Australian Government
Australian Transport Safety Bureau

Windshield cracking event involving Cessna Aircraft Company 750, VH-RCA

460 km south-east of Nadi, Fiji, 15 January 2013

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Windshield cracking event involving a Cessna Aircraft Company 750, VH-RCA

What happened

Cessna Citation 750, VH-RCA

Source: ATSB

On 15 January 2013, at about 1500 Coordinated Universal Time (UTC[1]), a Cessna Citation 750, registered VH-RCA (RCA) departed Faleolo International Airport, Samoa for Sydney Airport, New South Wales, with two flight crew and five passengers on board. The aircraft initially climbed to flight level[2] (FL) 340 and approximately 1 hour 35 minutes into the flight, the aircraft climbed to FL450.

Shortly after levelling at FL450, the crew reported that a WSHLD HEAT INOP L (windshield heat inoperative left) message was displayed on the EICAS[3]. The crew consulted the appropriate checklist, with the only action to leave icing conditions as soon as practical. The pilot flying (PF) reported that the left windshield was warm to the touch and that approximately 2 minutes later, the windshield outer ply shattered with a loud bang. The left and right windshield heat switches were subsequently switched to OFF. The flight crew completed the emergency depressurisation checklist, donned their oxygen masks and deployed the passenger oxygen masks. An immediate descent was commenced along with a turn towards Nadi International Airport, Fiji, which was one of the planned alternate airports. The PF declared a Mayday[4] which was acknowledged by Nadi radio. Once the descent was established, the pilot not flying (PNF) ensured passengers were on oxygen and briefed them on the situation. The cabin was prepared for a possible ditching, with the passengers directed by the PNF to don their life vests and review the safety briefing card. The PF reported that the windshield cracking remained constant during the descent and did not progress further. The cabin did not depressurise, and once at FL140 and with the cabin altitude stabilised, the passengers were directed to remove their oxygen masks. The mayday was downgraded to a PAN[5] and the flight continued to Nadi without further incident. There were no injuries to passengers or crew.

Windshield examination

The aircraft returned to Sydney on 26 January 2013 with no passengers on board. Subsequent examination of the left electrically heated glass windshield (part number 9914380-11) by the ATSB showed that the outer ply had shattered across the entire surface (Figure 1). A brown discolouration was observed towards the top right of the windshield (facing forward) along with staining around one of the soldered contacts (Figure 2). The damage was confined to the outer layer of the windshield.

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1 Coordinated Universal Time (abbreviated UTC) is the time zone used for civil aviation. All times used in this report are in UTC.

2 At altitudes above 10,000 ft, an aircraft's height above mean sea level is referred to as a flight level (FL). FL 370 equates to 37,000 ft.

3 Engine-indicating and crew-alerting system

4 Mayday is an internationally recognised radio call for assistance

5 An internationally recognised radio call announcing an urgency condition which concerns the safety of an aircraft or its occupants but where the flight crew does not require immediate assistance.

A review of the aircraft maintenance documentation showed that the left windshield, serial number 05123H7884, had been installed on 5 July 2005 and had accumulated approximately 3,200 hours and 2,050 flight cycles since that time.

Figure 1: Shattered left windshield external (left) and internal (right)

Source: ATSB

Windshield system description

The windshields were of a laminated glass construction, with an outer, middle and inner pane of glass. The middle and inner panes comprised the structural component of the windshield, and either pane was structurally capable of maintaining cabin pressure. There was a heated interlayer between the outer and middle glass panes.

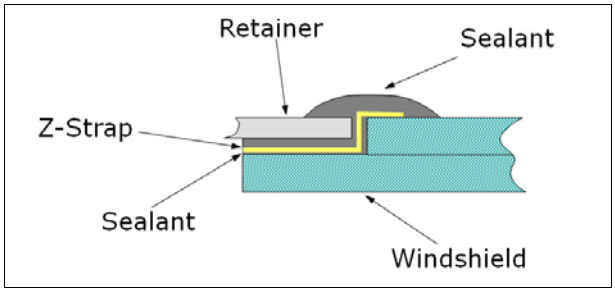
The windshield heating system consisted of a left and right component that included an AC alternator, a 3-phase circuit breaker, a heat controller and the windshield. The heat controller used temperature feedback from the windshield to control the supplied power, with a normal operating temperature of 43 °C. Each windshield had three heating zones, one for each phase of AC power, which were arranged vertically. Bus bars at the top and bottom of the windshield connected the wiring to the heater film through a braided wire lead which was soldered to the bus bar. Power flowed from the braided wire into the upper bus bar and was distributed to the thin metal oxide heating film, grounding in the same manner at the lower bus bar.

Manufacturer's comments

The manufacturer reported that they had experienced two reliability issues with windshield part number 9914380-11/-12.

The first issue was related to moisture ingress. Wear of the seal at the top of the windshield could allow moisture ingress to the bus bar and lead to degradation of the electrical connection between the bus bar and the heating film which could eventually begin to burn out. This could result in arcing that could eventually lead to failure of the outer non-structural face ply of glass. The manufacturer addressed the issue by adding a fiberglass z-strap along the boundary of the face ply to add an additional moisture protection layer and to also provide an indicator of seal wear.

Figure 2: Schematic showing location of z-strap



Source: Cessna Aircraft Company

The second issue was a breakdown of the bus bar at the bus bar solder joint as a result of differing thermal coefficients of expansion between the solder and bus bar material. Thinner bus bars (as a result of normal variation in production) were susceptible to progressively crack until the electrical circuit was opened and arcing began. The extreme heat and pressure build-up of locally vaporized interlayer material due to the arcing would then eventually lead to failure of the non-structural face ply. The issue was addressed by increasing the size and mass of the upper bus bar and moving it down sufficiently to allow for inspections if required.

The above changes were incorporated into part number 9914380-13/-14 which was released to service in early 2008. There have been no reported cases of either of these failure modes in the -13/-14 windshields.

ATSB comment

The windshield from VH-RCA had likely been affected by moisture ingress resulting in a degradation of the electrical connection between the bus bur and the heating film. The ATSB is satisfied that the issues leading to the non-structural failure of windshield part numbers 9914380-11/-12 have been addressed by the manufacturer.

Safety message

While the failure of the windshield involved the outer pane only, and did not result in a depressurisation, the precautions taken by the flight crew to descend to a lower altitude and diversion to the alternate airport highlighted the importance of good flight planning.

General details

Manufacturer and model:	Cessna Aircraft Company Citation 750	
Registration:	VH-RCA	
Type of operation:	Aerial work	
Primary occurrence type:	Windshield cracking	
Occurrence category	Incident	
Location:	460 km south-east of Nadi International Airport, Fiji	
	Longitude: S 22° 25.15'	Latitude: E 178° 30.18'
Persons on board:	Crew – 2	Passengers – 5
Injuries:	Crew – nil	Passengers – nil
Damage:	Minor	

About the ATSB

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