FLIGHT SAFETY FOUNDATION
Accident Prevention
Vol. 58 No. 7 *For Everyone Concerned With the Safety of Flight* July 2001

Lightning Strike, Loose Electrical Connector Disable Fokker 100 Hydraulic Systems

An in-flight lightning strike caused depletion of fluid from the main hydraulic systems, and the alternate anti-skid braking system failed, but none of the occupants was injured when the airplane veered off a wet runway during landing.

FSF Editorial Staff

About 1704 local time, Feb. 26, 1998, a US Airways Fokker 100 was being flown within 10 nautical miles (18.5 kilometers) of a squall line when a lightning strike caused damage that depleted fluid from the no. 1 hydraulic system and from the no. 2 hydraulic system. A disconnected electrical connector on the parking-brake shut-off-valve solenoid prevented the alternate anti-skid braking system from functioning while the airplane was being landed on a wet runway at Birmingham (Alabama, U.S.) International Airport. Three main-landing-gear tires failed, and the airplane veered off the side of the runway at 1729. The airplane was substantially damaged during the approach-and-landing accident. None of the 92 occupants was injured.

The U.S. National Transportation Safety Board (NTSB) said, in its final report, that the probable causes of the accident were "the inoperative alternate anti-skid control valve due to the disconnected electrical connector on the parking-brake shut-off valve [in an area of the airplane that] was inspected two days earlier [and] the total loss of the hydraulic system, resulting in the inability of the flight crew to maintain directional control."

The report said that factors in the accident were the following:

- "Inadequate lightning-protection design … between the horizontal [stabilizer] and the vertical stabilizer, which resulted in arcing damage to hydraulic lines and depletion of the hydraulic fluid from the no. 1 [hydraulic system] and the no. 2 hydraulic system;
- "Inadequate weather information disseminated to the flight crew during the preflight briefing by the company dispatcher … ;
- "The failure of the company dispatcher to relay pertinent weather information to the flight crew while en route … ;
- "The operation of the airplane by the flight crew within 10 miles from the northern edge of a ground-based weather-radar-depicted Level 5 thunderstorm, resulting in a lightning strike;[1]
- "Insufficient standards/requirements … by the company management to require weather-radar training in recurrent, upgrade and requalification training; [and,]

Fokker 100

The Fokker 100, a short/medium-range jet transport, replaced the F28-4000 in 1987. Compared with its predecessor, the Fokker 100 has longer wings, a longer fuselage, Rolls-Royce Tay turbofan engines, an improved cabin and an improved flight deck with electronic flight instrument systems.

The airplane accommodates two pilots, three cabin attendants and up to 122 passengers. The standard cabin accommodates 107 passengers in five-abreast seating.

Each of the standard Tay 620 engines produces 61.6 kilonewtons (13,850 pounds thrust). Tay 650 engines, each producing 67.2 kilonewtons (15,100 pounds thrust), became available as an option in 1989. Standard fuel capacity is 12,820 liters (3,387 gallons).

Maximum takeoff weight is 44,450 kilograms (97,995 pounds). Maximum landing weight is 39,915 kilograms (87,997 pounds). Maximum operating Mach number is 0.77. Maximum operating speed at 24,200 feet is 452 knots.

Source: *Jane's All the World's Aircraft*

- "The limitations of the weather products provided to the flight crew by the airline."

The accident occurred during a scheduled flight from Charlotte, North Carolina, to Birmingham with two pilots, three flight attendants and 87 passengers aboard the airplane. The airplane was being operated as Flight 861.

The captain, 42, was hired by USAir (later renamed US Airways) in 1982. He had 16,759 flight hours, including 2,283 flight hours in Fokker 100s. The first officer, 47, was hired in 1986 by Pacific Southwest Airlines, which merged with USAir in 1988. He had 12,800 flight hours, including 2,057 flight hours in Fokker 100s.

The crew received a weather package from the airline's dispatch office about 90 minutes before departure. The weather package included a terminal forecast for Birmingham that called for four statute miles (six kilometers) visibility, thunderstorms, light rain and a broken ceiling at 2,000 feet.

