PILOT ADVISORY

Cessna seat malfunction

BY J. JEFFERSON MILLER

A recent product liability trial stemming from the crash of a 1966 Cessna 172G has highlighted apparent flaws in the design of seats and seat-latching mechanisms in single-engine Cessnas.

The accident occurred on June 2, 1980. The pilot was returning to Cape May County Airport in New Jersey after a 15-minute, early evening flight. As the aircraft neared the runway, witnesses observed it begin a normal go-around. Then, the 172 pitched up sharply, stalled and crashed in a steep nose-down attitude.

The pilot, his son and one other passenger died. A third passenger suffered serious injuries, including a brain contusion that caused a temporary loss of memory. The National Transportation Safety Board concluded that the probable cause of the accident was the pilot's failure to maintain flying speed.

A metallurgist hired by attorney Arthur Alan Wolk, who represented the survivors of the pilot and his son in the lawsuit against Cessna Aircraft Company, sifted through the wreckage of the aircraft and came up with a more elaborate theory of what happened in the seconds before the crash. The seat-latching mechanism in the pilot's seat, the metallurgist reported, was defective: The single pin that held the seat in place on a set of aluminum tracks had popped out of its hole on the go-around, and the seat had slid aft, causing the pilot to lose control. The sole survivor eventually regained his memory and confirmed that the seat slid just prior to the accident.

During the three-week trial, which ended June 8, 1984, Wolk submitted as evidence warnings about the seat-latching mechanism that had appeared several times since 1967 in the Federal Aviation Administration's monthly *Airworthiness Alerts* safety bulletin. *Airworthiness Alerts* is sent to aircraft mechanics to aid them in their maintenance inspections. The latest alert on the seat-latching mechanism was published in July 1983 and is reprinted on p. 73 in its entirety.

Wolk also entered into evidence a passage from the 1968 Cessna service manual for Cessna 100 series aircraft. The passage reads: "WARNING: It is extremely important that pilot's seat stops are installed, since acceleration and deceleration could possibly permit the seat to become disengaged from the seat rails and create a hazardous situation, especially during takeoff and landing."

According to the theory Wolk expounded to the jury, it is not one poorly designed part that is to blame for seat slippages, but the design of the seat and seat-latching mechanisms themselves. Wolk presented evidence showing that Cessna, since 1963, had replaced certain components of the seat structure with less-durable parts. The purpose of the substitutions, according to Wolk, was to save money.

Interior shot of 1969 Skylane shows one reason for seat track wear: seats must slide forward for rear passengers to enter, aft for front occupants.

The company switched from a steel frame to an aluminum frame in the standard seat, Wolk said. A nylon roller (which rolls over the seat track as the seat is adjusted fore and aft) replaced an aluminum one. Plastic washers replaced washers made of metal. An aluminum roller housing and seat-track flange (the flange holds the seat to the track) were substituted for a steel housing and flange.

In an interview after the trial, Wolk said that "Cessna was using materials that would wear so quickly that it created a condition known as 'slop,' so that critical dimensions became more critical." According to Wolk, the seat frame bends, the seat tracks and rollers wear down, the holes in the seat track elongate and the flange spreads apart. Eventually, it is possible, he said, for a seat-latching pin to pop out of its hole, allowing the seat to slam backward.

Wolk told the jury that Cessna had modified the seat-latching mechanism three times but had not solved the basic problem with the design. Dual latch pins were installed in 1973, but only one pin had a spring to force it down in the hole in the track. In 1980, dual springs were added, but because of the rigid linkage between the pins, it was possible, if the seat was slightly out of alignment, for one pin to engage without the second pin engaging. In 1983, dual pins and springs that could latch separately were added to the design. According to Wolk, owners of earlier models were never notified of the design changes. Our own search of Cessna service bulletins turned up no mention of recommended changes to the latching mechanism.

Cessna countered by arguing that the seat cannot slip if the pin is engaged in the hole. Even if it did slip, the company said, it would fall into the next hole and hold the seat. Further, Cessna said that the accident occurred because the pilot was blinded by the sun during the go-around and inadvertently stalled in a turn. The pilot's limited

flight experience, 110 hours, also was a factor in the accident, the company said.

The jury sided with the plaintiffs. It assessed Cessna $4.3 million in compensatory damages and $25 million in punitive damages, reportedly the largest punitive damage award ever made in a general aviation case. Cessna is appealing the verdict. In the meantime, the company refuses to comment on the case. Cessna would not provide *Pilot* with any technical diagrams of, or information concerning, the seats.

