Australian Government
Australian Transport Safety Bureau

Loss of power on take-off and forced landing involving Cessna 182, VH-DGF

Tooradin Airfield, Victoria | 6 January 2019

Investigation

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Postal address: PO Box 967, Civic Square ACT 2608
Office: 62 Northbourne Avenue Canberra, Australian Capital Territory 2601
Telephone: 1800 020 616, from overseas +61 2 6257 2463 (24 hours)
Accident and incident notification: 1800 011 034 (24 hours)
Email: atsbinfo@atsb.gov.au
Internet: www.atsb.gov.au

Addendum

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Safety summary

What happened

On the morning of 6 January 2019, a Cessna 182G, registered VH-DGF, took off from Tooradin Airfield to conduct parachuting operations. The pilot reported that soon after take-off, at about 400 ft above the ground, the engine sustained a sudden power loss. After being unable to resolve the problem, the pilot conducted a forced landing in a nearby paddock.

During the forced landing, the aircraft collided with trees and a fence, which resulted in substantial damage. There were no injuries.

What the ATSB found

The ATSB found that the carburettor contained aluminium oxide corrosion deposits which, when loosened, likely blocked fuel flow within the carburettor, resulting in the aircraft engine losing power. Periodic inspections (every 100 hours or 12 months) play a vital role in ensuring the serviceability of an aircraft's engine, and these inspections had a requirement to drain and flush the carburettor. However, the extent to which this action was actually conducted during the six inspections since the engine and carburettor were overhauled could not be determined.

The engine had periods of inactivity over the preceding years, and maintenance on the engine had not always been conducted at the appropriate time intervals. However, it was not possible to determine exactly when the corrosion started and propagated.

After the engine lost power, the decision by the pilot to conduct a forced landing rather than turn back to the departure runway minimised the risk of loss of control during the forced landing.

The pilot was not wearing an upper torso restraint (UTR), but fortunately was not injured on this occasion. However, by not wearing his UTR, he significantly exposed himself to unnecessary injury risk.

What's been done as a result

The operator advised that it intends to direct pilots to wear upper torso restraints and that this requirement will be incorporated into its training and induction schedule.

Safety message

Corrosion was able to form within the carburettor that was not prevented or detected. This occurrence highlights the importance of following the maintenance program for the aircraft. Particularly in this case, this included draining and flushing the carburettor at its periodic inspection.

When available, upper torso restraints should be worn. While the pilot was uninjured during the accident, a substantial amount of research has shown that wearing an upper torso restraint significantly reduces the risk of injury compared to lap belts only.

Contents

The occurrence

Pre-flight preparation

On the morning of 6 January 2019, the pilot of a Cessna 182G, registered VH-DGF, prepared the aircraft for parachuting operations for Skydive South East Melbourne at Tooradin Airfield, Victoria. The single-engine aircraft had been refuelled from the bowser at the airfield on the previous day.

The pilot reported that, on the morning of the flight, he checked the quantity of fuel on board by dipping the aircraft's fuel tanks with a calibrated dipstick. He also conducted a normal pre-flight inspection of the aircraft, which included conducting a water drain check of each of the aircraft's three fuel drains.

After conducting the pre-flight inspection, the pilot started the aircraft's engine and taxied to the apron area. He allowed the engine to warm and carried out further operational checks. When complete, he repositioned the aircraft to pick up parachutists for the first sortie of the day. However, the flight was then delayed for about 90 minutes by unsuitable weather.

The passenger load consisted of a tandem master, a tandem passenger and two sport parachutists.

Take-off and engine power loss

The pilot conducted the take-off at about 1045 Eastern Daylight-saving Time,[1] toward the south-west. As the aircraft passed over the end of the runway, he raised the flaps and continued to climb.

The pilot reported that, at about 400 ft above ground level, there was a sudden loss of power and aircraft climb performance, and he observed the propeller was windmilling[2] without sound. He later described the power loss as being similar to the mixture control being pulled back. A witness at Tooradin Airfield recalled that the power loss sounded like a sudden closing of the throttle and there was no rough running.

The pilot lowered the aircraft nose and identified a suitable area to make a forced landing which required a heading change of about 45° to the west. He checked the engine controls and fuel selector were correctly configured and had not been disturbed by parachutists entering the aircraft.