The weather package indicated that no convective sigmets were issued for the Eastern Region of the United States. The weather package did not include convective sigmets issued for the Central Region; the convective sigmets said that a line of severe thunderstorms was expected to move into western Alabama. Birmingham is 15 nautical miles (28 kilometers) east of the line separating the Eastern Region and the Central Region.

The weather package did not include a weather watch for severe thunderstorms with one-inch (2.5-centimeter) hail, extreme turbulence and surface-wind gusts to 70 knots in Alabama.

The report said that the dispatch office did not provide the crew with information on several convective sigmets and weather watches that were issued after the crew received the weather package. The convective sigmets said that a line of severe thunderstorms 30 miles (48 kilometers) wide with tops to 45,000 feet was moving into western Alabama. The weather watches said that tornadoes were expected in Alabama and that a squall line was moving toward Birmingham.

At 1648 — 36 minutes after the flight departed from Charlotte — the flight dispatcher sent an airborne communications addressing and reporting system (ACARS) message to the flight crew indicating that thunderstorms were over the Birmingham airport but that the area to the north of the airport "looked good" on the dispatch office's graphic flight-following screen, which displays aircraft positions and ground-based weather radar data. The message also indicated that the airport would be clear of thunderstorms within 10 minutes.

The dispatcher sent the message twice. The dispatcher then received a reply from the flight crew indicating that they had received the first message. The dispatcher acknowledged this and repeated the message that the thunderstorms should pass through the Birmingham area in 10 minutes.

The report said, "The flight crew did not request weather data while en route using the ACARS until after the lightning strike occurred. There was no report that the flight crew obtained any of the convective sigmets or severe weather watches on any FAA [U.S. Federal Aviation Administration] flight service station [radio] frequency."

The airplane was descending from Flight Level (FL) 310 (31,000 feet) to 11,000 feet at 1701, when the captain told an Atlanta Air Route Traffic Control Center controller, "We would like to come right about 20 degrees, if we could, for weather." The controller approved the request.

The first officer said, "Looks like we're going to stay on the north side of all of it, which would be good."

The captain said, "Yeah." The cockpit voice recorder (CVR) then recorded a sound similar to thunder.

The airplane was descending in instrument meteorological conditions, and the crew was using the on-board weather-avoidance radar system. The report said that the precipitation levels being displayed by the system were inaccurate. The electromagnetic energy emitted by the system was being attenuated — that is, absorbed and scattered — by precipitation near the airplane. This caused the precipitation intensities displayed by the system to appear weaker than they actually were.

The report said that the airline's flight operations training manual (FOTM) required weather-radar operations training during initial training and transition training, but not during recurrent training, upgrade training or requalification training.

"The US Airways *Fokker 100 Pilots Handbook* contains no information on the operation of, or suggested techniques for the use of, radar in day-to-day operation," the report said.

After the airplane descended below FL 180, the pilots conducted an approach briefing and the "Preliminary Landing" checklist.

The first officer said, "OK, it looks like it's building a little bit now."

The captain said, "I told the [flight attendants] to sit down a little while ago."

"Oh, you did, good, OK," the first officer said. "Lightning around here." The CVR then recorded a sound similar to thunder.

The airplane was descending through 12,400 feet, about 28 miles (52 kilometers) northeast of Birmingham, when the lightning strike occurred. Ground-based weather radar showed an area of Level 5 precipitation less than 10 miles south of the airplane and an area of Level 6 precipitation, associated with the squall line, 22 miles (41 kilometers) south of the airplane.

The captain said, "I bet we took that one on the nose. I felt it on the rudder pedals."

"Yeah, I felt it," said the first officer.

The crew received an aircraft-interphone call from a flight attendant, who had observed a flash of light beneath the flight deck door. "Hey, you all OK up there?" she said. "You OK?"

The first officer said that the airplane had been struck by lightning and asked the flight attendant if she had observed anything.

"Yes," the flight attendant said. "We heard something, too. It was just a flash of light and then a clicking … . You could tell it hit."

"Yeah, I think we took it on the nose," the first officer said. "So, you guys got everything buttoned up back there and sitting down?" The flight attendant said yes.

At 1705, the captain told the first officer that they had "a lot of stuff going on." A master caution light had illuminated, and the multifunction display system (MFDS) showed low hydraulic-fluid quantity in the no. 2 hydraulic system.

