Australian Government

Australian Transport Safety Bureau

Partial power loss and collision with terrain involving Dynaero MCR-01 VLA, VH-SIP

near Serpentine Airfield, Western Australia, on 28 December 2020

ATSB Transport Safety Report

Aviation Occurrence Investigation (Defined)

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Addendum

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Executive summary

What happened

On 28 December 2020, at about 1438 local time, a Dynaero MCR-01 VLA, registered VH-SIP, departed Serpentine Airfield, Western Australia, to conduct a post-maintenance check flight. At about 300 ft above ground level, the engine began to run rough, however continued to operate. The pilot commenced a turn to the left, and the aircraft appeared to decelerate in a nose-high attitude without gaining height. Shortly after, the aircraft was observed to aerodynamically stall, pitch nose-down, and impact terrain. The pilot, who was the sole occupant, was fatally injured, and the aircraft was destroyed.

What the ATSB found

The ATSB found that multiple tasks in the aircraft's return to service after a significant period of inactivity were not adequately carried out, and that the left carburettor of the aircraft's engine was missing a component and contained a significant amount of contamination. This likely resulted in over-fuelling of the carburettor at a low power setting, and likely produced subsequent engine rough running at high power settings.

The pilot was unfamiliar with the aircraft and engine type, which increased the risk of not being able to adequately manage an inflight emergency. During the partial power loss on take-off, the pilot turned the aircraft in a likely attempt to land on another runway, when the aircraft stalled.

The ATSB found that the pilot had probably consumed a significant amount of alcohol the night before the accident, which increased the risk of post-alcohol impairment.

Safety message

Ongoing maintenance of an aircraft's fuel system is essential to ensure fault-free operation of its engine. In particular, the reliability of carburettors is dependent on their condition, and by following the manufacturer's maintenance requirements and service bulletins.

The ATSB encourages pilots to review and practice the conduct of a pre-take off safety brief before each flight, and highlights the importance of preparedness for possible emergencies on take-off leading to an off-airfield landing. The ATSB further encourages pilots to review the recommended partial power loss procedure in the aircraft pilot operating handbook if available, and cautions against turning back towards the runway unless in controlled situations where sufficient altitude exists. Further information can be found in the ATSB booklet, Avoidable Accidents No.3: *Managing partial power loss after take-off in single engine aircraft* AR-2010-055.

Pilots transferring from one type of aircraft to another are reminded that there is as much risk in moving to lower performance aircraft, as there is moving to higher performance aircraft. The ATSB encourages pilots to manage this transition using a risk-based approach such as Federal Aviation Administration (FAA) advisory circular AC90-109A – *Transition to Unfamiliar Aircraft* (U.S. Department of Transportation Federal Aviation Administration, 2015).

This accident is also a reminder that blood-alcohol can persist the day after significant alcohol consumption, and the residual effects of alcohol may impair performance, especially in demanding and time critical situations.

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The occurrence

Overview

On 28 December 2020, at about 1438 local time, a Dynaero MCR-01 VLA, registered VH-SIP, departed Serpentine aircraft landing area (ALA), Western Australia, to conduct a post-maintenance check flight. At about 300 ft above ground level, the engine began to run rough, however continued to operate. Shortly after, the aircraft was observed to aerodynamically stall,[1] pitch nose-down, and impact terrain. The pilot, who was the sole occupant, was fatally injured, and the aircraft was destroyed.

Aircraft return to service

Post-maintenance flight checks

On 27 December 2020, the new owner and a flight instructor were a conducting post-maintenance check flight of VH-SIP at Serpentine ALA, after undergoing maintenance after an extended period of inactivity (see *Return to service tasks*). As they departed from runway 05[2] on climb, at about 200–300 ft above ground level (AGL), the engine lost power and began to run rough. The instructor, who was the pilot in command, reported that they lowered the nose and reduced power, which cleared the rough running and allowed the aircraft to continue flight. There was sufficient power available to continue a reduced climb and conduct a circuit back onto runway 05.

The instructor recalled they then initiated a missed approach on short final approach to runway 05 and commenced a full power climb. While the aircraft engine power initially responded, rough running was again experienced at about 200–300 ft AGL. The instructor again reduced power, cleared the rough running, and conducted a slow climb before making a final landing back on runway 09. Both occupants identified the smell of fuel in the cockpit at the time.

The instructor, the new owner and several other people including the pilot of the accident flight (pilot) assisted a licenced aircraft maintenance engineer (LAME) with troubleshooting the engine rough running that afternoon. Numerous engine-runs were conducted on the ground with multiple witnesses stating that they were able to replicate the rough running and partial power loss during the static full power tests on the ground, both with and without the electric fuel pump assistance. The owner stated that the engine seemed to run smoother with the electric fuel pump on, however engine coughing and rough running was replicated on all of the full power runs to varying degrees. Other witnesses recalled the engine stopping when the throttle was reduced after the engine runs, one capturing the stoppage on video.

Engine troubleshooting

To try and diagnose the problem, basic fuel system troubleshooting was conducted by another LAME on behalf of the original LAME, who was no longer at the airfield. This included the draining and cleaning of the fuel filter on direction of the original LAME by phone. A witness described the contaminants within the fuel drain sample and filter as a significant amount of ‘brown gunk’. The engine troubleshooting continued until early evening, when the aircraft was then hangered for the night with the original LAME scheduled to conduct troubleshooting on the aircraft the next day.

The owner and instructor made the decision to return back to Queensland without the aircraft and have the aircraft ferried over when the rectification work was completed. The pilot, who was known to the LAME, volunteered to ferry VH-SIP from Serpentine to Queensland after working

[1] Aerodynamic stall: occurs when airflow separates from the wing’s upper surface and becomes turbulent. A stall occurs at high angles of attack, typically 16˚ to 18˚, and results in reduced lift.

[2] Runway number: the number represents the magnetic heading of the runway.

with the LAME to correct the engine problem. The owner accepted the offer before departing Serpentine Airfield back to Perth.

Evening activities

That evening, the local aero club held a dinner at the airfield (see *Social function*). Witnesses confirmed that the pilot attended the event, retiring to their accommodation at about 0200 the following morning.

Accident flight

On 28 December 2020, the pilot and LAME met at the airfield at about 1100. The LAME did not recall the pilot was any different to usual, however did remark that the pilot was consuming significant amounts of water. The pilot assisted the LAME with the running of the engine and mentioned that they had never flown an aircraft as small or light before and had not operated a Rotax engine previously. Subsequently, the LAME explained the absence of a mixture control, use of ignition systems and the operation of the electric inflight adjustable propeller.

The LAME removed the aircraft cowls and inspected the engine compartment for a fuel leak before replacing a newly installed mechanical engine driven fuel pump with the old pump to test positive fuel flow without any blockages as part of the troubleshooting sequence. The LAME identified that the fuel flow increased with the activation of the electric fuel pump.

The pilot conducted a troubleshooting check flight in VH-SIP at about 1415, with the support of a number of ground crew including several LAMEs. On return from the first flight, the pilot reported that the engine was not developing full power (5,500 RPM),[3] and was not able to produce much greater than 4,000 RPM. The LAME provided an additional brief to the pilot on the use of the automatic propeller system and requested further ground runs of the engine.

At about 1438, the pilot conducted a further post-maintenance troubleshooting flight from runway 09 (Figure 1). The LAME stated that they expected the aircraft operation to be a high-speed ground run. At about 300 ft AGL, witnesses described audible changes in the aircraft engine noise, and observed a noticeable change in aircraft performance. They observed the aircraft visibly slow and begin a left turn. Further change in the engine noise was heard before the aircraft was described to commence another left turn towards runway 23. At about 200 ft AGL, witnesses described the left turn beginning to tighten and the aircraft visibly slowing with a nose-high attitude. At about 150 ft AGL, the aircraft's left wing dropped and the aircraft entered a steep rotating descent to the left. The pilot was unable to recover control of the aircraft before it impacted with terrain.

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3 Engine revolutions per minute.