The pilot recalled that he conducted a flapless approach at about 70 kt to the identified landing area. During the descent, he instructed the passengers to prepare for a forced landing.

The aircraft touched down in a relatively flat, open paddock. It initially bounced on the unprepared surface before settling on the ground and passing through two boundary fences. The pilot attempted to slow the aircraft and manoeuvre to avoid trees. As the aircraft passed through a gap in the trees, the left wing strut collided with a tree, which resulted in the left wing folding over on top of the right wing and fuel leaking from it onto the fuselage. The aircraft further collided with a third fence, crossed a private road, and collided with a fourth fence, which collapsed the nose landing gear (Figure 1).

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1 Eastern Daylight-saving Time (EDT): Coordinated Universal Time (UTC) + 11 hours.

2 Windmilling: a rotating propeller being driven by the airflow rather than by engine power, and results in increased drag at normal propeller blade angles.

Figure 1: Accident site of Cessna 182, registered VH-DGF

Source: Victoria Police.

Egress from the aircraft

The pilot ordered the passengers to evacuate. Both doors were displaced open during the accident sequence and an interior panel from the rear of the cabin had propelled forward onto the parachutists. The panel obstructed emergency egress and was removed by the pilot.

The sport parachutist located at the right[3] rear position attempted to egress the aircraft but had not released his single-point restraint. After doing so, he was first to egress. The sport parachutist located at the right forward position also had not released his restraint prior to attempting egress. After doing so, he was next to egress. The tandem passenger was assisted out of the aircraft, followed by the tandem master and the pilot. Video footage showed that, after the aircraft came to rest, it took about 20 seconds for the occupants to egress.

The pilot returned to the aircraft to confirm the master switch and magnetos were off. The passengers and pilot moved away from the aircraft and waited for emergency services to arrive.

The aircraft was substantially damaged and there were no injuries.

[3] As viewed looking forward.

Context

General aircraft information

The Cessna 182G is a high-wing, all-metal, unpressurised aircraft with a fixed landing gear. It has a single, reciprocating piston engine driving a constant speed propeller.

VH-DGF was manufactured in 1964 and was first registered in Australia in 1965. The aircraft was reconfigured for parachuting operations in 2017.

The Cessna 182G has two fuel tanks, one in each wing. Fuel from each tank is gravity-fed to the fuel selector valve. Depending on the setting of the valve, fuel from the left tank, right tank or both tanks flows through a fuel strainer (also known as a ‘gascolator’), then the carburettor and the engine.

The Cessna 182G Owner’s Manual stated that pilots should take off with the fuel selector in the BOTH position. The pilot reported that the fuel selector was in the BOTH position during the take-off. Video footage taken during part of the accident flight confirmed that the fuel selector was in the BOTH position, and the fuel tanks indicated that sufficient fuel was on board.

A review of the video footage identified that the mixture was full rich and the carburettor heat was off during take-off. However, a review of the meteorological conditions and other information at the time of the occurrence indicated that the risk of carburettor icing was low.

The aircraft was within the required weight and balance limitations.