The first officer began reading the "Hydraulic System 2 Low Quantity" checklist.

"During single-channel operation of the flight controls, aileron forces increase approximately two times normal rate," he said.

The master caution light illuminated again, and the MFDS showed low hydraulic-fluid quantity in the no. 1 hydraulic system.

"We lost the number one, too, chief," the captain said. "And I think we're losing hydraulics. We've lost the whole thing, it looks like."

The report said that the no. 2 hydraulic system operates the normal brake system and that, if the no. 2 hydraulic system fails, the alternate brake system automatically is operated by the no. 1 hydraulic system.

"In the event of failure of both the no. 1 [hydraulic system] and no. 2 [hydraulic system], the alternate brake system is automatically operated by an accumulator which … allows for a specified number of brake applications," the report said.

Alternate-brake-system hydraulic pressure is routed from the wheel brakes through the parking-brake shut-off valve. The valve requires electrical current to open.

"With the shut-off valve in the 'closed' position, the hydraulic pressure is prevented from being released from the brake assemblies, resulting in no anti-skid protection," the report said. "Failure of the parking-brake shut-off valve, due to either a disconnected cannon plug or by an inoperative parking-brake shut-off valve, is not annunciated in the cockpit."

The airplane was descending through 10,000 feet when the crew was told by Birmingham Approach Control to descend to 6,000 feet.

"You want to go to a better airport than this?" said the first officer.

"Let's hang in there," the captain said. "Let's keep talking, keep going."

The first officer began reading the "Total Hydraulic System Fail Procedure" checklist.

"Flight controls are manual," he said. "Normal flaps are inoperative. Yaw damper is inoperative. Brakes are on accumulator, only. … With flight controls in manual, the elevator forces become five times normal."

The Birmingham Approach controller had told the crew that the surface winds were calm at the Birmingham airport and to expect clearance to conduct the instrument landing system (ILS) approach to Runway 23. The runway was 10,000 feet (3,050 meters) long and 150 feet (46 meters wide), and had a grooved asphalt surface.

At 1710, the captain said, "We're breaking out in the clear. Let's get a condition check here."

The first officer told the controller, "We had a lightning strike. … We need the current field conditions there right now, as I speak."

The controller said, "Wind is, uh, zero four zero at three, altimeter two niner six one, with two miles visibility, thunderstorms and rain showers, scattered at two hundred, broken at two thousand three hundred. … What [do] you need, sir? Descend to two thousand five hundred."

The crew checked weather conditions at alternate airports and decided to continue the flight to Birmingham, because weather conditions at the Birmingham airport were improving.

The first officer told the captain that he had not completed the "Total Hydraulic System Fail Procedure" checklist.

"We're going to have to delay someplace to get this done," the first officer said. "This [checklist] is two pages long."

The captain told the first officer to "carry on" and that he would communicate with air traffic control.

The captain told the controller, "We've got a double hydraulic failure. We're on manual controls. Not that big of a deal, but we're not going to have time to get everything done on this approach, so we'd like you to vector us right over the top of the airport at twenty-five hundred feet, as though we're coming down the localizer, but we will not shoot the approach this time. OK?"

"All right," the controller said. "Turn right heading two three zero."

The first officer resumed reading the "Total Hydraulic System Fail Procedure" checklist.

"OK, with flight controls in manual, the elevator force becomes five times greater than normal," he said. "Aileron forces increase to four times normal. Turn coordination and yaw damper will not be available. Stabilizer can be positioned using the alternate stab control, if you need it."

"I do," said the captain.

"OK, anticipate a slower-than-normal stabilizer response," the first officer said. "Status: flight controls are manual; normal flaps inoperative; normal gear inoperative, [thrust] reversers inoperative, nosewheel steering inoperative, yaw dampers inoperative. Uh, we'll tell them we can't clear the runway when we get down there."

"OK," said the captain.

"Speed brakes inoperative, if extended may be retracted," the first officer said. "When ready for an approach, establish a landing configuration early, as extension time for alternate flaps is increased considerably."

The approach controller asked the crew if the airplane was below the clouds at 2,500 feet. The first officer said yes.

At 1714, the controller said, "USAir eight sixty-one, what do you want to do now?"

