



Log 2007

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: December 30, 1987

In reply refer to: A-87-127 through -130

Honorable T. Allan McArtor
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Since 1975, Piper model PA-23 Apache airplanes have been involved in 14 accidents which occurred after water in the fuel led to engine stoppage. Six persons were killed and one was injured seriously in these accidents. Apache airplanes have been involved in 23 other accidents following engine stoppage wherein the reason for engine stoppage was not determined. Some of these accidents also may have involved water in the fuel (evidence of water is often elusive as in an accident involving fire after impact). These 23 accidents resulted in 14 fatalities and 3 serious injuries.

The Apache fuel system consists of 36-gallon, bladder-type fuel cells located outboard of each engine and, in most airplanes, 18-gallon auxiliary fuel cells in the outboard sections of the wings. The fuel cells do not incorporate fuel sump drains for eliminating contaminants but, instead, are drained through the fuel cell outlet ports to the main fuel strainers located in the inboard side of the main wheel wells. However, because of folds/wrinkles characteristic of these bladder-type fuel cells, a relatively large quantity of water may be entrapped within the fuel cell and remain undrainable and undetected during the conduct of a normal preflight procedure. Subsequent disturbance and movement of the water, as during takeoff, may cause it to flow to and overload the small (3-ounce) fuel strainer, resulting in engine stoppage.

The Piper PA-23 Apache/Aztec fuel systems were the subject of an open letter of June 11, 1987, addressed to both the National Transportation Safety Board (NTSB) and the Federal Aviation Administration (FAA) from Messrs. Norman L. Horton and Jerry L. Wells of Aviation, Safety and Management Consultants (ASMC), Central Point, Oregon. Messrs. Horton and Wells emphasized the potential for water entrapment in the PA-23 bladder-type fuel cells due to wrinkles or folds as outlined above and further stated that water might also be entrapped because of the relative position of the fuel cell outlet port. Based on the results of tests they conducted, they contend that even if the fuel bladders are not wrinkled, some water may still not be drainable but may remain entrapped in the aft inboard portion of the fuel cell with the airplane in its normal ground attitude. Part 3, subpart 3.444, "Fuel Tank Sump" of the Civil Air Regulations (CAR 3) governing certification of Piper Apache airplanes states:

4735/860-6

- (c) If a separate sediment bowl is provided in lieu of a tank sump, the fuel tank outlet shall be so located that, when the airplane is in the normal ground attitude, water will drain from all portions of the tank to the sediment bowl.

In view of the number of accidents involving engine stoppage in Apache airplanes due to water or undetermined reasons, the potential for entrapping water in the fuel cells of these airplanes is particularly disturbing. Moreover, a review of several accident reports, including those wherein water in the fuel was specifically cited as a causal element, clearly disclosed attempts by the pilots to remove water from the Apache fuel system during normal preflight procedures.

Piper model PA-23-250 Aztec airplanes, the successor design to the Apache, uses similar bladder-type fuel cells. However, unlike the Apache, the Aztec incorporates individual drain valves for each fuel line on the airplane that are located near the main fuel strainers. The Safety Board believes that the additional drain valves may contribute significantly toward elimination of (drainable) water from the fuel. ^{1/} Engine stoppage has been attributed distinctly to water in only one accident involving an Aztec since 1975. Both persons aboard that airplane were killed. However, 17 other accidents recorded since 1975 involved engine stoppage in the Aztec for undetermined reasons. Thus, the Safety Board is concerned that there is a similar potential for water entrapment in Aztec fuel cells. As a result, the Safety Board believes that the FAA, in conjunction with the Piper Aircraft Corporation, should conduct tests to determine whether or not significant amounts of water can be entrapped in the fuel cells installed in both the Piper Apache and Aztec airplanes.