Figure 1: Aircraft's flight path and accident site location

Source: Google Earth, modified by the ATSB

Context

Pilot information

Licencing

The pilot held an air transport (Aeroplane) pilot licence. This licence was for single and multi-engine aircraft, with endorsements for tailwheel aircraft, manual propeller pitch change, gas turbine engines, pressurisation and for aircraft with retractable undercarriage.

Aeronautical experience

General experience

The pilot's logbook showed a total flying experience of 5,999.8 hours, up to the last recorded flight on 31 November 2019, when the pilot ceased airline flying with a carrier in the US, before moving back to Australia.

Aircraft specific experience

The majority of the pilot's total flight time was conducted in multi-engine, piston and turbine aircraft operations. However, since the pilot's return to Australia, they had conducted a tailwheel design feature endorsement, an aeroplane flight review, and a number of private flights of the local aeroclub aircraft based at Serpentine ALA.

Although the pilot had considerable experience, a review of the pilot's logbook records found that they had not previously flown Rotax-powered aircraft or the Dynaero MCR-01 VLA.

Medical

The pilot held a valid class 1 and class 2 medical certificate, with the last examination conducted on 23 January 2020. The pilot's class 2 medical was valid until 23 January 2022 and included restrictions requiring the wearing of distance vision correction and additionally, that reading correction must also be available whilst exercising the privileges of the licence.

Recent history

The night before the accident, a number of airfield members met for an informal social dinner at the clubhouse facilities. It was reported that a number of people attended the dinner, and that alcohol was consumed as part of the social event. Witnesses reported seeing the pilot drinking alcohol during the dinner, 1 witness recalled that the pilot engaged in a 'fairly heavy' drinking session consuming a significant quantity of alcohol. The witness recalled the pilot being in a good state of mind, being exceptionally chatty and, later on, recalled them stating that the pilot was 'really drunk'.

The social function ended at about 0130 on the morning of the accident. Another witness recalled seeing the pilot shortly before driving home from the airport at about 0147, but did not believe that the pilot was significantly impaired by alcohol at that time. The pilot's quantity and quality of sleep could not be determined.

Post-mortem and toxicology

A post-mortem indicated that the cause of death was due to multiple injuries that were sustained as a result of the collision with terrain. Toxicology indicated low levels of carbon monoxide, consistent within normal levels, and did not detect any common drugs. Toxicology did not detect levels of alcohol within either blood or urine samples.

Aircraft information

General

The Dynaero MCR-01 VLA is a low-wing, high performance, experimental amateur-built aircraft. It was supplied in kit form and VH-SIP was constructed for the education and recreation of the previous owner. The Dynaero MCR-01 VLA was promoted as suitable for cross-country flying, with an airspeed range from 56 to 200 kt. It could be operated between +3.8 g and -1.5 g,[4] however aerobatic flight and intentional spinning of the aircraft were prohibited.

Airworthiness and maintenance history

The aircraft was constructed from a kit and had a special certificate of airworthiness issued on 15 May 2003, and was first flown on 22 May 2003. The aircraft was powered by a horizontally-opposed, 4-cylinder, dual carburettor, Rotax 912 ULS-FR, that was manufactured in May 2002.

On 6 November 2003, the canopy of VH-SIP shattered while the aircraft was in flight. This led to a loss of control and the aircraft entering a spin at altitude. After recovering controlled flight, the pilot conducted a forced landing into a paddock, which resulted in significant damage to the aircraft. VH-SIP was repaired over a period of about 18 months, and during this time, the carburettors were removed, cleaned and refitted. The aircraft was returned to service in April 2005.

Among other work carried out on the aircraft, the logbook recorded that, in September 2006, the carburettors were again cleaned and refitted. The aircraft did not fly between November 2009 and November 2013 (4 years). In August 2013, the original owner conducted maintenance on the aircraft for the last time. The aircraft was flown on 4 occasions in 2014, and then was inactive for over 5 years.

On 13 January 2019 the aircraft logbook indicated that work had been conducted on the fuel system and carburettors of VH-SIP, including a new fuel drain valve, removal and cleaning of the carburettors, the installation of new idle jets, O rings and new carburettor float bowl gaskets. Oil and oil filter replacements were also carried out, and the fuel system was flushed with 10 L of aviation gasoline (AVGAS) before being ground run.

In 2020, the aircraft was offered for sale. A pre-purchase inspection was undertaken on 22 May 2020 by a Recreational Aviation Australia Level 2 maintenance engineer on behalf of a prospective buyer. The engineer did not consider the aircraft to be in an airworthy condition due to contaminants in the carburettors, unactioned carburettor float service bulletins, and the mandatory rubber component replacement requirements had not been carried out. Subsequently, the condition of the aircraft was reported to the prospective buyer and the sale did not proceed.

The licenced aircraft maintenance engineer (LAME) at Serpentine ALA was contacted by another prospective buyer in early December 2020 to conduct a pre-purchase inspection before the aircraft was due to be auctioned. The LAME advised the prospective owner that they considered the aircraft to be in good condition, however it would require an annual inspection. Several days later the LAME was contacted by the buyer and advised of the successful acquisition of the aircraft and requested that the LAME carry out the work required to issue a maintenance release. The last entry in the aircraft maintenance log was on 27 December 2020, the day prior to the accident. It showed the most recent work conducted by the LAME.

Engine preservation and return to service

Preservation and storage requirements apply to aircraft engines fitted to an aircraft, as well as uninstalled engines. The Rotax operator’s manual had preservation and storage requirements for long out-of-service periods that were required to be repeated every year the engine was inactive.

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4 G load: the nominal value for acceleration. In flight, g load represents the combined effects of flight manoeuvring loads and turbulence and can have a positive or negative value.

This included inhibiting the engine both internally and externally, and covering all of the engine's openings to protect it from dirt and humidity. The line maintenance manual limited the storage period for engines to 24 months, and if this period had been exceeded, the engine required overhaul.

The engine manufacturer had an aircraft engine return to service schedule for Rotax 912 engines after a prolonged period or during preservation. These requirements included conducting the normal 100-hour inspection before flight if the engine has been preserved for greater than 12 months.

Return to service tasks

At the request of the new owner, the LAME performed the return to service over a period of several days. The LAME recalled that, during this work, the floats were removed from the carburettor bowls and weighed for discrepancies, refitted, and a carburettor balance was conducted. The LAME also recalled conducting a fuel calibration by draining and replacing the fuel at set increments to ascertain if the fuel quantity markings were correct. Additional work carried out included a periodic inspection, instrument and systems checks, a compression test, engine idle adjustment, and engine ground runs.

Logbook entries detailed that the airframe was inspected in accordance with the Dynaero schedule and considered airworthy along with entries stating:

- the propeller was inspected and found to have nil defects evident
- the engine was inspected in accordance with the BRP-Rotax 912 maintenance manual and CASA AD/ENG/4 with nil defects evident
- service bulletins for the flaps, main landing gear attach, trim tab attach, and canopy attach were carried out
- pitot-static leak tests
- engine-driven fuel pump was replaced
- the 5-year carburettor rubber part and coolant hose replacement was carried out in addition to fitting a new fuel pump and spark plugs.

A maintenance release was issued by the LAME on 27 December 2020 at an aircraft time in service of 439.3 hours. There were 3 endorsements on the maintenance release:

- an engine oil and filter change at 489.3 hours
- a periodic inspection by 539.3 hours or 26 December 2021
- the oil and fuel hoses to be changed by February 2021.

The LAME recalled that the oil and fuel hose replacement entry had been added because the required parts were not available to be sourced and therefore could not be fitted during the aircraft's return to service.

The other required parts were supplied by the engine importer directly to the LAME in mid-December 2020. Some of these parts were replaced during the return to service, however a few unused parts in their original packaging were found in the aircraft at the accident site.

After the aircraft was returned to service, it underwent a number of other maintenance troubleshooting checks the day prior to, and the morning of the accident. These checks included the removal and replacement of key parts, such as the refitting the original time-expired engine-driven fuel pump for troubleshooting purposes, however these changes were not documented.

The pilot also conducted several ground runs along runway 09 before becoming airborne and conducting a circuit.