"We'd like to have nice wide vectors back around for the approach," the captain said. "We'll go ahead and land here, we think. We're going through some procedures as we speak, but we'll need about five minutes, anyway."

"OK, I'll tell you what, just turn right heading three five zero," the controller said "Should keep you pretty clear of the heavier stuff, and just let me know when you [are] ready to come on in."

"OK, we'll do that," the captain said.

"Is it pretty rough handling?" the controller said.

"Yeah, and we'll need the equipment standing by on this approach," the captain said. "We'll not be able to clear the runway. You might get some guys in front of us if you can."

"OK, make sure everybody gets down before you get here?"

"I wouldn't go quite that far, but get as many as you can, anyway."

The first officer read the "Alternate Flap Procedure" checklist. The crew selected flap position eight.

"We haven't notified company or anything," the first officer said. "Do you want to do any of that?"

"No, let's just take it one step at a time," said the captain. "We will."

The captain then told the controller, "The weather's pretty good where we are … . Does it look good from here back around for a final?"

"Yes sir," the controller said. "I'll turn you eastbound in just a minute. I got two more air carriers; let me get them on the ground, and I'll put you right behind them."

"OK, we'll be declaring an emergency, also," the captain said. "We'd like the equipment, as previously stated … . If you can, slowly start bringing us around when you're ready."

The controller told the crew to fly a heading of 090 degrees.

At 1717, the crew sent an ACARS message to the dispatcher indicating that the flight had experienced failure of both main hydraulic systems.

The first officer then asked a flight attendant to report to the flight deck. When she arrived, the captain told her that they would be conducting an emergency landing.

"Basically, we had a double hydraulic failure, which means we're flying on manual," he said.

"Do we have landing gear?" the flight attendant said.

"Yeah," the captain said. "We just won't be able to get off the runway when we land. I don't think you'll need to be doing any bracing or anything like that, because everything will be there; the gear's going to be down, and the flaps will be there. We won't have normal brakes, but we will have brakes."

"You want me to brief the passengers in any way?" the flight attendant said.

"Tell them that we've had this hydraulic problem and we're going to be staying on the runway," the captain said. "Everything's going to be fine … but we've definitely got some problems."

The pilots then conducted the "Alternate Landing Gear Procedure" checklist.

The controller asked the crew if they could climb to 3,000 feet. After the first officer said yes, the controller said, "Maintain three thousand. That'd give you some terrain clearance there."

The first officer used the public-address system to brief the passengers.

"Well, ladies and gentlemen, we're just a little busy up here on the flight deck," he said. "As some of you have noticed, and you probably heard that loud pop earlier, we took a lightning strike on the nose of the aircraft. It is not a serious problem. However, we are having a hydraulic problem. The aircraft is flyable. We should be making a normal landing and a normal approach. We have a few procedures that we have to apply up here on the flight deck to operate some things manually, but this aircraft flies on manual reversion without hydraulics, so it is not something for you to be concerned about.

"We are being vectored back to shoot the approach to the airport. The airport is essentially VFR [reporting visual flight rules weather conditions] at this time, so we'll be making a visual approach, backing that up with some instrumentation up here. … We will be stopping the aircraft on the runway; we will not be taxiing clear of the runway because of the landing-gear doors. It's just a normal procedure when we have a hydraulic failure like this. So, we'd like for you to take a deep breath, sit back and relax, if that's easy for you to do. … We'll be commencing the approach here just momentarily."

The controller told the crew to fly a heading of 150 degrees and asked if they were ready to land. After the captain said yes, the controller told the crew to fly a heading of 190 degrees and to descend to 2,500 feet.

The crew extended the landing gear and selected flap position 15. The controller told the crew to fly a heading of 210 degrees to intercept the localizer course and to maintain 2,500 feet until established on the localizer. The controller cleared the crew to conduct the ILS approach to Runway 23.

The crew received an ACARS message from the dispatcher requesting that the flight return to Charlotte. The captain read the message to the first officer (see Appendix, page 7).

"'Please divert to Charlotte,'" he said.

"Can't do it now," the first officer said. "We're committed. Just disregard until we get on the ground."

At 1725, the airplane intercepted the localizer and the crew selected flap position 25. The controller told the crew to call Birmingham Tower.

