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Most Fatal U.S. Commercial Helicopter Accidents Occur in Instrument Meteorological Conditions

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Flight Safety Foundation is an international membership organization dedicated to the continuous improvement of aviation safety. Nonprofit and independent, the Foundation was launched officially in 1947 in response to the aviation industry's need for a neutral clearinghouse to disseminate objective safety information, and for a credible and knowledgeable body that would identify threats to safety, analyze the problems and recommend practical solutions to them. Since its beginning, the Foundation has acted in the public interest to produce positive influence on aviation safety. Today, the Foundation provides leadership to more than 910 member organizations in more than 142 countries.

Most Fatal U.S. Commercial Helicopter Accidents Occur in Instrument Meteorological Conditions

A study of 147 accidents from 1991 through 2000 involving helicopter operations conducted under U.S. Federal Aviation Regulations Part 135 found that 58 percent of the fatal accidents occurred in instrument meteorological conditions. Human error was the primary causal factor in 66 percent of the accidents. Many human-error accidents occurred during the en route phase of flight and involved inadequate in-flight planning and decision making or inadequate evaluation of weather information.

Patrick R. Veillette, Ph.D.

From January 1991 through December 2000, there were 147 accidents and 306 incidents involving helicopters operated under U.S. Federal Aviation Regulations (FARs) Part 135 (Figure 1, page 2). The accidents included 43 fatal accidents (29 percent of the total).

Of the 616 people aboard the accident helicopters, 133 people (22 percent) were killed, 66 people (11 percent) were seriously injured and 112 people (18 percent) received minor injuries.

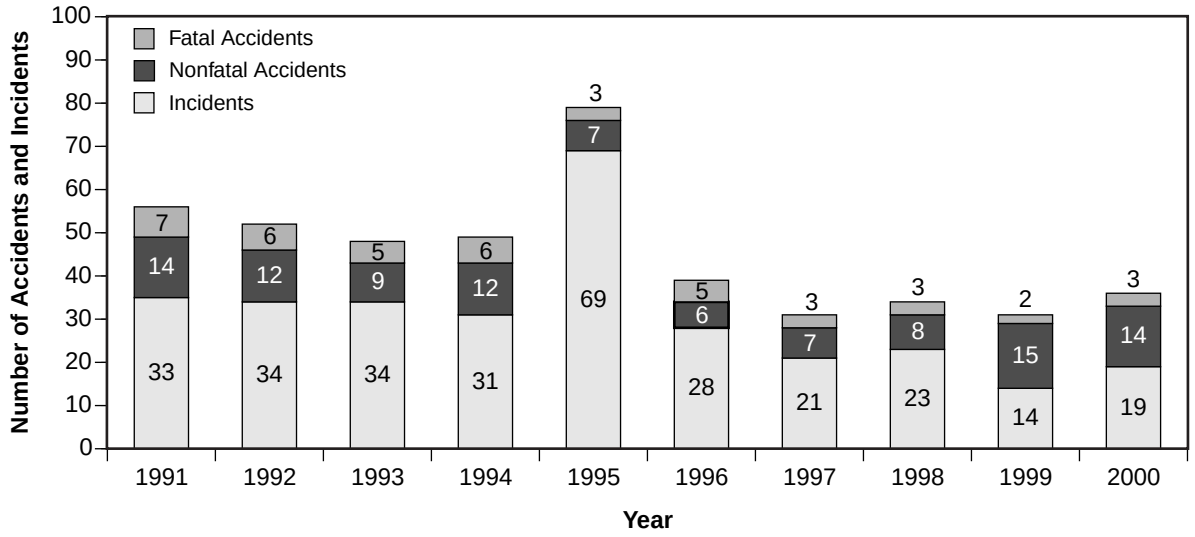
One of the 147 accidents was a collision between two helicopters; thus, 148 helicopters were involved in the accidents. Of the total, 48 helicopters (32 percent) were destroyed, and 97 helicopters (66 percent) were damaged substantially.

Helicopter operations conducted under Part 135 include on-demand (charter) flights, helicopter-positioning flights, emergency medical services (EMS) flights and air-tour (sightseeing) flights. Part 135 helicopter operations are conducted day and night, typically at low altitudes, often in remote areas with rugged terrain, often over water, in all types of weather and usually by a single pilot. Flights often are conducted to and from confined landing areas surrounded by terrain and/or obstacles. Offshore helicopters provide logistical support to oil-drilling facilities at small platforms primarily in the Gulf of Mexico. EMS helicopters often are flown relatively long distances at night and in marginal weather conditions to transport people injured in automobile accidents or requiring rapid medical care in other circumstances. Air-tour flights often are conducted in rapidly changing and localized weather conditions.

Part 135 helicopter operations typically involve high pilot workload, substantial communication requirements, time pressure, distractions, stressful flight conditions and stressful duty conditions.

To identify trends involved in the accidents, the author conducted a study of U.S. National Transportation Safety Board (NTSB) reports on the 147 accidents and U.S. Federal

U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000



Source: Patrick R. Veillette, Ph.D.

Figure 1

Aviation Administration (FAA) reports on the 306 incidents (see "U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000," page 24). The accidents and incidents included in this study were designated by the NTSB reports and the FAA reports as having occurred during Part 135 operations; commercial helicopter accidents and incidents designated by the official reports as having occurred during Part 91 operations were not included in this study. Additional accidents and incidents might be included in other databases maintained by the helicopter industry.

The author also reviewed reports submitted to the U.S. National Aeronautics and Space Administration (NASA) Aviation Safety Reporting System (ASRS) involving 457 Part 135 helicopter operations from January 1991 through December 2000.[1]

The study found that:

- Forty-two of the 147 accidents (29 percent), including 25 (58 percent) of the 43 fatal accidents, occurred during instrument meteorological conditions (IMC). Fifteen (36 percent) of these accidents involved controlled flight into terrain (CFIT).[2] Thirteen accidents (31 percent) involved loss of control and/or spatial disorientation;

- Eighty-two (56 percent) of the accidents, including 32 (74 percent) of the fatal accidents, and 169 (55 percent) of the 306 incidents occurred during the en route (cruise) phase of flight (Figure 2, page 3). Of the en route accidents, 43 (52 percent) resulted from human error (Figure 3, page 3). Thirty-two (39 percent) en route accidents occurred in low-visibility conditions; 22 (69 percent) of these accidents were fatal;

- Thirty-three accidents (22 percent), including five fatal accidents (12 percent of the fatal accidents), and 73 incidents (24 percent) occurred during the approach-and-landing phase of flight. Of the approach-and-landing accidents (ALAs), 27 (82 percent) resulted from human error. Five ALAs (15 percent), including one fatal accident, occurred in IMC;

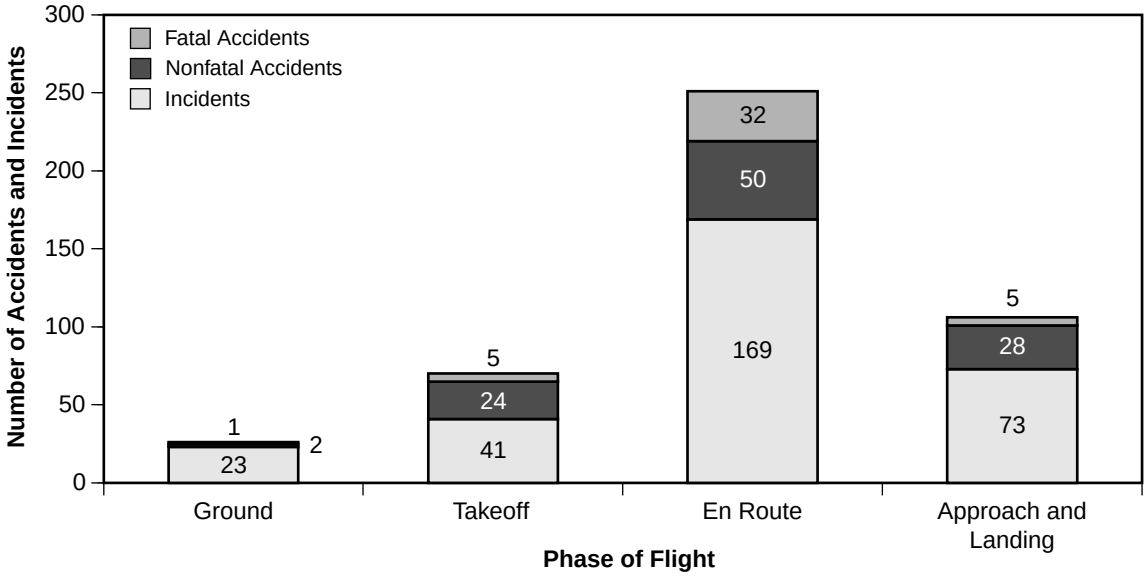
- Twenty-nine accidents (20 percent), including five fatal accidents (12 percent), and 41 incidents (13 percent) occurred during takeoff. Of the takeoff accidents, 24 (83 percent) resulted from human error. Eight takeoff accidents (28 percent) involved collisions with obstacles. Five takeoff accidents (17 percent), of which two were fatal, occurred in low-visibility conditions;

- Forty accidents (27 percent) and 98 incidents (32 percent) involved engine failure. Thirty-seven (93 percent) of the engine-failure accidents involved single-engine helicopters;

- All but one of the 147 accidents involved helicopters certified by FAA for single-pilot operation; and,

- Of the 306 incidents, 165 (54 percent) involved minor damage to the helicopters; 141 incidents (46 percent) involved no damage to the helicopters.

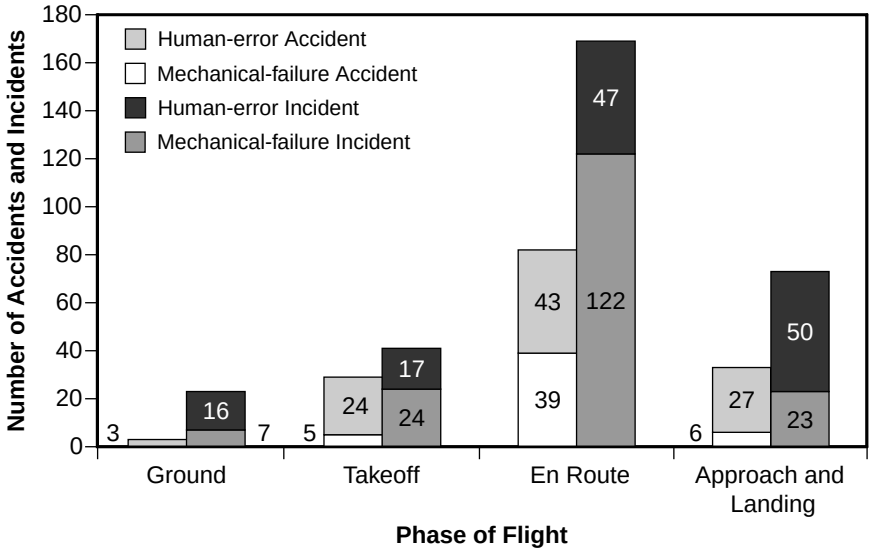
Phase of Flight for U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000



Source: Patrick R. Veillette, Ph.D.

Figure 2

Involvement of Human Error and Mechanical Failure by Phase of Flight in U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000



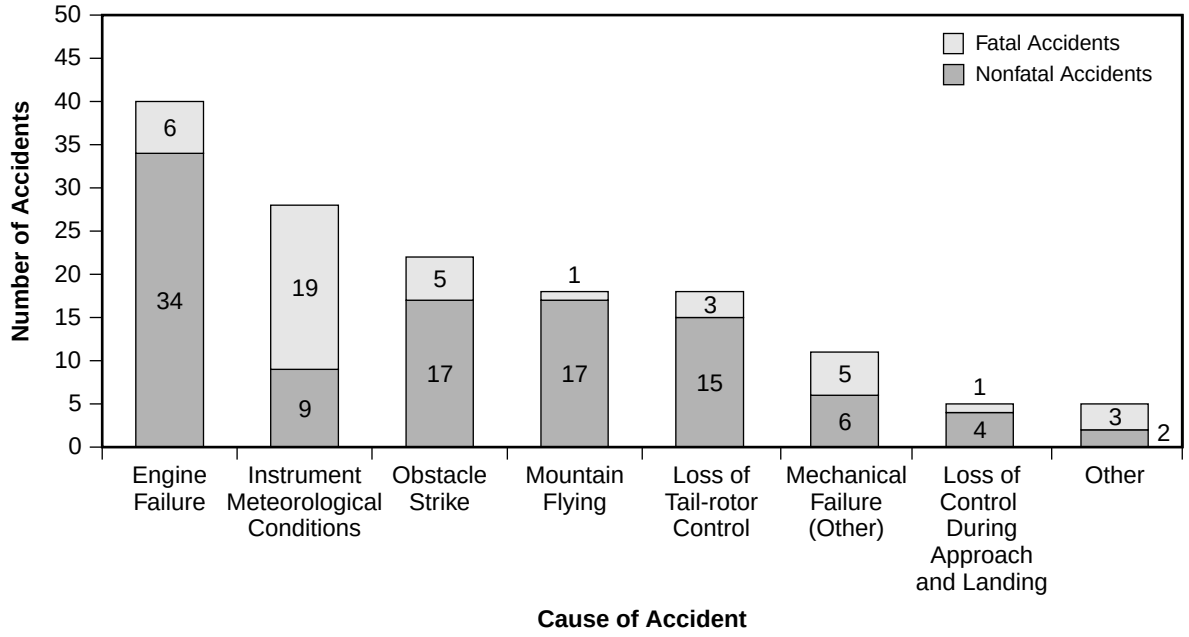
Source: Patrick R. Veillette, Ph.D.

