Australian Government
Australian Transport Safety Bureau

Collision with terrain involving Piper PA25-235/A9, VH-GWS

Near Hallston, Victoria | 1 May 2012

Investigation

ATSB Transport Safety Report
Aviation Occurrence Investigation
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Safety summary

What happened

On 1 May 2012, the pilot of a Piper PA 25-235/A9 (Pawnee) aircraft, registered VH-GWS, was conducting agricultural operations from a local airstrip near Hallston, Victoria. Shortly after takeoff, the aircraft collided with terrain near the base of a gully and was destroyed by a post-impact fire. The pilot was fatally injured.

What the ATSB found

The aircraft likely sustained a partial power loss shortly after takeoff, resulting in an inability to continue climbing or maintain altitude. Damage sustained during the accident and post-impact fire prevented an identification of the specific reasons for the power loss. The ATSB also found that operation of the aircraft over hilly terrain probably limited the pilot’s emergency landing options and increased the severity of the terrain impact following engine power loss.

What's been done as a result

The investigation did not identify any organisational or systemic issues that might adversely affect the future of aviation safety.

Safety message

Some of the circumstances surrounding this accident are highlighted in the ATSB research report AR-2010-055: *Managing partial power loss after takeoff in a single-engine aircraft*. Pilots and aircraft operators are encouraged to consider the topics covered in that report, which may assist in reducing the risks associated with partial or complete power loss after takeoff. In addition, pilots are reminded that the timely dumping of any aircraft payload where possible can assist in improving aircraft performance and may provide additional options for a safe outcome.

Contents

The occurrence

On 1 May 2012, the pilot of a Piper PA 25-235/A9 (Pawnee) aircraft registered VH-GWS commenced aerial agricultural operations near Hallston, Victoria.

That morning, the aircraft had departed Leongatha airport and was flown approximately 10 minutes to a local airstrip near Hallston. On arrival, the pilot parked the aircraft, shut the engine down and assisted the loader (aircraft operator) in removing the cover from the superphosphate fertilizer supply.

Prior to commencing operations, the pilot and aircraft operator conducted a briefing about the planned aerial application activities. The operator reported that the pilot did not express any issues with the operation of the aircraft at that time.

After the briefing, the pilot returned to the aircraft, started the engine without difficulty and left it idling for 2-3 minutes while approximately 350-400 kg of fertilizer (approximately half the maximum capacity) was loaded into the aircraft for the first run of the day. While the operator completed the fertilizer loading, the pilot programmed the aircraft's GPS tracking system. At around 0920 Eastern Standard Time[1], following engine run-up checks[2], the aircraft departed the airstrip to commence aerial spreading of the fertilizer on a property west of and adjacent to the airstrip.

The operator observed what appeared to be a normal departure of the aircraft, before driving the load vehicle back to the fertilizer supply in preparation for reloading the aircraft when it returned. After returning to the airstrip with another load of fertilizer, the loader briefly observed the aircraft flying at low altitude along the gully at the end of the airstrip. The loader indicated that as the application area was located to the west of the airstrip, the aircraft would normally have turned left after takeoff and overflown the airstrip before commencing the spreading operation.

Witnesses to the south-west of the airstrip (Figures 1 and 2) observed the aircraft become airborne and fly overhead at a very low altitude before disappearing from view. Shortly thereafter, the aircraft reappeared to the east of the witnesses and was observed descending into a gully while releasing some of the fertilizer load. The witnesses reported that the engine was making a continuous, even noise for the duration of the flight, but that it was noticeably quieter than other aircraft that had previously used the same airstrip.

As the aircraft descended into the gully, it was observed rocking its wings from side to side (about the longitudinal-axis) immediately before passing out of view and colliding with terrain near the base of the gully. The aircraft was seriously damaged[3] by the impact and an intense post-impact fire. The pilot was fatally injured.

