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Abrupt Flight Maneuvering Cited in Loss-of-control Accident

Earlier in the day, the pilot of the AS 350B — on his second day flying for a geophysical seismic team in the desert of the western United States — had been asked by one of the team members to fly the helicopter "a little easier."

FSF Editorial Staff

About 1555 local time on May 4, 2000, an Aerospatiale (now Eurocopter) AS 350B helicopter struck a rocky mesa while being maneuvered during a geophysical seismic flight in the high desert near Blanding, Utah, U.S. The helicopter was destroyed; the pilot and two passengers were killed, and three passengers received serious injuries.

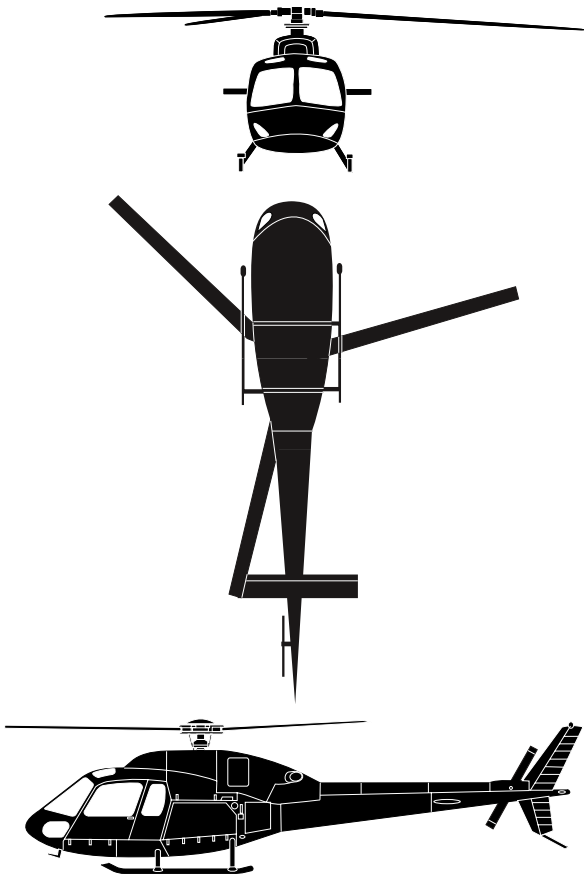
The U.S. National Transportation Safety Board (NTSB) said, in its final report, that the probable cause of the accident was "the pilot's loss of aircraft control due to abrupt flight maneuvering."

The report said that contributing factors to the accident were "the high density altitude weather condition, the total loss of engine power due to the pilot manually introducing excessive fuel into the engine and over-temping the turbine section, and the lack of suitable terrain for the ensuing autorotation."

The accident helicopter was operated by Peace Helicopters of Edmonton, Alberta, Canada. The helicopter was manufactured in 1980 and had accumulated 11,221 flight hours when the accident occurred. The Turbomeca Arriel 1B turboshaft engine was installed in the helicopter March 14, 2000; it had a total time of 9,274 hours in service. When the accident occurred, the engine had accumulated 9,427 hours in service.

The last weight measurement before the accident was conducted March 29, 2000, when the helicopter's empty weight was recorded as 2,624.01 pounds (1190.25 kilograms). The certificated maximum gross weight was 4,300 pounds (1,950 kilograms). The in-ground-effect maximum gross weight for weather conditions at the accident site was 4,025 pounds (1,826 kilograms); out-of-ground-effect maximum gross weight for the weather conditions was 3,725 pounds (1,690 kilograms).

A maintenance technician said that an annual inspection on the helicopter was conducted April 22, 2000. Helicopter records showed that the last daily inspection was conducted May 3, 2000; the maintenance technician said that an inspection



Aerospatiale AS 350B Ecureuil (Squirrel)

The Aerospatiale (now Eurocopter) AS 350B is a light utility helicopter with a Turbomeca Arriel 1B turboshaft engine and a rotor of three fiberglass blades that rotate clockwise as viewed from above. Directional control is effected by a two-blade tail rotor on the right side of the tail boom.

Deliveries of the AS 350B began in March 1978, shortly after certification in the United States of the AS-350C, which was powered by a Textron Lycoming LTS-101 turboshaft engine and known as the AStar. The AS 350C was marketed only in North America and was replaced in 1978 by the AS 350D.

The Aerospatiale helicopter division and the MBB (Messerschmitt-Bolkow-Blohm) helicopter division merged in 1992 to form Eurocopter, which markets the AStar and Ecureuil.

The AS 350B has two standard bucket seats at the front of the cabin and two two-place bench seats aft.