Examination of the aircraft and components

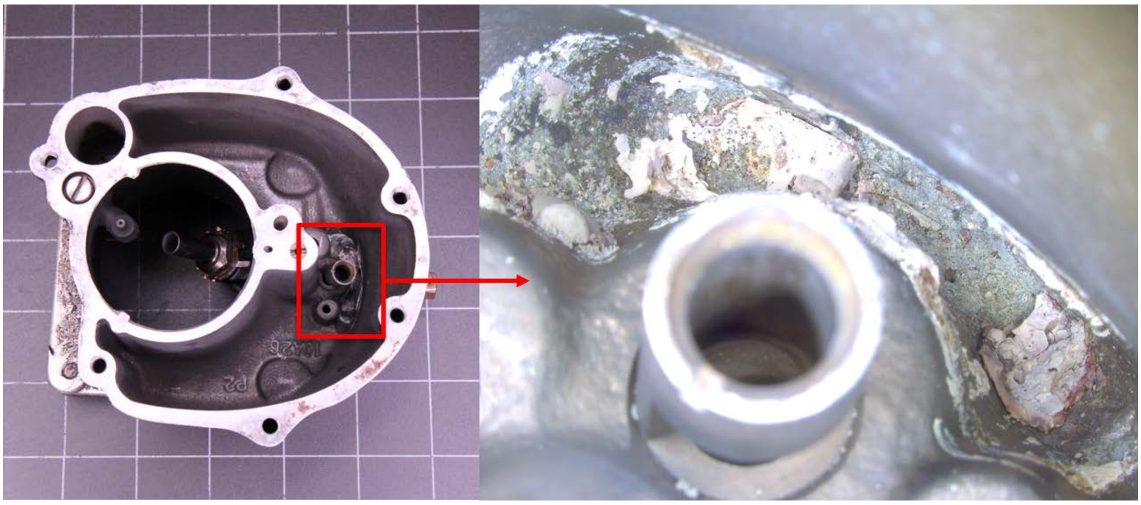
The ATSB did not attend the accident site or conduct a detailed examination of the engine. Examination by other parties did not identify any problems with the aircraft’s fuel system or the engine itself. However, a significant amount of debris was recovered from the fuel strainer, the carburettor float bowl and directly below the carburettor nozzle and main jet assembly. The debris in the fuel strainer appeared to include a range of different foreign materials.

The carburettor and the recovered material were examined by the ATSB. Most of the recovered material had a white, chalky appearance and ranged in size up to 5 mm. Inside the carburettor bowl, a significant amount of the material had accumulated at the drain area, and a 'tide' line was visible on the sides of the drain area. The inside surface of the bowl exhibited pitting corrosion where the material had dislodged (Figure 2).

A small amount of similar white chalky material was also observed on a ‘dip’ in the carburettor bowl, slightly above the drain. Other than the areas described, the internal surfaces of the bowl appeared to be relatively clean and in good condition, although some other foreign material was observed in the bowl.

ATSB analysis of the debris found in the carburettor showed that it was primarily comprised of aluminium and oxygen. It was considered likely that the particles were aluminium oxide, a corrosion product from the aluminium carburettor bowl.

Figure 2: Material inside the carburettor bowl of VH-DGF



Source: ATSB.

Engine history

The engine fitted to VH-DGF at the time of the accident was originally fitted to another Cessna 182, registered VH-EIZ. In December 2011 the engine (serial number 67386-7-R) and carburettor (serial number H-11-5085) were removed, overhauled and refitted to VH-EIZ.

In October 2016, the engine and carburettor were removed from VH-EIZ for fitment to VH-DGF. At that time the engine had accumulated 328.1 hours since overhaul. VH-DGF was rebuilt over a 2-month period, and a maintenance release was issued in early January 2017.

No flights were documented on the maintenance release during:

- the 4-month period from early January to early May 2017
- the 3-month period from mid-May to mid-August 2017
- the 7 weeks up until the end of January 2018.

Other than these periods of inactivity between October 2016 and August 2017, the lowest utilisation of the engine since last overhaul was 44.5 hours over an 18-month period between 2013 and 2014.[4]

The last periodic (100-hourly) inspection was carried out on 30 May 2018 at 7,730.1 airframe hours and 393.9 engine hours since overhaul. At the time of the accident, the engine had accumulated 438.4 hours since overhaul.

Between the overhauled engine commencing service in 2011 and the accident, six periodic inspections were conducted which examined the engine (four inspections when it was fitted to VH-EIZ and two when fitted to VH-DGF).

Periodic maintenance requirements

The aircraft was being maintained in accordance with Civil Aviation Safety Authority (CASA) maintenance schedule 5 and all airworthiness directives applicable to the aircraft.[5] Maintenance schedule 5 outlined requirements for daily inspections (conducted prior to the first flight of each day) and periodic inspections (conducted every 100 hours or 12 months, whichever came first).

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4 Records for monthly utilisation were not available to be examined when the engine was fitted to VH-EIZ.

5 Civil Aviation Regulation (CAR) 42B stated that the certificate of registration holder could maintain a class B aeroplane in accordance with CASA's maintenance schedule. Class B aeroplanes included all aeroplanes except transport category aeroplanes used for regular public transport operations.