"Tower, USAir eight sixty-one's with you on the approach," the first officer said. "Runway's in sight."

The tower controller cleared the crew to land.

The airplane touched down about 2,000 feet (610 meters) from the runway threshold. The captain told investigators that the

touchdown was normal and that he felt a pronounced vibration when he applied the wheel brakes.

The report said that three of the four main-landing-gear wheels (the two wheels on the left-main landing gear and the outboard wheel on the right-main landing gear) locked (i.e., stopped rotating) when the captain applied the wheel brakes. Marks on the runway indicated that the tires on the three wheels began to hydroplane about 3,000 feet (915 meters) past the touchdown point. (Investigators did not determine why the inboard wheel on the right-main landing gear did not lock when the brake was applied.)

Five seconds after the CVR recorded the sound of touchdown on the runway, the first officer said, "Blew a tire."

The report said that the CVR recorded a "rustling-and-rattling" sound and several thumps as the airplane veered off the left side of the runway 5,337 feet (1,628 meters) from the threshold. The nose-landing gear separated, and the airplane came to rest on a grassy area with the nose section on a taxiway.

The CVR recorded the "sound of faint voices and clapping" and a flight attendant telling the passengers to remain seated.

An aircraft rescue and fire fighting (ARFF) crewmember tapped on the captain's side window. The captain opened the window, and the ARFF crewmember said, "You are fire safe." (The captain told investigators that he had not heard that phrase before but believed that it meant that the ARFF crewmember had observed no signs of fire on or near the airplane.)

The captain told the passengers to remain seated until ground vehicles arrived to transport them to the terminal. The passengers remained in their seats. The flight attendants stood by the emergency exits. When ground transportation arrived, the occupants exited the airplane through the left forward door with the assistance of flight attendants and ARFF personnel.

Investigators found 104 lightning-burn marks, ranging in size from 0.06 inch to 0.63 inch (1.52 millimeters to 16 millimeters) in diameter, on the right side of the fuselage and scorch marks on the right tip of the horizontal stabilizer. Both hydraulic system reservoirs were empty, and there was hydraulic fluid on the vertical stabilizer.

"Both hydraulic systems were pressurized with low pressure, and leakage was noted from a hole in the no. 1 [hydraulic system] elevator pressure line approximately three-quarters up the vertical stabilizer, and leakage was noted from a second hole in the no. 2 [hydraulic system] elevator return line; the hole was located behind the rudder-flutter damper approximately halfway up the vertical stabilizer," the report said.

The report said that lightning current might have arced to the hydraulic lines and burned holes in the lines after the lightning current melted the five-inch (13-centimeter) bonding strap (flexible connector) that provides an electrical connection between the vertical stabilizer and the horizontal stabilizer.

The report said that the bonding strap between the vertical stabilizer and the horizontal stabilizer was inadequate to conduct the amount of electrical current specified in an FAA advisory circular as possible when lightning strikes an airplane empennage. [2]

"The airplane was only equipped by design with one bonding strap … for the horizontal [stabilizer] and vertical stabilizer; [the bonding strap] failed," the report said. "[The] advisory circular recommends that the area be designated for carrying substantial amounts of electrical current, but the airplane was not designed for such."

The report said that the parking-brake shut-off valve was replaced in August 1995 and was tested during a maintenance inspection of the airplane in November 1996. The valve was among hydraulic components inspected for "signs of leakage, general condition and security" during a maintenance inspection Feb. 24, 1998.

[Based on these findings, NTSB recommended that FAA "review the design of the bonding strap installation at the horizontal stabilizer hinge of the (Fokker 100 and Fokker 70) and require operators to modify their airplanes to increase the lightning-strike protection at that location." FAA on May 5, 2000, issued Airworthiness Directive (AD) 2000-07-04, which required installation of improved bonding straps between the horizontal stabilizers and vertical stabilizers on Fokker 100s and Fokker 70s. The AD required the installation to be performed in accordance with Fokker Service Bulletin F100-23-032.[3]]♦

[FSF editorial note: This article, except where specifically noted, is based on U.S. National Transportation Safety Board factual report and brief-of-accident report no. MIA98FA089. The reports comprise 532 pages and include diagrams and photographs.]