Figure 3

Demanding Mission Profile Affects Accident Rate

Figure 4 (page 4) shows the primary causes of the accidents. Forty accidents (27 percent), including six fatal accidents, involved engine failure. Twenty-eight accidents (19 percent), of which 19 were fatal, involved CFIT or loss of control in IMC. Twenty-two accidents (15 percent), including five fatal accidents, involved obstacle strikes. Eighteen accidents (12 percent), including one fatal accident, involved aspects unique to mountain flying.

Primary Causes of U.S. Federal Aviation Regulations Part 135 Helicopter Accidents, 1991–2000



Source: Patrick R. Veillette, Ph.D.

Figure 4

Eighteen accidents, of which three were fatal, involved loss of tail-rotor control.

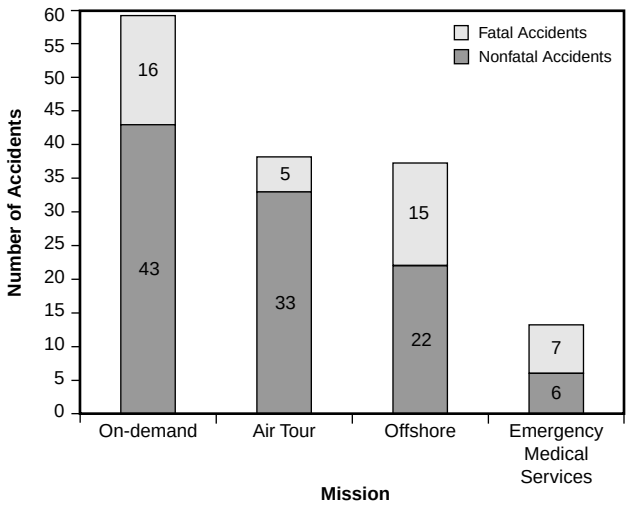
Mechanical failure, other than engine failure and tail-rotor drive-shaft failure, caused 11 accidents (7 percent), of which five were fatal. Loss of control during approach and landing was the cause of five accidents, including one fatal accident. Five accidents, including three fatal accidents, involved other causal factors (e.g., a passenger struck by turning rotor blades).

Typical mission profiles significantly affect the overall accident rate. Part 135 helicopter missions often are demanding, and the exposure to risk is relatively high. The vast majority of the missions are conducted with one pilot aboard the helicopter. Pilots typically are under pressure to maintain high utilization rates, provide reliable on-demand service and respond quickly to humanitarian missions. This results in frequent operations in marginal visual flight rules (MVFR) conditions and IMC, and landings and takeoffs at marginal sites (e.g., roads flanked by power lines, trees, hillsides).

Figure 5 shows the distribution of accidents by mission, including general on-demand operations, air-tour operations, offshore operations and EMS operations.

In general on-demand operations, there were 59 accidents, of which 16 were fatal. Fourteen of the 59 accidents occurred in IMC.

U.S. Federal Aviation Regulations Part 135 Helicopter Accidents by Mission, 1991–2000



Source: Patrick R. Veillette, Ph.D.

Figure 5

In air-tour operations, there were 38 accidents, of which five were fatal. Fifteen of the air-tour accidents occurred in IMC. Typical air-tour missions involve flying over mountainous terrain in rapidly changing and localized weather conditions

along the glaciers of Alaska and the islands of Hawaii; and flying along the rugged terrain of the Grand Canyon in Arizona.

Thirty-seven accidents, including 15 fatal accidents, occurred during flights providing logistical support to offshore oil-drilling platforms in the Gulf of Mexico. Eight of the offshore accidents involved IMC.

Thirteen accidents, including seven fatal accidents, occurred during EMS flights. Five accidents involved IMC. EMS operations frequently involve flights dispatched with little advance notice and conducted in MVFR conditions and at night to unimproved, confined landing areas surrounded by obstacles.[3]

Single-engine Turbine Helicopters Involved in Majority of Accidents

Helicopters with a single reciprocating (piston) engine were involved in eight (5 percent) of the accidents (Table 1). One helicopter was destroyed, and seven helicopters were damaged substantially.

Table 1
Aircraft Damage by Engine Type, U.S. Federal Aviation Regulations Part 135 Helicopter Accidents, 1991–2000

	Destroyed	Substantial Damage	None	Total
Reciprocating Engine	1	7	0	8
Single-engine Turbine	29	60	2	91
Multi-engine Turbine	18	30	1	49
Subtotals	**48**	**97**	**3**	**148**

Source: Patrick R. Veillette, Ph.D.

Helicopters with a single turbine engine were involved in 91 (62 percent) of the accidents. Twenty-nine helicopters were destroyed, and 60 helicopters were damaged substantially.

Multi-engine turbine helicopters were involved in 49 (33 percent) of the accidents. Eighteen helicopters were destroyed, and 30 helicopters were damaged substantially.

More than Half of Accidents Occurred En Route

Eighty-two (56 percent) of the 147 accidents occurred during en route flight (Figure 2). Thirty-two (39 percent) of the en route accidents involved fatalities; 22 (69 percent) of the fatal en route accidents occurred in IMC. Six (7 percent) of the en route accidents involved obstacle strikes.

Of the 306 incidents, 169 (55 percent) occurred during en route flight. Forty-seven (28 percent) of the en route incidents involved human error; the remainder involved mechanical malfunctions. Eleven of the en route incidents involved obstacle strikes.

Part 135 helicopter operations typically involve a large number of takeoffs and landings per flight hour. The average air-taxi helicopter accumulates 2.6 landings per hour, whereas the average general aviation (Part 91) fixed-wing aircraft accumulates 0.7 landing per hour. The relatively high frequency of takeoffs and landings in Part 135 helicopter operations indicates a significant workload for each hour flown.[4]

Helicopters often are landed on unprepared sites with no ground-based approach aids. Many heliports do not have adequate lighting or visual approach guidance; thus, pilots must rely on their helicopters' landing lights and on other available light (street lights, parking-lot lights, moonlight, etc.) at night and often in low-visibility conditions.

Thirty-three accidents (22 percent), including five fatal accidents, occurred during the approach-and-landing phase. Twenty-seven (82 percent) of the ALAs were attributed to human error.

Seventy-three incidents (20 percent) occurred during approach and landing. Fifty (68 percent) of the approach-and-landing incidents involved human error; the remainder involved mechanical malfunction.

Five ALAs involved hard landings and/or settling with power.[5] Four ALAs and 39 approach-and-landing incidents involved obstacle strikes. The obstacles included wires (two ALAs and 16 incidents), fences or light poles (one ALA and 13 incidents) and trees (11 ALAs and 10 incidents). Visual meteorological conditions (VMC) prevailed in four of the obstacle-strike ALAs and 36 of the incidents. Four of the obstacle-strike accidents and 33 of the incidents occurred in daylight.

Among the Part 135 helicopter accidents and incidents, 29 accidents (20 percent) and 41 incidents (13 percent) occurred during takeoff. Of the takeoff accidents, five were fatal. Twenty-four of the takeoff accidents and 17 of the takeoff incidents were attributed to human error. Ten accidents, including one fatal accident, and seven incidents involved obstacle strikes. The obstacles included wires (four accidents), fences (four accidents) and trees (two accidents). Seven of the incident aircraft struck fences or light poles. Eight of the obstacle-strike accidents occurred in VMC; two occurred in IMC. Eight of the obstacle-strike accidents occurred in daylight; two occurred at night.

Ground operations were involved in three accidents (2 percent) and 23 incidents (8 percent). All three accidents and 16 of the incidents were caused by human error. Two accidents involved obstacle strikes. Five of the incidents involved main rotors striking ground vehicles in daylight VMC conditions. Five incidents involved main rotors striking other helicopters in confined ramp areas.

Faulty In-flight Decision Making Was Frequent Accident Cause

This study revealed that human error was the primary causal factor in 97 (66 percent) of the 147 accidents, including 32 (74 percent) of the 43 fatal accidents. Human error involves factors such as improper decisions, overconfidence, complacency, inadequate planning, inadequate situational awareness, fatigue and economic pressure.

Human error coupled with inadequate instrumentation and the basic static instability and dynamic instability of helicopters has been cited as a factor in the majority of helicopter accidents.[6] A 2001 study of commercial EMS helicopter accidents found that human error was the primary causal factor in 66 (76 percent) of 87 accidents from 1987 to 2000.[7] An analysis of NTSB reports on helicopter accidents from 1991 to 1998 indicated that pilot error was a cause or a contributing factor in 78 percent of all accidents and 88 percent of fatal accidents.[8]

The following principal concentrations of human error were found in this study of Part 135 helicopter accident reports and incident reports:

- The largest concentration of human error occurred during the en route phase of flight. Of the 82 en route accidents, 43 accidents (52 percent) were the result of human error. Inadequate in-flight planning and decision making were cited in 32 en route accidents, inadequate in-flight weather evaluation was cited in 28 en route accidents, and spatial disorientation was cited in 11 en route accidents. CFIT was involved in 13 en route accidents;

- The second largest concentration of human error occurred during approach and landing. Of the 33 ALAs, 27 accidents (82 percent) resulted from human error. Of the 73 approach-and-landing incidents, 50 incidents (68 percent) resulted from human error; and,

- The third largest concentration of human error occurred during takeoff. Of the 29 takeoff accidents, 24 accidents (83 percent) resulted from human error.

There are several models for categorizing human error. One model, the "accident/incident sequence model" developed by J.D. Ramsey, includes the following elements: sensory, perceptual, decision making and biomechanical/motor-skill.[9]

This study examined the elements in Ramsey's model as possible primary causes and secondary causes of the Part 135 helicopter accidents involving human error. For example, inadequate decision making would be a primary cause of an accident involving continued VFR flight in IMC; the pilot's subsequent motor-skill deficiency resulting in loss of control would be categorized as a secondary cause.

None of the accidents was caused primarily by a sensory error; however, 17 accidents and 81 incidents involved sensory error as a secondary cause. Often, the pilot's ability to see a nearby object can be impaired by cockpit design, smoke, haze, glare, viewing angle or darkness. Eleven of the 22 obstacle-strike accidents and 54 of the 67 obstacle-strike incidents involved inadequately marked obstacles or difficult-to-see obstacles. Viewing angle can impair a pilot's ability to judge tail-rotor clearance from obstacles. Six accidents and 27 incidents occurred when tail rotors struck obstacles that the pilots could not see.

Thirty-one accidents — including six takeoff accidents, eight en route accidents and 17 ALAs — were caused primarily by perceptual errors. Perception involves the association of meaning to sensory input (e.g., sight, sound). Perceptual errors include misjudging clearance, speed, distance and size. For example, a pilot perceives an aircraft's flight path during approach by observing the apparent changes in the shape of the runway. Eighteen perceptual-error accidents resulted when pilots misjudged wind direction and/or speed.

Secondary perceptual errors in 12 accidents and 29 incidents involved misjudging clearance from objects. Snow, causing temporary whiteout conditions or featureless terrain that impairs depth perception, was a factor in 12 accidents. Pilots failed to see electrical wires in nine accidents and 24 incidents. Fifty-eight ASRS reports indicated that the pilots saw wires only after seeing their supporting towers.

Fifty-four accidents — including 14 takeoff accidents, 30 en route accidents and nine ALAs — were caused primarily by inadequate decision making. Decision-making errors include inadequate attention, inadequate situational awareness, failure to anticipate (i.e., inadequate risk assessment) and improper decisions (e.g., accepting excessive risk). Twenty-eight accidents were caused primarily by continued VFR flight into IMC. Landings and takeoffs conducted in confined areas were involved in 14 accidents. Intentional maneuvering too close to terrain was involved in five en route accidents.

Inadequate motor skills (i.e., "stick-and-rudder" skills) were a primary cause of one accident, which was fatal, and a secondary cause of 22 accidents. Thirteen accidents occurred when pilots were unable to maintain control of helicopters during flight in IMC. Nine accidents occurred when pilots were unable to maintain control of helicopters after a loss of tail-rotor control occurred.

Procedural errors — including inadequate maintenance/inspection and failure to follow standard operating procedures (SOPs)[10] — were the primary causes of six accidents. One pilot failed to follow company SOPs for takeoff from a confined area. Three accidents were caused by failure to follow maintenance-and-inspection procedures. Inadequately documented and supervised procedures caused two accidents.

Unintentional mispositioning of fuel controls caused engine failures that led to five accidents. Three of the accidents were caused by the pilots; two accidents were caused by passengers.