Fuel

The aircraft operated on AVGAS and had the capacity to carry 79 L of usable fuel, in one 80 L main tank. The aircraft was reportedly refuelled prior to the proposed departure from Serpentine ALA the day before the accident, and the new owner estimated that about 60-65 L would have been on board at the time of the accident. ATSB investigators confirmed a strong smell of fuel at the accident site.

Weight and balance

Weight and balance information retrieved from the accident site indicated the aircraft had an empty weight of 261 kg and a maximum take-off weight of 490 kg. The difference left about 229 kg of useable payload for the pilot and fuel. Weight and balance calculations placed the centre of gravity towards the forward limit of the envelope, and within limits.

Amateur-built aircraft

Pilots and passengers of experimental aircraft in Australia accept the risk that the aircraft may not meet the same airworthiness safety standards as certified aircraft, and operate these aircraft on the basis of informed participation.[5] Most amateur-built aircraft are constructed in Australia for the owners education and leisure, however in time many are sold to other private operators.

Operating limitations

Aircraft operating limitations were contained within the aircraft flight manual and the relevant stall airspeed limitations are detailed in Table 1.

Table 1: Stall speeds at 400 kg maximum take-off weight

Bank angle	0° flaps,[6] power off, knots indicated airspeed (KIAS)	10° flaps, power off, KIAS	25° flaps, power off, KIAS
0º	58	51	44
30º	62	53	47
60º	81	72	62

The flight manual also described the recommended glide speed of the Dynaero MCR-01 VLA of 70 KIAS with a 13.4:1 glide ratio,[7] indicating that the Dynaero MCR-01 VLA has a higher glide speed compared to many other low inertia aircraft in a similar weight category.

Aerodynamic stall speeds considerably increase beyond a 30° angle of bank turn (Table 1). Pilots should be aware these of characteristics during emergency manoeuvring.

The Dynaero MCR-01 VLA flight manual indicates the emergency procedure for an engine failure after take-off (Figure 2). Specifically mentioned, for engine failures immediately after take-off, is not to attempt a 180° turn to return to the runway.

5 Informed participation relies on the premise that before you take part or pay for an activity that you are fully aware of the potential risks and consequences.

6 Inboard trailing edge wing sections controlled by the pilot that protrude into the airflow to produce lift and drag, commonly used during take-off, landing and slow flight.

7 The glide ratio of an aircraft is the distance of forward travel divided by the altitude lost in that distance.

Figure 2: Engine failure on take-off procedure

4.2.2. Engine failure immediately after take-off

-	Airspeed	.... **70 knots**
-	Fuel tap	.... **closed**
-	Magnetos	.... **OFF**
-	Flaps	.... **as required**
-	Battery	.... **OFF**

Never attempt to make a U turn to return to the runway.

Source: Dynaero MCR-01 VLA flight manual

Meteorological information

Bureau of Meteorology graphical area forecast for the Serpentine local area indicated that at the time of the accident, that visibility was greater than 10 km with nil significant weather issues. However, moderate turbulence was expected below 10,000 ft over land in thermals and dust devils.

At about the time of the accident, Jandakot Airport, about 30 km to the north of Serpentine, recorded an easterly wind of about 13 kt with visibility greater than 10 km and no significant cloud or weather.

Witnesses at the airfield described the weather as a ‘belting easterly’ and similar to the previous day with hot, dry and windy conditions.

Wreckage information

Site and wreckage examination

The accident site was located in relatively flat and open farmland (Figure 3), about 200 m east of the threshold of runway 23 at Serpentine ALA. The ATSB conducted an examination of the site and wreckage and identified:

- ground impact marks indicated that the aircraft had impacted terrain nose-down, upright and with left rotation
- flaps were in the retracted position.

No pre-impact defects were identified with flight controls or aircraft structure. The fuel tank, located between the cockpit and engine compartment, had ruptured and a quantity of fuel had leaked into the soil. There was no pre- or post-accident fire.

A damaged GPS device, instrumentation including a fuel flow indicator, the engine, propeller, and fuel lines, were recovered from the accident site for further technical examination by the ATSB.

Figure 3: Accident site

Source: ATSB

Engine examination

The engine was disassembled and examined at a Civil Aviation Safety Authority (CASA) approved engine overhaul facility under the supervision of the ATSB. Apart from impact damage, the main engine components were generally in good condition.

Testing and dis-assembly of the carburettors and fuel system identified:

- the left carburettor was missing a clip that attached the float needle valve to the float hinge bracket
- corrosion was identified in both carburettor bowls and on both sets of carburettor floats
- significant corrosion deposits were found on the float needle valve, seat and on the valve tip
- carburettor floats were the incorrect type
- the right carburettor float guide pin was bent, causing float contact with side of carburettor bowl
- fuel line internals were perished and brittle with splitting at the securing end.

Further details relating to the engine teardown can be found in Appendix B – Engine examination.

Partial power loss

Partial power loss on take-off

The ATSB booklet, Avoidable Accidents No.3: *Managing partial power loss after take-off in single engine aircraft* (AR-2010-055) (Australian Transport Safety Bureau, 2013), describes partial engine power loss as a situation when the engine provides less power than commanded by the pilot, but more power than idle thrust:

> This kind of power loss is more complex than a complete failure, and it can be much harder to stay ahead of the aircraft. The pilot is thrust into a situation where the engine is still providing some power; however, the power may be unreliable, and the reliability may be difficult to assess. As a result, pilots are uncertain about the capabilities of their aircraft, and what their options are.

> Partial engine power loss can range from providing very little power to almost full power, with varying levels of reliability of the remaining engine power. When faced with a partial power loss, pilots should not try to diagnose the engine problems at the expense of maintaining aircraft control.

On take-off, once the aircraft climbs to a point where it does not have enough runway to land straight ahead, but is not high enough to safely return to the aerodrome for a landing, it has reached a 'no return' to the runway decision point (Figure 4). From this point, until the aircraft climbs to a height allowing safe return to the runway, the pilot is faced with conducting a forced landing beyond the prepared surface of the airfield. Decisions made by the pilot in command can be critical to the safety of flight at this point.

Figure 4: No return decision point

Source: Google Earth, modified by the ATSB

In the event of any emergency during critical phases of flight, such as below 200 ft above ground level (AGL) on take-off in a single engine aircraft without runway remaining, pilots should focus on the priorities of:

- **Aviate**: maintain glide speed and assess whether the aircraft is maintaining, gaining or losing height to gauge aircraft performance
- **Navigate**: fly the aircraft to make a landing, if height and power are limited, then an into wind landing, 30° left or right of the centreline is a safer option
- **Communicate**: Mayday call as appropriate.

Pre-take-off safety brief

The pre-take-off safety brief is a verbal and mentally prepared response, through the pre-visualisation of an emergency on take-off and is generally conducted once all engine run-ups are complete and prior to entering the runway. The brief mentally prepares a pilot with preprogrammed responses to possible unexpected events during this critical phase of flight when decision making time is short.

These anticipated actions in response to certain stimuli, assist pilots in making better decisions in accepting emergency circumstances and safely managing emergencies, especially when an off-airfield landing may be the safest option.

The briefing should include the pilot in command's intentions in the event of an engine related problem during the take-off roll and after take-off, both with runway remaining and without. This formulates pre-existing mental models of possible actions should an emergency arise.

A pre-take off safety brief should include:

- consideration of the runway in use, it's length, surface, boundary fencing and possible forced landing areas beyond the runway, including terrain and obstacles
- wind direction and strength, which will indicate the safest into wind turning options to safely maintain airspeed and provide a lower groundspeed in case of a forced landing beyond the airfield boundary
- consideration of required height and direction of turn, to conduct a turn back to the runway

The ATSB Avoidable Accidents booklet provides sound guidance to pilots on this subject and concludes that:

> Generally speaking, if you self-brief your plan of action just before flight, you have more chance of 'staying ahead' of the aircraft and being able to concentrate on flying.

