV and two samples from the right main and right nacelle tanks of another Beech 200 aircraft, that was found to be contaminated during maintenance in June 1980. A sample taken from the Melbourne city water supply was used as a base comparator. In addition, limited analyses were carried out on two samples from two supply sources at Lord Howe Island aerodrome. Elemental values were mainly determined by the atomic absorption carbon rod technique, which requires less than five microlitres per element analysis. In the case of sodium and potassium, which are less applicable to this technique, the conventional flame method of analysis was used. The results are at Table 1.

1.16.6 Engine performance

Pratt and Whitney PT6A-41 engines, as fitted to VH-AAV, have a torque limit rating of 850 SHP. This power is achieved at a torque of 2230 ft lb. During a normal take-off, this power is set by reference to the engine torque gauges, except that in the event an ITT of 750°C is achieved first, then power is limited so as not to overheat the engine turbine section. Whether torque limit or ITT limit is the governing factor depends upon ambient temperature and, at sea level, the transition is at about 31°C.

The air temperature at Sydney Airport at the time of the accident was 39°C and engine power was ITT limited. Based on the engine manufacturer's data, the minimum acceptable power that each engine should have produced in that situation was 800 SHP. This assumes normal bleed air was selected on, as was indicated by the cockpit switch positions during post-accident examination. However, as airconditioning was also found selected on, and as the airconditioning compressor was driven by the right engine, minimum power available to the right propeller would have been reduced by 7.5 SHP, to 792.5 SHP.

Table 1. ELEMENTAL ANALYSIS OF WATER SAMPLES
(values in mg/L or ppm)

Element		City supplies		Lord Howe Island		VH-AAV		2nd Beech 200	
		Melbourne	Sydney Airport	1st sample	2nd sample	Left FCU drain	Left FCU filter housing	Right main tank	Right nacelle tank
Copper	(Cu)	0.013	0.038	—	—	22.5	2.5	5	25
Cadmium	(Cd)	0.0006	0.0007	—	—	6.0*	1.8	0.6	1.7
Lead	(Pb)	0.005	0.003	—	—	0.9	1.1	5.2	55.2
Iron	(Fe)	0.037	0.021	—	—	0.2	0.2	0.3	0.3
Manganese	(Mn)	0.006	0.003	—	—	0.13	0.13	0.11	0.14
Magnesium	(Mg)	0.026	0.037	—	—	190.0*	133.0*	21.4	31.8
Potassium	(K)	0.7	1.5	3.0	1.1	154.0	61.5	3.1	5.3
Sodium	(Na)	4.5	12.0	41	27	557.0	179.0	18.6	80.0

*Disproportionately high levels of cadmium and magnesium may result from corrosion (over a period) if such metals had been in contact with the water. These elements are common in aircraft and prone to corrosive attack even in mild conditions.

The minimum power figures in the preceding paragraph are related to 'fully deteriorated' engines. Normally, engines could be expected to perform better than this. The purpose of the engine performance tests, carried out by the operator's maintenance personnel just before the accident flight, was to determine the actual output of the engines, and that it was not less than the fully deteriorated limit set by the engine manufacturer. As data were not recorded during the tests, however, the actual performance of the engines is not known. The maintenance personnel could only confirm that the engines met the required standard.

The operator did require that pilots complete a log of engine instrument readings on each flight. The logs for VH-AAV were available but, as the entries were made during cruise flight, it was not possible to modify the data, with adequate correlation, to the take-off power situation. It was evident from the logs, however, that the right engine consistently performed better than the left engine. The same cruise torque setting would be achieved on both engines with the right engine ITT 12°C cooler than the left. Assuming no instrument error and a straight line relationship between SHP and ITT, the difference equated to a higher output capability by the right engine of about 44 SHP during take-off at sea level. The possibility existed, therefore, that at 750°C ITT the right engine output could 'have been of the order of 836.5 SHP.

As the Company Operations Manual prescribed a normal maximum ITT of 700°C, the engine manufacturer's data were used to calculate the effect upon the output of the engines of the 50°C reduction. The difference equated to 185 SHP, or approximately 23 per cent of the power available at the engine manufacturer's ITT limit. Thus, for a fully deteriorated engine, the output from the left engine would have been 615 SHP and the output from the right engine 607.5 SHP. If the right engine output was 44 SHP higher than for a fully deteriorated engine, its output would have been 651.5 SHP.

These power figures formed the basis for the aircraft performance evaluation and tests. (Refer Section 1.16.7)

1.16.7 Aircraft performance

It was necessary to consider aircraft performance under two conditions of engine power:

(a) with the right engine operating at the engine manufacturer's ITT limit of 750°C, and

(b) with the engine operating at the operator's reduced ITT limit of 700°C.

Whilst the landing gear was retracted when the left engine failed and the left propeller probably feathered shortly afterwards, it was not known at what point the flaps were retracted. Hence it was also necessary to consider:

(a) flaps up, and

(b) flaps 40 per cent (normal take-off setting).

The aircraft manufacturer's data applicable to an ITT of 750°C provided the following single-engine rates of climb, applicable to the ambient conditions, gear up, inoperative propeller feathered and aircraft climbing straight ahead:

Flaps (per cent)	0	40
Best rate of climb IAS (knots)	121	106
Rate of climb (ft/min)	600	420

With the aircraft banked to the left, it has been estimated that these rates of climb would decrease, as follows:

Flaps (per cent)	0	0	0	40	40	40
Angle of bank (degrees)	0	10	20	0	10	20
Rate of climb (ft/min)	600	585	540	420	400	335

Any variation in IAS from the best rate of climb speed has been estimated to also result in a degradation in climb performance, as follows:

Flaps (per cent)	0	0	0	40	40	40
IAS (knots)	121	116	111	106	101	96
Rate of climb (ft/min)	600	590	570	420	375	320

Data were not available for the reduced power setting of 700 °C ITT and hence test flights were carried out by Beech Aircraft Corporation to determine appropriate performance figures. It was not practical to duplicate the ambient conditions existing at the time of the accident but by operating the right engine at a torque of 1648 ft/lb (the mid-point of the range of probable right engine output calculated at Section 1.16.6) most of the variables were eliminated. Assessments of the effects of changes in ambient conditions on propeller efficiency and true airspeed were made and the differences were found to be negligible.