The periodic inspection requirements included a requirement to 'drain and flush the carburettor fuel bowl and refit the plug and lockwire'. This requirement was reiterated in a number of advisory publications.[6]

The six periodic inspections carried out after the engine was overhauled were conducted by four different maintenance organisations. Maintenance records from these periodic inspections indicated that the task of draining and flushing the carburettor had been conducted. During interviews, personnel from three of these maintenance organisations noted that, although this task was required for every periodic inspection, they were aware that it was not always carried out.

A review of the recent maintenance releases for VH-DGF identified a number of anomalies:

- The second last periodic inspection and maintenance release were certified for on the 3 and 4 January 2017. The aircraft was ferried to Queensland on 11 December 2017 to be used by another parachuting operation. The maintenance release expired on 3 January 2018, after which the aircraft was used for numerous flights (totalling 4.2 hours flight time) during the period from 27 January until 25 March 2018. As the maintenance release was expired, a special flight permit[7] was issued and the aircraft ferried from Seventeen Seventy to Caboolture on 18 April 2018 (2.1 hours flight time). A second special flight permit was issued and the aircraft was ferried to Tyabb, Victoria, on 26 May 2018 which involved approximately 6.5 hours flying. In summary, based on documented records, the aircraft was operated for 12.8 hours over a period of 4 months without a valid maintenance release (and without a periodic inspection having being conducted within the previous 12 months).
- Between periodic inspections, oil and oil filter changes were required. The requirement for the engine fitted to VH-DGF was for an oil and oil filter change after 50 hours flight time or 4 months (whichever came first), and any such change had to be certified on the maintenance release. The second last maintenance release showed two oil and oil filter changes. The first was on 11 December 2017, 11 months since the last periodic inspection. The second occurred on 22 May 2018, 5 months after the previous oil and oil filter change.
- The last periodic inspection occurred on 30 May 2018, with a maintenance release issued on the same day. The maintenance release included a requirement to test the pitot static system as per Civil Aviation Order 100.5 (required every 24 months) by 4 January 2019. There was no annotation on the maintenance release to indicate that the inspection was conducted prior to the accident flight (6 January 2019).
- On the last maintenance release there was a requirement to carry out an oil and oil filter change on 30 September 2018, however there was no record of this being done.

Engine storage requirements

CASA Airworthiness Bulletin AWB 85-021 (Piston engine low utilisation maintenance practices) stated:

> It is widely acknowledged that piston engines that are not flown frequently are susceptible to damage from corrosion and contamination, which may adversely affect their expected service life.
>
> Susceptibility to corrosion is influenced by a number of factors, including but not limited to, geographical location, season, usage and storage.
>
> When a piston engine is exposed to adverse environmental conditions such as coastal areas and areas of high relative humidity, corrosion attack can occur within a few days. Conversely, engines

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6 These include the United States' Federal Aviation Administration's Advisory Circulars AC 20-106 and AC 20-125, Special Airworthiness Information Bulletin SAIB CE-10-40R1, and the Civil Aviation Safety Authority's Airworthiness Bulletin AWB 28-008 (*Water contamination of aviation fuel*).

7 Special flight permits are issued under CASR 21.200 for individual aircraft which for a variety of possible reasons may not meet the airworthiness requirements under the Civil Aviation Act, Civil Aviation Regulations (CASR 1998 and CAR 1988), and Civil Aviation Orders.

> under more favourable environmental conditions can remain inactive for several weeks without evidence of damage by corrosion.
>
> Experience has shown that the best course of action to reduce the likelihood of corrosion attack on engine internal surfaces is to fly the aircraft regularly. In circumstances where this action is not possible engine preservation procedures have been promulgated within engine manufacturer's instructions for continuing airworthiness to combat and minimise the corrosion condition a direct result of engine inactivity…
>
> In general, manufacturers recommend that for engines which won't be flown for 30 days or more, a preservation regime should be instigated.
>
> The need for engine preservation should be evaluated by the aircraft operator having regard to the prevailing environmental conditions and period of aircraft inactivity.

The aircraft manufacturer (Cessna) specified various maintenance actions if an engine was not being utilised for various periods of time. For periods up to 30 days (flyable storage) and 90 days (temporary storage), there was no required actions for preserving the carburettor, whereas there were such requirements for indefinite storage periods.