The turn back

The turn back is described as the conduct of an emergency manoeuvre to reverse the direction back towards the take-off runway, to either conduct a landing on the reciprocal runway or to land at another runway at the original departure point.

During this critical time, the pilot must assess four main considerations for the safe conduct of a turnback:

- Is the height sufficient to safely turn the aircraft back to the runway?
- Is there remaining power available to continue to climb or maintain height?
- Can a safe airspeed be maintained during the turn, taking into account the increased stall Speed associated with an increased angle of bank to prevent aerodynamic stall?
- assuming that the engine may fail at any time, is the remaining power reliable?

The ATSB Avoidable Accidents booklet noted:

> A turnback requires accurate flying during a period of high stress to prevent a stall and possibly a spin occurring. If an aerodynamic stall and or spin occurs, given that these circumstances are likely to be at low level, there is little likelihood of a successful recovery.
>
> There are many scenarios where it might be considered inappropriate to conduct a turnback. For example, consideration should be given to additional hazards such as other aircraft, obstacles, an unfavourable wind component, increased stall risk during a low-level turn and surrounding terrain.

Pilot decision making during partial power loss

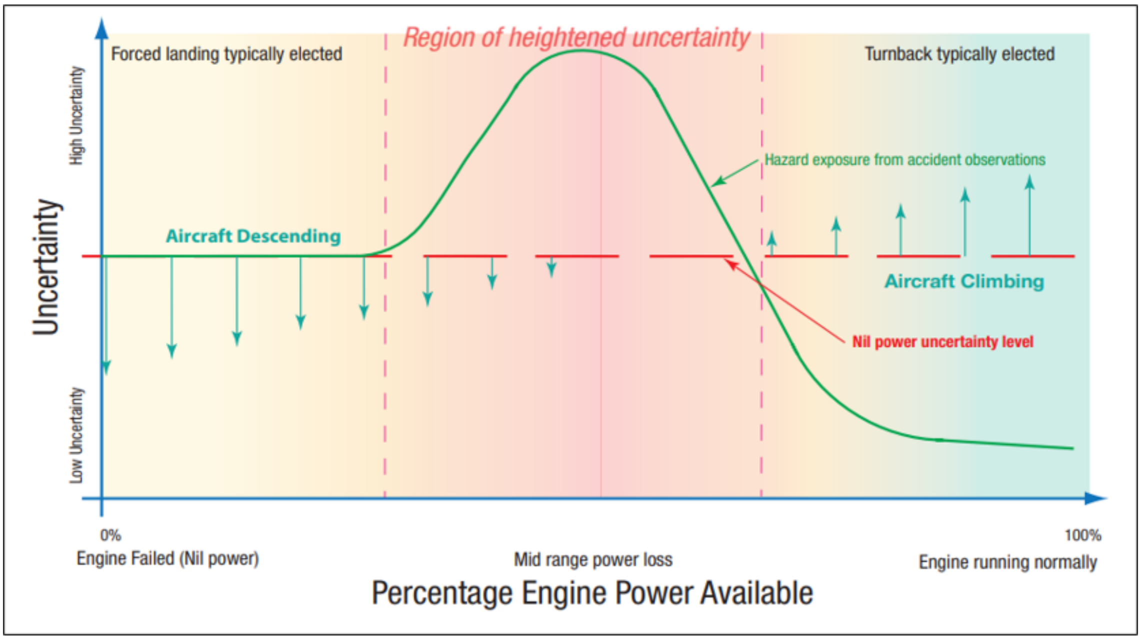
The ATSB Avoidable Accidents booklet also detailed influences on decision making affecting pilots:

> The course of action chosen following such a partial power loss after take-off can be strongly influenced by the fact that the engine is still providing some power, but this power may be unreliable. As the pilot, you may also have a strong desire to return the aircraft to the runway to avoid aircraft damage associated with a forced landing on an unprepared surface.

Based on an analysis of partial power loss accidents after takeoff, the booklet further noted that pilot decision making is also influenced by the amount of power loss experienced. In situations where power loss is substantial, pilots are more likely to recognise this as being close to a complete loss of power and typically conduct a forced landing outside of the runway environment. However, if the remaining power is sufficient to continue climb, albeit at a reduced rate, pilots were able to take advantage of increased options, such as a continuing a circuit or conducting a turn back towards the runway.

However, the ATSB identified a period between these 2 areas that represented a region of heightened uncertainty (Figure 5). In this region, excess power was not available to climb but there was sufficient power to prevent appreciable descent, resulting in a period of flight uncertainty where the aircraft may not be able to maintain height without bleeding off airspeed, eventually resulting in the aircraft slowing to maintain or gain height and increasing the risk of aerodynamic stall.

Figure 5: Region of heightened uncertainty during partial power failures on take-off



Source: ATSB

The ATSB identified that 8 out of 9 partial power loss accidents resulting in fatal injuries occurred with mid-range power loss. Inconsistent power or engine surging from high to low RPM present complex problems to the pilot. Inability to maintain height with partial power loss usually leads to aircraft stall and loss of control, mostly resulting in collision with terrain.

Transition to unfamiliar aircraft

General competency

In order for a pilot to operate a different aircraft type already covered by their licence category and class rating, they need only be satisfied that they are competent under Civil Aviation Safety Regulation (CASR) 1998.

CASR 61.385 *Limitations on exercise of privileges of pilot licences – general competency* requirement stated:

> (1) The holder of a pilot licence is authorised to exercise the privileges of the licence in an aircraft only if the holder is competent in operating the aircraft to the standards mentioned in the Part 61 Manual of Standards for the class or type to which the aircraft belongs, including in all of the following areas:

(a) operating the aircraft's navigation and operating systems;

(b) conducting all normal, abnormal and emergency flight procedures for the aircraft;

(c) applying operating limitations;

(d) weight and balance requirements;

(e) applying aircraft performance data, including take-off and landing performance data, for the aircraft.

Guidance on transition

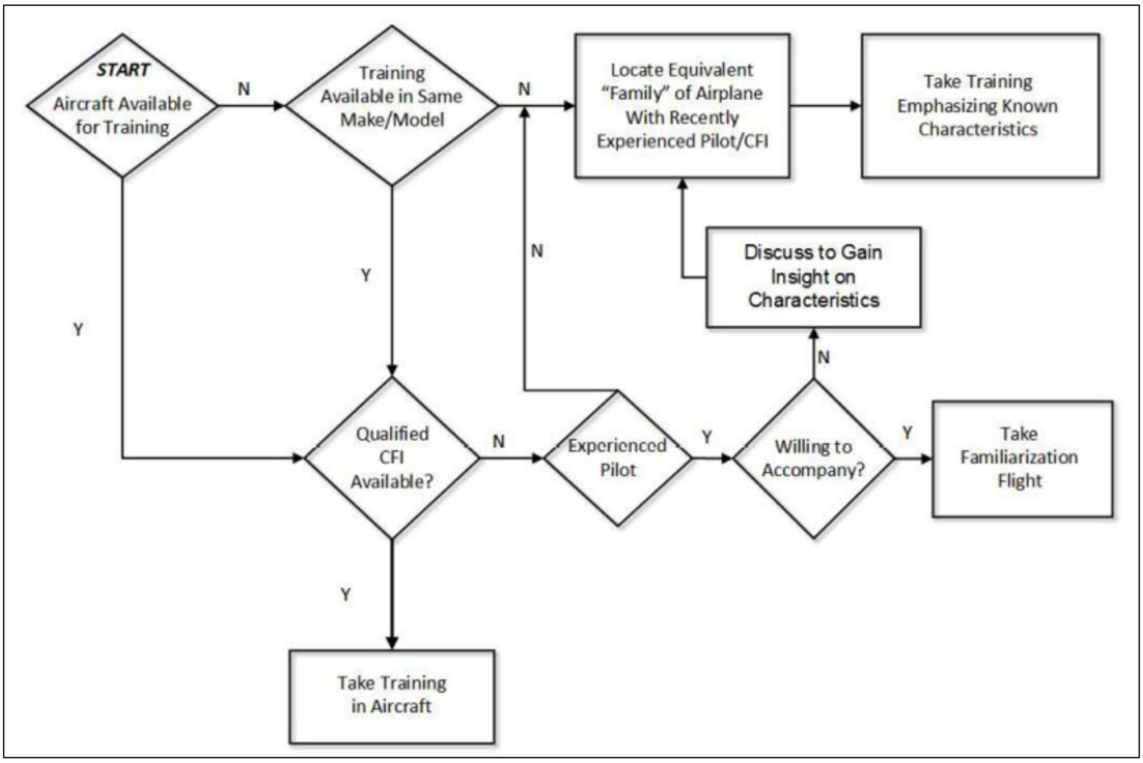
While no definitive Australian guidance provided advice on the transition of pilots to unfamiliar aircraft, the Federal Aviation Administration (FAA) advisory circular AC90-109A – *Transition to Unfamiliar Aircraft* (U.S. Department of Transportation Federal Aviation Administration, 2015) is a widely recognised and utilised publication providing a sound basis to consider the hazards of transitioning to unfamiliar types of aircraft, whether certified or experimental.