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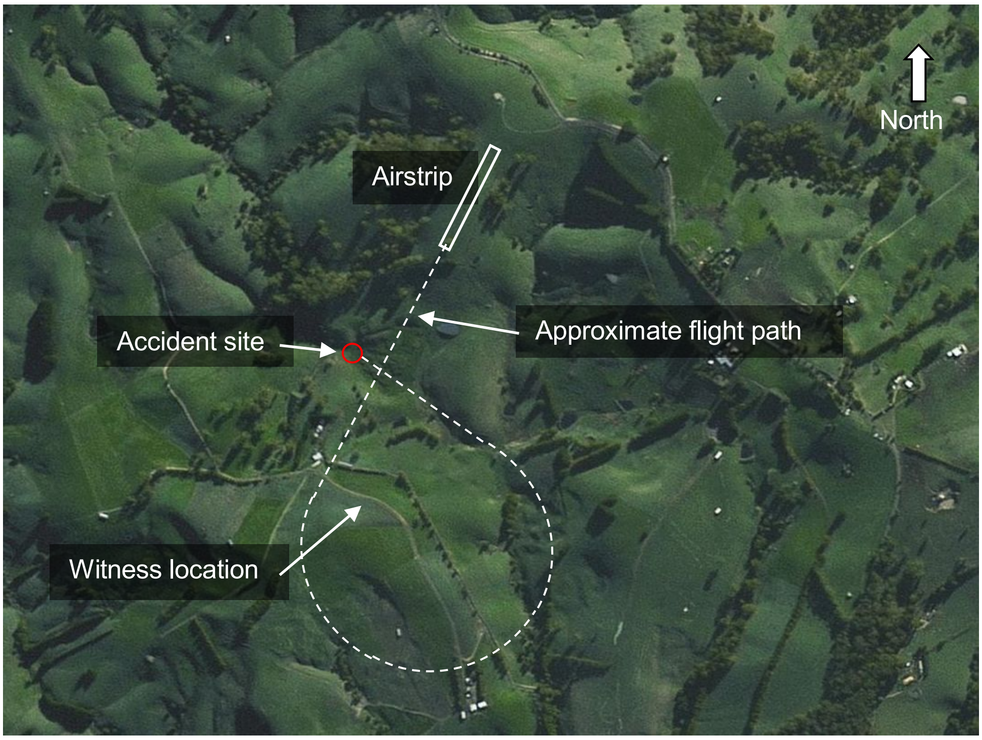
1 Eastern Standard Time (EST) was Coordinated Universal Time (UTC) +10 hours.

2 Generally, a high power run-up check is carried out in a piston-engine aircraft to check the aircraft's ignition and other systems before takeoff.

3 The Transport Safety Investigation Regulations 2003 definition of 'serious damage' includes the 'destruction of the transport vehicle'.

Figure 1: Accident location



Source: Google Earth

Figure 2: View of airstrip from witness location

Source: ATSB

Context

Pilot information

The pilot was appropriately qualified for the flight; holding an Air Transport Pilot Licence (aeroplane) issued in 1993 and a Grade 2 Agricultural Rating (aeroplane) issued in 2001. According to the pilot's logbook, the pilot's total aeronautical experience was about 10,600 hours. In 2012 to the accident date, the pilot had accrued approximately 66 hours of agricultural flying experience with 22 of those hours being in VH-GWS. In that time, the pilot had also accrued approximately 150 hours of commercial flying as First Officer on turboprop aircraft.

The pilot's most recent annual proficiency check for aerial agricultural operations comprised two flights conducted in November 2011. Both flights involved agricultural spraying activities, with one being flown in VH-GWS.

It was reported that several weeks before the accident, the pilot had successfully dumped the hopper load in two separate emergency situations – both while flying VH-GWS. The ATSB understood that both situations were related to maintaining terrain/obstacle clearance, rather than mechanical concerns with the aircraft. The operator advised that dumping of the aircraft payload was standard emergency procedure, and is normal practice in agricultural flying when a pilot experiences difficulty in achieving desired aircraft performance.

It was reported that the pilot had last operated from the Hallston airstrip 10 days prior to the accident. It could not be determined if the same airstrip had been used by the pilot on other occasions.

Aircraft information

General information

The aircraft, serial number 25-2490, was manufactured in the United States in 1963, as a Piper Aircraft PA 25-235, and first registered in Australia in the same year. It was originally produced as a single seat, fabric-covered, tubular steel frame aircraft, powered by a reciprocating piston engine and primarily used for aerial spraying activities. In the 1980s, a number of modifications had been made to the aircraft to enhance its operational capability and performance.

The aircraft was first modified during 1985; converting it to an 'A8' model, and then subsequently to an 'A9' model in 1989. Some of the modifications included:

- widening of the fuselage to fit a second seat and a larger chemical hopper
- installation of a higher-powered engine
- installation of a larger fuel tank, and
- manufacture and installation of metal wings.

All modifications had been carried out in accordance with approved supplementary type certification (STC) requirements.