The Safety Board has noted that several Apache airplanes which experienced engine stoppage due to water in the fuel had not been flown for 1 or 2 years preceding the accident. Typically, despite routine preflight efforts to remove water from the fuel system, engine stoppage in these airplanes occurred at very low altitude just after takeoff. Because of the potential for accumulating and/or entrapping relatively large quantities of water in the fuel system during such long periods of inactivity, e.g., through condensation or precipitation leakage, it would appear prudent to clean, purge, and swab the fuel system before resuming flight activity. As a result, the Safety Board believes that an article should be published in FAA Advisory Circular (AC) 43-16, General Aviation Airworthiness Alerts, pointing out the potential hazards of accumulating water in the fuel systems of the Piper Apache and other airplanes during extended periods of inactivity. The article should recommend means to avoid or minimize the accumulation of such water and ways and means of clearing the entire fuel system of water before initiating flight after such long periods of inactivity.

The fuel filler compartments on both Apache and Aztec airplanes are recessed within the tops of the wings and incorporate hinged access covers with seals. If the seals are defective, precipitation or wash water may enter the fuel filler compartment and leak into the fuel cell. Both airplane fuel systems also incorporate thermos-type fuel cell caps which often loosen, harden, or crack (especially on the older Apache airplanes) and are ineffective in sealing the fuel cells.

^{1/} On October 16, 1985, the Safety Board issued Safety Recommendation A-85-77 to the Federal Aviation Administration, recommending issuance of an airworthiness directive to require the installation of individual fuel line drain valves in the Piper Apache series airplanes.

On May 24, 1971, the Piper Aircraft Corporation issued Service Bulletin No. 340, "Fuel Cell Vent/Drain Lines Inspection," applicable to both Apache and Aztec airplanes, to prevent leakage of water into the fuel filler compartments and fuel cells, and to assure that the vent/drain hole inside the fuel filler compartment is not blocked or cracked. In view of the previous water in fuel/engine stoppage accidents involving Apache and Aztec airplanes and the potential for the influx of water into the fuel cells provided by the recessed fuel filler compartment design, the Safety Board believes that the FAA should mandate compliance with this service bulletin.

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

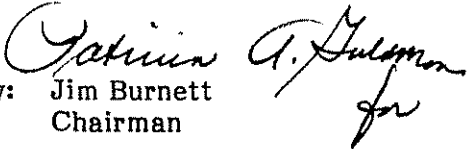
Conduct tests to determine whether or not water can be entrapped in the fuel cells installed in Piper model PA-23 Apache/Aztec airplanes because of wrinkles or folds in the bladders and/or because of the orientation of the fuel bladder cell with the airplane in a normal ground attitude. (Class II, Priority Action) (A-87-127)

If the Piper Apache/Aztec fuel cell tests disclose that unsafe quantities of water can be entrapped, issue an airworthiness directive containing appropriate remedial action that must be taken to purge the fuel cells of such water or to prevent the water from reaching the engine. The remedial action may include use of special fuel cell suction/siphoning devices, installation of fuel cell sump drains, larger capacity fuel strainers, and/or directed, special preflight action that a pilot must take to change the airplane's normal ground attitude and to optimize drainage of water through the existing fuel strainers. (Class II, Priority Action) (A-87-128)

Publish an article in FAA Advisory Circular 43-16, General Aviation Airworthiness Alerts, outlining the potential hazards of water in the fuel which may occur after extended periods of airplane inactivity, particularly in airplanes with bladder-type fuel cells and recessed fuel filler compartments. The article should recommend measures that should be taken to avoid or minimize the accumulation of water in the fuel system during such periods of inactivity and service procedures that should be followed to purge the fuel system of any water which may have accumulated before any subsequent flights are undertaken. (Class II, Priority Action) (A-87-129)

Issue an airworthiness directive applicable to Piper model PA-23 Apache/Aztec airplanes, requiring compliance with Piper Service Bulletin No. 340 concerning inspection of fuel cell vent and drain lines at every 100-hour or annual inspection, whichever occurs first. (Class II, Priority Action) (A-87-130)

BURNETT, Chairman, GOLDMAN, Vice Chairman, and NALL and KOLSTAD, Members, concurred in these recommendations. LAUBER, Member, did not concur.

By: 
Jim Burnett
Chairman