As it was not certain whether rudder had been applied to counter yaw, the tests covered two extremes of action: no rudder application, and rudder application, up to full rudder, to prevent the aircraft turning. The no rudder situation with 40 per cent flap could not be performed as the aircraft slowly porpoised. This caused the rate of climb to be essentially zero. The porpoising was considered to be probably caused by turbulent flow from the fuselage interacting with the horizontal tail under large side-slip angles.

The data obtained from the flight tests were:

Flaps (per cent)	*IAS (knots)*	*Angle of bank (degrees)*	*Rudder applied*	*Rate of climb (feet/min)*
0	121	5 Right	Yes	302
,,	,,	0	,,	287
,,	,,	5 Left	,, *	140
,,	,,	5 Right	No	190
,,	,,	0	,,	211
,,	,,	5 Left	,,	173
40	106	5 Right	Yes	135
,,	,,	0	,,	121
,,	,,	2 Left	,,	75
,,	,,	—	No	Not established

* With full rudder application the aircraft turned left at 22 degrees/min.

By extrapolation, it was estimated that, for the zero flap situation, climb capability would have ceased in the range 8 degrees to 14 degrees left bank. For the 40 per cent flap situation, climb capability would have ceased at about 4 degrees left bank.

1.16.8 Left propeller feathering

VH-AAV was equipped with an auto-feather system which was capable, in the event of a sensed asymmetry of engine power, of feathering the propeller of the engine that had sustained the power loss. The second Beech 200 aircraft operated by Advance Airlines was not similarly equipped and hence, for the benefit of standardisation, it was company policy not to arm the auto-feather system in VH-AAV.

The wreckage evidence indicated that the pilot had followed company policy as the auto-feather arming switch was found in the off position. The left propeller, however, was found in the feathered position. It was therefore likely that the pilot had carried out manual feathering action at some point during the flight.

Of the many witnesses who observed the accident flight, only two volunteered the information that the left propeller had been rotating more slowly than the right propeller. Both had been in close proximity to the aircraft's path; one in a car park to the north of the airport tower and the other on the beach to the west of the tower.

These two witnesses were placed approximately 50 metres in front of a Beech 200 aircraft whilst its propellers were exercised between the feathered and the full speed (2000 rpm) positions. The test was performed twice for each witness. The witness from the car park consistently indicated 350 rpm as the speed at which he believed the left propeller of VH-AAV had been operating. The witness from the beach nominated 100 rpm and 150 rpm as the propeller speed she recalled. All persons present at the test noted that the propeller disc appeared identical at speeds of 500 rpm and above.

As the test was both subjective and dependent upon human recall it was considered only valid to conclude that the pilot had most probably feathered the left propeller shortly after the left engine failed.

1.16.9 Flight path reconstruction

Numerous witnesses observed the flight of VH-AAV. This information was used to reconstruct the most probable flight path, in terms of ground track and altitude.

The reconstruction was tested by twice flying another Beech 200 aircraft along an approximation of the derived path. For safety reasons an engine was not shut down and minimum airspeed and altitude limitations were imposed. Six of the principal witnesses observed the simulations, from the same locations at which they had seen the accident flight. Their comparative comments were used to refine the reconstruction.

Further refinements were made after performance evaluation and testing was completed. The final results of this process indicate the following—(see also Appendix A):

VH-AAV commenced its take-off from a position on the centreline of Runway 25, some 50 metres from the end of the runway. The clearance to take off was transmitted at 1907:27 hours and, after acknowledgement of the clearance, the aircraft's brakes were released at approximately 1907:36 hours. Power was slowly increased on both engines until the take-off setting was achieved. Rotation speed of 94 knots IAS was reached after about 28 seconds, by which time the aircraft had travelled some 700 metres. The nose was raised and the aircraft became airborne at approximately 1908:06 hours. Shortly after lift-off, the landing gear was retracted.

At approximately 1908:19 hours, VH-AAV had passed over the intersection of Runways 25 and 34. It had reached a height of about 100 feet AGL and an IAS of some 115 knots. It is at about this point that the left engine lost power. The nose was lowered and the aircraft levelled at about 150 feet AGL. It then began to turn left, with a bank angle of some 10–15 degrees. It is probable that the pilot was carrying out emergency actions during this period and that, at about 1908:30 hours, he manually selected the left propeller to feather.

The aircraft had turned some 40 degrees to the left and was approaching the Cooks River when, at 1908:33 hours, the pilot commenced his transmission, advising of the left engine failure. The left turn continued and the aircraft was heading nearly 90 degrees from its take-off direction, and passing over the shore of Botany Bay, when the pilot was asked if he had the Boeing 727 in sight. Before the pilot responded, the angle of bank was reduced and the turn either slowed or briefly stopped.

It was probably either simultaneous with, or immediately following, the reply of 'affirmative' that the nose was lowered and the aircraft entered a descent at between 300 and 500 feet per minute. This was halted when the aircraft was only a few feet above the water. Just prior to the aircraft levelling, the pilot advised that the approach and landing would not be normal. At the time of this transmission, 1908:58 hours, the Boeing 727 was passing over the threshold of Runway 34. It touched down approximately six seconds later, some 450 metres into the runway.

