



# National Transportation Safety Board

Washington, D.C. 20594

## Safety Recommendation

Date: December 21, 1992  
In reply refer to: A-92-127  
through -131

Honorable Thomas C. Richards  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

On June 19, 1992, at 1405<sup>1</sup>, a Cessna 402C, N2715X, crashed shortly after takeoff, 1/2 mile south of the Grand Canyon West Airport, about 12.5 nautical miles east of Meadview, Arizona. The commercial pilot and nine passengers were fatally injured. The airplane was destroyed by impact forces.

The airplane was being operated under 14 CFR Part 135 in visual meteorological conditions and under visual flight rules by Adventure Airlines of Las Vegas, Nevada, as a sightseeing air tour flight. The flight had departed McCarran International Airport, Las Vegas, Nevada, about 1040 en route to the Grand Canyon West Airport. The flight was marketed as the "Indian Country Deluxe Air/Ground Tour." The airplane transited the Special Federal Aviation Regulation (SFAR) 50-2 airspace overlying the Grand Canyon and landed at Grand Canyon West Airport about 1153. At the conclusion of the ground tour, the pilot and passengers reboarded the airplane for the return flight to Las Vegas. The airplane crashed shortly after takeoff at 1405.

Shortly after liftoff, the airplane was observed in a right bank which increased suddenly with an abrupt drop of the nose. The airplane impacted the terrain in a flat attitude with high vertical forces.

Safety Board investigators recovered three videotapes from cameras among personal effects in the aircraft wreckage. Two of the tapes recorded portions of the accident flight. The video evidence and the wreckage examination disclosed that the right engine lost power during a right turn at low altitude shortly after takeoff. In one segment of the video, the pilot can be seen reaching between the front seats to the area where the fuel

<sup>1</sup>All times herein are mountain standard time in accordance with the 24-hour clock.

selector handles are located. This was about the time that the airplane departed from controlled flight.

Disassembly of the engines and testing of components were accomplished at several manufacturing facilities. These inspections found that the engines were capable of producing power.

The Safety Board's investigation continues, and its final report has not yet been adopted. However, certain findings raise concern about components of the fuel system of the airplane. The Safety Board believes that these findings justify urgent action by the Cessna Aircraft Company and the Federal Aviation Administration.

The investigation determined that Adventure Airlines operated a fleet of four Cessna 402C airplanes on this air tour route with a predetermined fuel load. Weight and balance calculations and operational procedures called for takeoff from the Grand Canyon West Airport with 240 pounds of total fuel (120 pounds or about 20 gallons in each tank). The videotape evidence showed fuel gauge indications of about 30/20 gallons, respectively, in the left/right fuel tanks during taxi for takeoff at the Grand Canyon West Airport. Interviews with company pilots confirmed that flights were routinely planned to accomplish takeoffs from the Grand Canyon West Airport with 20 gallons in each wing fuel tank. However, it is not possible to view partial fuel levels or "dip" the tanks of the Cessna 402 series airplanes due to the wing dihedral and a single fuel filler port located near the outboard end of the fuel tank. Therefore, in accord with procedures, Adventure Airlines pilots relied solely on the electric fuel quantity gauge to determine the amount of fuel on board. No low fuel level warning light or low fuel warning system was installed in the airplane. The Pilot's Operating Handbook (POH) establishes a 20 gallon minimum fuel quantity for each wing tank for takeoff.

The fuel quantity indicator, fuel selector valves, wing fuel tank inlet valves, right wing fuel capacitance probes, and the right fuel tank selector indicator plate were removed by the Safety Board for examination. None of these components revealed anomalies except for the wing fuel tank inlet valves.

The airplane was equipped with six (three in each wing) inlet fuel valves which were integral to the left and right wet wing fuel cells. All of the valves have a common Cessna part number, 99102-5; the manufacturer, Auto Valve Inc., identifies the valve by part number AVI 74D-81. The valves are located in the bottom of an inboard "wet wing fuel bay" that has cutouts in the wing rib bulkhead to allow fuel to transfer from the outboard wing section to the inboard section and the fuel valve area. Fuel is restricted from flowing back outboard of the rib bulkhead by check valves (flexible sheets allowing flow in one direction). The check valves were examined for security and condition. No evidence could be

found to indicate a check valve failure.