Engine

The aircraft was powered by a Lycoming O-540-G1A5 engine, driving a McCauley 1A200/FA8452, two-bladed, fixed-pitch, metal propeller. The engine was installed in 2007 and at the last 100 hourly inspection, it had accumulated 1,482 hours since the last overhaul (of a 2,000 hour overhaul life). There were no significant engine maintenance items recorded in the engine logbook.

Under the STC provisions, only the Lycoming O-540-A1D5 or O-540-H2A5 engines were approved for fitment to the PA 25-235/A9 aircraft. A list of certified Lycoming engines described the H2A5 engine as similar to the G1A5 but had piston cooling oil jets and different magnetos. The

G1A5 and H2A5 otherwise shared the same power rating and performance specifications. While the investigation was not able to determine why the G1A5 type engine was fitted to the accident aircraft, the ATSB considered that the differences between the approved and installed engines did not have the potential to have contributed to this accident.

Carburettor heat

The engine was fitted with a carburettor heat control, the function of which was to preheat incoming air supply to avoid or clear carburettor ice accumulation. The Pawnee operator's handbook stated that 'Carburettor heat should be checked during the warm up to ensure correct operation of the control and the availability of heat if needed'. The Lycoming engine operator's manual indicated that, for ground operation, carburettor heat 'must be held to an absolute minimum' to prevent ingestion of dirt and foreign debris because the air will bypass the air filter on some installations.

Fuel

The aircraft's fuel was supplied from a single 180 litre polymer fuel tank, located immediately behind the engine firewall and in front of the payload hopper.

Refuelling records indicated that GWS was last refuelled from drum fuel stock on 21 April 2012, after which it was flown on a number of aerial application flights. Those flights were reportedly suspended before completion, due to unfavourable weather, and the aircraft was not flown or refuelled before the commencement of operations on the day of the accident.

While a direct sample of fuel was not available from the aircraft, the fuel used in GWS was from the same supply that had been used by 37 other aircraft. There had been no reports of fuel related issues from the operators of those aircraft.

An intense post-impact fire destroyed all documentation on-board the aircraft and consumed any fuel that remained in the tank. Because of this, an accurate determination of the quantity and quality of fuel during the flight could not be made. However, the intensity of the fire indicated that there was probably sufficient fuel for continued flight.

Hopper

The aircraft hopper was located immediately in front of the cockpit. The hopper gate was controlled via a mechanical linkage to a cockpit lever on the left of the pilot's seat that regulated the rate at which material was released from the hopper. The pilot also had the ability to dump the entire load within a couple of seconds by pressing the release button on top of the handle and pushing the lever all the way forward. A significant amount of fertilizer was observed at the accident site, indicating that a full emergency dump of the hopper contents had not occurred before the aircraft impacted terrain.

Weight and balance

The pilot was the sole occupant of the aircraft, which was carrying less than full fuel and approximately half the hopper capacity. Calculations based on this concluded that the aircraft was below its maximum permissible take-off weight on departure from the airstrip.

Aircraft weight and moment changes were recorded in the aircraft logbooks as a result of modification of the aircraft to 'A9' status. Further documentation relating to the weight and balance of the aircraft was not available to the investigation and therefore the disposition of the load and the centre of gravity of the aircraft at the time of the accident could not be determined. However the aircraft had been operating in the 'A9' configuration since 1989 and, for the estimated load, it was considered unlikely that weight and balance issues were a contributing factor in this accident.

Aircraft maintenance

The aircraft was maintained per a CASA Schedule 5 system of maintenance, which was applicable and appropriate for the aircraft type. The airframe had accumulated a total of 14,241 flying hours at 15 January 2012 when the current maintenance release was issued. The last 100-hourly inspections were also completed at this time, with no significant maintenance items noted. The current maintenance release was not recovered from the aircraft and was presumed lost in the post-impact fire.

Meteorological information

Witnesses described the local weather conditions at the time of the accident as fine, with little to no wind at ground level. The nearest available weather observations were recorded at Latrobe Valley airport, 22 NM to the north-east of the airstrip. Data provided by the Bureau of Meteorology did not show any significant weather in the general area of operation, however temperature and relative humidity conditions at the time were favourable for "serious icing – any power setting" according to the carburettor icing-probability chart[4]. The aircraft was equipped with an outside air temperature gauge, however it was not known if the pilot had used this to determine the probability of carburettor icing on the morning of the accident.