VH-AAV continued in flight, at an extremely low altitude, and turning slowly to the left. Airspeed was low and the aircraft was in a noticeably nose-high attitude. Its tail was either furrowing the water or close enough to induce a wake. Approaching the sea wall, abeam of the Runway 34 threshold, the right propeller probably entered the water. The aircraft suddenly swung to the left, the nose pitched up and it struck the sea wall at approximately 1909:22 hours.

The elapsed time from brakes release was 106 seconds and the aircraft had travelled a total distance of some 4900 metres.

1.16.10 Cockpit workload

It appeared probable that, following the left engine failure, the pilot would have been required to carry out two particular tasks that, in other circumstances, could have been avoided. Specifically, to increase power on the right engine due to a reduced take-off ITT setting and to manually initiate left propeller feathering because the auto-feather system was not armed. These tasks would, of course, be in addition to unavoidable actions, such as maintaining control of the aircraft and identifying the nature of the emergency.

As the aircraft was in a busy traffic environment and under air traffic control, it was also necessary to communicate with the tower. This process would have been made more difficult by the use of a hand-held microphone rather than the aircraft's normal boom microphone equipment.

To evaluate the significance of these variables, tests were carried out in another Beech 200 aircraft to establish firstly the time required to complete the 'unavoidable' tasks associated with an engine failure after take-off and then the time to complete both unavoidable and the abovementioned 'avoidable' actions. Two senior pilots experienced with the Beech 200 were used. As it was not practical to simulate the surprise element of the engine failure for direct comparison with the accident flight, the pilots were given an opportunity to practise the exercise so that the times would indicate the minimum attainable under ideal conditions.

Times were measured with a hand-held stopwatch. Both pilots were tested twice and the results were averaged. The indicated increase in workload resulting from the need to increase power, manually initiate feathering and use a hand-held microphone was of the order of 42 per cent.

1.16.11 Fuel system

The Beech 200 has two separate fuel systems, connected by a valve-controlled crossfeed line. The system for each engine is further divided into a main and auxiliary system. Each main system consists of a nacelle tank, two wing leading edge tanks, two box section bladder tanks, and an integral (wet cell) tank, all interconnected to flow into the nacelle tank by gravity. This system of tanks is filled through a filler located near the wing tip.

Each auxiliary fuel system consists of a centre section tank with its own filler opening just inboard of the engine nacelle and an automatic system to transfer the fuel into the main fuel system nacelle tank.

Fuel in the auxiliary tanks will automatically be used first. During transfer of auxiliary fuel the nacelle tanks are maintained full. A swing check valve in the gravity feed line from the outboard wing prevents reverse fuel flow. Upon exhaustion of the auxiliary fuel, normal gravity transfer of the main wing-fuel into the nacelle tanks will begin.

Not all of the fuel in the aircraft is usable. By design, the outlet from each tank in the system is higher than the bottom of its tank so as to leave a fuel sump. The sumps also provide the space in which any contaminant, such as water, may collect. The amount of unusable fuel is dependent upon aircraft attitude.

The fuel system of VH-AAV was fitted with a total of 12 drain points. Two provided effective drainage for each engine filter. The remainder provided effective drainage for the various sumps. The term 'effective drainage' is applicable because whilst the drain outlet from each sump is lower than the normal outlet line, it is not necessarily at the lowest point of the sump. Hence 'undrainable' fuel can remain in the sumps and this can contain contaminants.

At the time of the accident, each engine of VH-AAV was being supplied with fuel from its respective auxiliary tank, via its respective nacelle tank. In view of the evidence of water contamination of the left engine fuel supply, tests were carried out to establish the unusable and undrainable capacities of the nacelle and auxiliary tanks.

An identical type of aircraft to VH-AAV was parked on level ground and the left engine run until all usable fuel was consumed from the left-side tanks. The left auxiliary tank and the left nacelle tank were then drained. Approximately 2.9 litres was obtained from each tank. The tanks were then opened and the undrainable fuel collected. This was measured at 276 mL and 550 mL respectively for the auxiliary tank and nacelle tank.

The test indicated that:

(a) a gross amount of water, in excess of 6 litres, would have to be introduced into the auxiliary tank before both auxiliary tank and nacelle tank sumps became totally contaminated and water flowed into the engine, and

(b) the unusable but drainable amounts of 2.9 litres in each tank should easily accommodate the normal rate of water accumulation between routine drain checks.

Consideration was also given to the mechanism by which any mass of water that did accumulate in the nacelle tank sump could enter that tank's outlet line and travel to the engine. As the engine failure occurred shortly after the aircraft became airborne, two ways appeared possible. The first was rearward movement of the denser water due to acceleration during the take-off run. The second was rearward tilting of the nacelle tank at rotation. The latter appeared more likely as it would only be a few seconds after water left the nacelle tank that engine failure would occur.

Neither theory could be supported. The outlet line from the nacelle tank is located near the front of the tank. Hence, rearward movement should have moved any mass of water away from the outlet.

1.17 ADDITIONAL INFORMATION

1.17.1 Engine handling procedures

It is an approved practice of a number of airline operators to operate their aircraft at less than maximum engine power settings, in order to extend engine life. In each case the operator, in co-operation with the Department of Transport, has developed performance data and procedures under which reduced power can be used.

One condition of relevance, when taking off with reduced power, is that in the event of an engine failure the aircraft should be able to meet the minimum climb gradient requirements with the remaining engine(s) still operating at the reduced power setting. That is, it is not acceptable for a need to exist to increase power on the remaining engine(s) in order to be able to climb away.

