Australian Government

Australian Transport Safety Bureau

Collision with terrain involving amateur-built Osprey 2 amphibian aircraft, registered VH-WID

Near Maitland Airport, New South Wales on 17 May 2020

ATSB Transport Safety Report

Aviation Occurrence Investigation (Defined)

AO-2020-028

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Cover photo: Owner/builder

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Addendum

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Safety summary

What happened

Mid-morning on 17 May 2020 an experimental amateur-built Osprey 2 amphibious aircraft, registered VH-WID (WID), took off from Maitland Airport, New South Wales, for a local private flight. The pilot was the sole occupant and was conducting the aircraft's second test flight.

During the climb, passing 2,400 ft, the pilot was advised, via radio, of white smoke coming from the aircraft and noted that the engine was not running smoothly. In response, the pilot broadcast that they were returning to land on runway 23. However, during the descent they turned to join the reciprocal runway 05. As the aircraft was turned on to the base leg of the circuit the engine failed, and the pilot attempted to conduct a forced landing on to the closer runway 08. During the final stage of the glide approach, the aircraft was observed to abruptly roll, pitch down and collide with terrain.

What the ATSB found

The ATSB found that the use of a damaged engine oil cooler fitting, which was not compatible with the fitted oil hose, most likely resulted in the hose disconnecting from the oil cooler during the climb, and the loss of oil from the engine.

During the return to the airport, the airborne duration and engine power required to maintain height were both increased when the pilot decided to change runways. This resulted in the engine failing due to oil starvation as the aircraft was turning on to the base leg of the circuit. During the subsequent forced landing, control of the aircraft was lost due to an aerodynamic stall at a height too low for recovery.

It was also identified that neither the required, nor the majority of the recommended stage build inspections of the aircraft were conducted. This was not detected prior to the issuance of a certificate of airworthiness that permitted the aircraft to be flown. While these inspections would probably not have detected the damaged fitting, they may have identified that the oil supply hose was in poor condition. They would also have been an opportunity to identify and improve the overall build quality of the aircraft.

The ATSB also identified a number of other deficiencies relating to the inspection and flight testing of amateur-built aircraft, including the risk assessment of the proposed test pilot.

What has been done as a result

As a result of this investigation, the Sport Aircraft Association of Australia (SAAA) amended the Authorised Person's Manual of Procedures and submitted it to the Civil Aviation Safety Authority (CASA) for approval. The revisions to the manual:

- stated that if the authorised person considered that an aircraft was unsafe, they were not required to issue a certificate of airworthiness and could refer the matter to CASA
- clarified that the Risk Radar Aviation report must be endorsed in writing by both the technical counsellor (TC) and the builder
- required that the authorised person (AP) receive 3 technical counsellor reports
- required the AP to name the pilot who would be conducting the initial test flying of the aircraft in the limitations
- required that any changes made to the aircraft after the certificate of airworthiness was issued be notified to the AP
- clarified that a TC or AP cannot inspect their own aircraft.

The SAAA also updated their other manuals to reflect these changes.

In addition, the SAAA have written to CASA to request an urgent 1-day refresher training course for all authorised persons and annual refresher training courses be made available. They have also amended their procedures to mandate that 3 stage inspections, inclusive of the final inspection, are conducted by a technical advisor (or equivalent) on the aircraft during the build. The SAAA have also requested that CASA provide them with a summary of the audits conducted on authorised persons to ensure they are aware of issues which may arise.

Safety message

As stated in the ATSB publication, *Avoidable Accidents No. 3 - Managing partial power loss after take-off in single-engine aircraft*, managing a partial engine failure is often a more complex scenario than a complete engine failure. The course of action chosen can be strongly influenced by the engine producing some power. Pilots are advised that as the engine could stop at any stage, the aircraft should be landed at the earliest opportunity and consideration should be given to forced landing options along the flight path.

This accident also highlights the importance of adhering to the design specifications and good engineering practices when building an amateur-built experimental aircraft. Attention should be given to the component manufacturer's specifications, installation instructions and limitations to ensure the component, and consequently the aircraft, will perform as intended.

Consideration should also be given to having independent inspections during the build process. Independent inspections conducted during the early stages of the build, and prior to closing components such as the wings and fuselage, will assist in ensuring the builder has used accepted practices and reduce the likelihood of inadvertent construction errors.

Finally, while most amateur-built aircraft are built to a high standard consideration should be given to the capability of the test pilot and the use of a professionally-trained test pilot for the initial test flying. Use of the Sport Aircraft Association of Australia's risk assessment tool, and consultation with their Flight Safety Advisors, can significantly assist the test flying stage.

Contents

The occurrence

On 17 May 2020, at around 0800 Eastern Standard Time,[1] a pilot arrived at Maitland Airport, New South Wales, to prepare for a private flight in an experimental amateur-built[2] Osprey 2 amphibious[3] aircraft, registered VH-WID (WID). The pilot was conducting their second test flight in the aircraft and was to be the sole occupant for the flight.

Immediately prior to the test flight, the pilot conducted a flight in a Piper Aircraft Inc. PA-28 Archer (PA-28) aircraft, reportedly to practice forced landings. This flight took about 35 minutes.

While the pilot was flying the PA-28, the owner/builder (builder) of WID conducted the aircraft's pre-flight inspection and ran the engine on the ground for about 5 minutes. The builder then signed the maintenance release to confirm that the inspection had been completed.

It was reported that the pilot also conducted a pre-flight inspection, however this did not include checks of the fuel for contamination or the oil level in the engine. The pilot consulted the checklist to start the engine and spent around 15 minutes on the ground taxiing and conducting further checks, including a high-speed taxi.

At 1002, the aircraft departed from runway 23[4] and turned left. During the subsequent climb, the pilot made a broadcast on the common traffic advisory frequency (CTAF),[5] advising they[6] were on climb to 3,000 ft to operate overhead the airport (Number 1 in Figure 1). At 1007, the pilot of a second aircraft made a radio transmission stating they were entering runway 05 (the reciprocal runway) for a departure to the west.

Shortly after, as WID passed approximately 2,400 ft above ground level (AGL), a witness on the ground contacted the pilot of WID, on the CTAF, to advise that white smoke could be seen 'coming back from the aircraft'. The pilot responded that they had also detected 'some rough running' and consequently they were returning to join the crosswind leg of the circuit for runway 23. The pilot of the second aircraft taxied back to the airport apron to ensure WID had access to all runways, however, they did not broadcast this on the CTAF.

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

2 An amateur-built aircraft is an aircraft, the major portion of which has been fabricated and assembled by a person or persons who undertook the construction project solely for their own education or recreation.

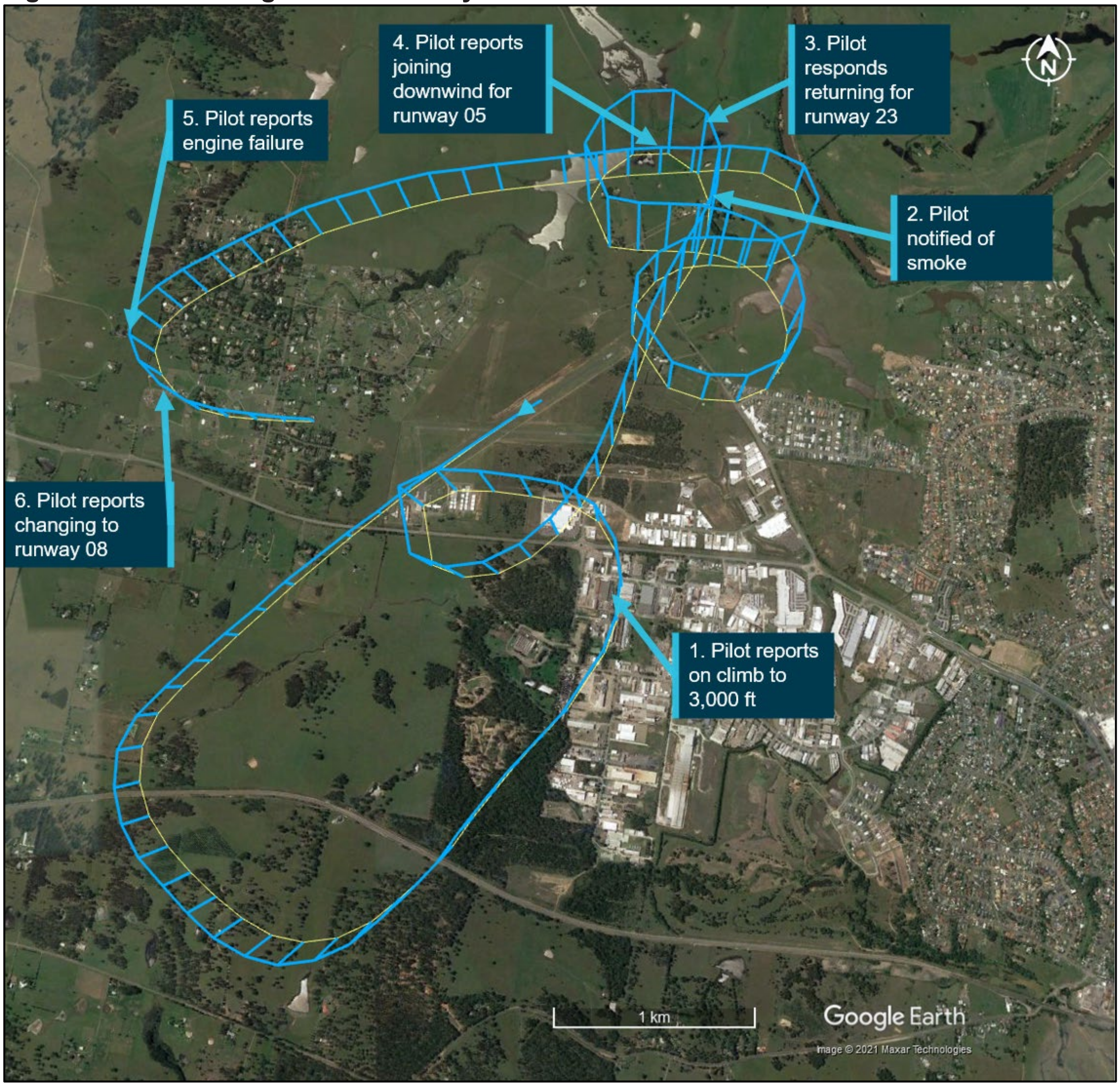
3 Amphibious aircraft: An aircraft that can take-off and land on both land and water.

4 Runway number: the number represents the magnetic heading of the runway.

5 Common traffic advisory frequency (CTAF): is the name given to the VHF radio frequency used for air-to-air communication at Australian non-towered airports. Pilots use the common frequency to coordinate their arrivals and departures safely, giving position reports and acknowledging other aircraft in the airfield traffic pattern. These frequencies are not normally monitored by ATC.

6 Gender-neutral plural pronouns are used throughout the report to refer to an individual (i.e. they, them and their).

Figure 1: Accident flight track and key events



Source: Google Earth with OzRunways data, annotated by the ATSB

The pilot of WID commenced a descending left orbit to the north of the airport. However, instead of continuing the descent to land on the previously-advised runway 23, they stopped the descent at about 1,000 ft AGL and conducted a turn in the opposite direction. They then turned to join the circuit for runway 05, advising on the CTAF they were joining downwind (Number 4 in Figure 1). The pilot subsequently increased the engine power and climbed to maintain between 1,100 and 1,200 ft AGL on a widening downwind leg.

As the aircraft turned base for runway 05, (about 5 minutes after the pilot was advised of smoke from the aircraft) the engine stopped. The pilot made a broadcast to advise they had a 'complete engine failure' and they were conducting a glide approach to runway 05, which they quickly changed to runway 08 (Numbers 5 and 6 in Figure 1).

Several witnesses reported that as the aircraft was on final approach to runway 08 with the wings level it suddenly rolled to the left and the nose dropped. The aircraft subsequently collided with terrain in an inverted position. The pilot was fatally injured, and the aircraft was destroyed.

Context

Pilot information

The pilot held a valid Private Pilot Licence (Aeroplane) issued in June 2010. They also held a single engine aeroplane class rating with manual pitch propeller control and retractable undercarriage design feature endorsements. In addition, the pilot had spin and aerobatic endorsements, issued in July 2012.

The pilot commenced flying in the United Kingdom (UK) however, they had not attained a UK pilot licence. They had recorded approximately 60 flight hours to the end of 2003. After attending the Empire Test Pilot's School[7] as a flight test engineer[8] in 2003, they had worked as a professional flight test engineer in both the UK and Australia.

The pilot commenced flying in Australia in 2007. A review of their logbook indicated they had accumulated approximately 189 hours of flying in Australia, of which approximately 103 hours were as pilot in command. Prior to the day of the accident, they had flown twice in 2020, with the last recorded flight on 29 March 2020. In 2019, they had flown 10.4 hours, including an aeroplane flight review, which covered stall recognition with recovery and forced landings.

The pilot conducted a high-speed taxi test and their first flight test in WID in December 2019. As far as the ATSB could ascertain, the pilot had not flown as a test pilot in any other aircraft prior to the first test flight.

Medical information

The pilot's Class 2 medical certificate expired on the 16 May 2020. However, due to the COVID-19 pandemic, the Civil Aviation Safety Authority (CASA) issued an automatic exemption to all medical certificates valid on 31 March 2020. This exemption authorised licence holders to fly without a current medical certificate for a period of 6 months beyond the certificate's expiry date. The pilot's medical certificate noted one restriction requiring distance vision correction to be worn during flight.

The post-mortem and toxicological examinations did not reveal any medical issues that may have contributed to the accident. In addition, there was no indication that the pilot was experiencing a level of fatigue known to affect performance.