The average experience of the pilots involved in the human-error accidents was 8,207 flight hours. The average experience of pilots involved in the mechanically caused accidents was 8,783 flight hours.

Helicopter Pilots Vulnerable to External/internal Pressure

A study conducted in 1980 found that helicopter pilots showed a pattern of basic personality factors that are conducive to an increased tendency to take risks. The helicopter pilots tested showed a lower tendency than other pilots to conform and a higher tendency to achieve. The findings indicated that helicopter pilots are more vulnerable to economic pressures, humanitarian pressures and management pressures to complete missions.[11]

Helicopter pilots generally are goal-oriented individuals. This characteristic adds motivational pressures, largely self-induced, to conduct a flight when requested, to complete the flight as planned, to please the passengers, to meet schedules, to make money and to impress peers.[12]

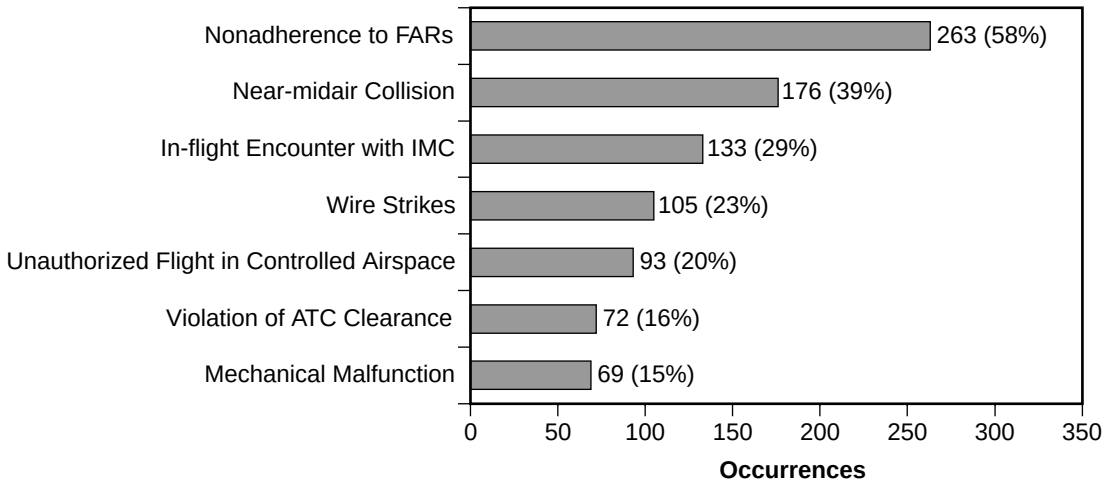
ASRS Reports Show Nonadherence to Regulations

NASA ASRS reports provided additional information about human factors in Part 135 helicopter operations. Of the 457 reports examined in this study, 39 percent were submitted by EMS pilots, 29 percent were submitted by on-demand pilots,18 percent were submitted by air-tour pilots and 13 percent were submitted by offshore-helicopter pilots.

Fifty-eight percent of the reports discussed incidents involving nonadherence to regulations (Figure 6). Other incidents discussed in the reports were near-midair collisions (39 percent), inadvertent encounters with IMC (29 percent), wire strikes (23 percent), unauthorized flight in controlled airspace (20 percent), violations of air traffic control (ATC) clearances (16 percent), and mechanical malfunctions (15 percent).

Eighty-one percent of the reports submitted by air-tour pilots involved nonadherence to regulations. Almost one-fourth of these reports cited Special Federal Aviation Regulation (SFAR) 71, which was adopted by FAA in October 1994 after a series

Subjects of 457 NASA ASRS Reports Involving U.S. Federal Aviation Regulations (FARs) Part 135 Helicopters, 1991–2000



Note: Many reports involved more than one subject.

NASA ASRS = U.S. National Aeronautics and Space Administration Aviation Safety Reporting System
IMC = Instrument meteorological conditions ATC = Air traffic control

Source: Patrick R. Veillette, Ph.D.

Figure 6

of air-tour accidents in Hawaii. Among the requirements of the SFAR is that air-tour flights be conducted no lower than 1,500 feet above ground level (AGL) and no closer than 1,500 feet (458 meters) to any person or property.

One air-tour pilot who submitted an ASRS report about nonadherence to the SFAR said:

> Conducting air tour at 3,000 feet MSL [mean sea level] (1,500 feet AGL) in the area of Hawaiian Falls. Weather conditions at arrival at this location were approximately 3,800 broken, 3,000 scattered and five [statute miles (eight kilometers) visibility in haze]. Approximately 8–10 minutes into the air tour of this area, weather deteriorated due to wind conditions, cloud movement and rain showers, which restricted visibility to the extent that I lost visual contact with another aircraft in the immediate vicinity which I knew at last sighting to be at the same altitude (1,500 feet AGL). I elected to immediately terminate the tour and return to Hilo Airport, and descended to a lower altitude (500 feet AGL) to avoid lowering cloud cover and improve my visibility conditions to see and avoid any traffic in my immediate vicinity. Safety of the passengers aboard my aircraft was my first priority, and the thought of violating SFAR 71 and the 1,500-foot-AGL altitude limit was not a consideration during this maneuver, only the safety and security of my passengers and aircraft. … I attribute [two recent near-midair collisions] to recently enacted SFAR 71, which places numerous aircraft at essentially the same altitude.[13]

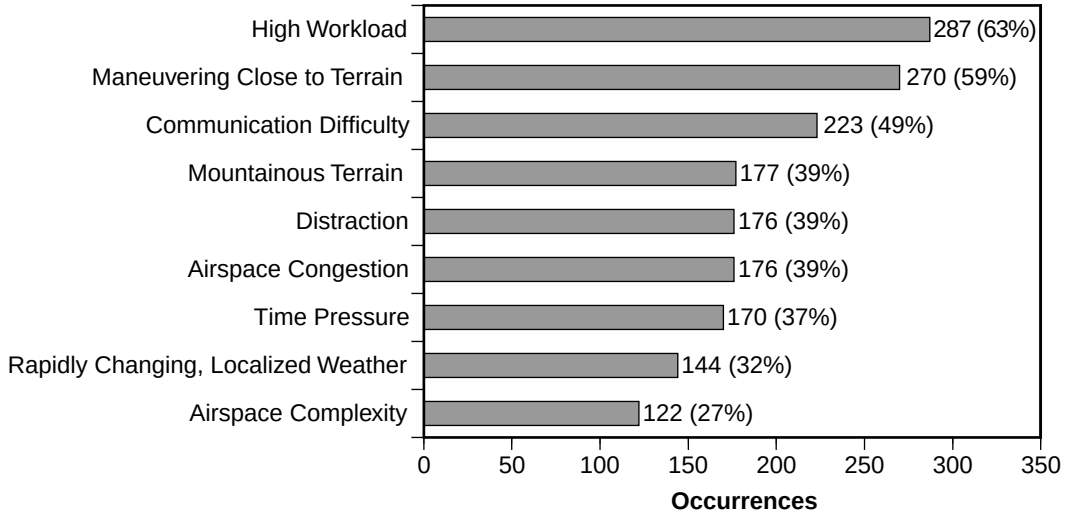
Pilots Describe Workload As Substantial

High workload was cited in 287 (63 percent) of the ASRS reports (Figure 7). The reports indicated that a contributing factor to high workload was multi-tasking — performing simultaneous actions such as controlling the aircraft, navigating, monitoring multiple radio frequencies and attending to collateral duties such as passenger briefings. In 77 reports, pilots said that they were overloaded.

More than half (150) of the reports of high workload were submitted by EMS pilots. One report said:

> I was flying an EMS helicopter dispatched from XYZ hospital in City A to recover a patient at the mall in City B. The [geographical] coordinates provided were incorrect and took me five nautical miles [nine kilometers] south of the City B airport before I recognized the error and reversed course. I was coordinating with dispatch, medic command (flight-following/status reports) and emergency vehicles on scene and broadcasting position reports and intentions on Unicom. … The [ATC] supervisor advised me that I entered his airspace and did not properly coordinate with his controller. … I was working four frequencies and receiving conflicting coordinates from the ground while searching for the landing zone. I was aware of my close proximity to the airport traffic area. I was preoccupied with traffic avoidance while coordinating

Contributing Factors to Human Error Cited in NASA ASRS Reports Involving U.S. Federal Aviation Regulations Part 135 Helicopters, 1991–2000



Note: Many reports involved more than one subject.

NASA ASRS = U.S. National Aeronautics and Space Administration Aviation Safety Reporting System
Source: Patrick R. Veillette, Ph.D.

Figure 7

with the ground vehicles during the search for and subsequent approach and landing at the landing zone.[14]

Communication difficulties were cited in 223 (49 percent) of the ASRS reports. Of these, 75 reports said that the pilots were monitoring several radio frequencies, 63 reports cited congested radio frequencies, 47 reports cited inadequate radio reception, and 38 reports cited communication interference from intercom calls by crewmembers or passengers.

Time pressure was cited in 170 (37 percent) of the reports. Of these, 119 reports (by EMS pilots) cited the medical conditions of patients, 37 reports cited fuel situations caused by delays or diversions because of unexpected or unforecast weather conditions, and 14 reports cited pressure by passengers to meet schedules.

A human-error study conducted by James Reason found that the probability of human error is increased by a factor of 11 by time pressure, by a factor of eight by circumstances involving inadequate human-system interface or the irreversibility of errors, by a factor of six by circumstances involving information overload, and by a factor of four by circumstances involving misperception of risk.[15] These critical error-causing factors often are cited in accident reports and incident reports.

Pilots Cite Distraction as Safety Problem

In 176 (39 percent) of the ASRS reports, pilots said that they had been distracted. Pilot performance was said to have been compromised in 172 of the 176 reports. Several reports cited multiple distractions.

In 50 reports filed by EMS pilots, the most common causes of distractions were actions of medical flight crewmembers, monitoring multiple radio frequencies, radio-frequency congestion, collision avoidance in high-density traffic areas, aircraft equipment problems, and inadequate cockpit organization.

In 42 reports filed by air-tour pilots, the most common causes of distractions were collision avoidance in high-density traffic areas, collateral duties such as providing tour narrations to passengers, interruptions by passengers, rapidly changing weather conditions, and aircraft equipment problems. Thirty-seven of the reports said that the distractions occurred while the pilots were maneuvering helicopters close to rugged terrain.

In 24 reports filed by offshore-helicopter pilots, the most common causes of distractions were obstacles, collision avoidance in high-density traffic areas, marginal weather conditions, avoidance of offshore-platform exhaust-stack gases, and passenger requests.

In 31 reports filed by on-demand pilots, the most common causes of distractions were collision avoidance in high-density traffic areas, radio-frequency congestion, aircraft equipment malfunctions and passenger requests. Twenty-five reports said that the pilots were distracted while flying helicopters in complex and congested airspace.

Mountainous Terrain Frequently Cited as a Contributing Factor

Mountainous terrain was cited as a contributing factor in 177 (39 percent) of the ASRS reports. More than half of the reports (54 percent) cited substantially reduced helicopter performance at high-density altitudes. Other factors cited in the reports were confined maneuvering areas, such as canyons, river beds and logging roads; unimproved landing surfaces surrounded by obstacles and terrain; wind conditions; limited options for escape routes and emergency landings; and terrain obscuration by snow and ice.

Rapidly changing, localized weather conditions were cited in 144 (32 percent) of the ASRS reports. Seventy-eight of the reports cited MVFR conditions. Thirty-seven incidents occurred at night. Twenty-eight incidents occurred in unforecast weather conditions. In 98 reports, the pilots said that they were unable to continue safely under VFR. Forty-three pilots were forced to climb to avoid terrain. Of the 25 pilots who said that they attempted to contact ATC for assistance, three pilots said that they were successful. Eighteen reports cited a temporary loss of aircraft control.

Often, mountainous terrain and rapidly changing weather conditions near scenic locations funnel traffic into confined areas, increasing the risk of collision, as shown by the following ASRS report:

> While on a sightseeing tour on a normal flight route and after departing the Waimea Canyon on its western rim en route to the Na Pali Coast via Kokee State Park, I had encountered a lower-than-normal ceiling and had avoided IMC by flying VFR under the ceiling at 200 feet AGL, which is permissible in uncontrolled airspace with a helicopter. During this transition through Kokee State Park, I visually spotted [another] helicopter approximately 1.5 miles [2.4 kilometers] away at my 2 o'clock position. Operators monitor 122.7, and as soon as I spotted the other helicopter, which was not easy because it did not have any anti-collision or nav[igation] lights on, I transmitted my relative position at least three times with no response from the other helicopter. This helicopter was also on a collision course relative to mine; and because he had the right-of-way, I had to alter my course to the left and descend to a lower altitude. Had I maintained my present altitude, I would have encountered IMC. After I had altered my course, the pilot of the other helicopter transmitted on 122.7 that he had

visual [contact with] me and in so many words indicated that an "official" was on board his helicopter and they were surveying helicopters flying at low altitudes in the Kokee State Park area.[16]

Airspace congestion was cited as a factor in 176 (39 percent) of the ASRS reports. Airspace complexity was cited as a contributing factor in 122 (27 percent) of the reports. Ninety percent of the ASRS reports submitted by air-tour pilots cited airspace congestion. Sixty-three percent of the ASRS reports submitted by offshore-helicopter pilots cited airspace congestion.

