



# National Transportation Safety Board

Washington, D.C. 20594  
Safety Recommendation

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**Date:** August 18, 1993

**In reply refer to:** A-93-104

Honorable David R. Hinson  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

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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 operated under 14 Code of Federal Regulations (CFR), Part 135, in visual meteorological conditions and under visual flight rules by Adventure Airlines, Las Vegas, Nevada, as a sightseeing air tour flight. The airplane had departed McCarran International Airport, Las Vegas, Nevada, about 1040 en route to the Grand Canyon West Airport. 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 a ground tour, the pilot and passengers reboarded the airplane for the return flight to Las Vegas. The airplane crashed shortly after takeoff at 1405.

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

Subsequent to 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 level flight attitude with high vertical forces.

Safety Board investigators recovered from the wreckage three videotapes from cameras that were among the passengers personal possessions. Two of the tapes recorded portions of the accident flight. The video evidence and the wreckage examination disclosed that the right engine lost power 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 selector handles are located. A brief videotape view of the fuel flow gage, taken about the time that the airplane departed from controlled flight, revealed indications well below the range required for takeoff.

Adventure Airlines operated a fleet of four Cessna 402C airplanes on this air tour route with a predetermined fuel load from the Grand Canyon West Airport of 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. The Pilot's Operating Handbook establishes a 20-gallon minimum fuel quantity for each wing tank for takeoff.

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

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 several wing fuel tank inlet valves that exhibited abnormal wear.

The Safety Board was concerned that a malfunctioning inlet fuel valve might have caused restrictions in fuel flow and the introduction of air into the engine fuel system. Engineering data available from the manufacturer and the airplane certification information required by the Federal Aviation Administration (FAA) did not reveal the operational consequences of worn inlet fuel valves.

Therefore, the Safety Board issued Safety Recommendations A-92-127 through -132 to the FAA and the Cessna Aircraft Company regarding the potential for fuel supply interruption due to worn wing tank fuel inlet valves.

The FAA issued several airworthiness directives (ADs), most recently AD 93-05-03, which was amended on March 30, 1993. The ADs directed the inspection of fuel inlet float valves and set minimum fuel limits if new valves were not available. Cessna initiated redesign of new, more serviceable valves.

Cessna also conducted ground and flight tests with a Cessna 402C airplane. Test results obtained while simulating worn valves suggest that, although air does enter the fuel flow stream at various levels of fuel quantity and airplane pitch attitude, power interruption is not abrupt and does not occur until the fuel remaining in the tank decreases to about 4 gallons.

While these tests were being conducted, Safety Board investigators noted Teledyne Continental Motors (TCM) Service Bulletin, M93-9 Rev 1, issued in March 1993, that called for the installation of a new-style engine drive fuel pump coupling in engine models that would have included the TSIO-520-VB engine used in the accident airplane. The bulletin stated that replacement was intended "to ensure proper engagement of the fuel pump drive coupling." The new-style coupling is 0.12 inch longer than the earlier style.

FAA Service Difficulty Reports indicate four instances of worn/rounded off/failed fuel pump drive couplings prior to the accident; and the Teledyne Continental Motors, Director of Service, reported three additional cases of coupling failures subsequent to the accident.

Safety Board factual reports on the Adventure Airlines accident contain an overall description of the right engine fuel pump drive coupling; however, the wear pattern on the coupling was not examined in detail.

The drive coupling and the fuel pump from the right engine of the airplane were located and sent to the Safety Board's Material Laboratory for evaluation. The end of the drive coupling, which is square, engages a square shaped hole in the end of the fuel pump drive to provide the rotational motion to the pump. Wear on one end of the drive coupling indicated that the coupling engaged only a portion of the fuel pump drive when the wear occurred. The corners of this drive coupling were so worn that it was nearly round. Laboratory measurements revealed that another .001

inch of wear on the drive coupling would have prevented it from engaging or turning the fuel pump drive at all. Under magnification, circumferential scoring marks were found in the wear pattern on the pump end of the coupling. The wear pattern does not provide sufficient evidence to determine the degree or the timeframe of slip/disengagement; however, it does suggest that disengagement (slipping) of the drive coupling has taken place.

The wear area on the drive coupling shaft was limited to within about 0.14 inch of the end of the coupling. The increased length of the new-style coupling specified in TCM Service Bulletin M93-9 Rev 1 (0.12 inch) would have about doubled the engagement length of the coupling in the pump drive on the accident airplane. The action called for in the service bulletin is intended to "ensure proper drive coupling engagement." However, the service bulletin is not obligatory for all operators.


The Safety Board's investigation continues, and its final report has not yet been adopted. However, these findings raise concern about the reliability of fuel systems in certain model engines. Engine-driven fuel pump failure emergency procedures require that the pilot select "high" on the auxiliary (boost) pump and adjust the fuel flow to coincide with the power setting. Although the auxiliary pump is capable of providing sufficient fuel to the engine under most circumstances, it is no substitute for a more reliable engine-driven fuel pump, especially because the emergency procedure can divert the pilot's attention at a critical time, such as immediately after takeoff.

The engine manufacturer lists the affected models as the IO 520, IO 550, TSIO 520, and TSIO 550, for a total of 12,454 units. The FAA issued a Notice of proposed rulemaking (NPRM) on August 5, 1993 pertaining to the fuel pump drive coupling. However, the Safety Board believes that these findings justify more urgent action by the FAA and Teledyne Continental Motors than the normal rulemaking process and the proposed rule will provide.

Therefore, the National Transportation Safety Board recommends that the FAA:

Issue an emergency airworthiness directive that requires operators with affected engines to comply with Teledyne Continental Motors Mandatory Service Bulletin M93-9 Rev 1 within the operating time stated (30 hours).  
(Class I, Urgent Action) (A-93-104)

Chairman VOGT, Vice Chairman COUGHLIN, and Members LAUBER, HART, and HAMMERSCHMIDT concurred in this recommendation.

By:   
Carl W. Vogt  
Chairman