Aircraft information

Overview

The Osprey 2 amateur-built aircraft was designed in the United States in 1972, to be built from a set of plans. It was a mid-wing, cantilever monoplane with a flying boat hull and a strut mounted engine, driving a wooden pusher style propeller (Figure 2). The aircraft was manufactured primarily from wood, with wooden formers and frames, and skinned with plywood. The conventional flight control surfaces (ailerons, elevator, and rudder) were covered with fabric and no flaps were fitted. It was equipped with retractable tricycle undercarriage.

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7 Empire Test Pilots School: trains UK Ministry of Defence and international pilots, engineers, and aircrew to run civil and military flight test programmes.

8 Flight test engineer (FTE): is an engineer involved in the flight testing of prototype aircraft or aircraft systems. Generally, they have overall responsibility for the planning of a specific flight test phase. They and the flight test pilot are jointly responsible for the safety of the test flying. They are also responsible for the analysis of the data acquired during a test flight.

Figure 2: VH-WID

Source: Aircraft owner/builder

Aircraft build

The aircraft build was started in 1977 in Australia, and the original builder had manufactured and built the:

- fuselage
- spars
- empennage
- wing ribs (which were not assembled)
- fuel tank
- landing gear
- engine mount.

The plans and the manufactured parts were then sold a number of times before being bought by the last builder in 2014. The aircraft was placed on the Australian register on 18 August 2014, with the aircraft build then completed over several years.

In 2016, the builder purchased a Lycoming O-320-E2A[9] engine, which had previously sustained a propeller strike. The engine was sent to a CASA-approved engine repair shop for a sudden stoppage inspection. After the inspection, the engine was test run, then inhibited to prevent corrosion and all entry points were covered. The builder received the engine, with a new engine driven fuel pump and oil filter, in August 2016.

Maintenance

The aircraft was being maintained in accordance with the CASA maintenance schedule, which required an inspection every 12 months or 100 hours, whichever came first. It had a valid maintenance release, issued by the builder[10] on 3 December 2019.

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9 The Lycoming O-320-E2A is a naturally aspirated, air-cooled, four-cylinder, direct-drive engine produced by Lycoming Engines.

10 Civil Aviation Regulations 1988 – Reg 42ZC allows an authorised person to perform maintenance on an amateur-built aircraft. The person must be authorised by a CASA-appointed Authorised Person (see the section titled *Amateur-built experimental aircraft*) having built the aircraft and completed an approved maintenance procedures course.

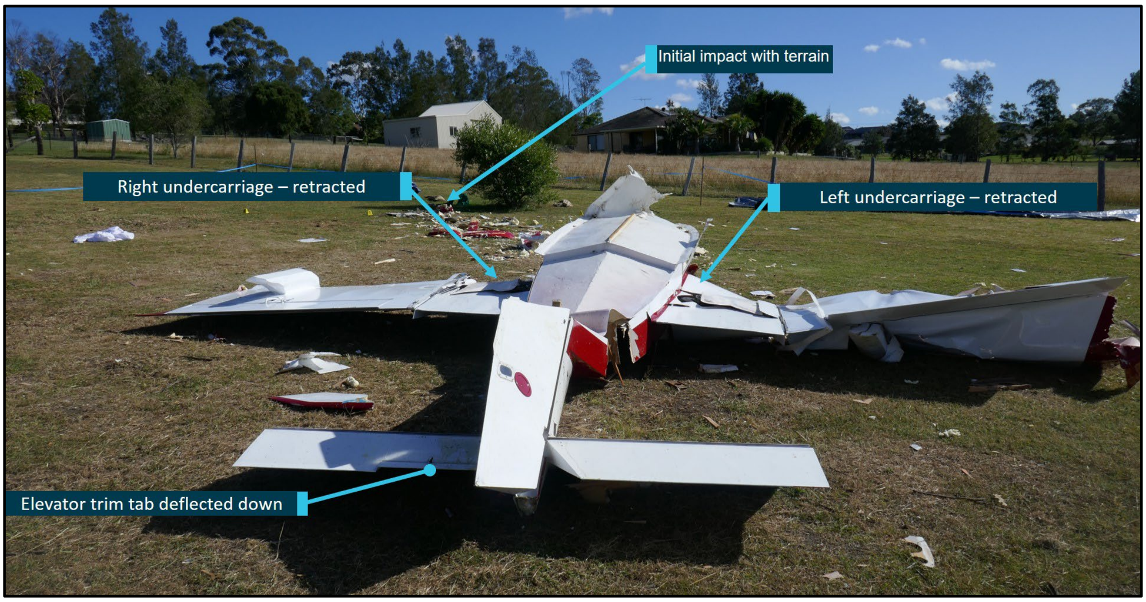
Wreckage and accident site information

Site and wreckage information

The accident site was located on the extended centreline, approximately 740 m west of the threshold for runway 08 (Figure 1). The on-site examination identified that the aircraft struck terrain in an inverted position with the left wing likely striking first, followed by the aircraft nose, engine pod and right wing (Figure 3). The ground impressions formed by the leading edge of the wings were of a curved nature and likely indicative of the aircraft rotating to the left as it impacted the ground.

The distance from the first impact point to the last item of wreckage was about 27 m, with the engine and fuselage coming to rest about 11 m from the initial impact point. This, along with the angle at which the impact occurred, suggested a low forward speed. There was no post-impact fire.

Figure 3: Accident site

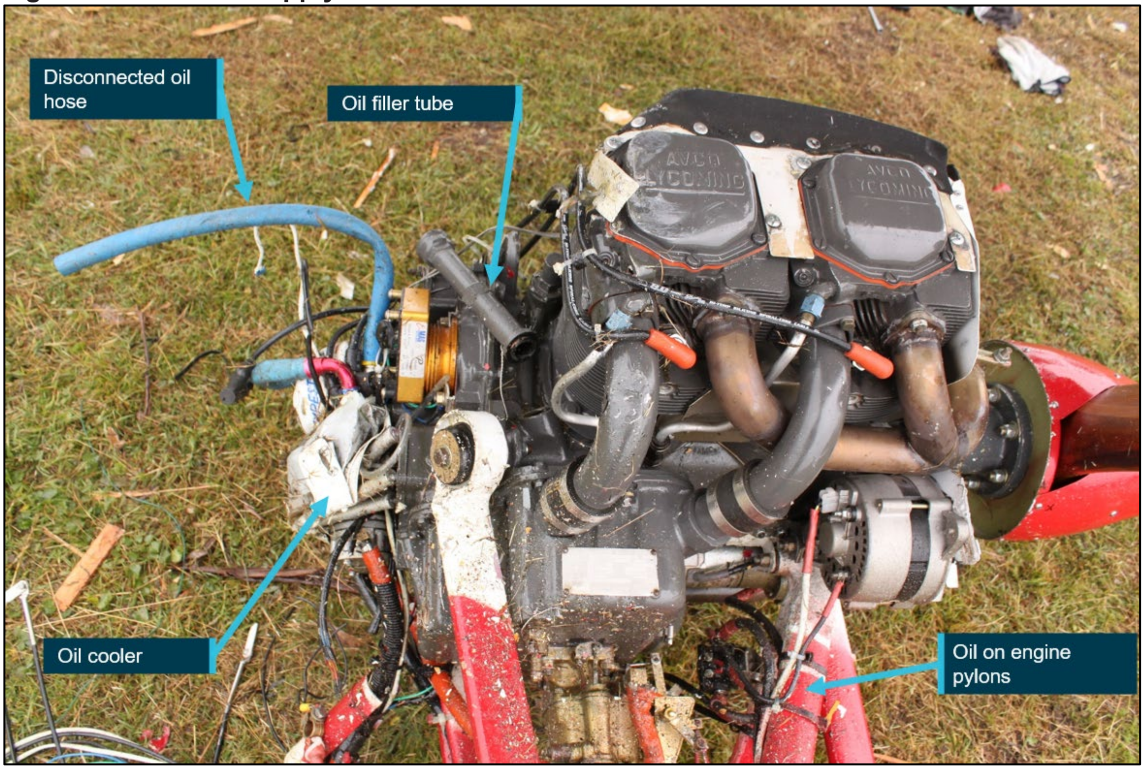


Source: ATSB

All the major aircraft components were accounted for at the site. The inspection also identified that:

- the flight control system was intact, with no defects identified that may have contributed to the accident
- while the main landing gear was found retracted, video evidence indicated that the gear was extended for the duration of the flight, as such retraction likely occurred during the accident sequence
- one of the propeller blades was significantly fragmented while the other remained intact
- the oil supply line from the engine to the oil cooler was disconnected (Figure 4)
- the engine cowl, rear fuselage, and empennage were heavily coated with engine oil, with streams forming as the oil migrated on the surfaces (Figure 5)
- there was no oil in the engine
- the oil gauge/filler tube was broken at the base where it attached to the engine lower crankcase assembly (Figure 4)
- the crankcase below the no. 1 cylinder was perforated (see the section titled *Engine inspection*).

Figure 4: Oil cooler supply hose disconnected



Source: ATSB

Figure 5: Empennage with oil residue

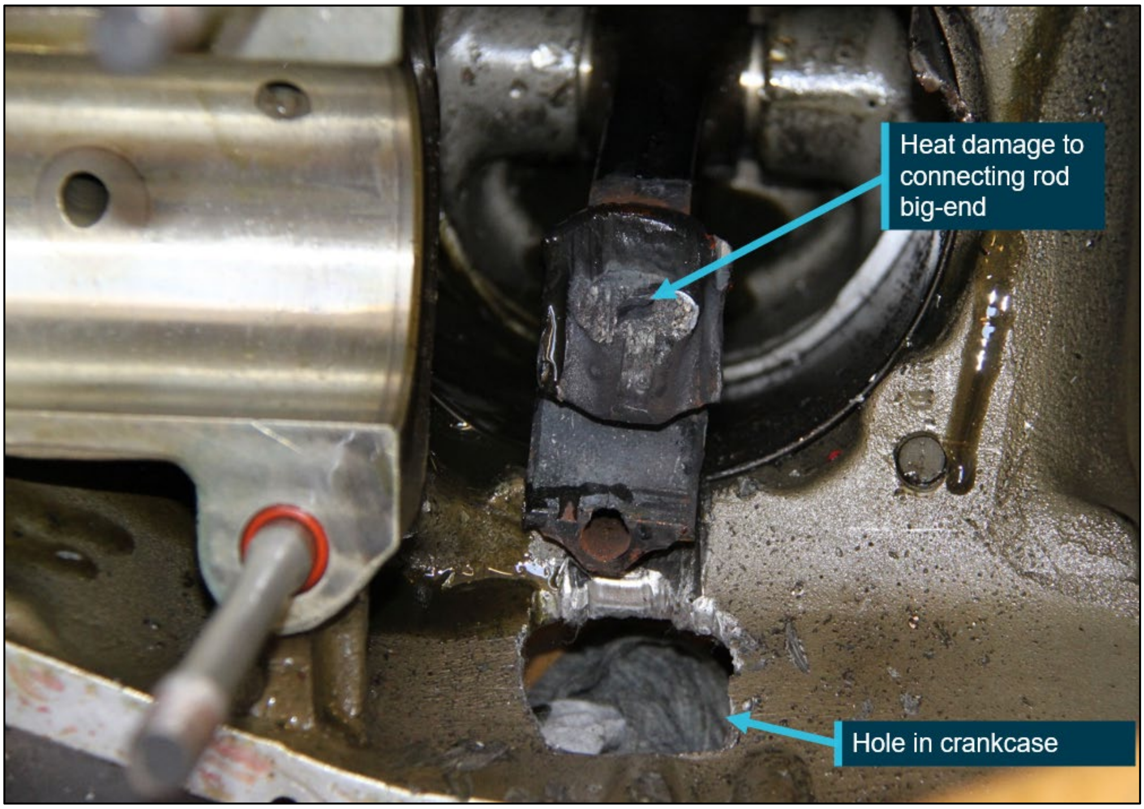
Source: ATSB

Engine inspection

The engine was inspected at an independent CASA-approved engine overhaul facility. The inspection found signs of internal damage indicative of an engine that had been starved of lubricating oil. The inspection also found that:

- the connecting rod in the no. 1 cylinder had separated at the big-end (Figure 6), most likely resulting in the observed hole in the crankcase (Figure 6 and Figure 7)
- the crankshaft journals[11] exhibited various levels of heat damage (Figure 7)
- within the no. 3 cylinder, corrosion was observed on the bolts on the connecting rod and the bearings were heavily distressed with copper discolouration and deformed on one side
- within the no. 4 cylinder, while oil was observed in the connecting rod bearing, it was discoloured black
- all oil galleries were clear of obstructions.

