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Australian Transport Safety Bureau

Fuel related event involving a Fairchild SA227, VH-UUO

Brisbane Airport, Queensland, 28 August 2013

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Addendum

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Fuel related event involving a Fairchild SA227, VH-UUO

What happened

On 28 August 2013, at about 0030 Eastern Standard Time,[1] a Fairchild SA227 aircraft, registered VH-UUO, arrived at Brisbane Airport from Cairns, Queensland. The pilot checked the fuel quantity after landing and advised engineering staff that the fuel tanks were out of balance and the left fuel quantity gauge was unserviceable. The unserviceability was recorded on the aircraft maintenance log (AML).

VH-UUO

Source: Victor Pody

The pilot and engineers rebalanced the fuel tanks in accordance with company procedures. They also refuelled the aircraft so that a total of 1,200 L of fuel was on board in preparation for the subsequent flight to Bankstown, New South Wales. The pilot then concluded his duty for the day.

The pilot of the next flight was en-route to Brisbane Airport when he contacted operations staff requesting an additional 200 L of fuel be uploaded due to the forecast weather at Bankstown. The pilot reported that a staff member then went to the aircraft and noted the left fuel quantity gauge unserviceability on the AML and that there had been an imbalance of about 100 L between the fuel tanks, with about 100 L more fuel in the left tank than the right. Unaware that the previous pilot and engineers had corrected the imbalance, the staff member ordered the additional 200 L of fuel as requested by the pilot. He requested that 150 L be put in the left tank and 50 L in the right as he believed this would balance the fuel tanks. However, the 150 L of fuel was incorrectly loaded into the right tank, resulting in a total of 750 L in the right tank, 650 L in the left tank, and an imbalance of 100 L.[2]

When the pilot arrived at Brisbane, he conducted a pre-flight inspection and noted the unserviceable fuel quantity gauge on the AML. He then checked the minimum equipment list (MEL),[3] which stated that one fuel tank quantity gauge may be inoperative provided that a reliable means was used to establish that the fuel quantity on board met the regulatory requirements for the flight.

Prior to commencement of a flight, the pilot was required to establish the fuel quantity by checking the previous flight record for calculated fuel quantity remaining and fuel added since the last flight. The previous pilot had been able to confirm the fuel on-board from three sources: magna sticks;4 the fuel burn during the flight; and the fuel log book. The magna sticks only provided valid fuel quantity readings for each tank between 114 L (30 USG) and 586 L (155 USG), which the previous pilot was able to use on arrival in Brisbane, but could not subsequently be used once the additional fuel had been uploaded. The pilot assessed that the previous pilot and engineers had established the fuel quantity, which complied with the MEL requirements.

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

2 According to the pilot operating handbook, the permissible fuel imbalance between tanks was 114 L (200 lb).

3 Minimum equipment list (MEL), approved by the State of the Operator which will enable the pilot-in-command to determine whether a flight may be commenced or continued from any intermediate stop should any instrument, equipment or systems become inoperative.

4 A Magna-stick was located under each wing, inboard of the engine nacelle. Magna sticks allowed checking of the fuel quantity, in 5 US gallon graduations, of each wing tank, provided the tank contained between approximately 30 and 155 US gallons (114 L to 586 L).

The pilot reported that he expected about 1,400 L of fuel to be on board. The serviceable fuel quantity gauge was indicating 852 L of fuel in the right tank and the left gauge was reading zero. According to the aircraft's fuel log book, there was about 1,400 L on board, with about 700 L in each tank. As the aircraft was on level ground, the pilot opened the cross-flow valve and the serviceable (right) fuel gauge dropped to read 795 L and then stabilised. The pilot believed that he had removed the fuel imbalance and that the aircraft was now in balance. He also made the assumption, in accordance with company procedures, that the gauges were over-reading (and therefore overestimating the fuel on board) and that the fuel log book was under-reading, (and therefore overestimating the fuel burn). The fuel log book reading was determined on the lowest fuel quantity obtained from either: the fuel log, the magna sticks, or the fuel quantity gauge/s.

At about 0130, the aircraft departed Brisbane on the flight to Bankstown. During the initial climb, the pilot reported that the right wing dropped markedly. As the weather was fine and the night was bright, the pilot was able to establish a visual reference and maintain control of the aircraft. The pilot raised the right wing and opened the fuel cross-flow valve to rebalance the aircraft. After about 2 minutes, the pilot reported that the aircraft was in trim[5] and he closed the cross-flow valve.

When in the cruise, the aircraft appeared to be in balance and was in a controllable state. He trimmed the aircraft and then engaged the autopilot. About 1 hour later, the pilot disengaged the autopilot and ensured the aircraft was still in trim.