The AC recognises the importance of providing guidance to pilots transitioning between aircraft types, or to experimental aircraft with differing design features to high performance and complex aircraft. It recommends that pilots' should develop a training strategy (Figure 6) for mitigating the risks of operation of an unfamiliar aircraft type.

The FAA AC recommend that:

> Prior to flying an unfamiliar airplane, all pilots should review the hazards and risks outlined in this AC, and complete the training recommended before operating the airplane. Accident data has shown that there is as much risk in "moving down" in performance as "moving up." For example, consider a pilot who has substantial experience in high-performance corporate, airline, or military airplanes. The knowledge and skills used to safely fly at high speeds, high altitudes, and over long flights will, by themselves, not prepare the pilot for the challenges of a low-inertia, high-drag airplane.

Figure 6: FAA recommended airplane transition training approach



Source: FAA AC90-109A

The guidance recommends firstly that pilots should consider undertaking flight training with a qualified flying instructor in the proposed transition aircraft, the same make and model or an aircraft that exhibits the same design features or characteristics of the transition type. If instruction is unavailable, seek another experienced pilot to conduct a familiarisation flight; however if unwilling, at least discuss the differences and expected characteristics of the transition aircraft.

The guidance further recommended that pilots take a risk management approach to formally identify the hazards and mitigate any known or elevated risks identified.

These may include:

- specific type training in the transition aircraft or similar type/design features
- safety equipment such as helmets, fire extinguishers or parachute
- condition, maintenance and history of the transition aircraft
- review of aircraft operating limitations
- plan transition flights to conservatively build up manoeuvres and aircraft experience
- conducting initial flights in benign weather conditions

Fitness for flight

Regulatory requirements

CASA identifies that any amount of alcohol in your body may affect a pilot's fitness to safely operate an aircraft.

Subparagraphs 91.520(2)(b)(i), (ii) and subregulation 91.520(5) of CASR outlines a crew member for a flight (pilot) commits an offence if they consume alcohol at any time during the period of 8 hours ending when the flight begins, or if a test of a body sample of the crew member to determine the level of alcohol in the sample was taken at the time of carrying out the duty (and) the test reveals that the permitted level for alcohol (within the meaning of Part 99) is exceeded.

Part 99 of CASR defines –

permitted level means:

- (a) for a testable drug—a level of the drug specified in subregulation (2A) for the purposes of this paragraph; and
- (b) for alcohol—a level of alcohol of less than 0.02 grams of alcohol in 210 litres of breath.

This means pilots should give considerable and reasonable thought to the amount and rate of alcohol consumption in order to determine if residual alcohol levels may affect cognitive functions, such as decision making, reduced attention and physical ability during the intended flight.

Post alcohol impairment

Post-alcohol impairment (PAI) has been defined as performance impairment after alcohol is no longer detectable. While the performance decrement of pilots under the influence of alcohol is well known and documented, the effect of post-alcohol impairment, commonly known as a 'hangover', is less tangible.

Although pilots must not operate an aircraft within 8 hours of the consumption of alcohol, a pilot's ability to make normal and emergency decisions may be impaired even after the blood alcohol concentration (BAC) has returned to zero.

Research conducted for the ATSB (Newman, 2004) into alcohol and human performance highlighted that:

> In simple terms, alcohol impairs human performance…

> It has detrimental effects on cognitive functions and psychomotor abilities. Risk taking behaviour may result, and a full appreciation of the consequences of a planned action may not be possible… Adverse effects can also persist the day after alcohol ingestion, with reductions in alertness, concentration and vestibule-ocular function, and increases in anxiety all being reported…
>
> Alcohol has been shown to impair registration, recall, and organisation of information, leading to increased reaction times and/or a greater number of errors…
>
> …performance has also been found to suffer most when an unexpected or unanticipated event occurs.

A study found that 14 hours after alcohol ingestion leading to a BAC of at least 0.10%, pilots performed much worse at a flight simulator task at a time when their BAC had returned to 0 (Yesavage & Leirer, 1986). Pilot performance was measured and found worse on almost every level, with detriments to precision and accuracy being highlighted. It was also found that pilots were not able to accurately judge their own degree of impairment and concluded that such performance effects would still be measurable sometime after 14 hours.

The ATSB study (Newman, 2004) also found that:

> The alcohol-induced impairment of cognitive performance becomes more evident when the nature of the flying task becomes more complex and demanding, such as in an emergency situation. A pilot suffering from the effects of post-alcohol impairment may not handle such a high-workload emergency appropriately, due to reduced attention, a slower rate of information processing, increased reaction time, and poor decision-making. All of these could ultimately result in an accident.

Safety analysis

Introduction

On 28 December 2020, the pilot of a Dynaero MCR-01 VLA, registered VH-SIP, was conducting post-maintenance troubleshooting check flights at Serpentine Airfield, Western Australia. While at about 300 ft above ground level (AGL), on the second flight for the day, the engine began to run rough. Shortly after, and while most likely attempting to return to the airfield, the aircraft’s left wing was observed to drop, the nose pitched down, rotate to the left, and impact terrain.

This analysis will explore airworthiness considerations pertaining to VH-SIP, its return to service, the pilot’s experience on the aircraft type and its effect on emergency management, and the effects of post-alcohol impairment.

Return to airfield and stall

A partial power loss occurred at about 300 ft AGL on take-off from runway 09. Although alternative ‘off-runway’ landing areas were available, the pilot elected to continue flight while manoeuvring the aircraft towards the eastern end of runway 15.

Manoeuvring an aircraft to return to the airport during critical periods of the initial climb, with inconsistent and unreliable power output, significantly increases risk.

With a combination of turning downwind, marginal power and performance, potentially an attempt to maintain altitude, probably led to the aircraft decelerating. During a further left turn towards runway 15, this decrease in airspeed likely resulted in the left-wing stall at about 200 ft AGL, that did not afford the pilot an opportunity to successfully recover.

Airworthiness of VH-SIP

Return to service

VH-SIP had 3 periods of inactivity, about 18 months, 4 years, then 5 years. There was no record in the logbooks for VH-SIP to indicate its engine had been preserved, however the logbook states the carburettors were cleaned on 3 occasions, with the most recent being in January 2019.

The requirement to replace time-limited components every 5 years was partially carried out. Some of the fuel lines that were not replaced were found to be in poor condition when examined at the overhaul facility after the accident. However, it could not be determined if this contributed to the engine rough running prior to, and on the day of the accident.

Engine defects and partial power loss

The preliminary examination of the engine at the accident site, and the subsequent engine examination at an overhaul facility did not identify any pre-impact mechanical defects. However, both carburettors were found to contain contamination, most likely forming during the aircraft’s extended periods of inactivity.

This contamination that was not rectified prior to the aircraft being released for service, or during the subsequent troubleshooting of the engine rough running. Additionally, there was no record of the fuel system being inspected and cleaned in accordance with the manufacturer’s requirements when carburettor contamination has been identified.