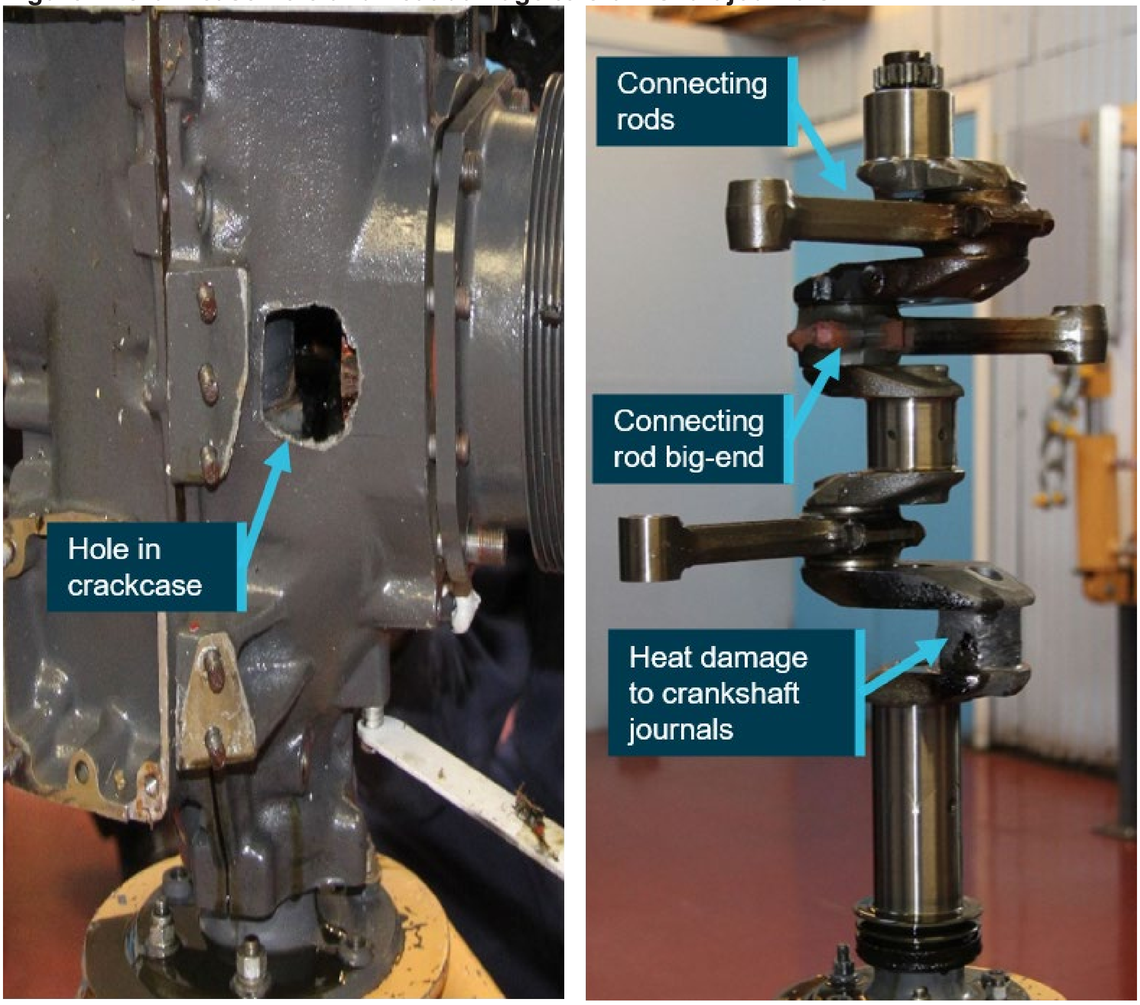
Figure 6: Number one cylinder damage



Source: ATSB

[11] A journal is the part of a shaft that rotates inside a bearing

Figure 7: Crankcase hole and heat damage to crankshaft journals



Source: ATSB

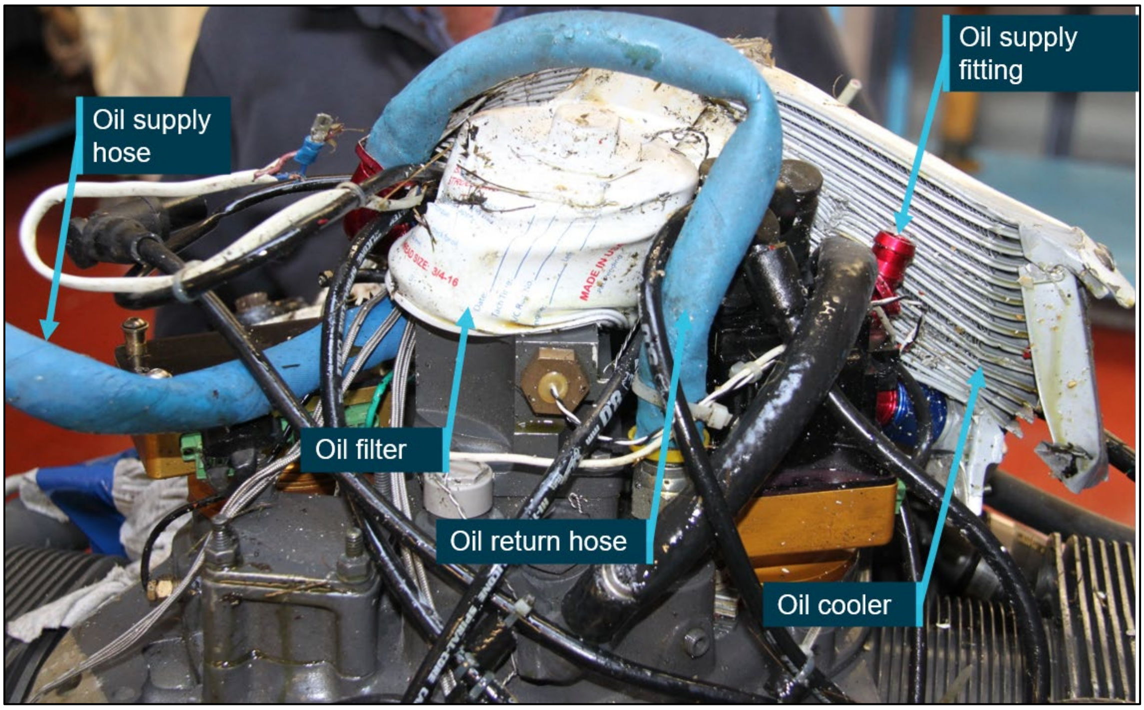
Engine manufacturer analysis

The ATSB subsequently transported engine parts to the engine manufacturer for additional inspection. They confirmed that the engine had most likely failed through oil starvation with the connecting rods and bearings showing obvious signs of oil starvation. They also advised that if a hose had disconnected from the oil cooler, that was the most likely cause of the oil loss.

Oil cooling system

An oil cooler removes surplus heat from an internal combustion engine. The oil pump transfers the oil from the sump through a supply hose to the oil cooler. The return hose passes the oil through an oil filter and then on to lubricate and cool the engine. The supply hose to the oil cooler was found disconnected at the accident site (Figure 8).

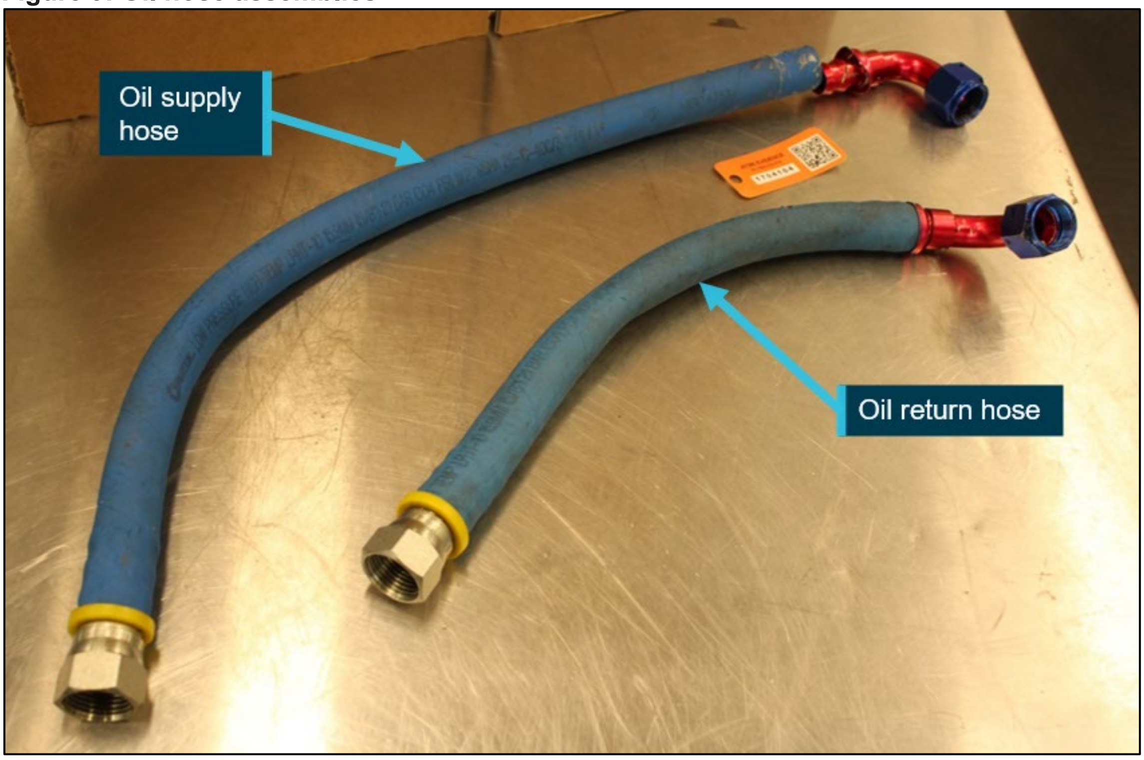
Figure 8: Oil cooling system



Source: ATSB

The builder advised they had reused an automotive oil cooler from a previous project. They also advised that a length of oil hose and fittings were purchased new from an automotive supplier, a few years before the hose was cut to length, assembled with the fittings and installed on the aircraft.

Figure 9: Oil hose assemblies

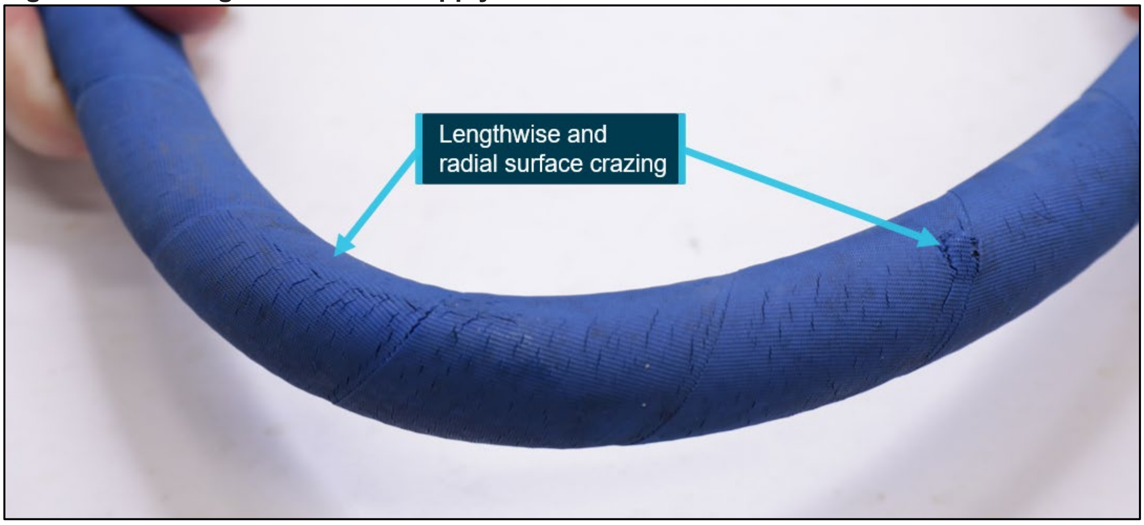


The hose assembly at the top of the image is the oil cooler supply hose which was found disconnected at the accident site. The lower hose is the oil cooler return hose. The lighting in this photo resulted in the silver coloured fittings appearing brass coloured.
Source: ATSB

Hose examination

The two hose assemblies were similar in construction but of different lengths. It was reported that the hoses were most likely cut from the same length of hose (Figure 9) however, they were different shades of blue. The hoses had a polyester textile outer braid with an internal textile reinforcement. They were designed to be used in low pressure, high temperature applications to carry petroleum-based products including lubricating fluids, hydraulic and transmission oils. Crazing was found on the outer surface of both hoses but was more significant on the detached oil cooler supply hose (Figure 10).

Figure 10: Crazing on oil cooler supply hose



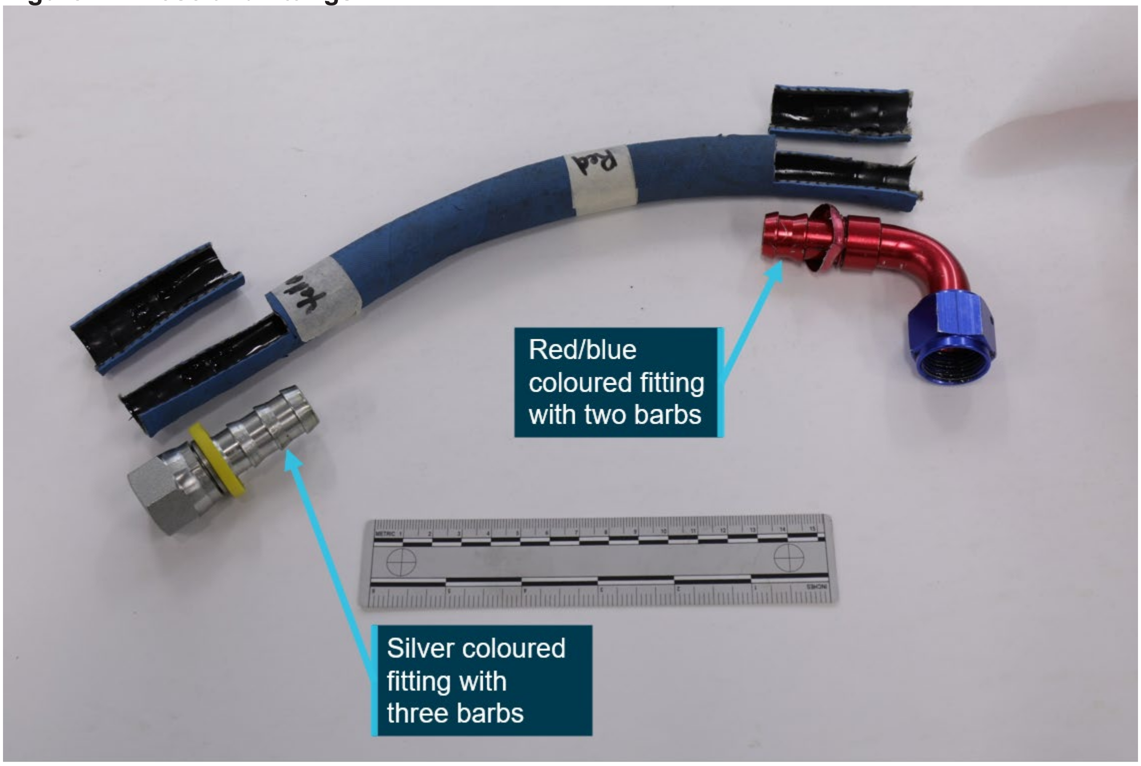
Source: ATSB

Fitting examination

Both hose assemblies had push-on type fittings that do not require external clamping (Figure 11). The integrity of the connection relied on the hose expanding over a series of barbs[12] on the fitting. The internal liner material conformed to the barbs under the pressure of the internal textile reinforcement and outer braid of the hose.