During the approach to Bankstown, the pilot reported that the aircraft handled normally until at about 400 ft above ground level, when the right wing dropped again when the final stage of flap was selected. The pilot raised the right wing and elected to continue the approach, landing without further incident.

The pilot and an engineer then used the magna sticks to ascertain the fuel quantity remaining in each tank. They determined that there was an imbalance of about 210 L. They opened the cross-flow valve and re-balanced the aircraft.

Pilot comments

The pilot provided the following comments:

- Following the departure from Brisbane, he elected not to return to Brisbane as the aircraft would have been above the maximum landing weight and he would have had to burn off fuel. Once the aircraft was in trim and controllable, he elected to continue to Bankstown.
- The aircraft was not normally operated with full fuel due to payload limitations. The sectors typically flown were 1 hour or less in duration. If the aircraft had been filled prior to departing, the only reliable way to re-check the fuel quantity on board after a short sector would be to fill the tanks to full because of the limited range of validity of the magna sticks.
- He elected not to conduct a go-around at Bankstown as the aircraft may have had similar controllability issues as experienced on climb-out at Brisbane.
- If the aircraft had entered instrument meteorological conditions (IMC)[6] on take-off, he may not have been able to control the aircraft as promptly.
- A pilot with less experience on the SA227 may not have been able to regain control of the aircraft as easily.
- The company pilots perform simulated asymmetric engine failures after take-off regularly as part of their ongoing training and checking, and he believed that practice assisted in his ability to control the aircraft.

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[5] Trim is a basic measure of any residual moments about the aircraft centre of gravity in hands-off flight.

[6] Instrument meteorological conditions (IMC) describes weather conditions that require pilots to fly primarily by reference to instruments, and therefore under Instrument Flight Rules (IFR), rather than by outside visual references. Typically, this means flying in cloud or limited visibility.

- Adding fuel in attempt to rebalance an aircraft carries a high level of risk. Draining and refilling fuel tanks would be a safer method.

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.

Aircraft operator

As a result of this occurrence, the aircraft operator has advised the ATSB that they are taking the following safety actions:

Recommended amendments to the MEL, subsequent to CASA approval

- The pilot in command is to supervise refuelling.
- If the aircraft has been refuelled from a known quantity, either full fuel or within the valid range for the magna sticks, then the next refuel can be from the known fuel burn.
- The subsequent refuel must again be from a known quantity.
- Removing the reliance on using previous flight records for obtaining fuel quantity onboard.

Safety message

This incident highlights the importance of thorough pre-flight preparation in particular with regard to fuel planning and loading. A *Flying* magazine article available at www.flyingmag.com/technique/tip-week/balance-your-fuel reminds pilots that ensuring sufficient fuel is being carried is not the only fuel-related concern to keep in mind. A fuel imbalance can potentially affect the controllability of the aircraft.

Civil Aviation Advisory Publication (CAAP) 234-1(1)[7] provides guidelines for aircraft fuel requirements and 13.1 states that:

> Unless assured that the aircraft tanks are completely full, or a totally reliable and accurately graduated dipstick, sight gauge, drip gauge or tank tab reading can be done, the pilot should endeavour to use the best available fuel quantity cross-check prior to starting. The cross-check should consist of establishing the fuel on board by at least two different methods…

The following provide additional information on fuel related events:

- *Flight Safety* magazine, November 2006, has an article regarding a Metro accident resulting from the crew inducing a sideslip to balance fuel, http://flightsafety.org/asw/nov06/asw_nov06_p46-50.pdf?dl=1.
- The ATSB report www.atsb.gov.au/publications/investigation_reports/2007/aair/ao-2007-017.aspx provides valuable information regarding assessment of an aircraft's fuel state.

[7] www.casa.gov.au/download/caaps/ops/234_1.pdf

General details

Occurrence details

Date and time:	28 August 2013 – 0130 EST	
Occurrence category:	Serious incident	
Primary occurrence type:	Fuel related event	
Location:	Brisbane Airport, Queensland	
	Latitude: 27° 23.05' S	Longitude: 153° 07.05' E

Aircraft details

Manufacturer and model:	Fairchild Industries Inc. SA227-AC	
Registration:	VH-UUO	
Serial number:	AC 530	
Type of operation:	Charter - freight	
Persons on board:	Crew – 1	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Nil	

About the ATSB

The Australian Transport Safety Bureau (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; and fostering safety awareness, knowledge and action.

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

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

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

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.

About this report

Decisions regarding whether to conduct an investigation, and the scope of an investigation, are based on many factors, including the level of safety benefit likely to be obtained from an investigation. For this occurrence, a limited-scope, fact-gathering investigation was conducted in order to produce a short summary report, and allow for greater industry awareness of potential safety issues and possible safety actions.