The engine manufacturer (Continental Motors) advised[8] operators to inject corrosion preventative oil into the carburettor while the engine is running for:

> an engine, which has been in operation, is to be stored much longer than a week under normal climatic conditions…

There was no indication in the aircraft's maintenance records regarding whether any storage or preservation measures were applied to the aircraft's engine during the periods of inactivity from October 2017 until January 2018.

Related occurrence

On the 14 February 2017, a Yakovlev 52 experienced a loss of engine power en route to its destination. While conducting a forced landing, the aircraft collided with a tree, pitched down and collided with the ground. The pilot was seriously injured and the aircraft was substantially damaged.

The Belgian Federal Public Service Air Accident Investigation Unit investigated the accident[9] and found:

> The engine loss of power was most probably caused by the internal corrosion of the carburettor which partially blocked the fuel flow at the pressure regulator valve. The corrosion of the magnesium alloy casing of the carburettor was likely caused by water contamination.

Occupant restraint

Pilot seat

Civil Aviation Safety Regulations 1998 (CASR) 90.105 required that the seats in the front row of an aircraft must be fitted with an approved safety harness. For small aeroplanes (with maximum take-off weight less than 5,700 kg) and helicopters, the safety harness needed to consist of a lap belt and at least one shoulder strap.

The pilot's seat of VH-DGF was fitted with a lap belt and upper torso restraint (UTR),[10] consistent with the regulatory requirements. Given the age of the aircraft, the UTR did not have an inertia reel (that is, when fitted correctly it was fixed in position and the person's movement was somewhat restricted). On the accident flight, the pilot wore the lap belt but the UTR was stowed in the seat

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8 Continental O470 Maintenance and Overhaul Manual, 4-12 Preparation for storage.

9 AAIU-2017-AII-02 Safety Investigation Report – Yakovlev 52 at Couvin, Belgium, on 14 February 2017.

10 Upper torso restraint: a shoulder strap or harness. A shoulder strap, when paired with a lap belt, effectively makes the occupant's restraint similar to the seat belt on modern cars.

pocket. The pilot noted that he was 165 cm tall and, when the UTR was worn and correctly adjusted, he could not reach the fuel selector or cowl flaps.

Previous ATSB investigations have found that pilots or passengers in the front seats of small aeroplanes and helicopters have not always worn the available UTRs, exacerbating the severity of their injuries in many accidents (for example, ATSB investigations 199800442, 200605133, AO-2010-053, AO-2012-083, AO-2012-142 and AO-2016-074).

A substantial amount of research has consistently shown that seat belts in small aircraft that include a UTR significantly reduce the risk of injury compared to lap belts only. UTRs minimise the flailing of the upper body and reduce the risk of impacts involving the head and upper body.

For example, a safety study by the United States' National Transportation Safety Board (NTSB) in 1985[11] examined 535 accidents involving small aircraft in 1982.[12] The NTSB estimated that 20 per cent of the 800 fatally-injured occupants would have had only serious injuries or minor injuries if they had been wearing a UTR. In addition, 88 per cent of 229 seriously injured occupants would probably have had less severe head or upper body injuries, only minor injuries or no injuries if they had been wearing a UTR.

A 2011 safety study by the NTSB[13] examined the rate of serious and fatal injuries of pilots in single-engine aeroplanes during the period 1983–2008. It found that pilots wearing only a lap belt had a 49 per cent greater likelihood of a serious or fatal injury compared with pilots wearing a lap belt and a UTR. Another study which examined take-off and landing accidents involving an engine power loss during 1983–1992 found that pilots wearing only a lap belt were 70 per cent more likely to be fatally injured than pilots wearing a seat belt and a UTR.[14]

Parachutists

Civil Aviation Regulation (CAR) 251 (*Seat belts and safety harnesses*) required seat belts to be worn during take-off and landing, during instrument approaches, when the aircraft was flying less than 1,000 ft above terrain and at all times when in turbulent conditions. CAR 251 had provision to change the type of restraint. In the case of aircraft used for parachuting operations, this was usually a single-point restraint.

Civil Aviation Order (CAO) 20.16.3 (*Air service operations – carriage of persons*) stated:

> Where a parachutist is not provided with a seat of an approved type, he or she shall be provided with a position where he or she can be safely seated.