12 Barb: A barb is a sloped, raised ring that provides grip to the fitting to prevent it separating from the hose.

Figure 11: Hose and fittings



Source: ATSB

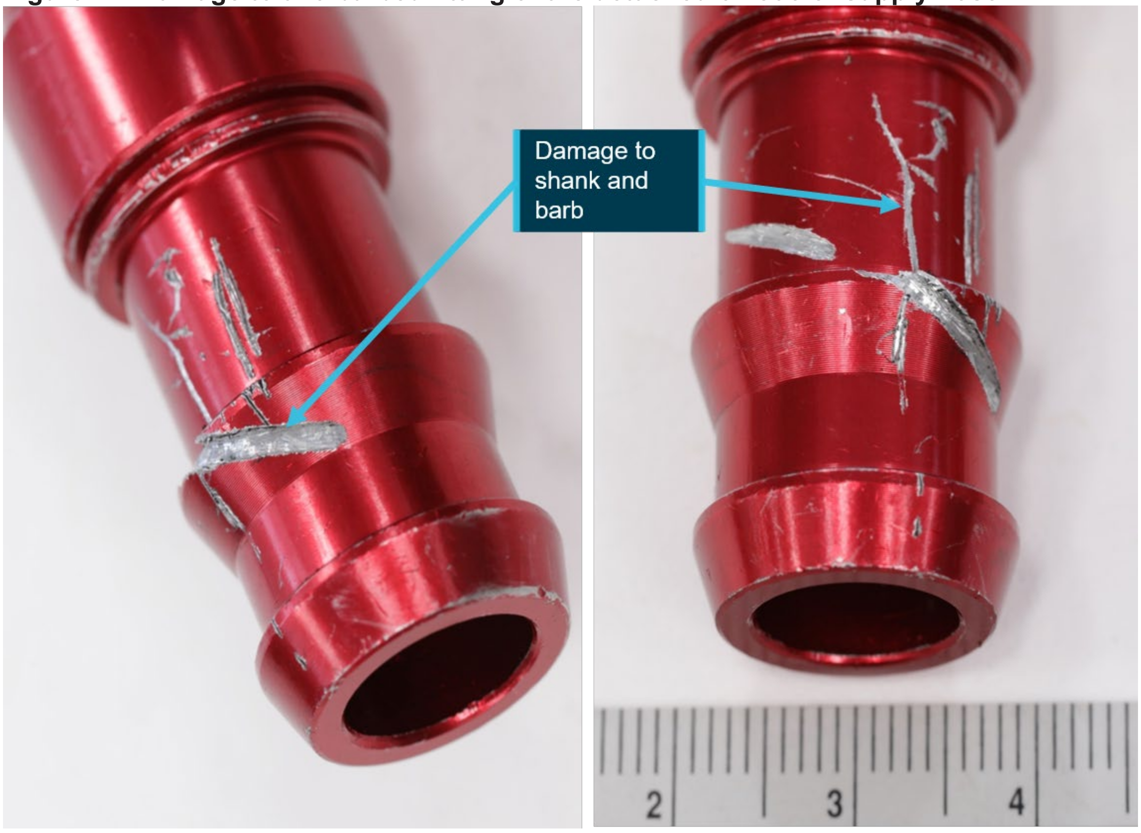
On each hose assembly, the end connected to the engine had a straight, silver colour plated mild-steel fitting, with three barbs and a yellow collar. The end connected to the oil cooler had a 90° curved, red and blue aluminium alloy fitting, with two barbs (Figure 11–Figure 13). Table 1 lists the differences between the two fittings.

Table 1: Differences between fittings

Silver coloured fitting (engine end)	Red-blue coloured fitting (oil cooler end)
Three-barbs: • mild-steel construction • equal height and spacing • outside diameter of barbs 18.11 mm	Two-barbs: • aluminium alloy construction • barbs of different heights • outside diameter of barbs 17.83 mm and 18.28 mm • shorter overall length than barbs on silver fitting • inside diameter slightly smaller than silver coloured fitting
Oil had migrated between first and second barb and the valley between the second and third barb was clear of oil	Oil had migrated between first and second barb on fitting which did not separate

The two-barb fitting from the detached oil cooler supply hose, showed signs of mechanical damage consistent with tooling marks which could not have been sustained during the accident sequence (Figure 12).

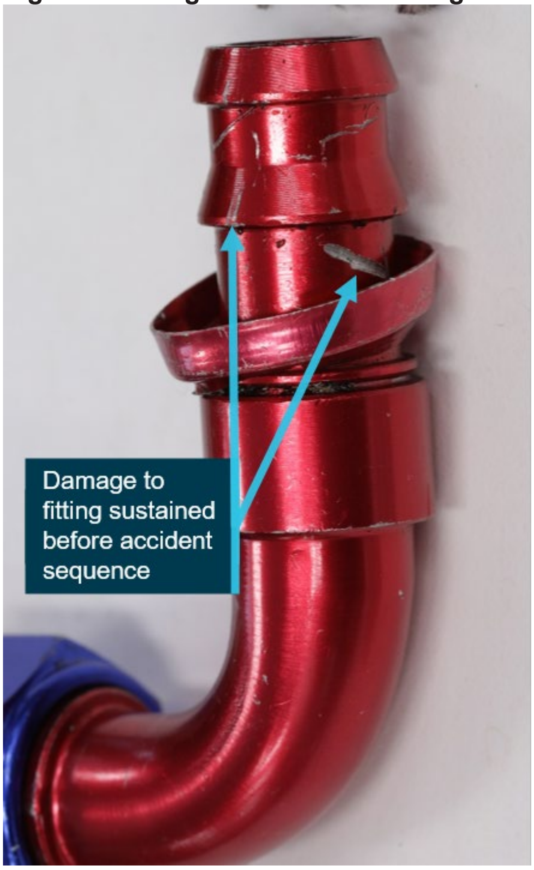
Figure 12: Damage to two barbed fitting of the detached oil cooler supply hose

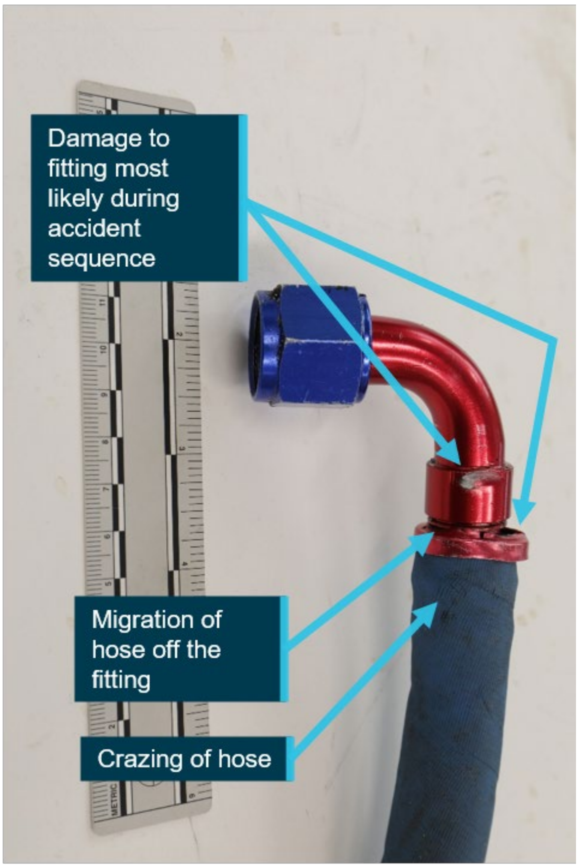


Source: ATSB

The two-barb fitting on the oil cooler return hose, which did not detach, also had some mechanical damage, though this was less severe, with no significant damage to the barb (Figure 13). This connection also showed signs of the hose migrating off the fitting. However, as there was impact damage on the fitting collar, it could not be established if the migration of the hose occurred prior to, or during, the accident sequence.

Figure 13: Images of two-barb fitting from the oil cooler return hose





The image on the left shows mechanical damage to the fitting, the image on the right shows damage to the fitting and migration of hose from fitting.
Source: ATSB

Hose supplier advice

The ATSB discussed the aspects of hose design and push-on fittings with the Australian supplier of the hose. They advised that:

- the hose was compatible with the type of engine oil that was in use
- the hose was rated for the operating temperature and pressure it would sustain in use on the aircraft engine
- external crazing indicated that the hose was at the end of its in-service life and would have lost its pliability due to age
- with external crazing, the inner braid reinforcement layer would likely also have deteriorated affecting the ability of the hose to grip the barbs of the fitting
- a fitting could be re-used provided it was undamaged
- they recommended a three-barb fitting be used with the hose
- they could not comment on the use of a two-barbed fitting, as no testing had been conducted on the fitting in combination with the type of hose used
- they had not conducted testing of the product to certify its use in an aviation setting.

Aircraft build

During the inspection of the aircraft wreckage, non-standard practices and parts, different to those specified in the build drawings, were identified. Examples of these are listed in Table 2.

There was no requirement to follow aviation-specific standards when building an amateur-built aircraft, for which an experimental, special certificate of airworthiness applied. However, CASA advisory circular (AC) 21.4(2) *Amateur-built experimental aircraft* – *certification* referenced ACs containing information and guidance on acceptable fabrication and assembly. Section 7.2 stated:

> …it is strongly recommended that approved components and established aircraft quality material be used, especially in fabricating parts constituting the primary structure, such as wing spars, critical attachment fittings, and fuselage structural members.

Table 2: Non-standard practices identified

Part or system	Practices or parts different to design drawing
Oil cooler hoses	• end-fitting type not used on engines fitted to certified aircraft, normally a 'screw together' or 'detachable-re-useable' fitting would be used
Aircraft fuel system	• electric fuel pump was mounted with commercial hardware, no locking devices (nuts or locking washers) fitted • electrical earth lead terminal was connected to a painted surface • hoses and fittings different to design drawing
Flight controls	• use of a non-castellated nylon lock nut in combination with a split pin in the elevator control rod • use of stainless-steel shackle and thumb pin (not locked) at aileron outer-wing bellcrank
Engine induction system	• no engine intake system air filter
Engine exhaust system	• no heat muff for carburettor heat incorporated - carburettor heat was taken from the engine cowl area
Electrical system	• electrical circuits, fuse array was retained with plastic cable ties

Weather

The weather observations recorded by the Bureau of Meteorology for Maitland Airport showed that at 1000 the wind was from the south-east at 4 kt reducing to 3 kt at 1030. Visibility was greater than 10 km with no cloud detected. This was consistent with both witness statements and video imagery recorded from inside the aircraft.

Recorded data

The aircraft was not equipped with a flight data recorder or cockpit voice recorder, nor was it required to be.

The aircraft was fitted with a Garmin AERA 500 GPS unit that was reported to be operating on the accident flight. The ATSB examined this unit and determined that the 'track record mode' was set to OFF, therefore the accident flight was not recorded.

A damaged iPad was recovered from the accident site. The pilot utilised the iPad to run an electronic navigation program (OzRunways), however the damage to the device precluded any on-device data download. However, the software provider supplied remotely stored data (Figure 1).

In addition, the aircraft was fitted with a Drift Innovation HD170 portable video recorder mounted inside the cockpit, behind the pilot, facing forwards. While the camera sustained significant damage during the accident sequence, audio and video imagery from the accident flight and the pilot's first test flight were recovered. The recorded audio was not in sync with the video, so was not used in the analysis of the accident flight.

Recording of the accident flight

The video of the accident flight ended prior to the accident when the aircraft was approximately 200 ft above the ground.

Most of the cockpit instrumentation was visible in the video, although at times the footage was affected by sun glare. The oil pressure and temperature gauges were difficult to see on the video however, it showed that about 30 seconds after the pilot gave their departure call, the engine oil pressure was in the normal range. Due to the sun glare, the gauge was not visible again until about 1 minute 50 seconds later, where it showed low oil pressure. This was after the pilot had advised the engine was running rough. The engine RPM gauge was not visible in the video. There was no evidence on the video of smoke entering the cockpit.

The video also recorded that as the aircraft was turning on to the base leg for runway 05, the shadow of the propeller became stationary and there was a change in vibrations, consistent with the engine stopping. As the pilot continued the turn onto final for runway 08, the airspeed displayed on the aircraft instruments decreased to between 60–65 kt and the rate of descent almost immediately increased from level flight to approximately 1,700 ft per minute.

Amateur-built experimental aircraft

CASA permitted an amateur builder to construct an aircraft solely for educational or recreational purposes.[13] There were no prescribed design standards, and the aircraft could be constructed from any materials, using any engine and propeller combination. In addition, CASA approval was not required before construction commenced and CASA did not conduct any inspections of the aircraft.