Although only approved for a limited number of operators, this concept of extending engine life, with its resultant economies, is in widespread use. Many operators have introduced the practice, but without a detailed evaluation of the operational repercussions or Department of Transport approval.

When Advance Airlines first purchased Beech 200 aircraft, consideration was given to operating them at reduced ITT. The subject was discussed at senior company management level and involved both engineering and operations personnel. It was reported that other Beech 200 operators and the local agents for the aircraft and engine manufacturers were also involved in these discussions. There was apparently unanimous support for the proposal.

The operator therefore introduced the procedure whereby for take-off, maximum ITT was to be limited to 700°C instead of 750°C. This was a pilot-controlled limitation and the engines were not mechanically adjusted to reduce maximum ITT. In the event of an emergency, such as an engine failure, the pilot was expected to increase ITT to the higher limit of 750°C. No reduction in maximum torque was introduced.

The company had included in the Operational Procedures part of its Operations Manual details of the reduced ITT procedure. A copy of this amendment had not, however, been submitted to the Department of Transport, as was required. Nevertheless it was established that Departmental surveillance officers were aware of the practice.

1.17.2 Company pilot training

Engine failure after lift-off was one of numerous emergency drills covered by the company during initial type endorsement training of pilots. Subsequently, the only practice in this drill was during the course of bi-annual instrument rating renewal testing.

The first item in the Flight Manual emergency procedure for an engine failure after lift-off was 'Power—MAXIMUM ALLOWABLE.' When a number of company pilots were questioned on their knowledge of this drill, however, no one mentioned increasing power at any stage. When this was pointed out, the responses were generally:

(a) the power at take-off was normally maximum anyway, and

(b) the Beech 200 single-engine performance was so good it was doubtful if more power was required.

The first response was considered a generally valid comment. The majority of Advance Airlines operations were under conditions of relatively low air temperature. Hence, for most take-offs, maximum torque would be achieved before the company-imposed ITT limit of 700°C was reached.

The second response may well have reflected the fact that training was usually carried out in an unladen aircraft. Consequently, the single-engine performance would be high and, even on those occasional hot days when take-off power was ITT-limited, there would be no demonstrable need to increase ITT from 700°C to 750°C.

Whilst interviewing the pilots the opportunity was taken to ask their estimates of the power loss incurred by limiting ITT on a hot day to 700°C instead of 750°C. The responses were of the order of 5 to 7 per cent.

1.17.3 Aircraft pre-flight preparation

At about 1700 hours on 21 February 1980, after undergoing scheduled maintenance, VH-AAV was towed to the parking area, in readiness for Flight DR 4210.

Flight Facilities undertook the refuelling of Advance Airlines aircraft at Sydney Airport and, at approximately 1730 hours, an employee of the agency commenced refuelling VH-AAV. He had been instructed by the pilot to fill both main tanks to capacity and put 100 litres in each auxiliary tank. The fuel was to be drawn from an underground storage tank, located beneath the parking area.

Only 30 litres of fuel had been placed in the right main tank when the underground fuel system pump failed. The refueller therefore contacted the fuel agent at the airport and requested a tanker. The tanker did not arrive until about 1750 hours and, by arrangement, it fuelled two other aircraft, scheduled for earlier departures, before VH-AAV.

At some point during the refuelling of those aircraft, the pilot of VH-AAV proceeded from the company office to his aircraft, probably to carry out a routine pre-flight inspection. He subsequently returned to the office and complained that there were dirty marks on and around both engine nacelles. This was confirmed by company management personnel and maintenance staff were instructed to wash the marked areas.

The cleaning was still in progress when the passengers and their baggage were embarked. The pilot had preceded the passengers and, when they arrived, was already seated in the aircraft cockpit. After a brief delay, whilst the tanker moved from in front of VH-AAV, the pilot commenced engine start-up.

It was a company practice that post-fuelling drain checks would be carried out by pilots, even if maintenance personnel were available. The pilot of VH-AAV was reported to consistently carry out a fuel drain as part of his pre-flight inspections but it could not be positively established that he had carried out a fuel drain on this occasion.

The aircraft fuel system was drained twice on 21 February 1980. The first time, at Condobolin, a few drops of water were found in the right main tank system. The second time was during maintenance at Sydney Airport, when there was no sign of contamination.

2 Analysis

The only finding of significance during the examination of the left engine was numerous droplets of water in the FCU and downstream components. The water was present in sufficient volume to conclude that it had probably caused a flame-out.

As the aircraft had been refuelled and then partly washed prior to the accident flight, it was logical to suspect that one of these activities might have introduced the water into the fuel system. However, tests of both the underground storage facility and the tanker proved negative and other aircraft fuelled from the same tanker, both before and after VH-AAV, showed no evidence of being water-contaminated.

The aircraft washing, that immediately followed refuelling, was also eliminated, for two reasons. Firstly, the aircraft fuel system was capable of accommodating a large volume of water, in excess of 6 litres if introduced into an auxiliary tank, before the contaminant entered the engine. Secondly, analysis of the water indicated that it had been present in the fuel for some considerable period prior to the accident. Elemental analysis revealed high concentrations, in the order of 100 times that found in tap water, and there is no likely mechanism by which these could have developed in the brief period between aircraft washing and the accident. The levels and ratios of elements in the water from VH-AAV were most consistent with those recovered from another Beech 200 aircraft that had been refuelled from contaminated drum stock. The phenomenon of 'concentrating effect' is well known and results from dissolving of water into the fuel. Water soluble elements are not, however, similarly dissolved and therefore accumulate in increasing concentrations in the remaining undissolved water.