Except when about to jump, parachutists were required to wear a seat belt, safety harness or parachute that was connected to an approved single-point restraint.

Additionally, the Australian Parachute Federation (APF) Operational Regulations, section 5.2.4, required an aircraft used for parachuting to be fitted with sufficient parachutist restraints that are manufactured to a standard approved by CASA and the APF, labelled accordingly, or have sufficient aircraft seats and seatbelts.

The ATSB and other investigation agencies have previously expressed concern about the suitability of single-point restraints for parachuting operations, with research showing that dual-

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[11] National Transportation Safety Board 2005, *General aviation crashworthiness project: Phase two – Impact severity and potential injury prevention in general aviation accidents*, Safety Report NTSB/SR-85/01.

[12] The selected accidents included those where at least one occupant was fatally or seriously injured. The accidents were evaluated to determine the extent to which they were survivable, based on whether one occupant either survived or could have survived if shoulder harnesses or energy-absorbing seats were used. The data suggested that a survivable envelope was defined by impact speeds of 45 kt at 90º angle of impact, 60 kt at 45º angle of impact and 75 kt at 0º angle of impact.

[13] National Transportation Safety Board 2011, *Airbag performance in general aviation restraint systems*, Safety Study NTSB/SS-11/01.

[14] Rostykus PC, Cummings P & Mueller BA 1998, 'Risk factors for pilot fatalities in general aviation airplane crash landings', *Journal of the American Medical Association*, vol. 280, pp.997-999.

point restraints offer occupants better protection in the event of an accident. In addition, in some previous take-off accidents, parachutists were not wearing the single-point restraints.[15]

The requirements of CAR 251, CAO 20.16.3 and APF regulation 5.2.4 were met by the operator of VH-DGF by using an approved single-point restraint for each parachutist. The parachutists on board the accident flight were wearing the approved single-point restraints during the accident flight.

15 ATSB investigation AO-2014-053, *Loss of control involving Cessna Aircraft Company U206G, VH-FRT, Caboolture Airfield, Queensland, 22 March 2014*.

Safety analysis

Engine power loss

The available evidence indicates that there was sufficient fuel on board the aircraft for the flight, the risk of carburettor icing was low and there appeared to be no mechanical defects with the engine.

The Cessna 182 fuel system was designed to provide gravity-fed fuel, free from contamination, to the carburettor. There are multiple components that remove contamination, such as filters and drain points. After the fuel has entered the carburettor bowl, there are no further defences in place prior the fuel being atomised for combustion.

The carburettor fitted to VH-DGF contained aluminium oxide corrosion deposits. These were of sufficient size such that, when loosened, they probably blocked fuel flow within the carburettor, resulting in the aircraft engine suddenly losing power shortly after take-off.

As the carburettor bowl is on the 'downstream' side of the defences to prevent contamination, there are maintenance and storage processes to ensure its serviceability. The corrosion was probably able to form in the carburettor bowl during periods of inactivity. However, it was not possible to determine exactly when the corrosion started and propagated.

Periodic inspections (every 100 hours or 12 months) play a vital role in ensuring the serviceability of an aircraft's engine, and these inspections had a requirement to drain and flush the carburettor. However, the extent to which this action was actually conducted during the six inspections since the engine and carburettor were overhauled could not be determined.

Maintenance overrun

It was also noted that a periodic inspection was not conducted at the required interval. A periodic inspection was required by 3 January 2018, but was not conducted until 30 May 2018. During the period from 27 January 2018 to 25 March 2018, the aircraft was flown without a valid maintenance release, and a further two flights conducted under special flight permits. However, given the last periodic inspection was done 7 months prior to the accident, the extent to which this previous omission contributed to problems with the carburettor was unclear.

There was also no indication on the last maintenance release that oil and oil filter changes were being conducted every 4 months. However, these omissions (if they occurred) should not have had an impact on the condition of the carburettor.

Use of occupant restraints

In general, the forces transmitted to occupants in light aircraft involved in an accident are higher than those transmitted in large transport aircraft involved in an accident. This is primarily due to the lack of protection from a crushable fuselage structure and therefore reduced energy absorption in a small aircraft.