Before an amateur-built aircraft could be flown, it was required to be registered with CASA and have a valid certificate of airworthiness (CoA). According to Advisory Circular (AC) 21.1(1)

> aircraft certification is the whole process of assessing an aircraft type against its type design and the aircraft’s condition for safe operation, which culminates in issue of a Certificate of Airworthiness (CoA) for an individual aircraft.

As amateur-built aircraft did not have a type design, there was no aircraft type-specific standard to assess the aircraft against. To allow these aircraft to operate, they are issued a specific special CoA.

An authorised person (AP)[14] or CASA was able to issue an experimental CoA.[15] To obtain a CoA a builder could:

- approach CASA directly
- approach an industry member who was a CASA-appointed AP
- become a member of the Sport Aircraft Association of Australia (SAAA – see the following section) and approach a SAAA member who was a CASA-appointed AP.

AC 21.4(2) *Amateur-built experimental aircraft - certification*, last updated in September 2000, provided guidance and information to applicants applying for a special certificate of airworthiness for an amateur-built aircraft in Australia. This stated that:

> Amateur builders should[16] call upon persons having experience with aircraft construction techniques, such as the SAAA technical counsellors [see the section titled *Technical counsellor*] …. to inspect particular components eg. wing assemblies, fuselages etc. prior to closure and to conduct other inspections as necessary. This practice is an effective means of monitoring construction integrity.

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[13] Advisory Circular (AC) 21.1 (1) Aircraft airworthiness certification categories and designation

[14] Under Civil Aviation Safety Regulation (CASR) 201.001, CASA could appoint a person to be an authorised person (AP). In making this appointment, CASA must be satisfied that the person has the appropriate qualifications and experience.

[15] CASR 21.195A

[16] AC 1-01 v2.0 8.2.3 stated that 'should' indicated that while the topic does not have a legal requirement, adherence to CASA policy or guidance material is strongly recommended. As these requirements are not specified in legislation, alternate methods that can be shown to meet the same intent can be accepted where deemed appropriate.

The AC went on to describe that although CASA had previously inspected aircraft at several stages though the build, overseas experience had shown that only one final inspection was required. The purpose of this inspection was

> to allow the inspector [AP] to make a subjective assessment of the workshop methods, techniques and practices used in the construction of the aircraft solely for the purpose of prescribing appropriate conditions and operating limitations necessary to protect other airspace users and persons on the ground or water, ie. to protect persons and property not involved in the activity.

It also stated that:

> the person carrying out the inspection is not responsible for the integrity of the design or construction of the amateur-built experimental aircraft, nor for the identification of any structural design or construction deficiencies – responsibility for the design, construction and integrity of the aircraft rests with the amateur builder.

In addition, in seeking a CoA the AC advised that the applicant should be prepared to supply

> evidence of inspections, such as logbook entries signed by the amateur builder, describing all inspections conducted during construction of the aircraft in addition to photographic documentation of construction details. This will substantiate that the construction has been accomplished in accordance with acceptable workshop methods, techniques, and practices.

CASA recommended that amateur builders contacted an approved organisation before commencing a project to seek advice. One of the ways of doing this was to contact the SAAA.

Sport Aircraft Association of Australia

The SAAA is a voluntary '…group of aviation enthusiasts, assisting each other to build, maintain and operate sport aircraft'. There was no regulatory requirement for members to follow the SAAA procedures or advice, nor did the SAAA have any powers granted by CASA to direct and enforce members to perform any activity in relation to building, certification and test flying the aircraft. To receive a CoA through the SAAA system, the builder was required to be a member when they applied for the CoA, but there was no requirement for them to be a member at the commencement of or throughout a build project.

The organisation had two functions, which were overseen by CASA. These included management of CASA-appointed APs and management and delivery of a CASA-approved maintenance procedures course for SAAA members. As the accident aircraft was in the flight-testing phase, the ATSB did not review the maintenance procedures course.

One of the main functions of the SAAA was to support people building their own aircraft, including assisting them to gain a CoA. They did this by providing:

- a risk assessment tool (see the section titled *Risk Radar Aviation*)
- a group of advisors to provide advice on building the aircraft (see the section titled *Technical counsellor*)
- access to APs to certify the aircraft
- advice on technical and regulatory matters.

They also provided advice on flight safety, including test flying, through flight safety advisors, and assistance with the flight testing of the aircraft once the aircraft had received a CoA. The builder stated that when they contacted the SAAA in relation to the flight testing, they were told that none of the advisors had experience in the aircraft type.

Risk Radar Aviation

According to the SAAA, the Risk Radar (RRAv) report was

> a whole of life measuring and awareness system developed by the SAAA that covers every aspect from choosing an aircraft to building/modifying that aircraft through to testing and routine flight operations and maintenance.

It was a self-assessment tool designed to alert the user to areas of high risk to allow appropriate mitigations to be considered, rather than to stop a project. It relied on the builder and when requested, a technical counsellor (TC), objectively answering relevant questions about the project.

The RRAv report covered four areas:

- planning (assessed whether the design of aircraft was suitable for the experience of the owner)
- build/modify (assessed the quality of the aircraft build)
- flight testing (assessed experience levels of test pilot and the suitability of the test area)
- post-build (assessed experience level of the owner/builder to continue flying the aircraft after the CoA was attained).

Build/modify section

The build/modify section had separated the assessment criteria into nine areas, including one on the engine group. This in turn had more specific questions, including for example, questions on the oil cooler (see Table 3*).* A user was required to select the rating which best described the aircraft from a drop-down list, and the tool would automatically alert if this was considered a concern. The RRAv instructions advised that a user should discuss and close out the concern with their TC and/or flight safety advisor and a TC should document in the RRAv tool detail of any concerns that had been waived.

Table 3: Example of questions raised within the oil cooler section showing all available options, ratings and alerts

Engine group	Rating selections available to the builder in a drop-down list	Rating	Automatic alert if appropriate
Oil cooler – secure mount, condition including fins for damage or blocking, lines for leaks and/or chafing and vibration, oil lines of approved types	Well-constructed to standards within AC43	10	
	Well-constructed to standards within AC43 with minor rectifiable issues	5	Concern
	Poorly constructed / assembled	0	Concern
	Poor quality materials	0	Concern
	Non-aviation grade materials in critical areas	0	Concern
	TC has concerns re design	0	Concern
	Outside design limits	2	Concern
	Meet design limits	10	
	Checked OK	10	
	Good condition	10	
	Poor condition / needs attention	5	Concern

Flight-testing section

The flight-testing section had an area relating to the proposed test pilot, including a space to name the test pilot and where their flying experience and currency was rated. Again, the various responses were automatically assessed and a caution was raised to alert the user to areas where additional risk mitigations may be required.

Technical counsellor

A TC was a member of the SAAA who was:

> willing to assist others, inspecting their work, guiding them through construction phases and finally, perhaps most importantly, guiding them through the lead up to the aircraft certification process.

To become a TC, an applicant had to have a reasonable amount of experience with building and maintaining amateur-built experimental aircraft. They were nominated by another TC or the president of the local area group. The TC was not responsible for the design or construction of an aircraft. They could provide suggestions to a builder, however the builder was under no obligation to accept their advice. However, where there was a difference of opinion on the design or construction technique being applied, it was recommended that the TC highlight this in a visit report and their copy of the RRAv report and provide that to the SAAA.

The TC's handbook, current at the time of the build but not available to a builder, stated in the list of duties that TCs were required to:

> assist the builder to prepare for Final Inspection day … this must also include a "Plan-Build-Test" RRAv Report (prepared by the Builder and signed off by both Owner/Builder and TC) that presents the project, the pilot and test flying programme plans for consideration by an Authorised Person (AP).

In the section titled Stage inspections, it stated that a:

> thorough nuts and bolts inspection **must** occur prior to the on-site visit carried out by the authorised person (AP). **The builder is responsible for this, with assistance from their TC and other experienced builders** [emphasis added by ATSB].

The handbook did not detail that a TC who was building their own aircraft was required to have an independent TC conduct the 'nuts and bolts' inspection of the aircraft.

Builder's assist program

The SAAA ran a voluntary program, called the Builder's Assist Program (BAP), where a builder and a TC worked together on a project. The program included a minimum of three inspections of an aircraft to be conducted at major milestones during the build.

Inspections of an aircraft during the build process

Regardless of whether a builder had signed up to the BAP, the SAAA recommended that they organise at least three formal TC visits, including:

- on completion of the first component
- during the fuselage/wing assembly
- engine installation.

The RRAv tool had a checklist section to document the inspection and it was recommended that a TC submit a report to the SAAA after each inspection. However, there was no regulatory requirement to organise stage inspections or inspections prior to the closure of any components.

Final assembly (nuts and bolts) inspection

To attain a CoA, the AP Manual of Procedures required that a

> duly completed and executed RRAv report pertaining to the planning, build and test phases of the applicant's project has been received.

This required that a builder organise a 'nuts and bolts' inspection to be completed with a TC, irrespective of whether they had liaised with a TC during the build. This inspection was to be completed prior to organising an inspection for the certificate of airworthiness.

The SAAA technical counsellor handbook advised that before conducting a 'nuts and bolts' inspection, the TC should use the RRAv report as a guide to create a checklist of what to inspect. The handbook also detailed that a report, signed by the builder of an aircraft, and endorsed by a TC, should be submitted to the SAAA after the 'nuts and bolts' inspection was completed.

While the 'nuts and bolts' inspection was required by the SAAA, the SAAA had no process to check that this inspection had been completed, or if any of the recommended TC visits for a project were completed or a report was submitted.

Information provided to members on inspection requirements

The SAAA made a number of information booklets available to members that contained advice on how to complete a project through the SAAA process. The ATSB reviewed the information available to a builder to determine if there was consistent advice that a TC was required to conduct the nuts and bolts inspection or endorse the RRAv report prior to it being submitted to the AP. A review of these booklets can be found in Appendix A.

In summary, while some documents advised that both the owner of the aircraft and the principal advisor (TC) must cause a RRAv report to be executed, none of the documents included any mandatory inspections, although they detailed that the TC was available to assist the builder to complete the 'nuts and bolts' inspection.

The information paper on the process for how to apply for the CoA listed the documents required to be submitted when applying for the certificate of airworthiness. It stated the RRAv report must be supplied, and that the TC was the 'first point of contact for any assistance required'. However, it did not specify that the TC was required to conduct the 'nuts and bolts' inspection nor that they were required to endorse the RRAv report.

Authorised Persons using SAAA processes

The SAAA nominated experienced members to CASA to become APs. These members were assessed by CASA and then completed a CASA-run training course, which provided training on the legal requirements to issue a CoA. There was no requirement for an AP to be a licenced aircraft maintenance engineer (LAME) or to have other engineering qualifications.[17]

According to the conditions of their instrument of appointment, the AP must issue the CoA in accordance with:

- the Sport Aircraft Association of Australia SAAA 'Authorised Person' manual of procedures Special certificate of airworthiness – Experimental (Amateur-built) … and
- for amateur-built experimental aircraft – CASA Advisory Circular AC 21-4

In addition, in accordance with Civil Aviation Safety Regulation (CASR) 21.195A *Issue of experimental certificates*, an AP must issue an experimental certificate if 'granting the authorisation would not be likely to have an adverse effect on the safety of other airspace users on the ground or water'[18] and the applicant:

- is eligible
- applies for the certificate
- is entitled to the certificate.

SAAA AP manual of procedures

The SAAA AP *Manual of procedures special certificate of airworthiness – experimental (amateur-built)* (manual) was written by the SAAA and approved by CASA. The manual did not identify that a TC was required to conduct a nuts and bolts inspection prior to the request for a CoA. It stated that before an AP could attend an aircraft, they were required to receive a

> duly completed and executed RRAv [Risk Radar (see the section titled *Risk Radar Aviation*)] report pertaining to the planning, build and test phases of the applicant's project...
>
> and

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[17] The CASA Delegates Management Manual required that an applicant have, among other requirements, 'substantial experience in the design, manufacture, modification, and maintenance of aircraft similar to the scope sought' and, 'Current technical knowledge and experience commensurate with that required for issuing experimental certificates.'

[18] Civil Aviation Safety Regulations 1998 11.055 *Grant of Authorisations*

> As a minimum, the owner of an aircraft must cause a RRAv report to be executed by both him/herself and the principal advisor (Technical counsellor) [see the section titled *Technical counsellor*] which presents the project, the pilot and test flying programme plans prior to consideration by an Authorised Person (AP) for issuance of a CoA.

A checklist itemised the documents the AP must receive before a CoA could be issued. It included a RRAv report, however it did not specify that the RRAv report was required to be endorsed by a TC.

Since this accident, the SAAA have clarified in a Special Bulletin to all APs that the requirement that the RRAv report must be 'executed' indicated it was required to be 'signed with the proper formalities' by the final assisting TC.

The checklist also listed the items on the aircraft the AP was required to inspect, including ensuring the aircraft markings and passenger warning placarding met the regulations. The AP was also required to do a general inspection of the aircraft to check the:

- engine and flight controls and pilot/static system operated correctly
- seatbelts met the minimum standards
- cockpit did not have protrusions
- carburettor heat system (where installed)
- firewall was adequate (where required).

The manual went on to state that after the AP's inspection of the aircraft was complete, the AP should consider any conditions and limitations to apply to the aircraft, which should be listed on the CoA. These limitations are designed 'in the interests of the safety of other airspace users and persons on the ground or water'. In determining whether any limitations were necessary, the AP was required to use the RRAv report to assess the:

- aircraft
- operating airfield
- area it was to be flown
- proposed test pilot's experience and flight test schedule.