A jury decision is not the final word on a design's fitness. Juries mainly are composed of laymen, not specialists in the matter being litigated. Critics of the litigation process say that, sometimes, juries' verdicts are based at least as much on an emotional response to the horror of an accident and the plight of the victims as they are on the facts of the case.

But the case against Cessna seats appears strong. Data collected by NTSB and the FAA show that seat slips leading to accidents occur almost exclusively in Cessna single-engine aircraft. NTSB lists seats as a cause or factor in 22 accidents investigated between 1977 and 1981. Eleven of the accidents occurred because seats slipped. Ten of those accidents occurred in Cessna singles and one in a Piper Cherokee. In an accident report on the crash of one of the Cessnas, a 185, the investigator wrote: "...Only a small force was required for the lock pin to slide out of the lock slot and the seat to travel to the full-aft position."

The remaining 11 NTSB reports involved a miscellany of aircraft and a variety of seat failures: A loose seat cushion jammed the controls of a Bellanca 7G when a window opened in flight; a seat back failed in a Lake amphibian; the use of wrong parts led to a seat failure in a Grumman Traveler; a seat collapsed on touchdown on a homebuilt Mitchell Wing U-2; the rear seat-bottom in a Piper Cherokee contacted the positive battery cable, causing an in-flight fire (an emergency airworthiness directive was issued to correct the problem).

Despite NTSB's findings in the 10 seat-slip accidents involving Cessnas, the safety board has not recommended that the FAA issue an AD aimed at modifying the seat-latching mechanism. However, in 1981, NTSB did recommend that an AD be issued to address a problem caused when pilots position Cessna seats in the full-forward position. The recommendation was based on the case of a 172XP that crashed. Investigators determined that the left-front corner of the seat had wedged against the door jamb, leading the pilot to believe the seat was latched into place, when it was not. The safety board recommended that seat-rail stops be positioned to prevent the seat from wedging in the door. The FAA declined to issue an AD.

Accident/incident information collected by the FAA also indicates a pattern of seat slippages in Cessna singles. A computer run

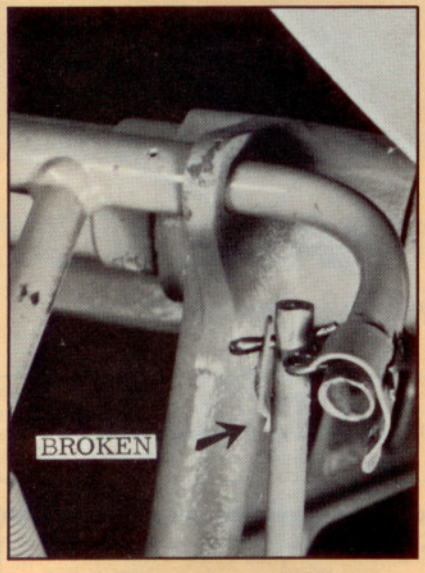
of accident/incident reports from 1978 through June 1984 turned up 20 reports of seat failures. Three of these detailed seat failures in the passenger cabins of airliners. One concerned a pilot seat-back failure in a Piper Warrior. The remaining 16 reports dealt with seat slippages in Cessna singles.

A telephone survey of 93 Cessna 172 owners, conducted in 1983 by Consumer Usage Laboratories, Incorporated, found that one-quarter of the pilots had experienced a seat slippage in a Cessna single (not necessarily a 172). The research company conducted the survey as part of an independent investigation of a Cessna 172 accident.

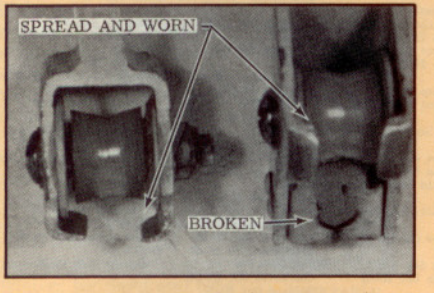
Our examination of several single-engine Cessnas on the ramp at Frederick Airport and Montgomery County Airport, both in Maryland, turned up examples of all the types of wear mentioned by Wolk. Based on our sampling of about a dozen airplanes, it appears that wear on seat tracks and seat-latching mechanisms is proportional to time on the airframe.

All the tracks we examined were worn down and had elongated holes. Seat tracks in Cessna singles differ from tracks in Piper

PREVENTIVE MAINTENANCE



Failed connection between actuating arm and linkage to latch pins.