The right wing middle outboard fuel tank inlet valve was clean; however, it operated abnormally and was chaffed on its aluminum piston shaft where the shaft passed through the inlet screen. The inlet screen appeared to be made of stainless steel material and the screen elements in the vicinity of the chaffed area of the valve piston shaft also exhibited wear. The worn areas of the screen had adhering aluminum flakes which were identified by spectral analysis. The piston shaft was worn about 50 percent through its diameter and had a notch worn into the shaft which permitted a "stuck open" condition when the float arm was operated manually. There was also abnormal wear on the float arm and the bottom of the piston shaft. The wear on the float arm was not smooth and had ridges. The piston exhibited axial end play of 0.33 inch. The axial movement, coupled with the notch in the piston shaft, allowed the piston shaft to "hang up" on the inlet screen allowing the inlet valve to stick in the open position. It was demonstrated that the valve would stay in the open position with pressure from the valve's internal spring, regardless of the float position.

The other two fuel tank inlet valves from the right wing and the three valves from the left wing operated normally; however, they had similar abnormal wear patterns on the float arm where the valve piston shaft and pneumatic test shaft would meet the arm in the "valve open" position of the float. The piston shaft on each valve had evidence of chaffing adjacent to the inlet fuel screen.

An assembly date of 1978 or 1979 was stamped on each of the fuel tank inlet valves. The total airframe time on the accident airplane was 9265.9 flight hours. According to the operator's maintenance records, the aircraft had been operated for 413.6 flight hours since the last fuel inlet valve maintenance check had been accomplished. The valves are supplied to Cessna Aircraft Company as an original item in the 402C and in other wet-wing Cessna 400 series airplanes including the 421C, 414, and 404.

Cessna Aircraft Company established unusable fuel quantities for the intended flight maneuvers through calculations and flight tests during initial airplane certification. Based on 14 CFR 23.959 and 23.1585, then verified by flight demonstrations, the airplane POH provides unusable fuel quantities and minimum fuel limitations for takeoff. The flight demonstrations for certification were predicated on fully functioning fuel system components and therefore did not consider the consequences of a malfunctioning inlet valve. With fuel levels approaching the 20 gallon minimum limit for takeoff, the Safety Board is concerned that a malfunctioning inlet fuel valve may cause restrictions in fuel flow and the introduction of air into the system. In the accident on June 19, the Safety Board believes that air may have entered the right engine fuel system and caused an interruption of

fuel to the engine, thereby affecting a power loss shortly after the airplane became airborne.

The Safety Board believes that frequent flight operations with partial fuel levels cause excessive repeated float movements that in turn cause abnormal wear as seen in the inlet fuel valves of the accident airplane. The Safety Board has learned that recent examinations of other Cessna 402C airplanes used for air tour operations have revealed other similarly worn fuel inlet valves. The Safety Board is concerned that such worn valves will malfunction, unporting fuel tanks during maneuvering flight and may cause interruptions in the required fuel flow at critical times in the aircraft's flight envelope.

The Cessna 402C maintenance manual recommended inspection interval for these fuel inlet valves is 600 hours. The inspection procedure consists of a pass/fail check for full closure through the application of an air charge which forces the valve float downward to a position corresponding to an unusable fuel level. There is no current requirement to check the valve for progressive wear or to ensure that the valve fully opens when the float rises. The check does not provide any indication of useful life of the valve and no life limits have been established for the part.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Issue an immediate airworthiness directive to require a revised minimum fuel quantity for takeoff and flight of the Cessna 402C until such time as there is an individual inspection of all inlet float valves manufactured by Auto-Valve, Inc., for chaffing or abnormal wear of the piston shaft and replacement as required. (Class I, Urgent Action) (A-92-127)

Require that the Cessna Aircraft Company calculate and revise the minimum fuel quantity for takeoff and flight of the Cessna 402C and other applicable Cessna 400 series airplanes to a level that will preclude the introduction of air into a malfunctioning inlet fuel valve. (Class I, Urgent Action) (A-92-128)

Require that the Cessna Aircraft Company conduct testing to determine the rate of wear for inlet fuel valves and to establish a recurrent inspection program for Cessna 402C and other applicable Cessna 400 series airplane fuel inlet valves for integrity and to require replacement of any defective valves. (Class II, Priority Action) (A-92-129)


Require that the Cessna Aircraft Company determine if the current pneumatic inspection procedure for Cessna 402C

and other applicable Cessna 400 series fuel inlet valves is adequate to detect all wear conditions. Re-establish, as necessary, the intervals at which the operational check and inspections should be accomplished to ensure detection of worn valves. (Class II, Priority Action) (A-92-130)

Identify all aircraft applications where Auto-Valve, Inc., fuel tank inlet valves or similar valves are used and notify the aircraft operators and manufacturers of potential valve wear situations that would warrant specific inspection criteria. (Class II, Priority Action) (A-92-131)

Also, the Safety Board issued Safety Recommendation A-92-132 to the Cessna Aircraft Company.

Chairman VOGT, Vice Chairman COUGHLIN, and Members LAUBER, HART, and HAMMERSCHMIDT concurred in these recommendations.

By:   
Carl W. Vogt  
Chairman