Engine Failures Led to About One-quarter of the Accidents

Engine failures occurred in 40 accidents (27 percent) and 98 incidents (32 percent). The accidents involved failures of three reciprocating engines and 37 turbine engines. Thirty-seven (93 percent) of the engine-failure accidents involved single-engine helicopters. Of these, eight helicopters were destroyed and 29 helicopters were substantially damaged.

Thirty-seven (38 percent) of the engine-failure incidents involved single-engine helicopters. Fourteen of the incidents resulted in minor damage; 23 incidents resulted in no damage.

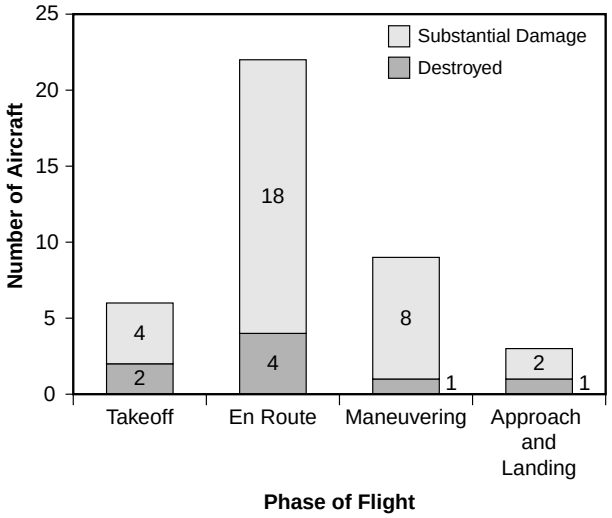
Three of the engine-failure accidents involved multi-engine turbine helicopters. In each accident, the pilot was unable to maintain level flight after a power loss occurred in one engine and conducted an autorotative landing that resulted in substantial damage. One helicopter was landed on mountainous terrain; one was landed on water; one was landed on unspecified terrain.

Sixty-one (62 percent) of the 98 engine-failure incidents involved multi-engine turbine helicopters. In 32 incidents, the pilots were able to divert the flights to airports and land; 30 of the helicopters were not damaged, and two helicopters had minor damage. In 10 incidents, the pilots were able to divert the flights to offshore platforms, rather than conducting autorotative landings on water; five helicopters were not damaged; five helicopters had minor damage. In two incidents, the pilots conducted autorotative landings in the Gulf of Mexico with no damage to the helicopters. Seventeen incident reports did not specify the terrain on which the helicopters were landed; 14 helicopters had no damage; three helicopters had minor damage.

Of the 40 engine-failure accidents, 22 engine failures (55 percent) occurred during en route flight (Figure 8). Two of the accidents were fatal; one accident involved serious injuries; 19 accidents resulted in minor injuries or no injuries.

Six engine-failure accidents occurred during takeoff. One accident was fatal; one accident involved serious injuries; four accidents resulted in minor injuries or no injuries.

Aircraft Damage and Phase of Flight for U.S. Federal Aviation Regulations Part 135 Helicopter Engine-failure Accidents and Incidents, 1991–2000



Source: Patrick R. Veillette, Ph.D.

Figure 8

Nine engine-failure accidents occurred during maneuvering flight. Two of the accidents were fatal; three accidents involved serious injuries; four accidents resulted in minor injuries or no injuries.

Three engine-failure accidents occurred during landing. One accident was fatal; two accidents resulted in no injuries.

Mechanical failure was the cause of 30 (75 percent) of the 40 engine-failure accidents. The other engine-failure accidents were caused by human error, such as improper operation of fuel-boost pumps or inadvertent movement of a fuel lever.

Eighty-nine (91 percent) of the 98 engine-failure incidents were caused by mechanical failure. The other engine-failure incidents were caused by human error.

Environmental conditions contributed to some engine-failure accidents. Twelve accidents occurred during snowfall. One accident occurred on April 3, 1994. A Bell 206L-3 carrying skiers in the remote Ruby Mountains of Nevada was landed at a remote site high on a mountain because of adverse weather conditions. Snow accumulated on the airframe. No external engine snow covers were available. About one hour after landing, the pilot started the engine and operated it about five minutes. After discussing the situation with the company's director of operations, the pilot took off. Density altitude was approximately 7,000 feet, and the helicopter was loaded near its certified maximum weight. Soon after liftoff, a loss of power occurred. The helicopter struck a 30-degree slope and rolled

over; four occupants were killed, and one occupant was seriously injured. The NTSB report said that the probable cause of the accident was "the ingestion of foreign material (snow) into the engine, which resulted in a flameout."[17]

Ingestion of volcanic gases was involved in the engine-failure accident of an Aerospatiale (now Eurocopter) AS 350D on Oct. 14, 1991, near Hilo, Hawaii. The helicopter was hovering near the edge of a volcanically active crater and downwind of the vent. Several loud popping sounds were heard from the engine, and the pilot detected a loss of power. During the subsequent autorotative landing on sloping terrain, the helicopter landed hard, and the main rotor struck the tail boom, causing substantial damage to the helicopter. The accident report said that the loss of power was caused by ingestion of gases from the active volcano vent.[18]

Part 135 helicopter operations often are conducted over large expanses of water or rugged terrain, providing few options for an emergency landing. In all of the engine-failure accidents and incidents involving single-engine helicopters, the pilots initiated autorotative flight. Twelve accidents occurred in mountainous terrain; four helicopters were destroyed, and eight helicopters were substantially damaged. Seven helicopters were landed on water; two helicopters were destroyed, and five helicopters were damaged substantially.

Six accident pilots conducted autorotative landings in urban areas, resulting in substantial damage to the helicopters. Four helicopters struck trees during autorotative landings; one helicopter was destroyed, and three helicopters were substantially damaged. The reports on the remaining eight accidents did not specify the terrain; one helicopter was destroyed, and seven helicopters were substantially damaged.

VFR Flight in IMC Set Stage for Many Fatal Accidents

Continued VFR flight in IMC was the leading cause of fatal helicopter accidents. Of the 43 fatal accidents, 25 accidents (58 percent) occurred in IMC. Twenty-two of the accidents occurred during the en route phase of flight.

Of the 147 total accidents, 42 accidents (29 percent) occurred in IMC. Twenty-seven of the helicopters were destroyed.

The NTSB accident/incident database includes final reports on 1,336 helicopter accidents from 1991 through 1998. Sixty-nine accidents (5 percent) occurred in IMC; the remainder occurred in VMC. The accidents that occurred in IMC typically were more serious than accidents that occurred in VMC. NTSB data show that 53 percent of the IMC accidents resulted in fatalities, compared with 17 percent of the VMC accidents.

Fifteen Part 135 helicopter accidents in IMC involved CFIT, and 13 IMC accidents involved spatial disorientation and loss of control. Of these 28 accidents, 19 resulted in fatal injuries. Fifteen accidents, including 10 fatal accidents, involved single-engine turbine helicopters flown by a single pilot. Thirteen accidents, including nine fatal accidents, involved multi-engine turbine helicopters flown by a single pilot.

Eight accidents involved mechanical failures that occurred during flight in reduced visibility. Six IMC accidents involved obstacle strikes.

Fifteen IMC accidents involved air-tour helicopters. Fourteen involved on-demand helicopters. Eight involved offshore helicopters. Five involved EMS helicopters.

The basic handling qualities and stability characteristics of helicopters make flying these aircraft significantly more demanding than flying fixed-wing aircraft, especially at night or in reduced visibility. Nevertheless, the relatively slow speed and high maneuverability of helicopters induce some helicopter pilots to fly in conditions providing no margin for error; for example, helicopters typically are flown within 1,000 feet of the ground. The belief is that "we can always put it down somewhere."

Although many helicopters are at least minimally equipped for flight in IMC, the information provided by typical helicopter flight instruments is not sufficiently sensitive or accurate for low-speed flight.[19]

The gyroscopic attitude indicator, for example, was designed for fixed-wing aircraft and can provide incorrect pitch attitude cues in helicopters. In a fixed-wing aircraft, an attitude indicator accurately depicts the nose-up attitude in a climb and the nose-down attitude in a descent. Depending on the speed of a helicopter, the pitch attitude during climb or descent can be the opposite of a fixed-wing aircraft — that is, a nose-down attitude in a climb and a nose-up attitude in a descent. Therefore, the helicopter pilot must use other sources of information, either from the panel or from external cues.[20]

Compounding the problem is that the en route IFR flight system is designed primarily for fixed-wing aircraft, which creates difficulties for helicopter pilots to file IFR flight plans. Many helicopter operations are conducted in areas where instrument departure procedures and instrument approach procedures are not available. All 15 CFIT accidents and 13 loss-of-control accidents occurred in airspace where ATC radar services were unavailable.

The layout of some helicopter cockpits also makes instrument flying difficult, as shown by the following ASRS report filed by a pilot who had selected an incorrect transponder code:

> The transponder is located on the INS [inertial-navigation system] panel in such a way that the pilot has to turn sideways and bend over the copilot seat to

> read the code. This has been written up by several pilots already because of the vertigo induced … when changing codes in flight. Several pilots have sent hazard reports to our company requesting the relocation of the transponder. I believe that had the transponder been located in a position where a normal scan would have picked up the transponder, the code would have been changed.[21]

Inadvertent encounters with MVFR conditions or IMC were cited in 133 ASRS reports. Thirty-seven reports discussed events that occurred at night. Twenty-eight reports discussed events that occurred in weather conditions that were not forecast. In 18 of the events, the pilots temporarily were not able to maintain control of their helicopters.

The following report was filed by an EMS helicopter pilot:

> Weather was marginal but acceptable. Landed at ZZZ [location de-identified by NASA ASRS] with no problem. Upon departure and climbout, flew into clouds at about 1,000 feet MSL. Due to rising terrain in vicinity and limited visual references, I performed a maximum-performance climb and came to a heading that would avoid terrain. Just as I was calling ZZZ approach for an IFR clearance, I broke out at 1,800 feet MSL. Continued flight with no further incident. Contributing factors to entering IMC were the darkness, low light illumination and ragged ceiling.[22]

Spatial Disorientation, Loss of Control Occurred in VMC

Thirteen accidents, of which 12 were fatal, involved pilots who became spatially disoriented during flights in VMC. Nine accidents occurred in the Gulf of Mexico. Seven accidents occurred at night.

An FAA manual on decision making says that "even on the clearest night with VFR conditions, a pilot can come close to IFR (instrument flight rules; i.e., inadvertent IMC) operations if there is no moon and/or no ground lights to establish a horizon reference. Or, on the other hand, a profusion of ground lights below and stars above can merge into a continuous sweep of pinpoints that deprive a pilot of any horizon reference."[23]

An FAA advisory circular on spatial disorientation says, "Surface references and the natural horizon may at times be obscured, although visibility may be above VFR minimums. Lack of a natural horizon or surface reference is common on overwater flights, at night and especially at night in extremely sparsely populated areas or in low-visibility conditions."[24]

An NTSB special report on EMS helicopter safety said, "Tests and experience have shown that non-instrument-trained pilots or nonproficient pilots are rarely successful in overcoming spatial disorientation. Most helicopters require some form of autopilot system in addition to appropriate navigation equipment and instrumentation in order to be approved and certificated for single-pilot flight into instrument conditions. Without this help, even if the helicopter has appropriate instrumentation, pilots will have a difficult time controlling the helicopter if they lose visual reference, since helicopters are unstable in flight and require constant input from the pilot to remain under control."[25]

None of the 13 helicopters involved in accidents resulting from spatial disorientation and loss of control was equipped with a stability-augmentation system.

During a survey of EMS helicopter pilots conducted in 1999 by the National EMS Pilots Association, 26 percent of the pilots said that they practice recovery from unusual attitudes during recurrent training. When the pilots were asked which technologies would help them most, 29 percent said that a fully coupled autopilot would be the greatest aid, while 21 percent said that global positioning system (GPS) approaches and improved access to the IFR en route system would yield the greatest help.

Official Weather Reports Often Are Unavailable

Twenty-seven (64 percent) of the 42 pilots involved in IMC-related accidents obtained a weather briefing before the accidents occurred. Thirteen of the pilots were conducting flight operations in remote areas where official weather briefings were not available.

In remote areas where official weather briefings are available, the forecasts often are not reliable because there are few weather-reporting stations and/or weather reports are infrequent.[26]

Of the 27 pilots who obtained weather briefings, 24 pilots were unable to obtain terminal weather forecasts for the areas of intended operation.