The manual listed examples of limitations, which were based on a list of examples contained within AC 21-4(2) Attachment 3. While these lists included the airfield to be used and the area the aircraft could be flown, neither specified the name of the pilot who was to conduct the testing or the flight test schedule to be used. AC 21-10 v 4.2 Experimental certificates, which also listed example limitations to apply to aircraft with an experimental certificate, similarly did not list the pilot's name in the examples.

The AP manual of procedures stated one of the reasons to revise the certificate of airworthiness was a change of nominated pilot, however, this was not stated in other publications.

After the CoA was issued, the AP was required to submit all the paperwork to CASA using the delegate notification management system (DNMS).

Interviews with authorised persons

The ATSB interviewed a number of SAAA APs to establish if consistent procedures were being followed when issuing a certificate of airworthiness. The APs were selected from a range of backgrounds (both LAME and non-technical) and included both those recently appointed and others who had held their authorisations for many years.

All APs advised that most of the aircraft they assessed were well built.

They also all advised that, as it was on the checklist, they ensured they received a copy of the builder's RRAv report. However, all but one advised that they had not been checking to ensure the RRAv report was endorsed by a TC. Some APs advised that they used the summary section of the RRAv report but did not assess the build section as builders mostly rated their aircraft construction highly, which was not always the case. They also did not routinely request a copy of TC inspection reports due to an assessment that they often just detailed that the TC had attended and did not add value to the process.

The interviewed APs also stated that, until they received the Special Bulletin from the SAAA on the 12 May 2021, they had been issuing CoAs to builders who had no TC involvement with the build. Consequently, CoAs had been issued in circumstances where TC inspections, including the 'nuts and bolts' inspection (see the section titled *Final assembly (nuts and bolts) inspection)*, had not been conducted.

However, all but one AP advised, they themselves conducted a thorough inspection of the aircraft to ensure, as far as they could establish, the integrity of the build. This was done by having the aircraft presented with all access panels opened and cowls removed. They would often identify areas where the builder could make improvements and, in most cases, the builder would correct the issues.

In the case of the one AP who did not conduct an inspection of this nature, they had knowledge of the build from the start, with all builds having TC involvement and regular inspections of the aircraft.

One AP advised that where a builder used non-aviation components, they required that the builder justify the safety and reliability of the part. The AP would also do their own research on the component and applied limitations on the aircraft to suit.

All APs stated that they considered the suitability of the flight-testing pilot who was named on the RRAv report and would often contact that pilot, especially if they were not known to them. However, only half the APs advised that they named the test pilot in the limitations on the certificate.

They all advised that the CASA surveillance of them as an AP was thorough in checking the paperwork against the regulations and would identify missing dates or areas where more detail should be added. However, they also stated that CASA did not assess the RRAv report to ensure they were received and endorsed or check if any inspections of the aircraft had been conducted during the build process.

CASA surveillance of SAAA authorised persons

The ATSB interviewed relevant personnel at CASA in relation to the surveillance conducted on the SAAA APs. The Sport Aviation section advised that they conducted regular surveillance events to ensure the APs were issuing the certificates in accordance with their instrument of appointment. The frequency of these surveillance events was determined by:

- the national surveillance scheme, generally each of the APs was surveilled every 2 years.
- response-based surveillance, which was based on intelligence from industry inspections and engagements
- campaign surveillance where any emerging risk across a particular sector was the focus of the surveillance.

The surveillance event consisted of randomly selecting and assessing work packages from the DNMS for the AP under surveillance. To ensure the AP met the requirements of their instrument of appointment, the audit assessed the paperwork to ensure it met the regulatory requirements and the process was conducted in accordance with the SAAA AP manual of procedures. They advised that even though all the SAAA APs used the same manual of procedures, CASA personnel did not have a checklist to ensure all events surveilled the same items.

The Sport Aviation section advised that as AC 21.4 was a condition of the instrument of appointment, it was mandatory that it be considered when issuing certificates. They also advised that although the SAAA Manual of procedures required that a RRAv report be submitted, CASA as part of a surveillance event, did not assess it, or ensure it was endorsed, as this was a SAAA requirement which was above the minimum mandatory requirements.

They advised that, regardless of CASR 21.195A stating that the AP was required to give the builder a certificate if they were entitled to one, the AP was required to inspect the aircraft to ensure it is safe to fly. CASA also stated that the AP should apply limitations appropriate to the aircraft being considered.

CASA's views were sought on the actions that an AP should take if they considered that the aircraft was unsafe but the builder was entitled to a certificate in accordance with CASR 21.195A. CASA advised the AP could request additional information relating to the deficient area/s and, if they requested something which could not be supplied, then:

- refuse to issue the certificate because they are not satisfied with the supplied information
- apply very stringent limitations on where and when the aircraft could be flown.

They also advised that if they refused to issue a certificate, this should be notified to CASA through the DNMS, which would prevent the builder from then going to another AP to have the certificate issued.[19]

CASA advised that they did not check if a test pilot had been named in the limitations as the minimum experience required to test an amateur-built aircraft was a private pilot licence and the appropriate aircraft-related endorsements, nor was it a requirement to name a test pilot.

However, in a separate interview, the CASA surveillance management team advised that they would expect the pilot of a certified aircraft operating under an experimental certificate conducting test flying to be named in the limitations on the certificate of airworthiness.

Comparable international amateur built aircraft regulatory systems

A review of the regulatory system for the construction of amateur-built aircraft systems internationally found that a number of countries had regulations which allowed amateur-built aircraft to be constructed under a similar system to that in Australia. These countries had based their legislation on the United States Federal Aviation Administration (FAA) legislation. These systems had a requirement that evidence of independent inspections during the build process be provided to the person conducting the assessment to issue the CoA. This was to ensure that the integrity of the aircraft build had been maintained. A review of these systems can be found in Appendix B

Other countries, such as the United Kingdom, required the design and construction to be approved by a licenced engineer. The European Aviation Safety Authority did not regulate amateur-built aircraft, leaving that to individual states to register the aircraft.

Build process for VH-WID

The builder was a member of, and TC with, the SAAA and had elected to use their processes to obtain a CoA for the aircraft and had signed up for the builder's assist program.

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19 DMNS – CASA was later asked whether the DNMS would alert an AP that a builder had previously been denied a certificate of airworthiness. They advised that there was no automatic alerting against a particular registration.

Risk radar aviation report for VH-WID

The builder submitted an RRAv report to the AP prior to the CoA inspection. On the form the builder documented that two TCs had been involved in the project and that more than two inspections had been completed.[20] However, a TC had not endorsed the form.

Of the two TCs named, one had inspected the aircraft in 2014, when the project was first started and had submitted a TC visit report and a RRAv report. The second named TC advised that while they had seen the aircraft at the start of the project, they were not involved in the project and had not inspected the aircraft nor written a TC report. The builder later advised they had not engaged an independent TC as there were not many TCs who had experience with wood and fabric construction.[21]

The builder also advised that a 'nuts and bolts' inspection with an independent TC had not been completed nor was it required, and they did not involve an independent TC with the completion of the RRAv report. However, the builder noted that they themselves were a technical counsellor. With regard to performing these dual roles, the SAAA advised that it was 'counterintuitive for a builder to do their own inspection, irrespective of whether they are TCs or not'.

Build section of RRAv report

The builder had selected 'well constructed to standards within AC43' for most questions in the build/modify area of the RRAv report, including the engine build/modify section. There was no indication on the RRAv report that the builder had used non-aviation parts in the aircraft, apart from the engine ignition system.

Flight test section of RRAv report

The builder advised that when they entered their own flying experience in the RRAv report, the tool flagged concerns. Consequently, they decided to contract a pilot to do the test flying, however they had not engaged a pilot when they organised the certificate of airworthiness inspection.

In the test phase section of the RRAv report, the builder had not named a pilot to conduct the test flying, although they had filled in the section with a specific, experienced test pilot in mind. As such, they had entered extensive experience against all criteria (Figure 14). This was not representative of the experience of the accident pilot (Figure 15).

Figure 14: Risk Radar Aviation section for test pilot as submitted by builder of VH-WID

TEST PILOT RADAR for: N/A
Aircraft Rating = 9.4

	Experience and Type Capability	Completed or Relevant	Comment	Rating	
1	Total hours	Y	> 5000 hrs	10	
2	Hours on actual AND similar performance category types	Y	> 300 hrs	10	
3	Total hours on actual type	Y	< 10 hrs	6	Caution
4	Hours training on actual type	Y	< 2 hrs on type	8	Caution
5	Recent GA Currency (fixed wing or rotary as relevant to type)	Y	> 25 hrs in past 60 days	10	
6	Long Term GA Currency (fixed wing or rotary as relevant to type)	Y	> 300 hrs in last 2 yrs	10	
7	Flight test experience & qualifications	Y	Professional pilot with flight test experience on similar performance types	7	Caution
8	Test Pilot Log Book - complete & up to date	Y	Documents complete	10	
9	Normal op procedures (on actual type)	Y	Sound understanding and high degree of familiarity demonstrated	10	
10	Emergency op procedures (on actual type)	Y	Sound understanding and high degree of familiarity demonstrated	10	
11	Flight envelope / characteristics (on actual type)	Y	Sound understanding and high degree of familiarity demonstrated	10	
12	Not Used	N/A		0	
13	Not Used	N/A		0	
			Group Rating	9.2	
		Test Flying		9.3	

Source: supplied

[20] The SAAA clarified that a TC visit report on the aircraft was submitted to them for an inspection conducted on 2 April 2010 by the builder as a TC for the previous owner, when that owner acquired the aircraft. Just after the builder acquired the aircraft, an independent TC submitted both a TC visit report and RRAv report for an inspection completed on 14 April 2014. On 6 August 2018, the builder submitted a RRAv report which was not endorsed by a TC, when applying for the CoA.

[21] The SAAA advised that while this was true, they had access to a technical network to provide advice where needed.

Figure 15: Risk Radar Aviation section with the accident pilot's experience

TEST PILOT RADAR for: N/A

Aircraft Rating = 9.4

	Experience and Type Capability	Completed or Relevant	Comment	Rating	
1	Total hours	Y	< 1000 hrs	0	Concern
2	Hours on actual AND similar performance category types	Y	< 200 hrs	6	Caution
3	Total hours on actual type	Y	Nil	5	Concern
4	Hours training on actual type	Y	Nil	5	Concern
5	Recent GA Currency (fixed wing or rotary as relevant to type)	Y	< 5 hrs in past 60 days	0	Concern
6	Long Term GA Currency (fixed wing or rotary as relevant to type)	Y	< 30 hrs in past 2 yrs	0	Concern
7	Flight test experience & qualifications	Y	Amateur experienced pilot with no relevant test experience	1	Concern
8	Test Pilot Log Book - complete & up to date	Y	Documents complete	10	
9	Normal op procedures (on actual type)	Y	General understanding and some familiarity demonstrated	5	Concern
10	Emergency op procedures (on actual type)	Y	General understanding and some familiarity demonstrated	5	Concern
11	Flight envelope / characteristics (on actual type)	Y	General understanding and some familiarity demonstrated	5	Concern
12	Not Used	N/A		0	
13	Not Used	N/A		0	
			Group Rating	3.8	Concern
		Test Flying		7.5	

Source: SAAA with changes by ATSB

Certificate of airworthiness on-site inspection for VH-WID

The builder applied for a CoA for WID in November 2017. The AP did not request a TC 'nuts and bolts' inspection report or evidence of previous inspections.

The AP conducted an on-site visit on the 16 March 2018, during which a number of issues were identified with the aircraft. These included:

- aft wing attach bolts not installed safely
- right wing attach bolts loose
- twisted flight control cables
- loose nuts in flight control connections
- wear on the aileron cable
- skin on the inboard section of both wings not bonded to the ribs
- loose engine mount
- sharp edges around items in the cockpit
- installed 'experimental' signage on the aircraft of the incorrect size.

Consequently, the AP cancelled the inspection to allow for defect rectification.

After a second on-site visit, organised after the listed items had been corrected, the CoA (valid for 12 months) was issued on 21 August 2018. The AP recorded that the quality of the build was 'fair'. The certificate was subsequently re-issued on 10 October 2019, due to the time taken to complete the test flying. The following limitations, among others, were included on both certificates:

- the AP was to be notified of any major changes to the aircraft or the aircraft sustaining major damage
- at least 25 hours flight testing was required within the stated test area
- the aircraft was not to be operated over built up areas
- no passengers were permitted
- all flights from Maitland were to be from/to runways 05/23 with no flight permitted over built up areas of Windella or Rutherford. Circuit operations at Maitland were to be left hand from runway 05, remaining clear of Windella.

The AP advised they discussed a specific pilot to do the test flying with the builder and had also discussed this with the proposed test pilot, however they did not name the pilot in the limitations. The builder advised that the nominated test pilot was subsequently too busy to do the test flying. The AP also stated that their expertise was not in assessing if a pilot was suitable to conduct the flight testing and that they encouraged all builders to talk to the SAAA flight advisors before conducting the first flight.

Aircraft changes after the certificate of airworthiness was issued

After the CoA was received, a registered operator (builder) was required to advise the AP when a 'major change' to the aircraft was made, before flying the aircraft again. In 2017, a major change was defined among other things as having an effect on 'the operational characteristics of the aircraft'. As such, the builder was required to assess if a major change had been made and if it would have a significant effect on the aircraft.

The builder made the following changes to the aircraft after the CoA was issued:

- after a circuit by a different pilot,[22] the wings were removed and the rear mounts for the wing were redrilled to change the angle of incidence on both wings
- a trim tab was fitted to the rudder
- vortex generators were installed on the underside of the horizontal stabiliser and the top of the cabin.