Related occurrences

In 1986, BASI[5] released Aviation Safety Investigation Report 198602335, relating to a Piper PA25-235 that was conducting operations similar in circumstances to VH-GWS. The narrative below is a summary of the occurrence and investigative findings:

> The pilot left his home base and flew to the strip from which he intended to conduct top dressing operations. Shortly after a normal take-off with the first load of superphosphate, the engine power suddenly deteriorated rapidly. The pilot dumped the load and landed in an adjoining paddock, but the aircraft collided with a fence and subsequently ground looped. No fault was subsequently found with the engine, which was still operating at idle power when the aircraft came to rest. After arrival at the agricultural strip, the pilot had left the engine idling for several minutes with the carburettor heat selected to the cold position. Atmospheric conditions were suitable for the formation of carburettor icing, and it was most probable that this had occurred. The pilot had been in the habit of using reduced power for take-off, which may have aggravated any tendency for carburettor ice to form.

Wreckage and impact information

Accident site examination

The aircraft was situated in a gully, near the base of an incline of approximately 30° (Figures 3 and 4). Ground scars at the point of impact were consistent with the aircraft contacting the soft terrain in a left wing down attitude, slightly greater than the slope of the terrain. The aircraft came to rest near the base of the incline, approximately 16 metres from the point of first impact. It remained upright and was oriented roughly in the direction of travel. Granulated superphosphate was found scattered along the ground scars as well as back along the flight path, which was consistent with the witness accounts that some product had dropped from the aircraft before it struck terrain. A significant quantity of the fertiliser load was also found in the remains of the hopper.

The fuselage forward of the cockpit sustained significant damage from the impact and a post-impact fire consumed the majority of the fuselage and inboard wing sections. There was no damage observed that could not be attributed to the impact or to the fire.

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4 Carburettor ice is formed when the normal process of vaporising fuel in a carburettor cools the carburettor throat so much that ice forms from the moisture in the airflow. This can restrict the airflow and interfere with the operation of the engine. A copy of the carburettor icing-probability chart may be found at http://www.atsb.gov.au/media/56519/carb_icing.pdf

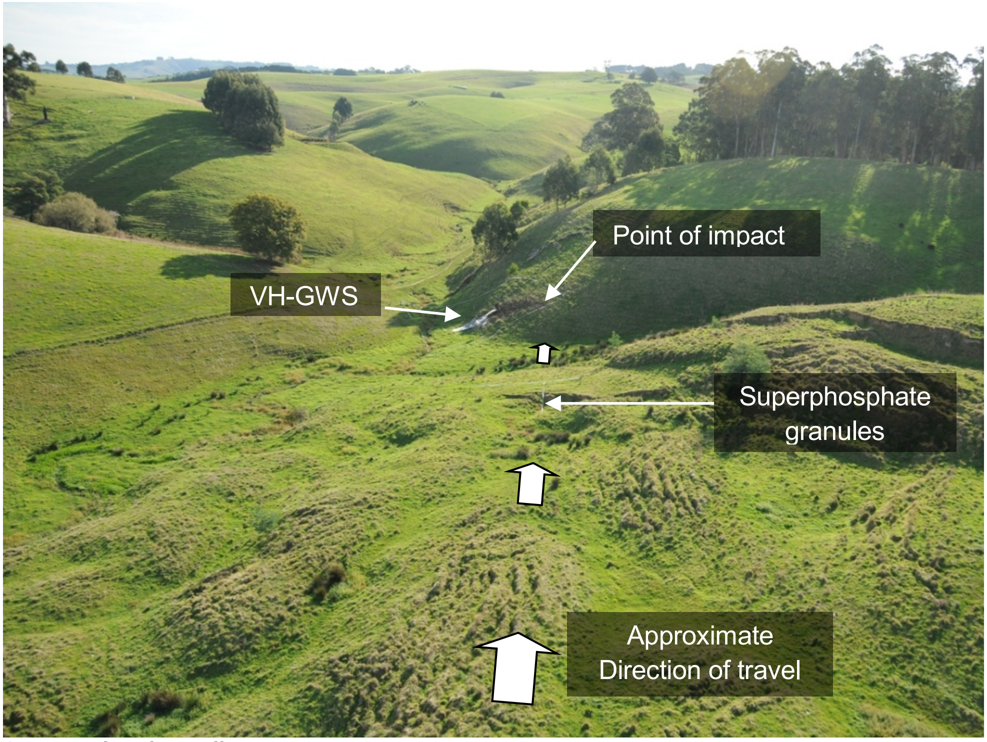
5 The Bureau of Air Safety Investigation was the former federal aviation investigation agency in Australia prior to July 1999, when its functions were incorporated into the Australian Transport Safety Bureau (ATSB).