The flooding that was observed during multiple tests of the left carburettor, was the result of significant contamination on its float needle valve and seat. Given the amount of contamination, the left carburettor was likely flooding prior to the accident, and as carburettor flooding is known to result in fuel odour, would have been the likely source of the reported fuel smell.

It's possible the contamination in both carburettors, along with the absence of the clip that attached the float needle valve to the float hinge bracket, resulted in the rough running of the engine at high power settings.

Ongoing maintenance of an aircraft's fuel system is essential to ensure fault-free operation of its engine. In particular, the reliability of carburettors is dependent on their condition, and by following the manufacturers maintenance requirements and service bulletins.

Unfamiliarity with aircraft type

Although experienced in passenger transport operations and heavier multi-engine aircraft, the pilot was not as experienced in flying lighter general aviation aircraft, with even less experience in very light, low inertia aircraft such as the Dynaero MCR-01 VLA.

The safe conduct of post maintenance flights and troubleshooting of aircraft systems requires pilot familiarity and experience in the aircraft type, its design features and its normal and emergency operating parameters.

Although appropriately licenced, the pilot had never flown a Dynaero MCR-01 VLA previously and had limited experience with low inertia aircraft, as well as the engine and the propeller type fitted to VH-SIP.

The conduct of a post maintenance flight with limited pilot experience and knowledge in the aircraft and its systems, increased the likelihood that the pilot would be unable to effectively manage any in-flight emergency.

Post alcohol impairment

Post-alcohol impairment is of particular importance in aviation. While regulations require a minimum time between drinking and flying, there is considerable evidence that pilot performance may be impaired for much longer periods. Post-alcohol impairment can increase the potential for spatial disorientation for up to 48 hours. While a pilot may be legally able to fly eight hours after drinking, the residual effects of alcohol may seriously impair their performance when they need it most, such as during an emergency.

Witness accounts of reported alcohol consumption the night before the accident, increased the likelihood that the pilot would have been experiencing some level of post alcohol impairment that may have contributed to reduced cognitive function which could have affected the pilot's decision making during the partial power loss after take-off.

Findings

ATSB investigation report findings focus on safety factors (that is, events and conditions that increase risk). Safety factors include ‘contributing factors’ and ‘other factors that increased risk’ (that is, factors that did not meet the definition of a contributing factor for this occurrence but were still considered important to include in the report for the purpose of increasing awareness and enhancing safety). In addition ‘other findings’ may be included to provide important information about topics other than safety factors.

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

From the evidence available, the following findings are made with respect to the partial power loss and collision with terrain involving, Dynaero MCR-01 VLA, VH-SIP near Serpentine Airfield, Western Australia, on 28 December 2020.

Contributing factors

- Shortly after take-off, the engine experienced a partial power loss. The pilot turned the aircraft to the left most likely in an attempt to return for landing.
- At about 200 ft above ground level, with low airspeed and no flap selected, the left wing aerodynamically stalled. This resulted in the aircraft entering into an upright spin, at an altitude that limited an effective recovery.
- Multiple tasks in the aircraft’s return to service after a significant period of inactivity were not carried out adequately before the aircraft was released to service.
- The left carburettor contained contamination that likely resulted in flooding at low power, and rough running at high power settings.
- The pilot did not adequately manage the risk of transitioning to an unfamiliar aircraft type, further increasing the risk of not being able to adequately manage in-flight emergencies during post maintenance flights.

Other factors that increased risk

- The pilot had probably consumed a significant amount of alcohol the night before the accident, which increased the risk of post-alcohol impairment.

General details

Occurrence details

Date and time:	28 December 2020 – 1438 WST	
Occurrence class:	Accident	
Occurrence categories:	Loss of control, Collision with terrain	
Location:	Serpentine Airfield, Western Australia	
	Latitude: 32º 23.528' S	Longitude: 115º 52.572' E

Aircraft details

Manufacturer and model:	AMATEUR BUILT AIRCRAFT DYN-AERO MCR01VLA	
Registration:	VH-SIP	
Serial number:	225	
Type of operation:	Private-Other - (Private)	
Activity:	General aviation / Recreational-Sport and pleasure flying-Other sport and pleasure flying	
Departure:	Serpentine Airfield, Western Australia	
Destination:	Serpentine Airfield, Western Australia	
Persons on board:	Crew – 1	Passengers – 0
Injuries:	Crew – 1 (fatal)	Passengers – 0
Aircraft damage:	Destroyed	

Glossary

AGL	Above ground level
ALA	Aircraft Landing Area
ATSB	Australian Transport Safety Bureau
AVGAS	Aviation gasoline
BAC	Blood alcohol concentration
CASA	Civil Aviation Safety Authority
FAA	Federal Aviation Administration
GPS	Global positioning system
KIAS	Indicated airspeed
LAME	Licenced aircraft maintenance engineer
PAI	Post alcohol impairment
RPM	Revolutions per minute
VFR	Visual flight rules.

Sources and submissions

Sources of information

The sources of information during the investigation included the:

- witnesses that operated the aircraft the day before the accident flight
- Civil Aviation Safety Authority
- Western Australian Police Service
- aircraft manufacturer
- engine manufacturer
- maintenance organisation
- Airservices Australia
- Bureau of Meteorology
- accident witnesses
- video footage of VH-SIP the day before the accident flight and other photographs and videos.

References

Australian Transport Safety Bureau. (2013). *Avoidable Accidents No. 3 Managing partial power loss after takeoff in single-engine aircraft*. Canberra: Australian Transport Safety Bureau.

Newman, D. G. (2004). *Alcohol and Human Performance from an Aviation Perspective: A Review.* Canberra: Australian Transport Safety Bureau.

U.S. Department of Transportation Federal Aviation Administration. (2015, July 06). *AC 90-109A Transition to Unfamiliar Aircraft.* Washington DC: U.S. Department of Transportation Federal Aviation Administration.

Yesavage, J. A., & Leirer, V. O. (1986). *Hangover effects on pilots 14 hours after alcohol ingestion: a preliminary report*. American Journal of Psychiatry, 1546-1550.

Submissions

Under 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. That section 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 following directly involved parties:

- Civil Aviation Safety Authority
- the Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile
- engine manufacturer
- a LAME witness
- the aircraft owner
- maintenance organisation.