Spread roller housing lets seat sway sideways and rock up and down. Slop could cause pin to unlatch.

If you fly a Cessna single, what can you do to prevent a seat slip? Very little, it appears, aside from inspecting the seats and seat-latching mechanisms regularly and replacing worn parts. The Federal Aviation Administration has published an inspection procedure for the seat tracks several times in recent years. Most recently, the inspection procedure was reprinted in the July 1983 issue of *Airworthiness Alerts*, a monthly publication of the FAA's Aviation Standards National Field Office in Oklahoma City. The passage from the *Alerts* reads as follows:

Cessna Single Engine Models

Numerous reports indicate that difficulties continue to be encountered with seat attachments, structure, locking mechanisms, tracks and stops. When required inspections are made, it is suggested the following items be examined:

1. Check the seat assembly for structural integrity.
2. Inspect the roller brackets for separation and wear.
3. Examine the locking mechanism (actuating arm, linkage, locking pin) for wear and evidence of impending failure.
4. Inspect the floor mounted seat rails for condition and security, locking pin holes for wear, and rail stops for security.
5. Determine that the floor structure in the vicinity of the rails is not cracked or distorted.

Defective or worn parts are a potential hazard which should be given prompt attention. Accomplish repair and/or replacement of damaged components in accordance with the manufacturer's service publications.

NOTE: This article was previously published in *Alerts* No. 32, dated March 1981. The same type problems are still being reported.

The October 1984 issue of *Airworthiness Alerts* will carry a new report on Cessna seats. This report includes a recommendation from a mechanic in the field on how to slow the rate at which the seat tracks wear down. The report, which quotes a Flight Standards District Office Newsletter, reads:

Cessna Single Engine Aircraft—Seat Track Wear

Judging by the number of complaints involving gouging of the lock pin holes, excessive clearance between the track rails and the seat rollers, and the occasional case of the seat slipping rearward on takeoff, these areas are not getting as much attention as they should be. Dust and debris accumulations on the seat rails contribute to the problem. So can overweight pilots. Since we can do little about the latter, we suggest improved cockpit cleanliness, a close check at each inspection, and replacement of parts when necessary. It might prevent an accident, or at least an embarrassing incident.

NOTE: The following was recently received from a mechanic via a Malfunction or Defect Report: "The seat stop is forcefully rammed into the top of the seat rails each time the seat is moved backwards. Eventually, the rail is grooved and then cracks. This process can be retarded by gluing a small piece of hard rubber channel to the underside of the stop. The rubber from a MS21919 DG clamp works very well."

Arthur Alan Wolk, an attorney for the plaintiffs in the recent case against Cessna (see accompanying article), maintains that following the Federal Aviation Administration's inspection procedures will not ensure against a seat slip because the parts wear so quickly. "The rails can be worn after 75 hours use, the rollers within 12 hours and the flanges can begin to bend almost immediately," he said.

Wolk's recommendation for pilots: Place a large flight bag behind the seat to prevent the seat from sliding all the way aft. —*JJM*

Repeated fore and aft seat movement chews up track. Note scoring where seat latching pin has carved a groove in the track.

or Beech singles in that the Cessna tracks are narrower and slightly rounded on top. Piper and Beech tracks that we looked at appeared to resist wear better than Cessna tracks. The Piper and Beech tracks are thicker and are flat on top. They also do not take as much abuse from frequent fore and aft adjustments on Cessna tracks. Because of the location of the doorposts in four-seat Cessnas and some six-seat Cessnas, it is necessary to slide the seat forward to allow passengers to crawl in back and slide the seat aft for the front seat occupants to enter. To exit the airplane, the process must be repeated.

The worst case of wear we found was in a 1977 Cessna 172 that had seen heavy use as a trainer. In this airplane, the seat could be swayed from side to side, so that only one latching pin would align with the holes in the track. Furthermore, the aluminum flanges that hold the seat to the track had opened to such an extent that the flanges on one side could be lifted over the track when the seat was rocked from side to side. However, as long as one pin was engaged, we could not jerk the seat loose from the latched position.

Despite the Federal Aviation Administration's warnings about the seat-latching mechanism in *Airworthiness Alerts*, the agency has not seen fit to issue an airworthiness directive on the seat-latching mechanism. The FAA shares Cessna's view that seat slippages are caused by pilots' failure to engage the latching pins properly. Robert W. Steven of the FAA's Central Region Certification Division, the division that certificates light aircraft, says, "If the pin is engaged, the seat will not move. If the pin is not engaged, the seat can move. I've had it happen to me." Steven added, however, "If we were starting from scratch, I would not accept the design as such. Now that we have the design, we can use it. To correct it would cost an astronomical number of dollars. There is no cheap, simple way to fix the problem."