The following ASRS report discusses an inadvertent encounter with IMC that might have been prevented if weather information had been available to the pilot:

> Performing as a commercial helicopter pilot, conducting a routine work-crew change at an offshore platform, I encountered weather condition other than forecast. The company that employs me requires that I try to maintain [flight with at least a] 500-foot ceiling and three miles [five kilometers] visibility en route. Unable to maintain [operations]-manual requirements, my corrective action was a 180-degree turn to return to my starting point. While en route weather deteriorated,

I performed a descent to 300 feet; visibility remained 1–2 miles. I noticed better weather conditions and flew to that location in search of an alternate platform in order to land. There were no platforms in the clear area, and flight visibility was declining due to fog and haze. Instead of trying to maintain VFR in deteriorating weather conditions, I performed an ascent to 1,200 feet and turned to a heading that would return my aircraft to the company's shore base. I contacted my company flight-following [service] and informed them of my status and intentions. My status was IFR on top and intentions were, if possible, to return to VFR conditions or perform an ASR [airport-surveillance radar] approach to Lafayette Regional Airport. En route, I received a PIREP [pilot report] that stated VFR conditions existed 20 miles [32 kilometers] south of my shore base and immediately proceeded to that location. Upon arrival, I was able to perform a VFR descent and return to company shore base in VFR conditions. … I believe the primary factor concerning this incident was the weather. Improving or increasing offshore weather stations may aid in prevention of further such incidents.[27]

Snow and Ice Frequently Limit Depth Perception

Twelve accidents, including four fatal accidents with 19 fatalities, and three incidents involved flights conducted over snow-covered terrain or ice-covered terrain that limited vision and impaired depth perception. Five helicopters were destroyed, and seven were substantially damaged.

In four accidents, the pilots' vision and depth perception also were impaired by flat light conditions. For example, on Sept. 10, 1999, the pilot of a Eurocopter AS 350B-2 was attempting to return to Juneau (Alaska) International Airport after completing an ice-field sightseeing flight. While conducting a gradual descent over a large, featureless and snow-covered field, the pilot's forward vision was reduced by a localized snow shower. The pilot slowed the helicopter to about 70 knots and attempted to use a mountain range on the left side of the helicopter for visual reference. He said, "The visibility got to the point where I was unable to discern any topographical features, only a dark shape on the horizon." Flat light conditions contributed to his inability to recognize any topographical features. During the descent, the helicopter struck snow-covered terrain, slid about 150 feet (46 meters) and nosed over. The helicopter was destroyed, and one passenger was seriously injured.[28]

On Sept. 10, 1999, during searches for the helicopter that struck terrain during the Part 135 sightseeing flight, two other Eurocopter AS 350 helicopters struck the ice field while being flown under Part 91. Based on the investigations of these accidents and other accidents involving flat light conditions, NTSB recommended that FAA require instrument ratings for pilots who conduct commercial, passenger-carrying operations in areas often affected by flat light conditions or whiteout conditions. NTSB also recommended that helicopters used in these operations be equipped with radar altimeters.[29] As of Jan. 6, 2003, NTSB was awaiting FAA responses to the recommendations.

Eight accidents, of which three were fatal, occurred in whiteout conditions. All of the accidents occurred when the helicopters were hovering within five feet (1.5 meters) of a snow-covered surface. None of the helicopters was equipped with a radar altimeter.

One accident occurred March 17, 1999, near Girdwood, Alaska, in an area that had received about six inches (15 centimeters) of light, powdery snow. The pilot of a Eurocopter AS 350B2 had transported photographers to the top of a mountain and was returning to the base of the mountain to pick up skiers. As the helicopter was being hovered near the landing area in whiteout conditions, the pilot became spatially disoriented. The helicopter drifted right, the right skid struck the snow, and the helicopter rolled onto its right side. The pilot was not injured; the helicopter was substantially damaged.[30]

Thirty-two IMC Accidents Occurred at Cruise Speed

In 32 accidents that occurred in IMC, the helicopters were being flown at cruise speeds. Twenty-two of the accidents were fatal.

Research indicates that the average helicopter pilot requires an average of five seconds to recognize a hazard, determine that corrective action is needed and perform the corrective action.[31] Thus, a helicopter being flown at 120 knots will travel about 1,013 feet (309 meters) by the time the pilot recognizes an obstacle ahead of the aircraft as a hazard, determines that a turn is necessary and begins the turn.

The following ASRS report by an EMS pilot describes an encounter with a tower while flying a helicopter at cruise speed:

I contacted the hospital and let them know we were about five minutes out at nine miles [14 kilometers]. I slowed the aircraft to 90 knots, and as I was slowing, medcom called for a position report. I told them I didn't have time right now and looked down to set my [radio-frequency-]selector switch back to approach control. When I looked up again, all I saw was a cloud for one or two seconds. As I was getting ready to transmit for an IFR clearance, I broke out of the cloud to see a tower to my right front at approximately 500 feet to 1,000 feet [153 meters to 305 meters]. I immediately turned 20

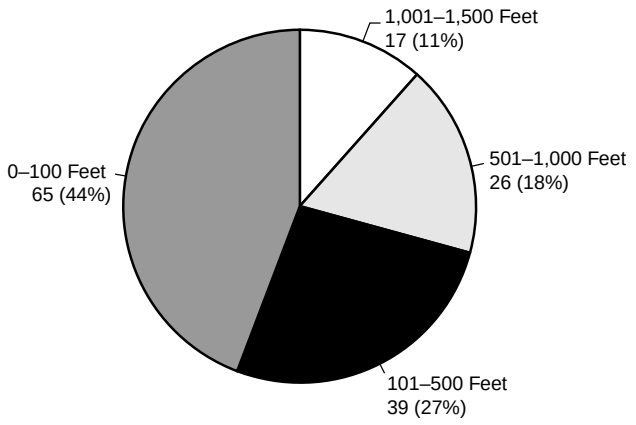
degrees to the left and momentarily heard the main rotor strike one of the guy wires [supporting the tower]. I felt a slight lateral vibration and continued a left descending turn into a 10-knot southerly wind. I found an open field and, after verifying my rotor [speed] was still in the green, did a power-on approach to the field. As I was landing, I gave a mayday call to [ATC]. After landing and finding all passengers safe, I executed an emergency shutdown. … I had let my attention divert to making radio calls instead of flying the aircraft. In the future, I will not hesitate to land or ask for a clearance much sooner in a deteriorating situation.[32]

Most Accident Helicopters Were Flown Low

Figure 9 shows the altitudes above ground level at which the helicopters were being operated when the accidents occurred. Of the 147 total accidents, 65 accidents (44 percent) occurred at or below 100 feet AGL; 104 accidents (71 percent) occurred at or below 500 feet AGL; and 130 accidents (88 percent) occurred at or below 1,000 feet AGL.

During helicopter operations close to the ground, precise and rapid flight-control movements often are required to avoid striking natural obstacles and man-made obstacles. When precise position changes are required, such as during confined-area operations or hovering close to the ground, pilots must maintain a safe distance from trees, wires, fences, buildings, parked helicopters, vehicles and other obstacles. This requires constant attention and precise awareness of the physical dimensions of the helicopter and its performance capabilities.[33]

Operating Altitude (AGL) at Time of Accident, U.S. Federal Aviation Regulations Part 135 Helicopter Accidents, 1991–2000



AGL = Above ground level

Source: Patrick R. Veillette, Ph.D.

Figure 9

Table 2 (page 15) shows that 22 accidents, including five fatal accidents, and 67 incidents involved collisions with obstacles. All the obstacle-strike accidents and incidents occurred within 100 feet of the ground.

Nine accidents, of which four were fatal, and 24 incidents involved wire strikes. Six accidents and 13 incidents occurred when helicopters struck trees or other types of vegetation. Two accidents and five incidents involved collisions with parked helicopters. Five accidents and 20 incidents involved collisions with fences or light structures. Five incidents involved collisions with motor vehicles.

Ten accidents and seven incidents occurred during takeoff. Six accidents and 11 incidents occurred during the en route phase of flight. Five accidents and 39 incidents occurred during approach and landing. One accident and 10 incidents occurred as the helicopters were being taxied on the ground.

Eighteen accidents and 53 incidents occurred during the day; four accidents and 14 incidents occurred at night. VMC prevailed when 18 accidents and 62 incidents occurred; IMC prevailed when four accidents and five incidents occurred.

The most common factors associated with obstacle-strike accidents are high workload, distractions, inadequate preflight planning, overestimation of prevailing visibility, underestimation of distance from objects, preoccupation with the closest terrain, spatial disorientation, and inadequate information or incorrect information about obstacles.

One fatal obstacle-strike accident occurred during an EMS flight on a dark night, Dec. 14, 1997, in Littleton, Colorado. The Bell 407 helicopter was landed at the site of an automobile accident, and a patient was loaded aboard the helicopter. On takeoff, the pilot was conducting a climbing right turn when the helicopter struck unmarked power lines and then struck the ground in an inverted attitude. The helicopter was destroyed, and all four occupants were killed. The NTSB accident report said that the power lines were not depicted on navigational charts and that the company's SOPs for landing-zone departures were to climb straight ahead in a near-vertical climb to a minimum of 300 feet AGL before turning.[34]

Wire Cutters Work Best in Level Flight

A U.S. Army study found that fatalities associated with wire strikes decreased by nearly half after helicopters were equipped with wire-strike-protection systems (wire cutters).[35] Wire cutters are installed on many civil helicopters.

Table 2
Obstacle Strikes in U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000

	Takeoff	En Route	Approach and Landing	Ground	Total
Wire					
Incident	—	8	16	—	**24**
Nonfatal Accident	3	—	1	1	**5**
Fatal Accident	1	2	1	—	**4**
Tree, Vegetation					
Incident	—	3	10	—	**13**
Nonfatal Accident	2	2	2	—	**6**
Fatal Accident	—	—	—	—	—
Other Aircraft					
Incident	—	—	—	5	**5**
Nonfatal Accident	—	2	—	—	**2**
Fatal Accident	—	—	—	—	—
Fence, Light Pole					
Incident	7	—	13	—	**20**
Nonfatal Accident	4	—	—	—	**4**
Fatal Accident	—	—	1	—	**1**
Vehicle					
Incident	—	—	—	5	**5**
Nonfatal Accident	—	—	—	—	—
Fatal Accident	—	—	—	—	—
Total					
Incident	7	11	39	10	**67**
Accident	10	6	5	1	**22**
Nonfatal Accident	9	4	3	1	**17**
Fatal Accident	1	2	2	0	**5**

Source: Patrick R. Veillette, Ph. D.

Eight of the nine helicopters involved in wire strikes were equipped with wire cutters. The effectiveness of wire cutters is affected by the helicopter's forward speed and pilot-reaction time. Wire cutters were designed to work best when contact is made in level flight.[36] Eight of the nine accident helicopters were ascending or descending when they struck wires.

Wire cutters, which typically are installed on the upper surface and lower surface of the aircraft, will not help if the rotor strikes the wire.[37] Seven of the nine wire-strike accidents involved wire strikes by the main rotors.

Three of the wire-strike accidents occurred between 100 feet AGL and 200 feet AGL; five accidents occurred below 100 feet AGL. None of the nine accident pilots detected the wires before their helicopters struck the wires; none of the wires was marked with colored balls; only one of the wires was depicted on a navigational chart.

The ASRS database included 104 reports of near collisions with wires. The following report is an example:

> I was on a low-level photo flight for a boat-manufacturing company. Power line was unmarked and crossed lake. It was virtually invisible, with hills and terrain in the background. Main rotor struck power line, severing it. Helicopter was still flying, and I was able to land it safely. No injuries. Should have markers on line to make it visible.[38]

In 58 ASRS reports, the pilots said that they became aware of their close proximity to wires only after seeing the supporting tower structures, as the following report illustrates:

> Conducting mountain-flying-training/photography flight for magazine article. Flying … along the Gunnison River, noticed unmarked high-tension power lines crossing the river at the east entrance of the canyon. There are no

"balls" marking these lines. The sectional chart (Denver) indicates power lines in the area; however, there is insufficient detail to show the lines crossing the river. … Note: The power lines are difficult to see! I noticed the tower structures (only because I was looking for them). Did not see the wires until crossing them and seeing the sun reflected off them. The lines did not pose a hazard to this flight, but some pilots flying in an unpopulated area may transition this area at low altitude and impact the lines.[39]

Misjudged Clearance Leads to Rotor Strikes

In 12 accidents, including three fatal accidents, and 29 incidents, the helicopters' main-rotor blades struck obstacles when the pilots misjudged rotor clearance.

Six accidents and 16 incidents occurred while the helicopters were being maneuvered in confined areas. The following ASRS report provides an example of this type of incident:

> While in a hover over a pool at the base of a waterfall, I experienced some light turbulence and was also subjected to flicker vertigo caused by the sunlight through [the] rotor blades. I misjudged the distance on the right side of the helicopter, and the main-rotor tips struck the side of the mountain. A vibration was immediately experienced. I ascertained I could control the aircraft, and I flew to a suitable landing area and shut down.[40]

Six accidents, including one fatal accident, and 27 incidents occurred when helicopter tail rotors struck objects. In four other accidents and in three incidents, landing skids struck obstacles. All the accidents and incidents occurred while the helicopters were hovering in close proximity to the ground.