A substantial body of research has shown that the risk of serious and fatal injuries can be significantly reduced if the occupants of small aircraft wear upper torso restraints (UTRs). In this case, the pilot was wearing a lap belt but not wearing the UTR.

It was fortunate that the pilot was not injured on this occasion. However, by not wearing his UTR, he significantly exposed himself to unnecessary injury risk. Noting that a UTR without an inertial reel can be restrictive, this should not prohibit the use of UTRs during critical phases of flight, such as take-off and landing.

Preparation for an emergency landing

During the accident flight, the parachutists were wearing the single-point restraints and, given the relatively-low impact forces, the restraints were sufficient to minimise injury risk during the forced landing.

However, after being ordered to evacuate by the pilot, the parachutists adjacent to the right door attempted to exit the aircraft without releasing their single-point restraints, delaying the egress of all on board. Fuel leaking from the damaged left wing of the aircraft increased the likelihood of a post-accident fire, and therefore the importance of rapid evacuation.

In this case, the parachutists knew how to undo their restraints, and would have been aware of the required actions for exiting the aircraft in the case of an emergency during take-off. However, this investigation highlights the additional benefits of mentally rehearsing the required actions immediately prior to or during take-off. According to the Civil Aviation Safety Authority's Cabin safety bulletin 12 – *General aviation passenger briefings* (October 2018):

> Survivors of aircraft accidents have provided anecdotal evidence as to the importance of their recollection of information… Adequately briefed passengers, who understand how to help themselves, will assist in the quick and successful evacuation of an aircraft.

Pilot response to the engine power loss

Airborne emergencies can be dynamic, fast-paced, and place a high cognitive workload on the pilot. When confronted with an airborne emergency, a pilot's hierarchical priorities are to ensure the aircraft remains in controlled flight, navigate (in this case to a suitable landing area) and, if time permits, communicate the nature of the emergency to authorities enabling them to respond appropriately.[16]

Standard flight training and guidance for pilots is to land straight ahead, or within 30º either side of straight ahead, following an engine failure or power loss at a low height. Pilots are also taught to only consider a turnback manoeuvre once they have achieved a minimum height, which may vary depending on the aircraft type and other factors.

A substantial amount of guidance material has been published about managing engine failures after take-off, and such guidance material continually emphasises the importance of not considering a turnback until a pre-determined safe altitude has been reached. For example, a recent article in CASA's *Flight Safety Australia* publication[17] (Stobie 2019) provided the following guidance:

> Something that should have stuck from basic training was that you should never turn back following engine failure immediately after take-off. There's good reason for this lesson—countless fatal accidents have involved pilots unsuccessfully attempting to turn back to the airport following an engine failure on upwind at low level. It's often labelled the impossible turn, and it's a procedure fraught with risk.

In this case, when the power loss occurred at about 400 ft, the pilot correctly assessed there was insufficient height to conduct a turnback to the departure runway. He selected a suitable landing area off the airfield 45° to the right of his current heading which, given the height of the aircraft, was able to be reached safely. The pilot automatically lowered the nose of the aircraft to maintain controlled flight and attain best glide speed, and he then focussed on navigating the aircraft to the suitable landing area.

With the limited time and height available, the pilot displayed sound airmanship and decision-making by conducting a forced landing and accepting the risk of a minor accident, rather than

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16 These hierarchical priorities are colloquially known as 'aviate, navigate, communicate'.

17 Stobie N 2019, 'Your one and only: Mitigating the risk of engine failures in singles', *Flight Safety Australia*, uploaded March 2019. Available from www.flightsafetyaustralia.com.

turning back and risking a loss of control and an accident involving much more serious consequences.

Findings

From the evidence available, the following findings are made with respect to the loss of power on take-off and forced landing involving a Cessna 182, registered VH-DGF at Tooradin Airfield, Victoria on 6 January 2019. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing factors

- The carburettor contained aluminium oxide corrosion deposits which, when loosened, likely blocked fuel flow within the carburettor, resulting in the engine losing power shortly after take-off.
- The engine had periods of inactivity over the preceding years, and corrosion was able to form within the carburettor that was not prevented or detected by maintenance providers during periodic inspections (every 12 months or 100 hours flight time).