The presence of microscopic amounts of water in any fuel is normal. It has been estimated that an uplift of 2500 litres of fuel, when subjected to cold soak conditions at high altitude, could result in an accumulation of approximately 50 to 100 mL of free water from solution. In addition, water was probably introduced into the nacelle tanks of VH-AAV via its fuel collector system but, again, in very small quantities.

Therefore, whilst the presence of water could be expected in an aircraft's fuel sumps, it should not be found in significant quantities, provided regular sump drains are carried out. With the possible exception of immediately prior to the accident flight, it was reported that such checks had been done. It was not therefore possible to explain where, in the left fuel system of VH-AAV, a significant volume of water had progressively accumulated or by what mechanism the water had travelled to the left engine at the time of the accident.

The loss of left engine power was not, of itself, the primary cause of the ensuing accident. The failure occurred at a critical phase of flight, the aircraft was overloaded by some 128 kg and the ambient temperature was 39 °C. Nevertheless, the single-engine performance of a Beech 200 is such that safe continuation of flight should have been possible. This, of course, assumes that the remaining engine was capable of normal operation. In respect of the right engine of VH-AAV, no evidence of significant pre-existing fault was found. Maladjustments of the propeller governor and propeller overspeed governor existed but, on test, were found to have negligible effect upon engine operation.

To achieve the best single-engine climb performance, a Beech 200 should be flown straight ahead with the inoperative propeller feathered, landing gear and flaps up, maximum power set on the operating engine, at the optimum airspeed, with five degrees bank into the operating engine. A variation in any of these parameters will reduce the rate of climb. When the left engine of VH-AAV failed it is known that the landing gear was up and the aircraft was climbing straight ahead. It is probable that the left propeller was feathered shortly afterwards and, at some stage of the flight, the flaps were raised. On the other hand, it is known that instead of bank to the right being introduced, the aircraft banked and turned to the left shortly after the engine failed and, with minor variations, stayed in such an attitude for most of its flight. The situation in respect of other parameters is not known but, from circumstantial evidence, the following appears likely.

The take-off was probably carried out with power set at the company limit of 700 °C ITT. This would have reduced the acceleration, and hence increased both the time and distance to lift-off, but, given the long runway available, not to any significant extent.

When the left engine failed the pilot was confronted with two important tasks: to control the aircraft in its state of asymmetric power and to identify and shut down the failed engine. Of the two, controlling the aircraft is more important. This should have involved countering the yaw caused by asymmetric power with opposing rudder, adjusting the aircraft pitch attitude to gain and maintain optimum airspeed, introducing 5 degrees of right bank and applying full power. The second task, identifying the failed engine, confirming by reference to the engine torque gauges, and then moving the left propeller control to the feather position, should have been carried out next.

Given the expected delay in human reaction due to surprise, the second task was commenced with reasonable speed. Feathering of the left propeller was apparently initiated about 10 seconds after engine failure. In terms of controlling the aircraft, however, the only action to be expected was the lowering of the aircraft nose to gain or maintain airspeed. There was no obstruction ahead and hence no obvious reason to place the aircraft into a left turn. The pilot could, as indicated in his transmission to Aerodrome Control, have decided the best plan was to make a landing on Runway 34, but it would have been usual to climb straight ahead to at least 500 feet before turning left. It therefore seems likely that the left turn was entered unintentionally, as the aircraft would naturally tend to do in the absence of opposing control inputs.

Two reasons, probably in conjunction, appear possible for such a turn. Firstly, in the stress of the moment the pilot's attention may have been primarily directed to what was wrong with the left engine and what could and should be done about it. This would have involved an inspection of the engine instruments, with associated diversion of attention from both the flight instruments and external references. The second reason was the low azimuth of the sun, almost directly ahead. This would have created both delay and difficulty in visual adjustment to the relative darkness of the cockpit interior and would have further compounded the loss of outside reference.

By the time the pilot had resolved the engine problem and returned his attention to aircraft control it is probable that VH-AAV had already turned some 30 degrees to the left. The situation was not critical, in that the turn could have been stopped or even reversed but, probably conscious that he was in a busy traffic area and had deviated from his authorised track, the pilot's immediate reaction was to call Aerodrome Control to explain this emergency and obtain clearance for the left turn. Both his transmission and monitoring the response would have occupied his attention and this distraction was prolonged by the need to then scan for and acknowledge sighting of the Boeing 727 on approach for Runway 34. By the time this transmission was completed the aircraft had turned through approximately 90 degrees and the pilot commenced to straighten the aircraft onto a downwind leg.

If, shortly after left engine failure, the right engine had been set to the maximum limit of 750°C, then VH-AAV should have retained a climb potential throughout the initial turn, albeit less than flight straight ahead would have provided. As the aircraft maintained a virtually constant altitude, this potential should have resulted in an increased airspeed. It would therefore have been expected that the aircraft would climb on the downwind leg, towards the normal circuit height of 1000 feet AGL. Instead, shortly after straightening, the aircraft descended to just above sea level.

The most obvious explanation for such a manoeuvre is that the pilot was attempting to trade altitude for airspeed. If power had not been increased from the take-off setting of 700°C ITT then, during the turn, the aircraft would have been in a negative climb potential regime. By holding height in such a situation, airspeed would have reduced and, given all the other demands upon his attention, this could have been overlooked by the pilot. When it was noticed, he could be expected to react rapidly in an attempt to rectify the situation.

That the pilot had not appreciated the deteriorating situation prior to this is supported by the normality of his early transmissions to Aerodrome Control. It was not until responding to the query whether the approach and landing would be normal that he conveyed an awareness of real danger.