Notes and References

1. The U.S. National Weather Service classifies precipitation detected by ground-based weather-radar systems in six VIP (video integrator processor) intensity levels, ranging from VIP Level 1 (defined as "light") to VIP Level 6 ("extreme"). A VIP Level 5 precipitation intensity ("intense") corresponds with convective-activity rainfall rates from 4.5 inches (11.4 centimeters) per hour to 7.1 inches (18 centimeters) per hour.

2. U.S. Federal Aviation Administration (FAA). Advisory Circular 20-53A, *Protection of Airplane Fuel Systems Against Fuel Vapor Ignition Due to Lightning*. April 12, 1985.

3. FAA. *NTSB Recommendations to FAA and FAA Responses Report*. Report no. AA-99-19. nasdac.faa.gov/asp/asy_searchus.asp. June 26, 2001.

Appendix
Cockpit Voice Recorder Transcript, US Airways Flight 861, Feb. 26, 1998

[FSF editorial note: The following transcript begins when the crew receives clearance to conduct the instrument landing system (ILS) approach to Birmingham (Alabama, U.S.) International Airport. The transcript is as it appears in the U.S. National Transportation Safety Board (NTSB) report, except for minor column rearrangement and minor editing for consistency and style. All times are local.]

RDO = Radio transmission from accident aircraft
CAM = Cockpit area microphone voice or sound source
PA = Voice transmitted over aircraft public-address system
INT = Voice transmitted over aircraft interphone system
APR = Radio transmission from Birmingham Approach controller
TWR = Radio transmission from Birmingham Tower controller
-1 = Voice identified as captain
-2 = Voice identified as first officer
-4 = Voice of unidentified flight attendant
-? = Voice unidentified
* = Unintelligible word
( ) = Questionable text
[ ] = NTSB editorial insertion
… = Pause

Time	Source	Content
1725:06	**APR**	USAir eight sixty-one is five miles from ROBEY. turn right heading two one zero. maintain two thousand five hundred until established on the localizer, cleared ILS runway two three approach.
1725:14	**RDO-2**	USAir eight sixty-one, two ten on the heading. cleared for the ILS uh, two three approach.
1725:18	**CAM**	[sound of double chime]
1725:19	**CAM-1**	OK.
1725:20	**CAM-2**	cleared for the approach.
1725:21	**CAM-1**	what are we messing up here? do you see anything at all?
1725:22	**CAM-2**	nope, we have got the … ignition is continuous two. landing gear is down, three green.
1725:34	**CAM-1**	down and three green.
1725:36	**CAM-2**	lift dumpers are inop.
1725:38	**CAM-1**	please divert to Charlotte.
1725:42	**CAM-2**	can't do it now. we're committed.
1725:51	**CAM-2**	just disregard until we get on the ground.
1725:54	**CAM-1**	OK, I'm showing a localizer.
1725:55	**CAM-2**	OK, I got you on the localizer.
1725:57	**CAM-1**	let's go with twenty-five.
1725:58	**CAM-2**	flaps comin' to twenty-five. glideslope's comin' alive.
1726:09	**CAM-1**	send him a message and tell 'em we're landing … when you get a free moment.
1726:12	**CAM-?**	OK. yeah, we're committed, we can't * *.
1726:16	**CAM-2**	flaps are twenty-five selected indicating.
1726:19	**CAM-1**	twenty-five selected and indicating.
1726:21	**APR**	USAir eight sixty-one uh, capture the localizer OK?
1726:22	**RDO-2**	eight sixty-one yeah, we just went through it a little bit here but we're on it. we're comin' back.
1726:26	**APR**	all right. you'all doin' pretty good now?
1726:27	**RDO-2**	yeah, we got everything set. gear is down, everything's normal in the green uh, we just don't have hydraulics like we say, we will not be able to clear the runway.
1726:33	**APR**	USAir eight sixty-one roger and uh, contact tower one one niner point niner, good day you'all.
1726:37	**RDO-2**	nineteen nine, thanks for your help.
1726:38	**APR**	you bet.
1726:47	**RDO-2**	say that tower frequency again, nineteen one?
1726:47	**APR**	uh, one nineteen nine.
1726:48	**RDO-2**	nineteen nine, good day.
1726:49	**APR**	good day.
1726:51	**RDO-2**	tower USAir eight sixty-one's with you on the approach uh, runway's in sight.
1726:56	**TWR**	USAir eight sixty-one Birmingham tower runway two three. cleared to land. wind one zero zero at four.
1727:01	**RDO-2**	cleared to land uh, USAir eight sixty-one.
1727:04	**CAM-1**	get rid of that overhead light.
1727:05	**CAM-2**	OK. push button's stuck.
1727:11	**CAM-1**	that's all right * * *. OK, what do we got left, we're twenty-five.
1727:16	**CAM-2**	OK …
1727:17	**TWR**	USAir eight sixty-one, can you give me uh, fuel remaining, souls on board please if you got a chance?
1727:21	**RDO-2**	OK, fuel remaining is eight thousand souls on board …
1727:25	**CAM-1**	eighty … eighty-five plus uh …
1727:26	**CAM-2**	eighty-six and five, is ninety-one.
1727:30	**RDO-2**	ninety-one souls on board.
1727:33	**TWR**	say that again sir?
1727:35	**RDO-2**	ninety-one souls on board will be eight six passengers and five crewmembers.