Sun glare, which can reduce significantly the ability of a pilot to see an obstacle, was a factor in eight of the obstacle-strike accidents and 17 obstacle-strike incidents. One incident occurred on Nov. 5, 2000, after the pilot of a Robinson R-44 rejected an approach after determining that the area was unsuitable for a landing. The pilot turned the helicopter into the sun and was not able to maintain visual contact with a tower guy wire. The pilot tried to bank the helicopter away from the wire, but the rotor-blade tips struck the wire. The pilot then conducted a precautionary landing. The helicopter had minor damage; none of the three occupants was injured.[41]

Offshore Platforms, Ramps Provide Limited Maneuvering Room

Offshore platforms and ramps provide very limited room for maneuvering. Six of the obstacle-strike accidents and 14 incidents occurred when helicopters collided with objects on offshore platforms.

Other helicopters, cranes, exhaust stacks and fences are among the obstacles that challenge pilots operating helicopters at offshore platforms, as shown by the following ASRS report:

> I was asked to fly a mechanic from one offshore platform to another one to fix a grounded aircraft. I was informed by telephone that the pilot of the grounded aircraft said there was plenty of room to land. Upon arrival at the platform, I observed the grounded aircraft parked midway between the upwind and downwind sides of the helipad. … I made my approach and landing so that my main-rotor disc would be in the void created between two of the other aircraft's [four] stationary blades. After landing and retarding throttles to flight idle, I advised the mechanic to exercise caution in getting out of the aircraft. As he started to leave, the forward blade of the other aircraft rotated into the plane of my turning rotors, striking two blades. I had violated company policy of always having 13 feet [four meters] of blade clearance to the nearest fixed obstruction. Upon landing, there was five feet [two meters] of clearance. … My judgment was poor for deciding to land when there was obviously not 13 feet of clearance. The only pressure put on me was by myself for wanting to help get a grounded aircraft operational. Had the pilot of the other aircraft parked farther forward, put on more than one blade tie-down or applied the rotor brake, this [incident] could have been avoided altogether, just as it could have been had I decided not to land.[42]

Three obstacle-strike accidents and 17 incidents occurred when helicopters were being operated at confined ramps. Two accidents involved people who walked into rotating tail rotors. One tail-rotor-strike accident occurred Nov. 20, 1994, in Juneau, Alaska. The pilot had landed a Bell 206B and locked the flight controls. The engine and rotors were turning at flight idle when the pilot exited the cockpit and began refueling the helicopter. A company employee walked to the pilot and asked if he could get a ride to the destination. The pilot agreed to take the employee on the flight. The employee then began to walk toward his truck to retrieve his luggage, stooped to pass under the tail boom of the helicopter and was struck and killed by the tail rotor. The report said that the employee "had worked around helicopters in the past and had received company training concerning the dangers of helicopter rotor blades."[43]

Some operators require that the rotors be stopped when a helicopter is loaded. This is called "cold loading." Some operators allow "hot loading," wherein the helicopter's rotors are turning under power while passengers are loaded or the helicopter is refueled. "Hot loading" saves time and eliminates

a start cycle on the engine, but hot loading poses a threat to people near the helicopter.

Loss of Tail-rotor Control Precedes 24 Accidents

Partial loss of tail-rotor control or total loss of tail-rotor control was involved in 24 accidents, including four fatal accidents. Of these, 18 accidents, including three fatal accidents, involved total loss of tail-rotor control. The 18 accidents were caused by tail-rotor-component failures, tail-rotor strikes by objects that exited the cabins of helicopters being flown with the doors removed, operation at high-density altitudes in situations requiring high power output, and operation in adverse wind conditions.

Nine accidents, of which three were fatal, were caused by a failure of the tail-rotor drive shaft. Nine other accidents, all nonfatal, were caused by loss of tail-rotor effectiveness. Contact with objects during hovering flight resulted in compromised tail-rotor control in an additional six accidents, of which one was fatal.

A total of 71 incidents involved loss of tail-rotor control. Forty-one incidents resulted from a mechanical failure in a component of the tail-rotor-drive system. Of these, 26 occurred when doors, windows or cowlings separated from the aircraft and struck the tail rotor, 13 occurred when the tail-rotor drive shaft failed, and two occurred when debris struck the tail rotor.

Twenty-seven incidents occurred when the helicopter's tail rotor struck an object (e.g., tree, wire). Three incidents involved loss of tail-rotor effectiveness because of adverse wind conditions.

Tail-rotor failures are among the most threatening mechanical failures associated with helicopter operations because of the extreme and rapid loss of control that accompanies the failure. One accident involved a Eurocopter AS 350B2 that was being flown between two offshore platforms on Nov. 28, 1996. The helicopter departed from one platform at 1504 local time. At 1526, the pilot radioed that the tail-rotor-gearbox chip light had illuminated and that he was experiencing a vibration that lessened at slower airspeed; he said that he was diverting the flight to another platform three nautical miles (six kilometers) away. At 1531, the pilot radioed that during his first attempt to land on the platform, he was not able to control the tail rotor; he said that he would attempt another landing and, if unable to land on the platform, would divert to Galveston, Texas. No further radio transmissions were received from the pilot. The wreckage of the helicopter was found in the water near the platform. The three occupants had been killed. Examination of the tail-rotor system revealed that one pitch-change link had disconnected. The NTSB report said that the probable cause of the accident was the "pilot's failure to use the proper emergency procedure as outlined in the aircraft flight manual." The operator's SOP for a loss of tail-rotor control is to comply with the instructions given in the flight manual. The flight manual's instructions are, in part, to make a shallow approach to a run-on landing.[44]

Two accidents occurred when the helicopters were being flown with the doors removed and objects exited the cabins and struck the tail rotors. One of the accidents occurred Sept. 12, 1997, near Brinkley, Arkansas. The pilot was transporting a television crew to several high-school football games. He had removed the left-rear door to facilitate aerial photography. During cruise at approximately 500 feet AGL, the pilot heard a loud bang, and the helicopter yawed right. The pilot said that the anti-torque system did not respond to control inputs. He conducted a running landing. The helicopter struck two levees, and the right landing skid separated. An examination revealed that the tail-rotor drive shaft had separated. One of the tail-rotor blades had seven small indentations near the tip. The NTSB report said that the probable causes of the accident were "the in-flight collision of the tail-rotor blade with an object that had a brass zipper on it and the subsequent overload and failure of the tail-rotor drive shaft."[45]

Loss of tail-rotor effectiveness can occur for many reasons. Tail rotors are susceptible to damage from dirt and small rocks dislodged by rotor turbulence. Vortices from the main rotor disrupt the airflow to the tail rotor; the air flow also is disrupted by the vertical stabilizer and tail boom. Airflow disruptions are exacerbated by wind striking the tail rotor at specific angles. The tail rotor also is exposed to turbulent airflow created by the fuselage.[46]

Adverse wind conditions frequently are a factor in incidents involving loss of tail-rotor effectiveness, as the following ASRS report illustrates:

> During a normal tour flight … in a helicopter with four passengers being 250 pounds [113 kilograms] below maximum gross weight … I departed the airport (2,671 feet MSL) and started climbing toward the mountains. At 3,400 feet MSL and 100 feet AGL, I started a slow deceleration from 80 knots with the intent to come to a hover and [to] look down a valley to see if the weather was good enough for me to descend into the valley. … As I was decelerating, I could clearly see that I could not descend into the valley, so I started a left 180-degree turn at about 100 feet AGL. At this time, [airspeed] was about 15–20 knots. Sometimes in the mountains, it's hard to tell wind direction, but I must have caught a tail wind from the ridge line, and the aircraft started settling with power. With not enough altitude to fly out of this condition, I just held max[imum] power and a level attitude with the hope that the impact would be minimal. But at about three feet AGL, the aircraft started an uncontrolled rotation to the right. I

concentrated on keeping the aircraft in a level attitude. We must have rotated three or four [times]. We remained between five [feet] and 10 feet above the ground. I tried a number of things to stop the rotation. Finally, I decided to lower the collective slightly and try to get the aircraft on the ground. We hit the ground while still rotating, but I think by lowering the collective, the rotation slowed considerably. It was kind of a hard landing, but not much harder than a hovering autorotation. The area we landed in had some fairly tall ferns, but luckily the aircraft was still upright and everything seemed to be OK with no damage. So I picked up the aircraft to hover. Everything still seemed to be OK, so I apologized to my passengers and continued the tour. (This was my big mistake.) After the completion of the tour and returning to our hangar and shutting the helicopter down, considerable damage was found to the tail-rotor blades, and the main-rotor blades had slight dings in two of them. So, here's the moral of the story, in my opinion: Never, after an incident like that, continue a flight. Shut down and get help. Something could have really let loose when that flight was continued. Also, about getting into a situation to induce loss of tail-rotor effectiveness or settling with power — this was completely my fault, even though I have made a turn similar to that and under those same conditions. We, as pilots, need to be aware of all conditions around us and never get complacent.[47]

Of the 24 accidents involving partial loss or total loss of tail-rotor control, three accidents occurred when the helicopters were being operated in high-density-altitude conditions and near the helicopters' maximum weight limits for hovering out of ground effect. Nine accidents occurred when a loss of tail-rotor control occurred during cruise flight.

Thirty-three incidents involved loss of tail-rotor control during cruise flight, resulting in immediate and uncontrolled yaw — typically, to the right, because most helicopter main-rotor systems rotate counterclockwise when viewed from above.

Three accident pilots conducted running landings after a loss of tail-rotor control occurred. The accidents resulted in substantial damage to the helicopters but no fatal injuries. Seventeen incident pilots conducted running landings, which resulted in minor damage but no serious injuries.

Six accident pilots conducted power-off autorotative landings after a loss of tail-rotor control occurred. Five pilots maintained enough control to prevent the helicopter from spinning. The other pilot was unable to maintain control, and the helicopter was spinning when it touched down, resulting in fatalities.

Fourteen accident pilots were unable to regain control of the helicopter after a loss of tail-rotor control occurred. Two of the fourteen accidents resulted in fatal injuries. Four accidents resulted in destroyed helicopters.

Mechanical Failures Cited in 50 Accidents

Of the 147 Part 135 helicopter accidents, 50 accidents (34 percent) involved mechanical failures. Eleven accidents were fatal. Of the 306 incidents, 176 incidents (58 percent) involved mechanical failures.

Table 3 (page 19) shows the distribution of mechanical-failure accidents and mechanical-failure incidents by the affected component and the phase of flight. Mechanically induced engine failures caused 30 accidents, including three fatal accidents, and 89 incidents.

Tail-rotor drive-shaft failures caused nine accidents, including three fatal accidents, and 41 incidents.

Mechanical failures, excluding engine failures and tail-rotor drive-shaft failures, caused 11 accidents, of which five were fatal, and 46 incidents. All five fatal accidents were caused by failure of a component within the flight-control system.

Maintenance often cannot be performed in remote areas typical of Part 135 helicopter operations. This has been a factor in continued operation with inoperative equipment or beyond required equipment-inspection periods, as the following ASRS report illustrates:

> [The required compliance period for an] airworthiness directive for the helicopter was [exceeded] during a flight from a deep-water oil rig to Lafayette, Louisiana. Upon landing, [the airworthiness directive] was taken care of by maintenance [personnel, and the] aircraft was returned to service. Due to bad weather offshore and fog, I was unable to have maintenance complete the inspection at the oil rig. To [avoid exceeding inspection requirements], we need to have maintenance personnel stationed on the oil rig. Too many times, it is difficult to get roving maintenance [personnel] to fly to your location due to weather.[48]

More Than One-third of ASRS Reports Cited Near Collisions

Two Part 135 helicopters were involved in midair collisions; both helicopters were engaged in air-tour flights when the collisions occurred.