The descent was evidently not successful in that the gain in airspeed was not sufficient to permit the aircraft to climb. During the final low level segment of the flight the aircraft attitude was nose high and the continuing gradual left turn indicated the pilot was experiencing directional control problems. At the extremely low height, ground effect, with its resultant reduction in drag, would have assisted, but not sufficiently to recover the situation in the time available.

If power on the right engine had been increased at this stage of the flight, it is doubtful whether an accident could have been avoided. To have increased power would have introduced a greater yawing force that, at the low airspeed, would have accentuated control problems. The aircraft's low height and the proximity of the runway extension left little or no room to manoeuvre.

The pilot might have contemplated ditching the aircraft, but the short time available would not have permitted this to be a carefully planned manoeuvre. The evidence of the right propeller striking the water might indicate an attempt to turn right to parallel the sea wall and ditch but this can be no more than conjecture.

In considering why an experienced pilot might overlook increasing power on the operating engine, two aspects appear germane. Firstly, he was not practised in the particular circumstances of the emergency that occurred. A reduced power take-off had not been a practical consideration in any of the lower powered aircraft he had flown prior to the Beech 200. Even in this aircraft, the number of occasions when a take-off was ITT limited were few. And the pilot's training had been in a lightly loaded aircraft, on much cooler days, when the effect of the lower ITT setting would not have been significant.

Secondly, the pilot was faced with a very high workload, which is conducive to error. There were, however, at least three means by which the workload could have been alleviated. Power could have been set at the maximum for take-off, the auto-feather system could have been armed and a boom microphone could have been used. The effect of these tasks upon events in the cockpit of VH-AAV cannot be positively established but a simple experiment, in which the test pilots were fully prepared and practised, indicated an increase of 42 per cent over the time taken for unavoidable tasks such as maintaining aircraft control. In an unprepared situation, it could be expected to be greater.

Whilst the use of a hand-held microphone was a matter of pilot preference, the introduction of a reduced power take-off procedure and the decision, in the interest of standardisation, not to use the auto-feather system fitted to VH-AAV originated with company management. There were valid reasons for both decisions but little consideration was apparently given to the effect upon pilot workload in a critical situation.

It was evident that Departmental surveillance officers were aware of both the reduced ITT take-off procedure and the use of non-standard weights for passenger loading. The procedures were of such long standing and so widely known that the surveillance officers and Advance Airlines management believed they were approved.

A final consideration is whether air traffic control might have been able to influence events so as to prevent the accident, or at least have reduced its severity. The only factor under their control was the movement of other traffic that might have hindered the freedom of VH-AAV to manoeuvre. Only one aircraft, VH-RMO, entered this category and it could have been instructed to go around when the pilot of VH-AAV first reported an engine failure. Such a decision, however, could not be justified on the facts available to Aerodrome Control at the time. The controller's knowledge of Beech 200 aircraft was sufficient to appreciate that single-engine flight should not have been a critical condition. The aircraft was apparently under full control and the pilot had not indicated, by either the universal alert of 'Mayday' or in any other terms, that an accident was imminent. Furthermore, the Boeing 727 was so advanced in its approach to land that there was no question of it hindering VH-AAV in the event of that aircraft following the expected approach pattern.

Once the situation deteriorated, with VH-AAV in a descent and the pilot confirming a normal approach was not possible, Aerodrome Control took action to ensure the availability of Runway 34. From a reconstruction of the flight path of VH-RMO, it is considered that the decision to allow it to complete its landing was correct. This did not significantly affect availability of the runway and to have required the Boeing 727 to effect a go around in the middle of a landing sequence could have introduced a hazard to that aircraft and its occupants.

3 Conclusions

1. The pilot of the aircraft was appropriately qualified and licensed.
2. The air traffic control personnel in Sydney Tower were either appropriately qualified and licensed or, in the case of the two trainees, directly supervised by appropriately qualified and licensed personnel.
3. There was a current Certificate of Airworthiness for the aircraft. No evidence was found of pre-existing mechanical defect or malfunction that might have contributed to the accident.