The helicopter's maximum normal takeoff weight is 1,950 kilograms (4,300 pounds), or 2,100 kilograms (4,630 pounds) with a maximum sling load. Maximum rate of climb is 1,575 feet per minute. The AS 350B has a maximum cruise speed at sea level of 125 knots and a service ceiling of 15,000 feet. Hovering ceiling in ground effect is 8,200 feet; hovering ceiling out of ground effect is 5,900 feet. It has a range with maximum fuel (535 liters [141.3 gallons]) at sea level of 700 kilometers (435 miles).

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

was conducted May 4 but was not recorded in the aircraft logbooks.

The pilot who had flown the helicopter on a 10-hour flight from Edmonton to the project site and had been the pilot for the seismic team throughout April said that maintenance on the helicopter during April consisted of a tail-rotor change and an engine bleed-valve change. He said that he "felt very good about the aircraft," that it was one of the operator's better aircraft and that he had "very few problems with it."

The pilot also said that throughout April, because of the high-desert terrain, he never filled the helicopter's fuel tanks more than 30 percent full. He said that on hot days, he separated the geophysical crewmembers into groups and conducted more than one flight to transport them to ground work sites to reduce the load and "not push the capabilities of the helicopter."

The accident pilot arrived in Blanding on May 1 to relieve the previous project pilot. The accident pilot was a 37-year-old Canadian citizen with a Canadian commercial pilot certificate for helicopters and a private pilot certificate for single-engine airplanes; he did not have an instrument rating. He had a Canadian category 1 medical certificate. When the accident occurred, he had accumulated about 2,900 flight hours in helicopters, including about 1,500 flight hours in AS 350s. The report said that records showed that the pilot had flown in a variety of environmental conditions in Canada, including desert conditions. [The northern portion of the Upper Sonoran Desert is in southern British Columbia, Canada.] The assignment was the pilot's first in the United States.

On May 2, the accident pilot flew a familiarization flight with the previous project pilot and received a briefing on "operational procedures and environmental concerns," the report said. The previous project pilot said that he had emphasized to the accident pilot that the desert mesa area was "difficult because of updrafts, downdrafts, unpredictable winds and swirling winds."

The report said that the previous project pilot "got the impression that [the accident pilot] 'really liked to fly' but was not [very] comfortable in high-density altitudes."

The previous project pilot said, "When you live with and fly for a geophysical seismic crew for three [weeks] or four weeks, they get used to you; a new guy has to prove himself."

On May 3, the relief pilot flew his first day as the project pilot for the seismic crew.

"In the afternoon, the safety officer of the geophysical project said that the pilot told him that this was 'his first time to fly in the desert and the [desert's unpredictable] winds,'" the report said. "He also said that the pilot seemed 'very brash.'"

On May 4, the helicopter was fueled at the staging area for landing zone 1 (LZ1), receiving the project maximum of 57 gallons (216 liters) of fuel — 40 percent of the 143-gallon (541-liter) tank. Before leaving the staging area, the pilot received a briefing from a member of the geophysical team who operated the NS500 Kodiak navigation system.[1] The team member said that the briefing had included a request for the pilot to "fly a little easier, less aggressive."

"The Kodiak operator told the pilot that two other team members had spoken to him and [had] requested that he talk to him about his 'rough handling of the helicopter,'" the report said.

Visual meteorological conditions prevailed for the 1545 departure from LZ1. The pilot flew the helicopter 5.35 nautical miles (9.91 kilometers) southeast to landing zone 4 (LZ4), where five members of the geophysical team boarded the helicopter. The helicopter's estimated weight, including the pilot, five geophysical team members and their equipment, was 4,076 pounds (1,849 kilograms).

The Kodiak system recorded neither the landing time nor the departure time, but at 1552, the system resumed recording the position of the helicopter, which at the time was being flown west from LZ4.

"At this point, the Kodiak operator said that he was scheduled to transmit the team's multiple drop-off points to the pilot," the report said. "But instead, he transmitted a radio request for the pilot to land the helicopter so that a seismic shot could be fired. (The helicopter's noise/vibration is picked up by the geophones and recorded if the helicopter is airborne at the time of the shot.) According to the Kodiak operator, the pilot radioed back that he would set [the helicopter] down 'on top, up here' (on top of the mesa.)"

The Kodiak system last recorded the helicopter's location as 2.6 nautical miles (4.8 kilometers) northwest of LZ4, being flown on a heading of 065 degrees at 68 knots. The helicopter was 199 feet above the mesa at 5,565 feet above mean sea level. The temperature in the area was estimated at 95 degrees Fahrenheit (F; 35 degrees Celsius [C]); the density altitude was calculated to be 8,908 feet.