All of the flight control surfaces were accounted for and the wing flaps were in the retracted position. Flight control cable continuity was verified, however the serviceability and symmetry of the flight control system could not be confirmed due to the damage sustained.

The engine had separated from the airframe during the impact sequence. The engine exhibited no gross, internal mechanical defects that would have precluded normal operation. The engine accessories were substantially damaged by impact and fire and could not be functionally tested, thus preventing a complete determination of engine serviceability at the time of the accident.

An irregular series of propeller ground scars were observed at the point of impact. The propeller had separated from the engine and the blades displayed mild leading-edge damage with bending and twisting. One blade showed pronounced aft bending. Damage to the blades was not consistent with the propeller being driven at high engine power.

Figure 3: Accident location



Source: Victorian Police

Figure 4: Accident site

Source: ATSB

Medical and pathological information

The pilot held a current Class 1 medical certificate, endorsed with ‘for CASA audit’. This type of endorsement was usually placed on a medical certificate to allow CASA to monitor an ongoing medical condition, while allowing the holder to continue to exercise the privileges of their licence. Details of the specific condition were subsequently examined by the ATSB and assessed as not likely to have been contributory to the development of the accident.

A general review of the pilot’s available medical records did not reveal any preconditions for incapacitation. The post-mortem report did not identify any pre-existing physiological condition that may have affected the pilot’s ability to control the aircraft. Toxicology results did not detect the presence of alcohol or other substances of impairment in the sample examined.

A review of the pilot’s immediate 72-hour history indicated that he appeared well-rested and in good spirits in the time of the accident.

Survival aspects

The post mortem report indicated that the pilot had succumbed to multiple, impact-related injuries. Considering the relatively intact cockpit survivable space, the injuries suggested that, in addition to the forces resulting from a high rate of deceleration, the pilot restraint system may have been compromised during the impact sequence.

The accident site characteristics suggested the aircraft impacted terrain with a low forward speed, but at a high angle relative to the slope of the terrain. This scenario would have produced greater deceleration forces than if the terrain was flatter and the angle of impact shallower.

The pilot was wearing a flying helmet and appeared to have been restrained by a four-point harness. The airframe harness attachment points were intact, however the post-impact fire had consumed the harness webbing and inertia reel, precluding any further assessment of the restraint system integrity.

Safety analysis

The ATSB's investigation found no evidence of any gross mechanical defect or failure within the airframe or engine that may have contributed to the accident. This was consistent with witness accounts of continuing engine noise for the flight duration, with no rapid deviation from stable flight that would suggest a loss of control. Reports of the pilot's general health and post mortem results indicated that it was unlikely that the pilot had become incapacitated during the flight.

After takeoff, the aircraft's flight did not proceed along the expected path to commence spreading on the property (crossing back over the airstrip), with witnesses observing the aircraft tracking along the gully as it was losing altitude. This was consistent with a deliberate action by the pilot in response to the aircraft having insufficient performance to out-climb the rising terrain back towards the airstrip. Similarly, the observed partial release of the hopper load during the aircraft descent was likely an attempt by the pilot to counteract a loss in performance by reducing the aircraft weight. Both actions were consistent with the pilot acting in response to a partial loss of engine power. This was also supported by damage to the aircraft propeller, which suggested that the engine was operating at reduced power levels on impact. The reason/s why the hopper load had been only partially released, rather than a full dump, could not be determined. It was possible that a full hopper dump at the first sign of performance issues may have improved the performance of the aircraft enough to provide additional options for a safe forced landing.

The potential causes of an engine partial power loss are numerous. While this investigation was limited by the damage sustained to the aircraft and did not find any direct evidence of factors that could have contributed to a power loss, the atmospheric conditions on the morning of the accident, coupled with the reported period of ground idling during the hopper loading, suggested that accumulated carburettor icing was a possible factor. While the Pawnee owner's handbook requires a test of carburettor heat operation during engine warm-up and ground checks, the pilot's consideration of the icing risk, his respective actions, and the effectiveness of those actions in the mitigation of carburettor icing were not known.