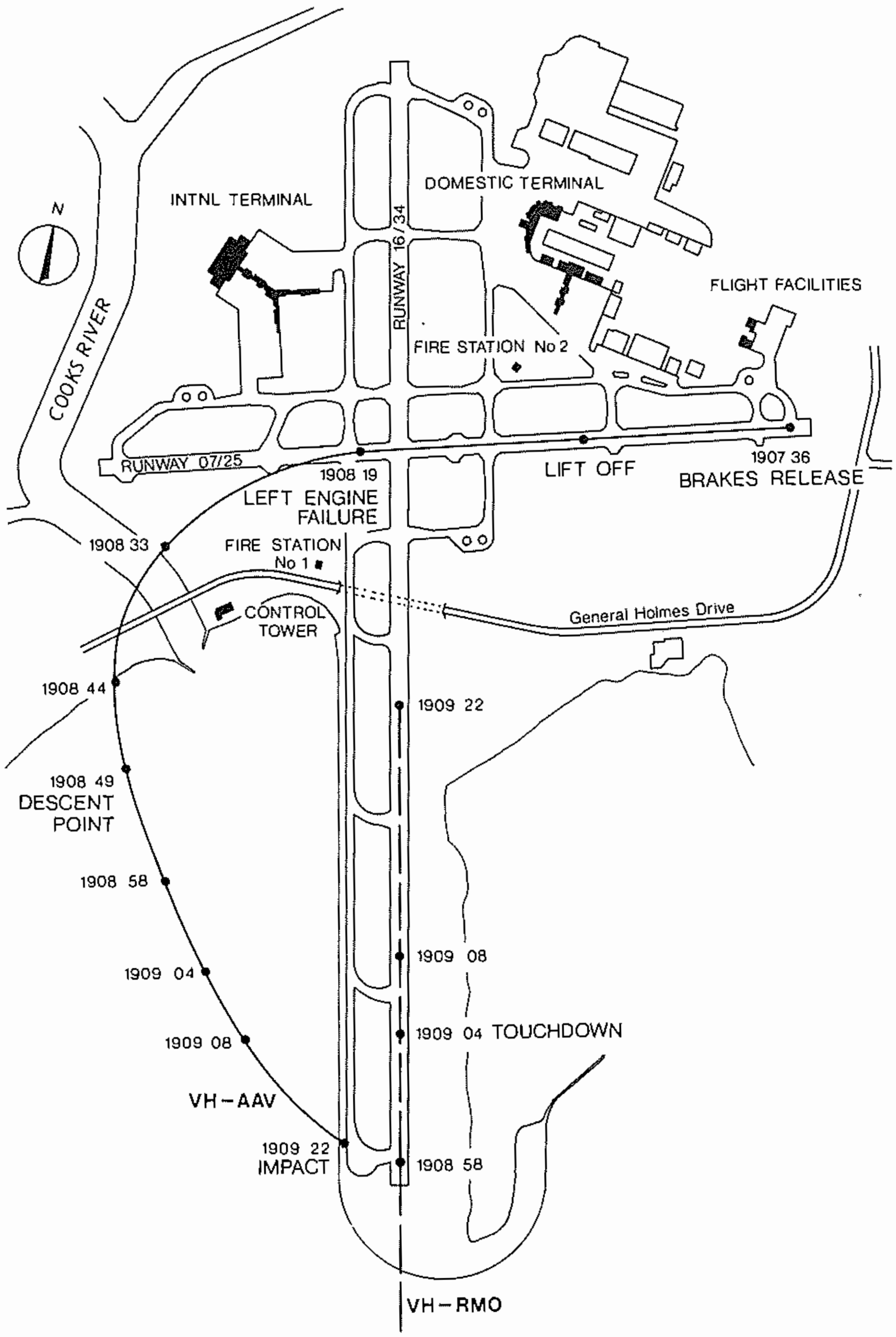
4. During the preparation of aircraft loading documentation, the pilot employed a company practice in respect of standard passenger weights which was contrary to ANO 20.16.1 and had not been approved by the Department of Transport.
5. The aircraft operating weight used by the company did not make allowance for all the equipment carried on the aircraft.
6. Although details of passengers, baggage and freight were accurately compiled on appropriate manifests, the pilot used estimated figures for these loads when preparing the aircraft Weight Sheet, apparently rather than await completion of the manifests. The Weight Sheet incorrectly indicated that the aircraft was loaded within the maximum permitted limit.
7. The fuel load figure used by the pilot was in error by some 50 kg. The reason for this error could not be established.
8. The centre of gravity of the aircraft was within limits. Its weight at take-off was approximately 128 kg above the maximum permitted limit. This extra weight would have caused a reduction in the aircraft's performance capability.
9. Relevant airport facilities complied with prescribed standards. There was no evidence of defect or malfunction of these facilities which might have contributed to the accident.
10. The weather was fine, but the air temperature was 39°C and this would have caused a major reduction in the aircraft's performance capability.
11. The sun was six degrees above the horizon on a bearing of 249° magnetic. Although behind a thin layer of cloud, it still created a strong, diffuse glare that might have affected the pilot's vision during the take-off and initial flight from Runway 25.
12. The company's Operations Manual contained a requirement to take off at an ITT of 700°C instead of the Flight Manual limit of 750°C. This procedure was intended to extend engine life but insufficient consideration had been given to its effects upon aircraft performance under high weight and high temperature conditions and upon pilot workload in critical situations. The variation to the Flight Manual had not been approved by the Department of Transport, nor had a copy of the relevant Operations Manual amendment been provided to the Department.
13. A take-off at the company limit of 700°C reduced the power available by approximately 23 per cent and, under the ambient conditions, reduced the single-engine performance to a critical level.
14. Officers of the Department of Transport were aware of the unapproved practices in respect of standard passenger weights and reduced power take-offs but action had not been taken to regularise the company's operations.
15. Although the aircraft was equipped with an auto-feather system, it was company policy, in the interests of fleet standardisation, not to use the system.
16. The take-off was probably made with power set at the company limit of 700°C ITT.
17. At a height of about 100 feet AGL the left engine failed, probably due to the ingestion of water-contaminated fuel.
18. Following engine failure, the aircraft was levelled at about 150 feet AGL. It then entered a gradual turn with some 10–15 degrees angle of bank to the left.
19. During the turn, the pilot reported the left engine failure to Aerodrome Control and requested an immediate landing on Runway 34. He did not indicate that a critical situation existed or that an accident was imminent.