Other factors that increased risk

- During the period from 27 January 2018 to 25 March 2018, the aircraft was flown without a valid maintenance release, and a further two flights conducted under special flight permits, without a periodic inspection having been conducted in the previous 12 months.
- The pilot was not wearing an upper torso restraint during the accident flight, thereby increasing the likelihood of serious injury during the forced landing.
- The parachutists adjacent to the door attempted to exit the aircraft without releasing their single-point restraints, delaying the egress of all on board.

Other findings

- After the engine lost power, the decision by the pilot to conduct a forced landing rather than turn back to the departure runway minimised the risk of loss of control during the forced landing.

Safety actions

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.

Aircraft operator

The operator advised that it intends to direct pilots to wear upper torso restraints and that this requirement will be incorporated into its training and induction schedule.

Australian Parachute Federation

As a result of a separate occurrence prior to the accident involving VH-DGF, the Australian Parachute Federation has advised the ATSB that in February 2019 it distributed 'Continuing Improvement Package 4 – Aircraft Emergency and Evacuation Procedures' to 60 parachuting clubs to incorporate into their operations and to prompt discussion on the subject.

The aims of the package were to:

- reduce the risk and resultant injuries in the event of an aircraft emergency
- discuss procedures in the event of aircraft emergency and/or evacuation
- discuss multiple aircraft emergency and evacuation scenarios
- implement aircraft evacuation training/drills.

Additionally, the Australian Parachute Federation advised in January 2020 that it was in the process of conceptualising a dual point, single release restraint.

General details

Occurrence details

Date and time:	6 January 2019 – 1045 EDT	
Occurrence category:	Accident	
Primary occurrence type:	Engine failure or malfunction	
Location:	Near Tooradin Airfield	
	Latitude: 38° 12.9300' S	Longitude: 145° 25.4220' E

Aircraft details

Manufacturer and model:	Cessna Aircraft Company 182G	
Registration:	VH-DGF	
Operator:	Skydive South East Melbourne	
Serial number:	18255755	
Type of operation:	Sports Aviation - Parachute Operations	
Departure:	Tooradin	
Destination:	Tooradin	
Persons on board:	Crew – 1	Passengers – 4
Injuries:	Crew – nil	Passengers – nil
Aircraft damage:	Substantial	

Sources and submissions

Sources of information

The sources of information during the investigation included:

- the pilot of VH-DGF
- the parachuting school that was operating the aircraft (Skydive South East Melbourne)
- various maintenance providers
- Civil Aviation Safety Authority
- the carburettor manufacturer (Marvel).

Submissions

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

A draft of this report was provided to the pilot, the aircraft operator / parachuting school (Skydive South East Melbourne), the maintenance organisation that conducted the last periodic inspection on the aircraft, the carburettor manufacturer (Marvel, via the United States National Transportation Safety Board (NTSB)), the engine manufacturer (Continental, via the NTSB), the aircraft manufacturer (Cessna, via the NTSB), Civil Aviation Safety Authority and the Australian Parachute Federation (APF).

Submissions were received from the pilot, aircraft operator / parachuting school and APF. The submissions were reviewed and, where considered appropriate, the text of the report was amended accordingly.

Australian Transport Safety Bureau

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

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

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

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

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

Developing safety action

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

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

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

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

Terminology used in this report

Occurrence: accident or incident.

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

Contributing factor: a factor that, had it not occurred or existed at the time of an occurrence, then either:

(a) the occurrence would probably not have occurred; or

(b) the adverse consequences associated with the occurrence would probably not have occurred or have been as serious, or

(c) another contributing factor would probably not have occurred or existed.

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

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

Australian Transport Safety Bureau

Enquiries 1800 020 616
Notifications 1800 011 034
REPCON 1800 020 505
Web www.atsb.gov.au
Twitter @ATSBinfo
Email atsbinfo@atsb.gov.au
Facebook atsbgovau
Linkedin Australian Transport Safety Bureau

Investigation

ATSB Transport Safety Report
Aviation Occurrence Investigation

Loss of power on take-off and forced landing involving
Cessna 182, VH-DGF, Tooradin Airfield, Victoria on 6 January 2019

AO-2019-002

Final – 31 January 2020