"The [geophysical project's] safety officer, located 0.74 nautical mile [1.37 kilometers] east of the crash site, observed the helicopter flying eastbound towards him," the report said. "He said that as it approached the eastern edge of the mesa, it made a 'very hard left-hand turn (180 degrees) back to the west.' He later estimated that the helicopter's bank was 45 [degrees] to 60 degrees. He then saw the helicopter turn southbound, lower its nose almost vertically down and then reduce its nose-low pitch to approximately 45 degrees as it disappeared from sight. Immediately, he observed a cloud of dirt and dust. … Approximately one minute from the helicopter's disappearance, he observed smoke rising from the mesa top."

The wreckage was found on an "irregularly surfaced" area of the mesa, which was sparsely vegetated with cedar trees and scrub brush. The fuselage was on its right side, and the empennage was upright. The pilot and the two passengers who were killed had all been seated on the right side of the cabin.

Helicopter debris and ground scars related to the impact, including one ground scar that resembled one that would result from a tailskid strike, extended for about 100 feet (31 meters) from the spot where the helicopter was found.

A surviving back-seat passenger said later, in an interview translated into English from Spanish, that the pilot had flown the helicopter toward a power line but could not locate the power line.

"The pilot was bothered (upset) by not being [able] to locate the power line, and he performed some strange movements," the passenger said. "Once he backed up, he raised the helicopter very high, and when he tried to regain control of the helicopter, he lost control (or was unable to control the helicopter). We heard a noise, and we lost sight of the ground ahead of the helicopter. … When we heard the noise, the pilot attempted to climb. He pulled the stick [collective] up, but the helicopter did not respond, and it crashed."

In a subsequent interview, the passenger said that, during a turn to the left, there had been a "loud pop, then a screaming whir, followed by a red light on the pilot's instrument panel."

The left-front-seat passenger said that he heard a loud noise from the back of the helicopter that sounded like two pieces of metal striking each other, followed by a beeping sound.

One of the passengers said that he observed the pilot "move his left hand quickly towards something near his left knee."

The helicopter's manual fuel-flow-control lever (FCL) was located near the pilot's left knee. In an AS 350B, the FCL is used to start the engine and to manually control fuel flow in the event of a malfunction of the engine's fuel controller. The pilot manually operates the FCL by disengaging it and slowly manipulating it "in the emergency side of the quadrant."

The report said, "According to the manufacturer's representative, the manual FCL has a small range for movement and is very sensitive to operate."

The helicopter was equipped with a low-rotor horn, designed to sound if the main-rotor speed decreased below 360 revolutions per minute (rpm; normal main-rotor speed during flight is 386 rpm) or if the hydraulic system pressure

decreased below 30 bar (435 pounds per square inch). The helicopter's master caution panel included six red warning lights designed to illuminate in the event of low hydraulic pressure (when main-rotor-blade speed decreased below 250 rpm), low engine-oil pressure (when power turbine speed decreased below 70 percent), low main-rotor gearbox oil pressure (when main-rotor-blade speed decreased below 200 rpm), elevated main-rotor gearbox oil temperature, engine fire and high battery temperature.

An examination of the wreckage revealed no pre-impact anomalies involving the engine or airframe that might have affected the helicopter's performance. The engine FCL was in the "full-off" position required for engine shutdown; the emergency fuel-flow shutoff lever was in the forward position required for operation. The fuel-control unit throttle pointer was in the emergency position.

The report said, "During disassembly of the engine, the first[-stage] and second-stage turbine wheels were found with their blades 50 [percent] to 70 percent melted. The engine manufacturer reported that 'the general evidence indicates an engine that functioned during a certain time at a temperature level well above the limits — something like 200 [degrees C] to 300 degrees C [392 degrees F to 572 degrees F] more than the temperatures measured by the manufacturer during the certification tests.'"♦

[FSF editorial note: This article, except where noted, is based on the U.S. National Transportation Safety Board final report on accident no. DEN00FA084. The report comprises 111 pages and includes illustrations.]

Note

1. The NS500 Kodiak navigation system, manufactured by Eagle Navigation Systems, is a vehicle-guidance and management system for seismic operations. The system used by the accident helicopter included a helicopter-mounted global positioning system and a personal computer with a guidance display. The helicopter system communicated by radio with the base station, where an operator used a personal computer to view the helicopter's location and to transmit instructions to the pilot. The accident report said that the system stored the helicopter's flight data at 10-second intervals.

   The report said that the system's data link was limited to line-of-sight operations, and that because of the rugged terrain, a second receiver was located at the southern end of the project area to increase the system's capabilities. The report said that "when the helicopter's location was blocked by terrain from both Kodiak receivers, the aircraft's location could not be recorded, nor could it receive instructions."

Helicopter Safety

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