20. A Boeing 727 was on approach to land on Runway 34. This was drawn to the attention of the pilot of VH-AAV. In view of the relative positions of the two aircraft and the expected operation of VH-AAV, the Boeing 727 was allowed to continue its approach.
21. Shortly after turning through some 90 degrees and straightening, VH-AAV descended to just above the water of Botany Bay.
22. At this time, the pilot of VH-AAV, in response to a question from Aerodrome Control, reported that his approach and landing would not be normal.
23. The aircraft remained in flight, at an extremely low height and turning slowly to the left, until close to the extension of Runway 34. The right propeller then probably struck the water, the aircraft yawed left and struck the sea wall.
24. Following the pilot's advice that his approach and landing would not be normal, Aerodrome Control activated the crash alarm and instructed the Boeing 727 to go around. The situation was then reappraised and, as the Boeing 727 was on the ground and established in its landing roll sequence, a correct decision was taken to amend the instruction in order to expedite the landing and runway clearance.
25. The source of water contamination of the left fuel system of VH-AAV was not established but elemental analyses indicated the water had been present in the fuel system for some time.
26. The Beech 200 fuel system incorporates a number of sumps designed to trap the normal accumulation of water and prevent its ingestion by the engines. It could not be determined where the water in the left fuel system of VH-AAV had accumulated or by what means it travelled to the left engine.
27. It was not established whether or not the pilot had carried out a fuel drain check prior to the accident flight. It was, however, established that such checks had been regularly carried out, including two occasions on 21 February 1980, and no significant water contamination had been found.
28. The reason for the abnormal performance by VH-AAV was not determined, but was consistent with the right engine being operated at 700°C ITT and the use of 10–15 degrees angle of left bank, which would have placed the aircraft in a regime of negative climb potential.
29. At the time of engine failure, a high cockpit workload situation existed. This workload would have been significantly reduced had there not been the need to increase power, manually feather and use a hand-held microphone.
30. Airport emergency services promptly attended the accident and controlled the post-impact fire. This was not, however, a survivable accident.

4 Cause

The cause of the accident has not been determined, but the most likely explanation is that the aircraft was operated in a reduced power configuration which, under the prevailing conditions, reudered its single-engine performance critical in respect to aircraft handling.

APPENDIX A



INTNL TERMINAL
DOMESTIC TERMINAL
FLIGHT FACILITIES
COOKS RIVER
N
RUNWAY 16/34
FIRE STATION No 2
RUNWAY 07/25
1908 19
LEFT ENGINE FAILURE
LIFT OFF
1907 36
BRAKES RELEASE
1908 33
FIRE STATION No 1
CONTROL TOWER
General Holmes Drive
1908 44
1909 22
1908 49
DESCENT POINT
1908 58
1909 04
1909 08
1909 08
1909 04 TOUCHDOWN
VH-AAV
1909 22
IMPACT
1908 58
VH-RMO

Transcript of communications concerning Beech Super King Air 200 Aircraft VH-AAV recorded at Sydney Airport between 1844 hours and 1910 hours on 21 February 1980.

Legend
AAV — Beech Super King Air 200 VH-AAV
RMO — Boeing 727 VH-RMO
SCD — Sydney Clearance Delivery
SMC — Sydney Surface Movement Control
ADC — Sydney Aerodrome Control
// . . . // — Explanatory note or editorial insertion
(. . . . .) — Word(s) open to other interpretation
——— — Unintelligible word(s)

Time h/min/sec	*From*	*To*	*Text*
1844:12	AAV	SCD	SYDNEY CLEARANCE DELIVERY ALPHA ALPHA VICTOR Flight four two one oh for Temora Condobolin request airways clearance
1844:23	SCD	AAV	ALPHA ALPHA VICTOR change of runway er two five Katoomba two departure cruise flight level two two zero
1844:28	AAV	SCD	ALPHA ALPHA VICTOR two five Katoomba two departure flight level two two zero
1848:47	AAV	SMC	SYDNEY GROUND er ALPHA ALPHA VICTOR Flight four two one oh for Temora Condobolin received Romeo taxy clearance
1848:56	SMC	AAV	ALPHA ALPHA VICTOR SYDNEY GROUND clear to taxy runway two five hold short of the first taxiway intersection caution jet blast time four niner
1849:05	AAV	SMC	ALPHA ALPHA VICTOR
1850:12	SMC	AAV	ALPHA ALPHA VICTOR follow the er Queenair outbound
1850:16	AAV	SMC	ALPHA ALPHA VICTOR
1858:22	AAV	ADC	er ALPHA ALPHA VICTOR is ready in turn
1858:26	ADC	AAV	ALPHA ALPHA VICTOR
1858:46	AAV	ADC	ALPHA ALPHA VICTOR just confirm we're behind the first Queenair
1858:50	ADC	AAV	ALPHA ALPHA VICTOR understood
1906:00	RMO	ADC	SYDNEY TOWER ROMEO MIKE OSCAR
1906:03	ADC	RMO	ROMEO MIKE OSCAR SYDNEY TOWER report short final
1906:05	RMO	ADC	MIKE OSCAR
1906:32	ADC	AAV	ALPHA ALPHA VICTOR Queenair departing line up behind that aircraft
1906:36	AAV	ADC	ALPHA ALPHA VICTOR
1907:27	ADC	AAV	ALPHA ALPHA VICTOR maintain runway heading maintain three thousand clear for take off

Time h/min/sec	*From*	*To*	*Text*
1907:32	AAV	ADC	ALPHA ALPHA VICTOR three thousand
1908:17	RMO	ADC	——— final
1908:19	ADC	RMO	ROMEO MIKE OSCAR clear to land
1908:22	RMO	ADC	MIKE OSCAR
1908:33	AAV	ADC	ALPHA ALPHA VICTOR we've lost er the left engine request landing ah landing on runway three four immediately please
1908:38	ADC	AAV	ALPHA ALPHA VICTOR roger make visual approach left base runway three four
1908:44	ADC	AAV	ALPHA ALPHA VICTOR do you have the seven two seven in sight on short final
1908:49	AAV	ADC	Affirmative
1908:50	ADC	AAV	ALPHA ALPHA VICTOR roger make visual approach left base will your approach and landing be normal
1908:58	AAV	ADC	ALPHA ALPHA VICTOR negative
1909:08	ADC	RMO	ROMEO MIKE OSCAR go around correction st stay on the runway and expedite we have a landing er right behind you (he's) one engine out //Bell in background throughout this transmission//
1909:20	ADC	AAV	ALPHA ALPHA VICTOR clear to land ———

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