The degree of performance degradation sustained, as well as the point at which the pilot became aware of any partial power loss may have dictated the options available to land the aircraft safely. Being the first flight for the day from the airstrip, the pilot probably did not have a ready reference for how the aircraft was performing under load. In addition, the added aircraft acceleration associated with the downslope takeoff may have masked any initial performance issues. If the issue became apparent immediately after takeoff, then continuing the flight towards the south may have presented the pilot with safer options for landing the aircraft. However, if the pilot was initially able to climb or maintain altitude after takeoff, then this may have influenced the decision to turn back towards the airstrip. Once this decision was made, the aircraft's rate of descent and the rising terrain meant that safe options for landing were limited. In a general sense therefore, the operation over the hilly terrain in the vicinity of the airstrip probably increased the likelihood and severity of an accident associated with a loss in aircraft performance requiring a forced landing.

Findings

From the evidence available, the following findings are made with respect to the collision with terrain of the Piper PA25-235/A9 aircraft, registered VH-GWS, and should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing safety factors

- The aircraft likely sustained a partial power loss after takeoff that resulted in an inability to maintain altitude.
- Operation of the aircraft over hilly terrain probably increased the risks associated with a forced landing in the event of a partial or complete engine power loss.

Other safety factors

- Meteorological conditions at the time of the accident were favourable for carburettor icing, with the resulting potential for engine power loss.

Other key findings

- A complete dump of hopper contents when the pilot first became aware of a power-loss situation may have assisted aircraft performance and provided additional options for a safe landing.

General details

Occurrence details

Date and time:	1 May 2012 – 0931 EST	
Occurrence category:	Accident	
Primary occurrence type:	Collision with terrain	
Type of operation:	Aerial work	
Location:	Near Hallston, Victoria	
	Longitude: E 145° 55.35'	Latitude: S 38° 23.90'

Aircraft details

Manufacturer and model:	Piper PA25-235/A9	
Registration:	VH-GWS	
Serial number:	25-2490	
Persons on board:	Crew – 1	Passengers – 0
Injuries:	Crew – 1 (Fatal)	Passengers – 0
Damage:	Destroyed	

Sources and submissions

Sources of information

The sources of information during the investigation included the:

- Aircraft operator
- Victorian Police
- Office of the State Coroner - Victoria
- Pilot’s next of Kin
- Bureau of Meteorology

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003*, the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the aircraft operator, the supplemental type certificate holder and the Civil Aviation Safety Authority.

Submissions were received from the Civil Aviation Safety Authority. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.

Australian Transport Safety Bureau

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The Bureau is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated. The terms the ATSB uses to refer to key safety and risk concepts are set out in the next section: Terminology Used in this Report.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

Terminology used in this report

Occurrence: accident or incident.

Safety factor: an event or condition that increases safety risk. In other words, it is something that, if it occurred in the future, would increase the likelihood of an occurrence, and/or the severity of the adverse consequences associated with an occurrence. Safety factors include the occurrence events (e.g. engine failure, signal passed at danger, grounding), individual actions (e.g. errors and violations), local conditions, current risk controls and organisational influences.

Contributing safety factor: a safety factor that, had it not occurred or existed at the time of an occurrence, then either: (a) the occurrence would probably not have occurred; or (b) the adverse consequences associated with the occurrence would probably not have occurred or have been as serious, or (c) another contributing safety factor would probably not have occurred or existed.

Other safety factor: a safety factor identified during an occurrence investigation which did not meet the definition of contributing safety factor but was still considered to be important to communicate in an investigation report in the interests of improved transport safety.

Other key finding: any finding, other than that associated with safety factors, considered important to include in an investigation report. Such findings may resolve ambiguity or controversy, describe possible scenarios or safety factors when firm safety factor findings were not able to be made, or note events or conditions which 'saved the day' or played an important role in reducing the risk associated with an occurrence.

Safety issue: a safety factor that (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operational environment at a specific point in time.

Risk level: The ATSB's assessment of the risk level associated with a safety issue is noted in the Findings section of the investigation report. It reflects the risk level as it existed at the time of the occurrence. That risk level may subsequently have been reduced as a result of z taken by individuals or organisations during the course of an investigation.

Safety issues are broadly classified in terms of their level of risk as follows:

- **Critical safety issue:** associated with an intolerable level of risk and generally leading to the immediate issue of a safety recommendation unless corrective safety action has already been taken.
- **Significant safety issue:** associated with a risk level regarded as acceptable only if it is kept as low as reasonably practicable. The ATSB may issue a safety recommendation or a safety advisory notice if it assesses that further safety action may be practicable.
- **Minor safety issue:** associated with a broadly acceptable level of risk, although the ATSB may sometimes issue a safety advisory notice.

Safety action: the steps taken or proposed to be taken by a person, organisation or agency in response to a safety issue.

Australian Transport Safety Bureau

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Investigation

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