Sun glare was a causal factor in a collision that occurred Aug. 4, 1996, in Healy, Alaska. A McDonnell Douglas MD-369D was being flown in an easterly direction at about 400 feet. The pilot said that he was looking down for potential landing sites and that when he looked up, he saw an airplane traveling head-on to the helicopter. The airplane and the helicopter collided, severing the helicopter's tail-rotor drive shaft. The helicopter began to spin. The pilot conducted a partially controlled landing in brushy terrain. The helicopter was substantially damaged;

Table 3
Mechanical Failures Involved in U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000

	Ground	Takeoff	En Route	Approach and Landing	Total
Engine					
Incidents	3	14	65	7	**89**
Nonfatal Accidents	—	5	21	1	**27**
Fatal Accidents	—	—	3	—	**3**
Tail Rotor Drive Shaft					
Incidents	2	7	28	4	**41**
Nonfatal Accidents	—	—	5	1	6
Fatal Accidents	—	—	2	1	**3**
Flight Controls					
Incidents	1	1	8	5	**15**
Nonfatal Accidents	—	—	—	2	**2**
Fatal Accidents	—	—	5	—	**5**
Structure					
Incidents	—	2	7	4	**13**
Nonfatal Accidents	—	—	3	1	**4**
Fatal Accidents	—	—	—	—	—
Cowls, Doors, Windows					
Incidents	—	—	5	—	**5**
Nonfatal Accidents	—	—	—	—	—
Fatal Accidents	—	—	—	—	—
Miscellaneous					
Incidents	1	—	9	3	**13**
Nonfatal Accidents	—	—	—	—	—
Fatal Accidents	—	—	—	—	—
Total					
Incidents	7	24	122	23	**176**
Nonfatal Accidents	0	5	29	5	**39**
Fatal Accidents	0	0	10	1	**11**

Source: Patrick R. Veillette, Ph. D.

four occupants received minor injuries, and five occupants were not injured. The pilot of the airplane, a Cessna 185, continued the flight to the destination and conducted an uneventful landing; the airplane's lower fuselage had been damaged and the tail wheel had broken off during the collision. The helicopter pilot told investigators that his forward vision had been partially restricted by sun glare.[49]

On May 30, 1998, an Aerospatiale AS 350B2 helicopter was being flown at 2,100 feet when it collided with a Cessna 172RG. One of the five helicopter passengers was seriously injured during the collision; four passengers and the pilot were not injured. The helicopter continued flying. The airplane struck water; both occupants were killed. After the helicopter was landed, an 18-inch (46-centimeter) section of the airplane's right wing was found attached to the helicopter.[50]

Of the 457 ASRS reports, 176 reports (39 percent) discussed near-midair collisions. Many of the reports cited the congestion of air-tour routes and the absence of ATC services, such as traffic advisories. In one report on a near collision in Hawaii, the pilot said:

> Hilo's departure radar controller released me from his control near the Pahoa NDB [nondirectional beacon]. On 122.9 [a Multicom frequency], I announced my presence at the NDB and [that I] was proceeding to the old geothermal site in a southerly direction. I did not hear any aircraft acknowledge my call. Several minutes later, I announced that I was passing the geothermal site and proceeding toward Kalapana southbound. Two aircraft announced their locations; one was approaching the Royal Gardens area; the other was a helicopter at the Puu O'O

> Vent and would be departing the vent soon. The aircraft at the vent suggested that I plan on viewing the vent first [during my tour] because the conditions and the views were good. I acknowledged his advice, [changed] course from Kalapana to the vent and announced on 122.9 that I was heading toward the vent. … I initiated a slow climb and a right turn toward the vent. While in the climbing right turn, I saw a twin-engine aircraft on my left. The aircraft was on a collision course with my aircraft. I made an abrupt climb and turn to my left. All of the passengers on board saw the aircraft pass just below us. After composing myself, I contacted the pilot of the twin-engine aircraft. He was apologetic and stated that he did not see me prior to my aircraft passing above his aircraft. … My failure to see the oncoming aircraft was aggravated by the climbing right turn of my aircraft.[51]

Nearly two-thirds of the ASRS reports filed by offshore-helicopter pilots described near-midair collisions over the Gulf of Mexico. In one report, the pilot said:

> I had just departed from an offshore oil platform en route to Ingleside, Texas, with two passengers on board. The [left-]front-seat passenger keyed his microphone and said, "That jet is flying low, isn't he." I looked at him when I heard him key his mike and saw a [U.S.] Coast Guard jet in my left windshield closing at a high rate of speed. I immediately descended and turned sharply left to avoid a collision. The [jet] continued north, and I saw no evasive actions from him. This occurred in an area of fairly intense offshore helicopter operations. We normally operate at altitudes below 1,000 feet. I was squawking a discrete transponder code assigned to our company with altitude readout. I feel that if we are required to squawk appropriate codes with altitude readout to operate in the air defense identification zone, then military aircraft should be on an appropriate frequency so that they can be given our aircraft as traffic. This was very nearly fatal.[52]

Nonuse of common traffic advisory frequencies (CTAF) in air-tour areas was cited in 24 percent of the ASRS reports on near-midair collisions. In one report, the pilot said:

> Location: 1/2 mile [3/5 kilometer] north of the Statue of Liberty. Aircraft: I was flying a Bell 206L-4 helicopter. We were flying sightseeing trips out of [the] East 34th Street Heliport (GNS), Manhattan [New York]. Based on its profile, I believe that the other aircraft was a [Piper] Tomahawk. Positive identification was not possible. Other pilot was not talking on the Hudson River [CTAF]. Weather was clear. … Upon approaching the statue, I caught sight of the position lights and dark outline of an airplane at my 2 o'clock position and less than 100 yards [92 meters]. Upon spotting the airplane, I immediately made a hard left diving turn. The airplane was in a right turn around the statue. Since it was a low-wing aircraft, I believe that the position of his left wing would have prevented him from seeing me. While still in my evasive maneuver, I looked to my right and saw him to my right and slightly above me. He was no more than 20 feet [six meters] from my rotor tip. I continued to turn hard left and he continued his slow right turn until we had adequate separation. I don't believe that he ever saw me.[53]

More than Three-fourths of Occupants Survived Accidents

There was at least one fatality involved in 43 (29 percent) of the 147 accidents. Table 4 shows that 483 (78 percent) of the 616 accident-helicopter occupants survived and that 133 occupants died.

Table 4
Fatalities and Nonfatalities in Accidents Involving U.S. Federal Aviation Regulations Part 135 Helicopters, 1991–2000

	Number of Accidents		Number of Occupants and Their Injuries				
Year	Total	Fatal	Total	Uninjured	Minor	Serious	Fatal
1991	21	7	103	58	10	17	18
1992	18	6	67	33	14	2	18
1993	14	5	57	14	19	10	14
1994	18	6	81	44	12	8	17
1995	10	3	39	19	7	5	8
1996	11	5	44	22	8	1	13
1997	10	3	48	18	13	8	9
1998	11	3	46	28	2	1	15
1999	17	2	66	44	8	5	9
2000	17	3	65	25	19	9	12
Total	**147**	**43**	**616**	**305**	**112**	**66**	**133**

Source: Patrick R. Veillette, Ph.D.

Injury severity varied with the terrain involved in the accidents. Fatalities and/or serious injuries occurred in the following:

- All of the nine accidents in urban areas;
- All of the eight accidents that occurred in trees;
- Three (75 percent) of the four accidents that occurred on offshore platforms;
- Twenty-two (60 percent) of the 37 accidents in water;
- Three (60 percent) of the five accidents on ramps;
- Twenty-four (41 percent) of the 58 accidents in mountainous terrain; and,
- Five (25 percent) of the 20 accidents in fields.

Of the 133 occupants killed in the accidents, 119 (90 percent) died of impact injuries, 11 (8 percent) died of drowning; two died of trauma (shock); and one died of a heart attack. Eighty-six of the 119 impact fatalities occurred in accidents in IMC.♦

Notes

1. The U.S. National Aeronautics and Space Administration (NASA) Aviation Safety Reporting System (ASRS) is a confidential incident-reporting system. The ASRS Program Overview said, "Pilots, air traffic controllers, flight attendants, mechanics, ground personnel and others involved in aviation operations submit reports to the ASRS when they are involved in, or observe, an incident or situation in which aviation safety was compromised. … ASRS de-identifies reports before entering them into the incident database. All personal and organizational names are removed. Dates, times, and related information, which could be used to infer an identity, are either generalized or eliminated."

   ASRS acknowledges that its data have certain limitations. ASRS *Directline* (December 1998) said, "Reporters to ASRS may introduce biases that result from a greater tendency to report serious events than minor ones; from organizational and geographic influences; and from many other factors. All of these potential influences reduce the confidence that can be attached to statistical findings based on ASRS data. However, the proportions of consistently reported incidents to ASRS, such as altitude deviations, have been remarkably stable over many years. Therefore, users of ASRS may presume that incident reports drawn from a time interval of several or more years will reflect patterns that are broadly representative of the total universe of aviation safety incidents of that type."
2. Controlled flight into terrain (CFIT) occurs when an airworthy aircraft under the control of the flight crew is flown unintentionally into terrain, obstacles or water, usually with no prior awareness by the crew. This type of accident can occur during most phases of flight, but CFIT is more common during the approach-and-landing phase, which begins when an airworthy aircraft under the control of the flight crew descends below 5,000 feet above ground level (AGL) with the intention to conduct an approach and ends when the landing is complete or the flight crew flies the aircraft above 5,000 feet AGL en route to another airport.
3. Veillette, Patrick R. "Human Error Cited as Major Cause of U.S. Commercial EMS Helicopter Accidents." *Flight Safety Digest* Volume 20 (April–May 2001).
4. Adams, R.J. "Special Considerations for Helicopter Safety," In *Aviation Psychology*, Jensen, Richard S. Brookfield, Vermont, U.S.: Gower Publishing Co., 1989.
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6. Adams.
7. Veillette.
8. Harris, Joel S. "Data Show Downward Trends in U.S.-registered Helicopter Accidents in 1991–98. *Helicopter Safety* Volume 27 (January–February 2001).
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23. FAA. *Aeronautical Decision Making for Air Ambulance Helicopter Pilots: Situational Awareness Exercises*. Report no. DOT/FAA/DS-88/6. Washington, D.C., U.S. July 1988.

24. FAA. Advisory Circular 60-4A, *Pilot's Spatial Disorientation*. February 1983.

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26. Adams.

27. NASA ASRS report no. 390410. January 1998.

28. NTSB accident report no. ANC99FA139.

29. NTSB Safety Recommendation A-02-33 through -35. Oct. 7, 2002. NTSB defines flat light as "the diffuse lighting that occurs under cloudy skies, especially when the ground is snow covered. Under flat light conditions, there are no shadows cast, and the topography of snow-covered surfaces is impossible to judge." NTSB said that FAA, in Advisory Circular 00-61, described *whiteout* as "a visibility-restricting phenomenon that occurs in the Arctic when a layer of cloudiness of uniform thickness overlies a snow[-covered] or ice-covered surface. Parallel rays of the sun are broken up and diffused when passing through the cloud layer so that they strike the snow surface from many angles. The diffused light then reflects back and forth countless times between the snow and the cloud, eliminating all shadows. The result is a loss of depth perception."

30. NTSB accident report no. ANC99LA036.

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About the Author

Patrick R. Veillette, Ph.D., a professional pilot with more than 13,000 flight hours, is a Raytheon Hawker 800XP first officer for a major U.S. corporation. He formerly flew as a Boeing 727 first officer for a U.S. air carrier and has flown emergency medical services fixed-wing operations, aerial fire fighting operations and charter-aircraft flight operations; investigated failure modes, weaknesses and performance capabilities of aircraft involved in accidents; and investigated accidents for the U.S. Department of Agriculture. Veillette earned a bachelor's degree in aeronautical engineering at the U.S. Air Force Academy and a doctorate in civil engineering at the University of Utah, and studied accident investigation at the undergraduate level and at the graduate level. He has conducted numerous research projects on flight-deck automation and human error in high-risk environments. Veillette has an airline transport pilot certificate and is a former U.S. Federal Aviation Administration designated pilot examiner.

Further Reading from FSF Publications

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Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000

Date	Location	Helicopter Type	Damage	Injuries
Jan. 11, 1991	Patterson, Louisiana	Sikorsky S-76A	none	11 uninjured
The no. 1 engine chip-detector light illuminated during flight; the no. 1 engine then failed when a turbine wheel burst.				
Jan. 17, 1991	Tampa, Florida	Agusta A109	minor	2 uninjured
The pilot did not extend the landing gear during a simulated single-engine landing. The helicopter was landed on its belly.				
Jan. 18, 1991	Boston, Massachusetts	MBB BK 117A-3	minor	4 uninjured
The pilot observed a fire warning for the no. 2 engine, shut down the no. 2 engine and activated the engine-fire-extinguishing system. A turbine blade had punctured the exhaust pipe housing.				
Jan. 18, 1991	Louisiana[1]	Bell 206L-1	minor	1 uninjured
A power loss occurred during descent. The pilot conducted an emergency landing on a road.				
Jan. 19, 1991	Gulf of Mexico	Bell 206B-3	destroyed	3 fatal
The aircraft did not complete a flight from one offshore platform to another offshore platform. There were no radio calls to indicate that the flight had encountered difficulties. The bodies of two of the three occupants and assorted pieces of the wreckage were found about two nautical miles (four kilometers) from the departure platform. Examination of the wreckage indicated that the aircraft struck the water at a high rate of speed and in uncontrolled flight. The report said that the limited amount of recovered wreckage precluded a determination of why the pilot was not able to maintain control of the helicopter. Weather conditions included indefinite ceilings at 200 feet to 400 feet, obscured skies and 1.0 statute mile to 1.5 statute miles (2.0 kilometers to 2.5 kilometers) visibility in light rain and fog. Prior to departure, the instrument-rated pilot told the crew chief that if weather conditions became adverse, he would fly the helicopter back to the departure platform.				
Jan. 22, 1991	Oklahoma[1]	Bell 206B	none	3 uninjured
The helicopter struck a wire on final approach and severed the wire. The helicopter was landed safely.				
Jan. 27, 1991	Gulf of Mexico	Bell 206L-1	destroyed	2 fatal
After departing from an offshore oil-drilling platform, the pilot received a weather briefing that included adverse conditions in the area. When a mandatory 15-minute flight-following message was not received from the pilot, a search was initiated; the search was hampered by inclement weather. Neither the main wreckage nor the occupants were found. The lower flooring of the cabin, a landing skid and a main-rotor-blade tip were found floating on the water. Examination of the items revealed signatures consistent with a high-speed impact with the water.				
Feb. 10, 1991	Valdez, Alaska	MBB BO-105	substantial	1 minor, 3 uninjured
About 30 minutes after takeoff, a power loss occurred in one engine. The pilot conducted an emergency landing on water. The report said that the pilot had not turned on the four fuel pumps prior to takeoff, as required by the aircraft flight manual.				
Feb. 12, 1991	Beaumont, Texas	MBB BK 117A-4	none	5 uninjured
An overspeed condition in the no. 1 engine developed en route when a fuel-control-unit bearing failed. The helicopter was landed without further incident.				
Feb. 16, 1991	Kodiak, Alaska	Bell 206B	substantial	1 minor, 2 uninjured
The pilot said that soon after liftoff, the helicopter entered whiteout conditions. The pilot was not able to maintain control of the helicopter, which struck mountainous terrain.				
Feb. 18, 1991	Kahului, Hawaii	Aerospatiale AS-350B	minor	7 uninjured
After a loss of tail-rotor control occurred on climbout, the pilot landed the helicopter without further incident. The report said that the tail-rotor-control tube was severed by the Thomas coupling.				
Feb. 22, 1991	Mobile, Alabama	Bell 206B	minor	3 uninjured
The helicopter struck a bird during cruise flight. The pilot conducted a precautionary landing.				
March 1, 1991	Smith Point, Texas	Bell 206B	minor	4 uninjured
The engine decelerated in flight, and the pilot conducted an emergency landing on water. Water entered the left emergency float, and the aircraft turned over.				
March 5, 1991	Gulf of Mexico	Bell 206B	none	2 uninjured
A power loss occurred during cruise flight, and the pilot landed the helicopter on water. The right float detached, and the helicopter sank.				
March 8, 1991	Honolulu, Hawaii	Bell 206B	substantial	2 uninjured
The helicopter was en route from Honolulu to a ship about 130 nautical miles (241 kilometers) south. The pilot was unable to locate the ship and decided to return to Honolulu. The pilot told air traffic control (ATC) that he had minimum fuel. About 15 nautical miles (28 kilometers) south of Honolulu, a power loss occurred because of fuel exhaustion. The pilot conducted an autorotative landing on the water. After the helicopter touched down, the right-forward emergency float deflected, and the aircraft sank.				