These changes were recorded in the aircraft logbook, however the AP was not advised.

The builder advised that between the accident pilot's first and second test flight, the aileron movement had also been adjusted. The design instructions for the aircraft stated that to eliminate adverse yaw, the ailerons should be set such that the up moving aileron moved 80 per cent further than the opposite side moved down. The owner advised that initially they had set the ailerons to move in a 1:1 ratio. After the pilot's first test flight, this had been adjusted so the up moving aileron moved 70 per cent further than the down moving aileron. The accident pilot had been made aware of these changes.

Test pilot requirements for amateur-built aircraft

The minimum qualification required to conduct initial flight testing in an amateur-built experimental aircraft was a private pilot licence with the appropriate aircraft-related endorsements. There were no minimum experience requirements however, CASA advised it was 'unwise' for the initial flight test to be carried out by someone other than a pilot with specific test flying qualifications or knowledge.[23]

In addition, CASA AC 21.47 *Flight test safety* stated that personnel involved in flight testing should be 'appropriately qualified, experienced and current'. It also advised:

> A formal experimental test flying certificate does not, in itself, necessarily mean that the holder is the best person to employ for a specific flight test project. For example, a qualified TP [test pilot], who graduated from Test Pilot School over thirty years ago and who has only operated military fast jets or transport category airliners since that date, may not be the ideal pilot to choose for the developmental test flying of a Light Sport Aircraft with a tail-wheel landing gear configuration.

The CASA AC also urged 'most strongly' that builders made detailed reference to the FAA AC 90–89 *Amateur-built aircraft and ultralight flight testing handbook*. This FAA AC stated that the test pilot should be 'rated, current, and competent in the same category and class as the aircraft being tested'. The minimum flying experience suggested for an aircraft built from a 'time-proven set of plans' was 100 hours in command, and a minimum of 1 hour training in recovery from unusual attitudes within the 45 days prior to the first flight test.

Information provided by the accident pilot to the builder

Just before the CoA was re-issued in 2019, the builder was put in contact with the accident pilot. The pilot sent information about their experience, advising they had 'been in testing for a long time for both the UK and Oz [Australian] militaries, plus flown GA [general aviation] and gliders for years'. They advised that they were a flight test engineer and had attended the Empire Test Pilot's

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[22] This was the only reported flight prior to the accident pilot's first test flight, this occurred prior to the issuing of the second CoA.

[23] The SAAA RRAv tool would flag concerns in the Flight Test section if the minimum level of experience was entered.

School (ETPS), however, they did not specify that their attendance at ETPS was as a flight test engineer rather than as a test pilot.

They stated that they had a private licence and did not provide their total number of flying hours. In discussing their recent flying experience, they advised that

> Just of late, I fly the robin[24] out of WLM [Williamtown] for aerobatics, plus the archer and occasionally the lance[25] out of MND [Maitland] for touring.

They also advised that they had an aerobatic, retractable landing gear and constant speed endorsement. The builder did not request further information.

Aircraft testing

Taxi test

The pilot had written a report on the initial taxi test conducted on the 13 December 2019, which identified that:

- the airspeed indicator was overreading by about 10–12 knots compared to the onboard GPS unit (with no headwind or tailwind present)
- there was considerable slack in the nose wheel steering control cables
- the braking system was not effective.

In response to these observations, the builder conducted work on the nose wheel and rudder tracking to correct the issues.

The builder advised that the airspeed indicator overread was not corrected prior to the test pilot flying the aircraft as the pilot and builder were unsure if the discrepancy was the result of the aircraft's attitude during taxi. They had planned to test the airspeed indicator at a later stage in the flight testing. However, the builder advised the pilot had intended to use the speed indicated on their iPad rather than the airspeed indicator in the aircraft, during the initial flights, as the wind conditions were light.

Accident pilot's first flight test

While no report could be found relating to the accident pilot's first flight test, conducted on the 30 December 2019, the video recorder was operational during the flight. The video showed the aircraft was controllable, although the yaw and roll characteristics of the aircraft were poor. In an email to the builder, the pilot advised that all turns were done using rudder almost exclusively and stated

> if you use the stick at all the adverse yaw is so strong it has the nose off in the opposite direction … the only issue is near the ground when you may wish to pick up a wing. Getting it to roll with your feet has some delay, which isn't ideal near the ground.

Stall

A note in the pilot's test sheet for the accident flight, indicated that the pilot had assessed the stall speed as 65 kt on the airspeed indicator in the aircraft, during the first test flight. They had also assessed that they should not fly below 75 kt on the airspeed indicator during the approach.

The information in the pilot operating manual, written by the builder, stated that the stall speed was 56 kt with the landing gear extended.[26] In the 'Operating suggestions' section of this document, it stated that 'the aircraft is very docile approaching the stall and does not exhibit any

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24 Robin is a single engine aircraft manufactured by Robin Aircraft.

25 Piper Lance is a six-seat, single engine aircraft manufactured by Piper Aircraft.

26 Landing gear: The owner/builder and the accident pilot had decided the landing gear should remain extended during the initial test flights. The video showed that the pilot did not retract the landing gear during the flight.

bad characteristics'. This document suggested that 70 kt be used in the circuit, however, it also stated in the downwind check that 78 kt be maintained on final.

The ATSB discussed the aircraft's flight characteristics with another pilot who had built and owned an Osprey 2 in the early 1980's. They advised that their aircraft stalled at 52 kt with the landing gear retracted and there were no inherent indications of an approaching stall. They also advised that during the stall, while the wing did drop, it was not violent, and the aircraft required 100–200 ft to recover. As these aircraft were built from plans by different builders, the stall characteristics may have differed.

Finally, this pilot stated that during the process to get a certificate of airworthiness for their aircraft, the Department of Civil Aviation[27] had required that a stall warning system be installed.

VH-WID did not have a stall warning system installed.[28]

Previous occurrences

ATSB research report AR-2007-043(2) Amateur-built aircraft Part 2: Analysis of accidents involving VH-registered non-factory-built aeroplanes 1988-2010 found that amateur-built aircraft had an accident rate three times higher than comparable factory-built certified aircraft. They also found that over half of the accidents were precipitated by mechanical events, which were mainly complete or partial engine failures.

[27] From 1938, the Department of Civil Aviation regulated aviation in Australia. In 1988, the Civil Aviation Authority was established and, in July 1995, that organisation separated into the Civil Aviation Safety Authority and Airservices Australia.

[28] On the RRAv report, the stall warning device was marked as 'N/A' and no alert flag was raised.

Safety analysis

Introduction

Passing 2,400 ft on climb after taking off from Maitland Airport, the pilot was advised, via radio, of white smoke coming from the aircraft and noted that the engine was not running smoothly. In response, the pilot broadcast that they were returning to land on runway 23, however, during the descent, they turned to join the reciprocal runway 05. As the aircraft was turned on to the base leg of the circuit, the engine failed, and the pilot attempted to conduct a forced landing on to the closer runway 08. During the final stage of the approach, the aircraft was observed to abruptly roll, pitch down and collide with terrain.

This analysis will discuss the reason for the engine power loss and the pilot's response. It will also examine the aircraft build and approval process, including the involvement of the Civil Aviation Safety Authority (CASA) and the Sport Aircraft Association of Australia (SAAA).

Development of the accident

Examination of the engine identified a number of significant deficiencies with the oil supply hose and fitting connected to the oil cooler. Firstly, a damaged fitting was used to connect the oil supply hose to the oil cooler. This damage would likely have allowed oil to leak past the fitting's barbs. Secondly, the external condition of the supply hose indicated that it had reached the end of its effective lifespan. Its aged condition probably reduced the ability of the hose to mechanically grip the barbs and ensure the integrity of the connection.

Finally, the fitting was not approved for use in combination with the hose by the hose manufacturer and had slightly different dimensions, and one less barb, compared to the hose manufacturer's approved fitting on the other end of the assembly. The combination of these three factors likely resulted in the pressurised hose separating from the oil cooler fitting (either partially or completely), allowing the oil to be lost overboard.

This disconnection and oil loss most likely occurred while the aircraft was on climb, as white smoke was observed by witnesses on the ground and the pilot reported rough running of the engine. Given that the engine was above and behind the pilot's position in the aircraft, this would not have been visually obvious to the pilot.

The pilot initially advised that they were returning to runway 23, which would have allowed the aircraft to land as soon as possible. However, the pilot then turned to join the reciprocal runway 05, possibly due to a pilot of another aircraft reporting they were departing from this runway. The pilot also flew a widening circuit, which was in accordance with one of the limitations on the certificate of airworthiness (CoA) to avoid a built-up area. However, this extended the time the aircraft was airborne and increased the power required from the engine to maintain height. The combination of these factors resulted in the engine failing in flight due to oil starvation.

The engine failed as the aircraft commenced the turn to base. Due to its relatively poor glide performance, from that position it was likely unable to reach any runway. There were opportunities for a forced landing to be conducted off the airport. However, it is possible that, as the pilot had just practiced forced landings in an aircraft (PA-28) that was probably capable of reaching the airport environment from that position, they overestimated the Osprey's glide performance.

During the forced landing, video imagery recorded the speed decreasing to between 60–65 kt on the aircraft's airspeed indicator, which was below the speed the pilot had previously identified as the stall speed. There was no stall warning system installed, and no known aircraft indications to increase the pilot's awareness of the approaching stall.

Examination of the accident site confirmed that the aircraft contacted the ground with low forward airspeed while rolling to the left, consistent with an aerodynamic stall. The height at which the stall occurred was too low to permit recovery.

Amateur-built aircraft system

The amateur-built aircraft system was designed to allow people the freedom to design and build their own aircraft. Responsibility for ensuring that such aircraft were built to a safe standard rested with the builder and methods of ensuring safety and reliability included:

- following build instructions and plans
- using accepted construction techniques/practices and aviation-compatible parts.

Assistance in this regard was available from the SAAA, specifically the technical advice from their Technical Councillors (TCs).

Build inspections

Independent inspections at milestone points during the construction are an effective method of ensuring the builder is following accepted practices and that no inadvertent errors have been made. CASA stated that to meet their safety objectives, amateur builders should have independent inspections of the aircraft and these inspections should be documented in the builder's log. However, this was not mandated and so while the SAAA recommended that at least three inspections with a technical counsellor (TC) occurred during the course of the build, compliance was optional.

Despite this, the SAAA had written a clause into the Authorised Person's (AP's) manual of procedures requiring that an AP receive a TC-endorsed risk radar aviation (RRAv) report. This clause did not clearly articulate that a TC was required to conduct a 'nuts and bolts' inspection of the aircraft. In addition, the checklist of the required documentation to be supplied to an AP, which included the RRAv report, did not clarify that it was required to be endorsed by a TC. This resulted in some APs accepting RRAv reports which had not been endorsed. This allowed aircraft to be presented for the Certificate of Airworthiness (CoA) assessment without having an independent 'nuts and bolts' inspection. However, most of the APs interviewed by the ATSB were conducting their own inspection of the aircraft, which mitigated some of the risk.

On this occasion the builder had supplied an RRAv report to the AP, however it had not been endorsed by an independent TC, nor had any independent stage or closure inspections of the aircraft been conducted during the builder's project. While it was considered unlikely a TC would have detected the damaged barb on the fitting, as the oil hose assembly would most likely have been assembled prior to an inspection, they may have identified the visibly aged condition of the oil supply hose.

Additionally, had these inspections been conducted, it is likely several other building practices not normally used in aviation would have been detected. These had the potential to increase risk but were not considered contributary to the accident.

The SAAA information booklets were written to ensure that builders understood that they were responsible for the integrity of the construction of the aircraft. The booklets, available to a builder at the time of the project, did not clearly articulate that a TC was required to conduct an independent 'nuts and bolts' inspection of the aircraft before it was presented to the AP for inspection.

They also did not state that a builder, who was also a TC, was required to have an independent TC conduct a 'nuts and bolts' inspection. The builder of VH-WID was a TC with the SAAA. Recognising that this was the only TC-built aircraft examined by the ATSB, the issues found in the techniques used in the construction of the aircraft, raised questions as to the efficacy of the method of appointing TCs by the SAAA.[29]

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[29] The SAAA advised that in 2017, issues around the depth of experience and currency of some TCs was recognised and a procedure (Criterion for the Appointment of a Technical Counsellor) was put in place. This was implemented after the builder was appointed as a TC.

At the time of the accident, the SAAA also did not have a system in place to ensure inspections, including the 'nuts and bolts' inspections, were being completed on aircraft which were built using the SAAA processes. The TCs were supposed to complete reports to document their visits and inspections of the aircraft, but this was not formally monitored by the SAAA.

Regulatory oversight of Authorised Persons

The purpose of CASA surveillance was to ensure APs were issuing certificates in accordance with their instrument of approval. Their instrument of approval required that they issue certificates in accordance with the CASA Advisory Circular AC 21-4 and the SAAA AP *Manual of procedures special certificate of airworthiness – experimental (amateur-built)* (manual), which was approved by CASA.

CASA inspectors were conducting regular surveillance on the APs. However, during these events, they were ensuring the APs were meeting the regulatory requirements but not ensuring that the requirements in the manual were being met. As such, they were not ensuring APs were receiving endorsed copies of the RRAv report. While the RRAV report was above the minimum requirements of the legislation, it was a requirement of the AP's manual of procedures which in turn was a requirement of their instrument of approval.

The use of an Advisory Circular (AC) as a mandatory item in the instrument of approval introduced an element of uncertainty in the process. AC 21.4, in particular, was written for a number of different audiences and created uncertainty around which inspections were required and which were recommended.