Steven may be right about the cost. To address fully the problems of the Cessna seats, it would appear necessary to redesign the seat itself and the seat-to-fuselage attachments. In Cessna's three attempts to rectify the seat-slip problem, the company seemed to have opted for quick, inexpensive

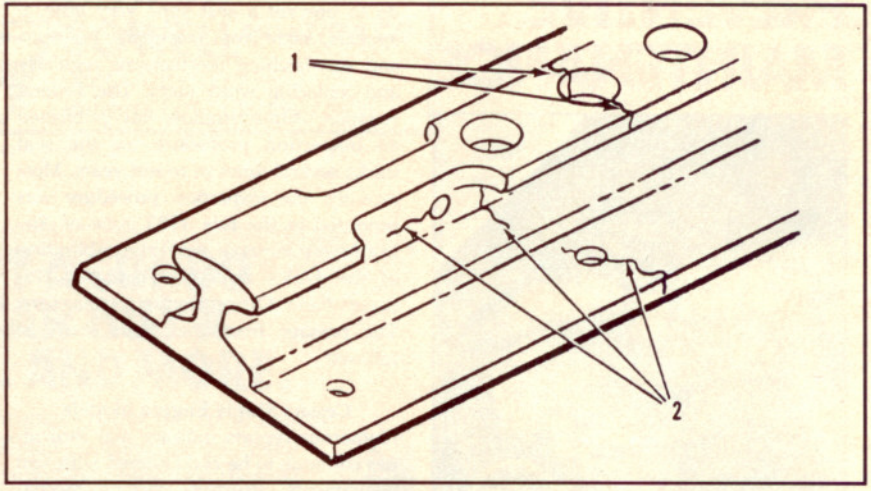


Illustration from Cessna 207 manual. Number 1: Track usable if crack not closer than one inch to similar crack. Number 2: Track unusable.

fixes rather than the expense of a total seat redesign.

Because of the seat-slip problem, Cessna has more reason than other general aviation manufacturers to rework its seat design. But Cessna is not alone in its complacency toward designing new, safer seats and seat attachments. No general aviation manufacturer can lay claim to having installed in its aircraft seats incorporating the best crashworthiness technology. And sometimes the manufacturers fall short of complying with the FAA's lax standards for seat structures. In 1975, the FAA issued an AD on several models of Pipers (Cherokee 180, Cherokee Arrow, Cherokee 235, Cherokee Six, Seneca and Seneca II) requiring inspection and repair of the seat mounts for the rear seats. Until the inspections could be made, pilots were required to fasten and tighten the seat belts in the unoccupied rear seats to prevent them from flying forward in an accident.

The present FAA requirements for seats and seat tests were last revised in 1956 and require that seats be able to withstand a 9-G static load. These standards were established to ensure that seats could withstand loads imposed in flight. No consideration was given to crashworthiness.

Tests conducted since the early 1970s by the National Aeronautics and Space Administration (NASA) and the FAA's Civil Aeromedical Institute (CAMI) have shown that a properly restrained body can survive far more Gs than typical general aviation seats are designed to withstand.

One key to occupant survival, it has been learned through NASA and CAMI research, is to keep aircraft seats bolted securely in place in a crash. It is all too easy for currently configured seats to break loose in an accident, allowing occupants to be flung about the cabin, even though seat belts and shoulder harnesses are used.

An amendment to the Federal Aviation Administration's Part 23 certification standards for light aircraft, proposed by the General Aviation Safety Panel (a group composed of representatives of the FAA, NTSB, manufacturers and aviation associations, including AOPA) would require that seat tracks be capable of warping 10 degrees vertically in a crash without releasing the seat. This measure and others proposed by the safety panel represent a step in the right direction of more-crashworthy aircraft. However, if the panel's proposals are adopted, they will apply only to newly certificated airplanes. They will do nothing to make the approximately 200,000 existing light aircraft in the United States safer.

General aviation manufacturers, operating perhaps on the philosophy that safety doesn't sell, have felt little incentive to invest in designing and manufacturing safer seats and more-crashworthy cockpits. With the possibility of more multi-million-dollar settlements and impending regulation in the area of crashworthiness, manufacturers now seem to have an incentive. □