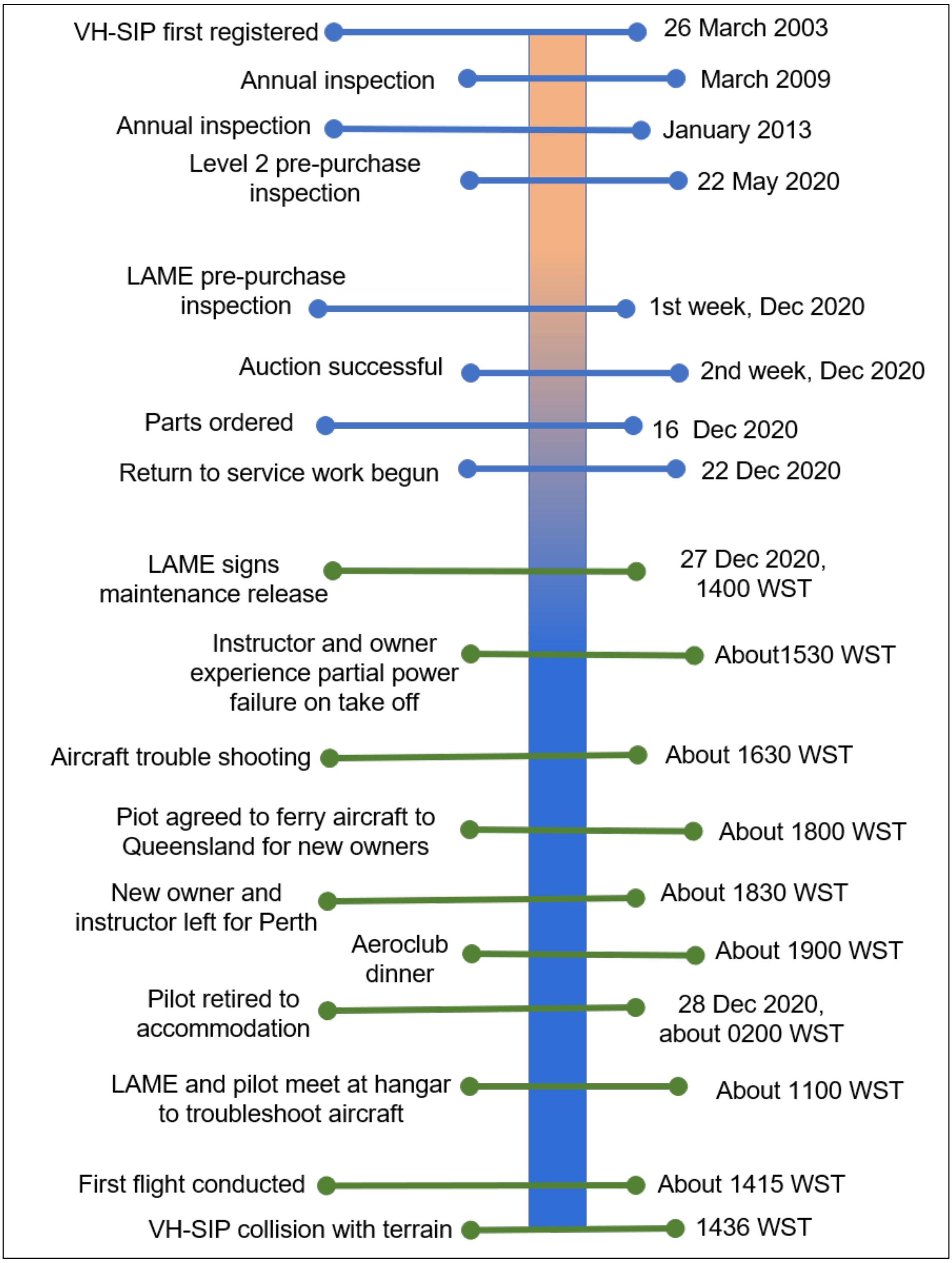
Submissions were received from:

- Civil Aviation Safety Authority
- A LAME witness.
- the Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile

The submissions were reviewed and, where considered appropriate, the text of the report was amended accordingly.

Appendices

Appendix A – Sequence of events



Source: ATSB

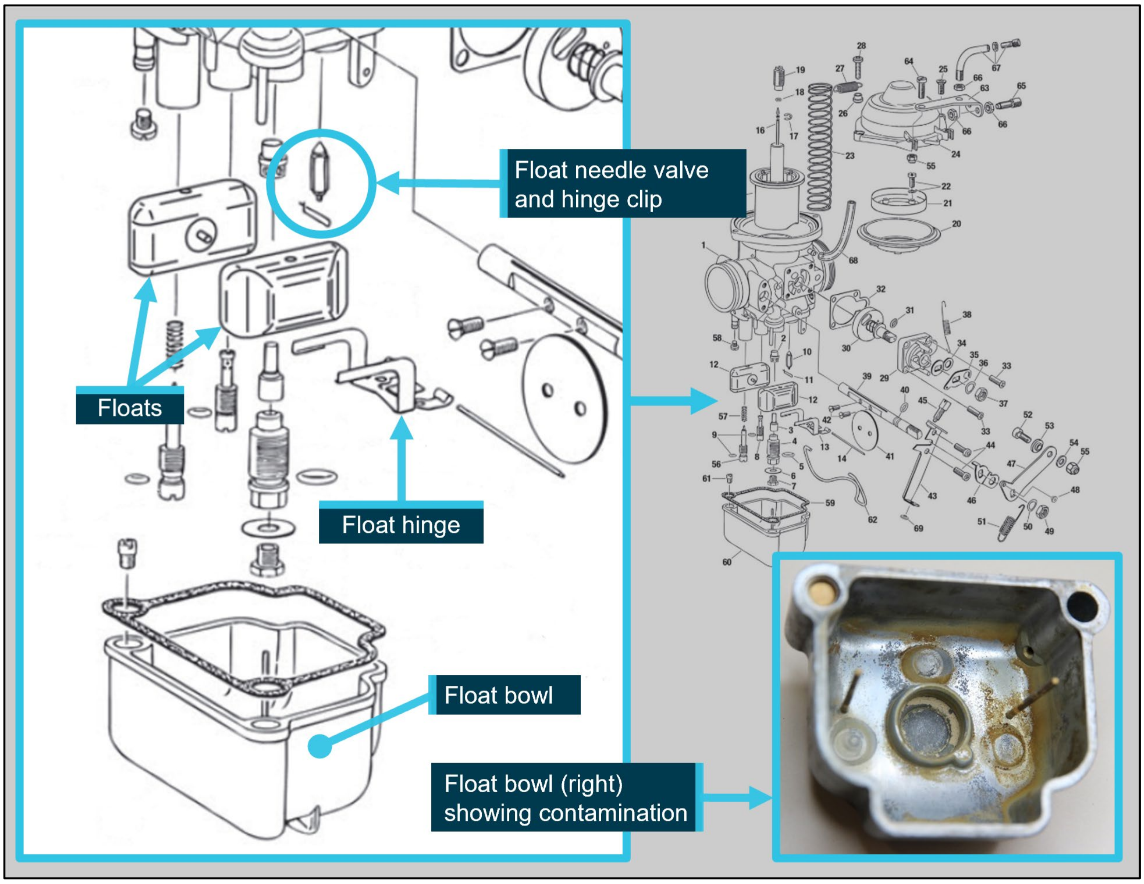
Appendix B – Engine examination

The engine was disassembled and examined at a Civil Aviation Safety Authority (CASA) approved engine overhaul facility under the supervision of the ATSB.

Some impact damage was identified; however the main engine components were found generally in working order.

Review of the engine systems found that the left carburettor was missing a clip that attached the float needle valve to the float hinge bracket (Figure B 1 and Figure B 2). During multiple tests under controlled conditions, the left carburettor flooded[8] repeatably. It was later determined that this was likely due to the presence of significant amounts of corrosion on the float needle valve, its seat, and a deposit on the on the valve tip (Figure B 3).

Figure B 1: Carburettor components



Source: BRP-Rotax, modified by the ATSB

Additionally, both carburettor float bowls were contaminated. The floats fitted to both carburettors were the original type (Figure B 4), which were required to be replaced as part of a mandatory service bulletin. Pre-service bulletin floats could lose buoyancy and increase the likelihood of carburettor flooding, also characterised by the presence of fuel odour.

The float bowl of the right carburettor was also contaminated, and one of the float guide pins was bent, causing a float to contact the side of the bowl.

A number of fuel lines were destructively inspected. The internal surfaces in some fuel lines were perished and had become brittle, compromising the security of their end fittings. Some of the fire sleeves covering the fuel lines had marks where securing clamps had previously been removed.