Other countries with similar systems to Australia for the certification of amateur-built aircraft had a requirement that evidence of independent inspections of the aircraft during the build process, be provided to the person conducting the assessment to issue the CoA. This was to ensure the integrity of the aircraft build had been maintained. The Australian system did not have this requirement.

Test pilot suitability

The AP advised that, while they did not name a specific pilot to conduct the flight test program in the limitations on the CoA, they had discussed a specific highly experienced test pilot with the builder, and had this pilot in mind when they considered the limitations. That pilot was later unavailable to conduct the flight test program, so the builder engaged a new test pilot.

The accident pilot met the minimum requirements to test fly the aircraft. However, while they were a professional flight test engineer, they had significantly less pilot in command experience than the originally suggested test pilot, having accrued approximately 100 hours flying as pilot in command over 13 years.

When the builder arranged for the pilot to do the testing, they did not assess the pilot's experience using the RRAv report. Use of the RRAV report would have provided an objective assessment of the pilot's experience levels. Furthermore, the RRAv report would most likely have raised 'concerns' due to the pilot's recent flying and overall flying experience.

In addition, if the pilot had been named in the limitations on the CoA, the builder would have been required to advise the AP of the change. This would have provided the AP an opportunity to consider the pilot's experience and discuss the test flying program with the pilot. They would also have had the opportunity to reassess the RRAV report and consequently whether they needed to reassess the limitations on the CoA.

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 collision with terrain involving an Osprey 2 Amphibian aircraft, registered VH-WID, near Maitland Airport, New South Wales on 17 May 2020.

Contributing factors

- The use of a damaged fitting, which was not compatible with the installed, aged hose, most likely resulted in the hose disconnecting from the oil cooler during the climb and the loss of oil from the engine.
- During the descent to runway 23, the pilot elected to approach the reciprocal runway 05. This necessitated increased power from a damaged engine to maintain height and extended the time airborne.
- As the aircraft turned on to the base leg of the circuit for runway 05, the engine failed due to oil starvation.
- While attempting a forced landing, control of the aircraft was lost due to an aerodynamic stall at a height insufficient for recovery.

Other factors that increased risk

- Neither the recommended stage nor the final ‘nuts and bolts’ inspections were conducted. Additionally, the technical counsellor had not endorsed the risk radar aviation report and the authorised person did not detect that these inspections were not completed before the certificate of airworthiness certificate was issued, resulting in missed opportunities to improve the aircraft’s build quality.
- While the intention by Sport Aircraft Association of Australia was that an independent ‘nuts and bolts’ inspection with a technical counsellor was required, this was not clearly stated in the procedures applicable to the builder, and the authorised person.
- The Civil Aviation Safety Authority (CASA) had approved the system to allow the Sport Aircraft Association of Australia authorised person to issue a special certificate of airworthiness - experimental (amateur-built). This system required the authorised person to receive an endorsed risk assessment prior to the authorised person’s inspection. However, during surveillance activities, CASA inspectors did not assess that these risk assessments were complete.
- The builder did not use the Sport Aircraft Association of Australia 'risk radar aviation' (RRAv) assessment report to establish the risk for the accident pilot to conduct the test flying. Use of the RRAv report would most likely have raised ‘concerns’ due to the pilot's recent, and overall, flying experience.
- The Sport Aircraft Association of Australia's Manual of Procedures for the authorised person (approved by CASA) required, and Advisory Circular 21.4 recommended, that the proposed test pilot's experience be assessed when considering limitations placed on a certificate of airworthiness. However, the pilot was not required to be named and therefore there was no

means of ensuring the test pilot would be re-assessed if they were changed after the certificate was issued.

Safety action

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety action in response to this occurrence.

Proactive safety action Sport Aircraft Association of Australia

The SAAA have:

- written to CASA to request an urgent 1-day refresher training course for all authorised persons (AP)
- requested that CASA provide annual refresher training and require that an AP must attend at least once every 3 years
- advised APs that they are not required to issue a CoA if they are of the opinion that operation of the aircraft would present an unacceptable risk
- amended their procedures to require 3 stage inspections be completed during an aircraft build (this is inclusive of the final 'nuts and bolts' inspection). They have amended the Technical Counsellor Handbook – now TC manual, including that the TC must submit reports to the SAAA and use the risk radar checklist to conduct the inspection
- submitted a revised Authorised Person Manual of Procedures to CASA. This reinforces that RRAv form must be 'completed and executed' which means signed with comments from both builder and an independent TC. It also required:
  - that the AP receive 3 TC visit reports – one of which may be the final TC 'nuts and bolts' inspection – if these are not available the AP must request an independent inspection by a licenced aircraft maintenance engineer or equivalent
  - the test pilot be named in the limitations contained within the certificate of airworthiness and if the pilot is changed, the authorised person needs to be informed
  - any structural change or damage repair to the aircraft during the 'phase 1' testing are to be notified to the AP and written authorisation is required before flying can continue
  - if the AP considers it is not safe to issue a certificate they can refer the matter to CASA.
- specified that a technical counsellor or an authorised person are not permitted to inspect their own aircraft
- updated the Risk radar aviation report signature blocks
- written a new booklet 'Construction of Amateur-built experimental aircraft' to include information on the risk radar aviation report (this clarifies that the RRAv is required however it does not state it must be endorsed by a TC)
- updated the Member's Handbook to explain how to use the risk radar and require its use to create checklists
- requested that CASA provide summaries of the audits conducted by authorised persons to ensure they are made aware of developing issues

SAAA intend to:

- further review and update the SAAA Member handbook to ensure any matters referred to unequivocally describe the steps and processes an owner / builder of an aircraft should follow through construction, obtaining an experimental certificate of airworthiness, and managing flight operations through the Phase 1 flight testing phase
- publish a new topic in the Builder CoA pack regarding 'Nominating your test pilot(s)'
- develop a visual guide that sets out the essential process and requirements a builder needs to observe through the build of an aircraft

- all documents will be updated to reflect the findings in this report.

Glossary

AC	Advisory Circular
AP	Authorised Person
BAP	Builder's Assist Program
CAA	Civil Aviation Authority
CASA	Civil Aviation Safety Authority
CoA	Special certificate of airworthiness – experimental (amateur-built)
CTAF	Common Terminal Area Frequency
DNMS	Delegate Notification Management System
EST	Eastern Standard Time
FAA	Federal Aviation Administration
LAME	Licenced Aircraft Maintenance Engineer
NZ	New Zealand
PFA	Popular Flying Association
RRAv	Risk Radar Aviation
SAAA	Sport Aircraft Association of Australia
SACAA	South African Civil Aviation Authority
TC	Technical Counsellor
UK	United Kingdom

General details

Occurrence details

Date and time:	17 May 2020 – 1000 EST	
Occurrence category:	Accident	
Primary occurrence type:	Collision with terrain	
Location:	near Maitland Airport, New South Wales	
	Latitude: 32° 42.2520' S	Longitude: 151° 29.3280' E

Aircraft details

Manufacturer and model:	Amateur-Built Aircraft Osprey 2 Amphibian	
Registration:	VH-WID	
Serial number:	WJC 003	
Type of operation:	Private – Test & Ferry	
Activity:	General aviation – Other general aviation flying – Test flights	
Departure:	Maitland, New South Wales	
Destination:	Maitland, New South Wales	
Persons on board:	Crew – 1	Passengers – 0
Injuries:	Crew – 1 Fatal	Passengers – N/A
Aircraft damage:	Destroyed	

Sources and submissions

Sources of information

The sources of information during the investigation included the:

- owner/builder of aircraft
- authorised person
- engine rebuild workshop
- Sport Aircraft Association of Australia
- Civil Aviation Safety Authority
- New South Wales Police Force
- accident witnesses
- video footage of the accident flight
- OzRunways flight data
- engine manufacturer
- Air Accidents Investigation Branch, United Kingdom

References

CASA (Civil Aviation Safety Authority) (2000), Advisory Circular 21.4(2)*, Amateur-built experimental aircraft – certification*, September 2000, Australia.

CASA (Civil Aviation Safety Authority) (2019*)* Advisory Circular 21.47(1.1), *Flight test* safety, March 2019, Australia.

CASA (Civil Aviation Safety Authority) (2019) Advisory circular 21-10 v 4.2, *Experimental certificates*, March 2019, Australia.

FAA (Federal Aviation Administration) (2015) Advisory Circular 90–89B, *Amateur-built aircraft and ultralight flight testing handbook*, April 2015, United States.

FAA (Federal Aviation Administration) Advisory Circular 43.13-1B, *Acceptable methods, techniques, and practices–aircraft inspection and repair*, September 1998, United States.

FAA (Federal Aviation Administration) (2009) Advisory Circular 20–27G, *Certification and operations of amateur-built aircraft*, September 2009, United States.

CAA (Civil Aviation Authority) New Zealand (2014) Advisory Circular 21-4, *Special category – Amateur-built aircraft airworthiness certificates*, February 2014, New Zealand.

CAA (Civil Aviation Authority) United Kingdom (2005) Civil Aviation Procedure 659, *Amateur built aircraft A guide to approval, construction and operations of amateur built aircraft*, November 2005, United Kingdom.

CAA (Civil Aviation Authority) South Africa (2017) Technical Guidance Material, *Amateur-built aircraft guidance material for constructing and certification of an amateur-built aircraft*, December 2017, South Africa.

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:

- owner/builder of aircraft

- authorised person
- engine manufacturer
- Sport Aircraft Association of Australia
- Civil Aviation Safety Authority
- New South Wales Police Force
- National Transportation Safety Board, United States
- Air Accidents Investigation Branch, United Kingdom

Submissions were received from:

- owner/builder of aircraft
- Sport Aircraft Association of Australia
- Civil Aviation Safety Authority
- Air Accidents Investigation Branch, United Kingdom

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

Acknowledgements

The ATSB acknowledges the significant assistance provided by the Sport Aviation Association of Australia throughout the investigation and the safety action they have undertaken in response to this accident.

Appendices

Appendix A – Summary of Sport Aircraft Association of Australia reference handbooks available to a builder in 2017–2018

SAAA reference	Information related to inspections contained in booklets
IPM18-001 Information paper – construction records and stage inspections	This booklet advised the builder to conduct stage inspections as recommended in Advisory Circular 21.4 section 6.3, however it did not advise that the 'nuts and bolts' inspection was required.
RRAv report tutorials	There was a section on SAAA website which provided tutorials on how to use the RRAv report. One slide titled 'RRAv - When to use and reporting requirements' stated that the build and test phase was required prior to CoA presentation and a report was required by the owner and discretionary by TC. There was a note which stated the RRAv report must be signed by both TC and owner as part of CoA package submitted by an AP to CASA.
Members handbook	This booklet stated the builder was not legally required to engage a TC, but, irrespective of the builder's experience, a TC afforded a second pair of eyes and some check and balance as no one is infallible. In regard to issuance of a CofA, it also stated that the person responsible for issuing the CoA needed to have confidence in the quality of the build, and if a TC had not been involved during the build, this could be problematic.
COA1.1-002 SAAA CofA Pack process and framework	This booklet included a flow chart of the process. The flow chart stated a TC was available to help and that the builder, TC and flight safety advisor should agree that the builder is ready to apply for CoA. Information on the AP's on-site visit stated the TC was available to assist the builder to ensure the aircraft was complete and ready to fly. The checklist of required documentation listed the RRAv report, however it did not specify that this must be TC-endorsed. The section on the RRAv report stated the RRAv report was required to be completed by the builder.

Appendix B – Summary of comparable international amateur-built aircraft systems

United States Federal Aviation Administration (FAA) publication AC 20-27G *Certification and Operation of amateur-built aircraft* stated that, while aircraft were not inspected by the FAA during the build, the aircraft was inspected for general airworthiness before a certificate of airworthiness was issued. They also required evidence of inspections conducted by an Experimental Aircraft Association technical counsellor, certified mechanic or other builders/commercial assistance providers during construction. The FAA could refuse to issue a certificate of airworthiness if it was considered that the aircraft was unsafe to fly.

Civil Aviation Authority of New Zealand (CAA NZ) AC 21-4 *Special category – Amateur-built aircraft airworthiness certificates* advised that the builder should contact CAA NZ prior to commencing the project. It also stated an aircraft was not inspected by the CAA NZ during the build, however evidence of inspections conducted during the construction of the aircraft was required including mentor visits and vital point inspections.[30] Vital point inspections should be carried out by an appropriately rated licenced aircraft maintenance engineer, mentor appointed by Sport Aircraft Association of New Zealand, or a person nominated by the builder who was acceptable to CAA NZ.

[30] Vital point inspection means an inspection carried out to ensure the correct assembly and functioning of a structural item or component, the failure of which would cause structural collapse or loss of control.

South Africa Civil Aviation Authority (SACAA) Technical guidance material *Guidance material for constructing and certification of an amateur-built aircraft* advised that builders must register that they are commencing a build project with the SACAA. To receive an authorisation to conduct a ‘proving flight’, the builder must supply evidence describing the inspections which were conducted during the build. The SACAA may conduct an inspection of the aircraft to enable the applicant to demonstrate compliance, including examination of the aircraft builder’s logbook and the completed aircraft.

United Kingdom Civil Aviation Authority (CAA) Civil aviation publication (CAP) 659 *Amateur-built aircraft A guide to approval, construction and operation of amateur built aircraft* advised that an amateur-built aircraft could not qualify for a certificate of airworthiness as it had not been designed and constructed by an appropriately qualified organisation. However, an amateur-built aircraft could receive a permit to fly. To do so, the builder must register with the CAA or Popular Flying Association (PFA) before the project was commenced. The CAA, or PFA, appointed a licenced engineer, or similar, to oversee the project. They approved the design of the aircraft, and inspected the premises it was to be built, and then conduct inspections as required. The licenced engineer had responsibility for the quality and design of the aircraft.

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.