1727:38	**TWR**	* thanks a lot.
1727:40	**CAM-2**	I've got you out of a thousand feet, plus ten. sink is, eight.
1727:47	**CAM-2**	can't get it down …
1727:48	**CAM-2**	*.
1727:50	**CAM-1**	OK, we're gonna roll out, no nosewheel steering, less brakes. how we gonna steer? I guess we'll just, uh …
1727:58	**CAM-2**	just rudder pedals and differential steering on the brakes I mean with the uh, rudder pedals.
1728:02	**CAM-1**	all right. you take over the yoke when we land. I'll be holding on to the nosewheel 'cause I'm used to it.
1728:07	**CAM-2**	OK, all right.
1728:10	**CAM-1**	you wanna start the APU?
1728:13	**CAM-2**	and uh, I've got you …
1728:15	**CAM**	[sound similar to windshield wipers starts and continue to end of the recording]
1728:15	**CAM-2**	comin' up on five hundred feet. runway's in sight on the VASI. plus ten sink five.
1728:22	**TWR**	wind zero eight zero at four.
1728:26	**CAM-1**	zero eight zero at four *.
1728:35	**CAM-2**	quartering tailwind.
1728:40	**CAM-1**	* duck under here.
1728:41	**CAM-2**	that's fine.
1729:00	**CAM-2**	very nice.
1729:00	**CAM**	[sound similar to aircraft touching down on the runway]
1729:01	**CAM-2**	I don't know if you'll get any reverse or not.
1729:05	**CAM-2**	blew a tire.
1729:06	**CAM**	[rustling and rattling sound starts and continues]
1729:11	**CAM**	[rustling and rattling sound stops]
1729:13	**CAM**	[sound of several thumps]
1729:14	**CAM**	[sound of two chimes]
1729:16	**CAM**	[sound of several thumps]
1729:18	**CAM-2**	well, (* * not good).
1729:24	**CAM**	[sound of several thumps]
1729:24	**CAM-?**	you OK in the tail.
1729:25	**CAM-?**	shuttin' 'em down.
1729:26	**CAM**	[sound of faint voices and clapping]
1729:29	**CAM-2**	parking brakes are on.
1729:31	**CAM**	[sound of triple chime repeats three times to end of recording]
1729:34	**CAM-4**	everybody stay seated, stay seated.
1729:38	**CAM-2**	* APU * on.
1729:41	**End of Recording**	

Accident Prevention

Staff: Roger Rozelle, director of publications; Mark Lacagnina, managing editor; Wayne Rosenkrans, senior editor; Linda Werfelman, senior editor; Karen K. Ehrlich, web and print production coordinator; Ann L. Mullikin, production designer; Susan D. Reed, production specialist; and Patricia Setze, librarian, Jerry Lederer Aviation Safety Library

Subscriptions: One year subscription for twelve issues includes postage and handling: US$240. Include old and new addresses when requesting address change. • Attention: Ahlam Wahdan, membership services coordinator, Flight Safety Foundation, Suite 300, 601 Madison Street, Alexandria, VA 22314 U.S. • Telephone: +1 (703) 739-6700 • Fax: +1 (703) 739-6708.