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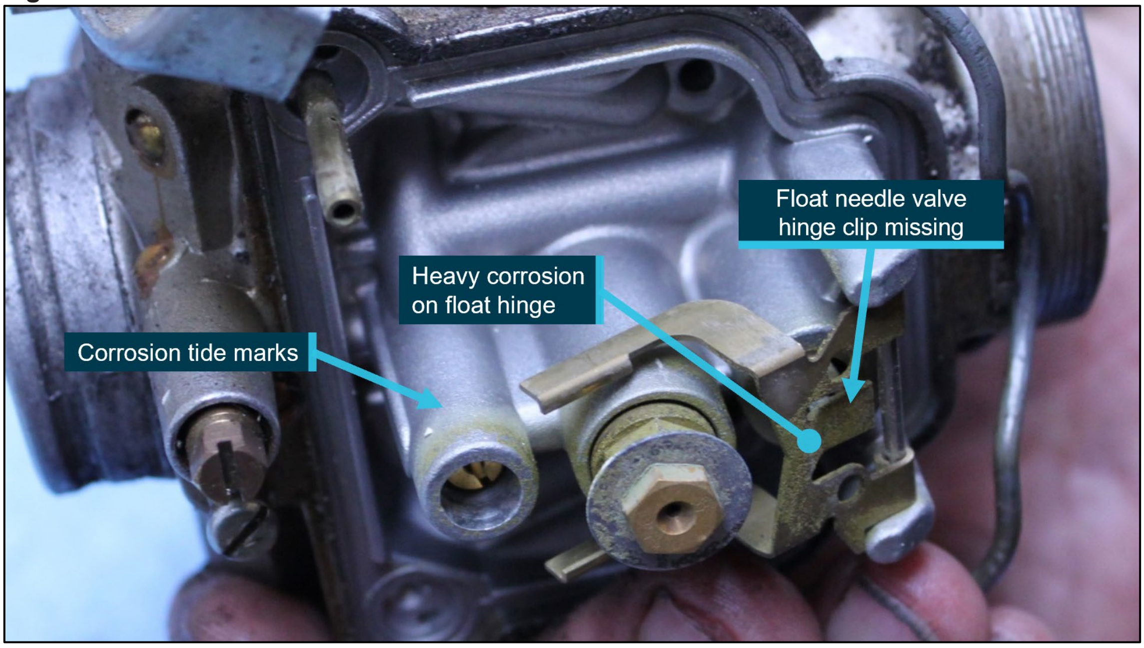
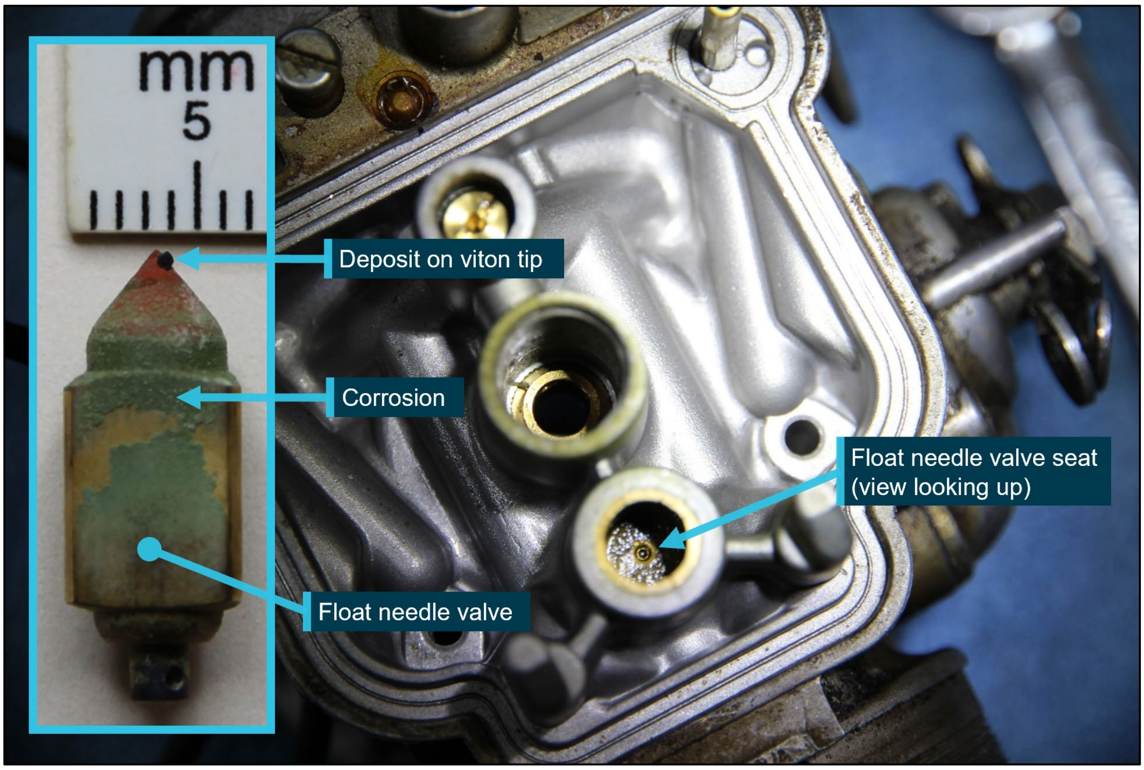
8 Overfilling the float chamber of carburettor.

Figure B 2: VH-SIP left carburettor condition



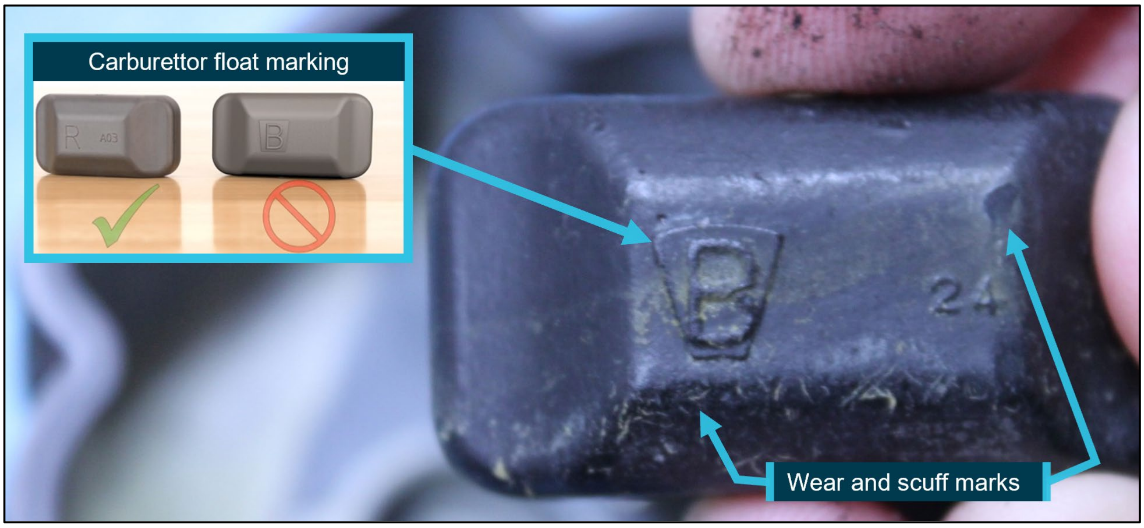
Source: ATSB

Figure B 3: VH-SIP left carburettor float needle valve and seat



Source: ATSB

Figure B 4: Left carburettor float condition



Source: ATSB, BRP-Rotax, modified by the ATSB

Carburettor contamination

ATSB technical analysis found that the contamination on the left carburettor float needle valve showed that it was corrosion, and the deposit on the valve tip was a carbon-based material. The contamination in the bowls of both carburettors was considered a likely corrosion by-product from the bowls.

The engine manufacturer advised the ATSB that faultless function of the engine could not be guaranteed if contaminants were found in the carburettor bowls. Corrosion on the float needle valve, and the absence of the clip that attaches the float needle valve to the float hinge bracket further increased the risk that the engine would not satisfactorily perform. The engine manufacturer also advised that the deposit on the left carburettor float needle valve could cause flooding and engine rough running at low power settings.

Service bulletins from the manufacturer recommended that if any contamination was found within the carburettor bowl, that the entire fuel system must be inspected and cleaned.

Australian Transport Safety Bureau

About the ATSB

The ATSB is an independent Commonwealth Government statutory agency. It is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers.

The ATSB's purpose is to improve the safety of, and public confidence in, aviation, rail and marine transport through:

- 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, as well as participating in overseas investigations involving Australian-registered aircraft and ships. It prioritises investigations that have the potential to deliver the greatest public benefit through improvements to transport safety.

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

Purpose of safety investigations

The objective of a safety investigation is to enhance transport safety. This is done through:

- identifying safety issues and facilitating safety action to address those issues
- providing information about occurrences and their associated safety factors to facilitate learning within the transport industry.

It is not a function of the ATSB to apportion blame or provide a means for determining 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. The ATSB does not investigate for the purpose of taking administrative, regulatory or criminal action.

Terminology

An explanation of terminology used in ATSB investigation reports is available on the ATSB website. This includes terms such as occurrence, contributing factor, other factor that increased risk, and safety issue.