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
March 30, 1991	Thompson Pass, Alaska	Bell 47	substantial	3 uninjured
The helicopter was landed hard on a 5,000-foot mountain ridge. The main-rotor blades struck the tail boom.				
April 6, 1991	Butler, Missouri	Bell 206L-3	minor	3 uninjured
A bird strike during cruise flight broke the helicopter's left chin bubble, and debris entered the cockpit. The pilot conducted a precautionary landing.				
April 18, 1991	Gulf of Mexico	Bell 212	none	11 uninjured
After a loss of hydraulic pressure occurred, the pilot flew the helicopter back to shore and conducted a running landing on a runway.				
April 23, 1991	Louisiana[1]	Sikorsky S-76A	minor	2 uninjured
A small hole was found in the vertical fin after flight. The report said that the hole was caused by application of aft cyclic control and full-down collective control.				
April 23, 1991	Gulf of Mexico	Bell 206B	destroyed	2 fatal
When a required radio check was not received from the pilot after departure from an offshore platform, a search was initiated. About two hours later, debris was found floating about three nautical miles (six kilometers) from the platform. Examination of the debris indicated that the vertical fin had separated from the helicopter in flight and main-rotor mast bumping then had occurred; the vertical-fin-attachment fittings had separated because of fatigue induced by corrosion. The report said that the operator had attempted to combat the corrosion by refurbishing the airframe; all the fatigue fractures appeared old, and one contained paint.				
May 1, 1991	Patterson, Louisiana	Bell 206B	none	3 uninjured
After a partial loss of power occurred during departure, the pilot lowered the collective control, returned to the departure site and conducted a running landing.				
May 5, 1991	Keanae, Hawaii	Hughes 369HS	substantial	3 minor, 2 uninjured
A power loss occurred during an air-tour (sightseeing) flight. The helicopter struck trees during the emergency landing. Examination of the engine revealed that the forward splines on the spur-adapter gearshaft had failed from fatigue.				
May 7, 1991	Houston, Texas	Bell 206B-3	substantial	2 serious, 2 minor
The helicopter was on an aerial-photography flight when the main-drive-shaft coupling failed. The pilot attempted to conduct an autorotative landing in a parking lot but was unable to reach the parking lot; the pilot landed the helicopter on the roof of a building. Investigators found the engine mount soaked with oil and delaminated, which had caused misalignment of the drive shaft.				
May 9, 1991	Mississippi[1]	Sikorsky S-76A	none	9 uninjured
The aircraft began vibrating en route when a main-rotor-blade-tip cap separated. The pilot landed the aircraft without further incident.				
May 30, 1991	Draper, Utah	Bell 222U	minor	3 uninjured
The emergency medical services (EMS) helicopter's tail rotor struck a sign during a night landing on a road illuminated by emergency-vehicle headlights.				
June 8, 1991	Houston, Texas	MBB BK 117A-4	none	3 uninjured
A power loss occurred when an engine bearing failed during an EMS flight in day visual meteorological conditions (VMC). The pilot landed the helicopter in a field.				
June 17, 1991	Gulf of Mexico	Sikorsky S-76A	substantial	10 serious
The helicopter drifted during an attempted landing on an offshore platform. The pilot decided to reject the landing and applied collective control. When the helicopter yawed right, the copilot believed that the pilot had not maintained directional control, and he selected ground-idle power for both engines. The main-rotor blades struck the platform, and the helicopter descended to the water.				
June 18, 1991	Gulf of Mexico	Bell 212	minor	7 uninjured
The right lower engine cowling separated in flight.				
June 27, 1991	(location not specified)[1]	Bell 212	none	9 uninjured
A power loss occurred because of fuel exhaustion, and the pilot conducted an autorotative landing on a road. The report said that the fuel gauge had malfunctioned.				
June 30, 1991	Gulf of Mexico	Bell 206L-1	substantial	4 uninjured
During a daylight approach to an offshore helicopter-landing platform, the pilot was not able to reduce a high sink rate by applying collective control. The helicopter landed hard, and the main-rotor blades severed the tail boom.				

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
July 1, 1991	Sheep Mountain, Alaska	Bell 206B-3	substantial	3 uninjured
The pilot rejected the first landing on a 6,000-foot ridge and conducted a go-around. During the second approach with a gusty, right-quartering head wind, a loss of tail-rotor control occurred, and the helicopter was landed on sloping terrain.				
July 4, 1991	Colorado Springs, Colorado	Bell 47G-3B-1	substantial	2 uninjured
Density altitude was 11,700 feet during takeoff from a helicopter pad (helipad), and insufficient power was available to maintain flight out of ground effect. The helicopter settled onto rough terrain. The main-rotor blades struck the terrain on impact.				
July 24, 1991	Kahului, Hawaii	Aerospatiale AS 350B	substantial	6 uninjured
The helicopter landed hard during an autorotation onto sloping terrain after a total loss of engine power occurred 45 minutes after departure for an air-tour flight. Investigators found two gallons (eight liters) of fuel in the tanks. After the helicopter was refueled, the engine started and operated normally. The fuel-quantity-indicating system had a malfunctioning low-fuel warning light.				
Aug. 1, 1991	Houma, Louisiana	Sikorsky S-76	none	12 uninjured
No. 2 engine torque decreased, and the pilot shut down the engine and returned to base. The overspeed control system had failed.				
Aug. 8, 1991	Gulf of Mexico	Bell 412	substantial	15 uninjured
The first officer experienced a directional-control problem during takeoff from a moving vessel. The crew decided to attempt to fly the helicopter to an offshore platform. As directional control become more unstable, the captain ordered the first officer to make a water landing. Floats were inflated, and the landing was made without further incident. The report said that the tail-rotor drive shaft had been assembled incorrectly and that the quill assembly had failed.				
Aug. 19, 1991	Intracoastal City, Louisiana	Sikorsky S-76A	minor	9 uninjured
A severe vibration developed during cruise flight when a tail-rotor blade failed. A precautionary landing was conducted without further incident.				
Aug. 26, 1991	Gulf of Mexico	Bell 412	substantial	1 fatal, 4 serious, 1 minor, 7 uninjured
The helicopter was on final approach to an offshore platform when a loss of tail-rotor authority and directional control occurred. As the crew began an autorotation to the water, the helicopter spun out of control to the right and then struck the water. The right flotation gear deployed; the left flotation gear did not deploy because pneumatic lines had been pulled apart during impact. The helicopter rolled over. The crew and 10 of the 11 passengers escaped through the emergency windows. The other passenger was incapacitated by injuries and drowned. An investigation revealed that the no. 1 hanger bearing had overheated and disintegrated, which caused the tail-rotor drive shaft to fail.				
Aug. 28, 1991	Walton, Ore.	Aerospatiale AS 350B1	destroyed	3 fatal
While being flown in remote mountainous terrain on a dark night, with light drizzle and patchy clouds, the helicopter struck a mountain and was destroyed by fire. Investigators found no indication of mechanical failure or malfunction.				
Sept. 11, 1991	Lake Charles, Louisiana	Bolkow BO 105S	minor	4 uninjured
An open door separated from the aircraft during an aerial-photography flight. A nut had backed off the forward-door slider.				
Sept. 22, 1991	Buffalo, New York	Bolkow BO 105C	none	2 uninjured
After the 90-degree-gearbox chip-detector light illuminated, the pilot conducted a precautionary landing. The report said that the chip-detector system required cleaning.				
Sept. 25, 1991	Billings, Montana	Aerospatiale AS 355F	none	3 uninjured
The right engine fire-warning light illuminated after takeoff. A precautionary landing was conducted. A broken wire at the fire-detector terminal was repaired.				
Oct. 3, 1991	Hilo, Hawaii	Aerospatiale AS 350D	none	7 uninjured
The hydraulic-failure warning light illuminated after departure. The pilot used emergency procedures to lower the landing gear. A hydraulic-pump-drive belt had failed.				
Oct. 4, 1991	Baltic, Ohio	Bell 206	minor	2 uninjured
During an attempted landing in a field, the helicopter struck and severed a wire.				
Oct. 8, 1991	New Iberia, Louisiana	Bell 206B	minor	2 uninjured
The helicopter was yawing right when it touched down on a seaplane ramp. The helicopter then turned over in shallow water.				
Oct. 11, 1991	Sand Point, Alaska	Bell 212	minor	4 uninjured
The helicopter was being hover-taxied when the main-rotor blades struck a metal building. The pilot was distracted while trying to avoid a parked aircraft.				

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
Oct. 14, 1991	Hilo, Hawaii	Aerospatiale AS 350D	substantial	7 uninjured

The helicopter was being hovered 15 feet to 20 feet above ground level (AGL) near the edge of a volcanically active crater, downwind of the vent. Several loud popping sounds were heard from the engine, and the pilot detected a loss of power. The pilot conducted an autorotative landing on a slope; the helicopter landed hard, and the main rotor struck the tail boom. The loss of power had been caused by ingestion of volcanic gases.

Oct. 14, 1991	Louisiana[1]	Sikorsky S-76A	none	5 uninjured

The no. 2 engine oil pressure decreased to zero. The pilot shut down the engine and flew the helicopter to the departure site. A broken wire at the oil-pressure-transmitter plug was found.

Oct. 24, 1991	Wichita Falls, Texas	Bell 222U	minor	4 uninjured

During an attempted landing on a helipad, a tail-rotor blade struck an object.

Nov. 9, 1991	Hilo, Hawaii	Bell 206B	substantial	1 serious, 2 minor, 2 uninjured

The helicopter was flown into instrument meteorological conditions (IMC) over a mountain pass. The pilot told investigators, "I had no choice but to slow down and try to turn around without getting into the low clouds that were moving in." As the helicopter slowed, it suddenly began to rotate right. The pilot was unable to correct the rotation with left anti-torque-pedal input. After three rotations, the low-rotor-speed warning sounded. The pilot said that she felt helicopter control diminish and elected to land the helicopter. At about six feet AGL, the pilot lowered the collective control, and the helicopter landed hard in a level attitude.

Nov. 20, 1991	Davis, California	Bell 206B-3	destroyed	3 fatal

The helicopter was 20 nautical miles (37 kilometers) southeast of the destination when the pilot told ATC that the flight had encountered IMC with low visibility in light rain showers. A witness observed the helicopter at an altitude below the level of an interstate highway and climbing to cross the highway. The helicopter then descended, struck the ground and disintegrated.

Nov. 27, 1991	Bridgeport, California	Aerospatiale SA 316B	destroyed	4 fatal

The EMS helicopter was on a night flight in VMC over mountainous terrain when the pilot interrupted a routine position report and declared mayday three times. He did not state the nature of the emergency. Witnesses observed the helicopter fly toward them and begin to rotate counter-clockwise. The helicopter then struck the ground. The report said that the tail-rotor drive shaft and bearing had failed for undetermined reasons.

Dec. 20, 1991	Utah[1]	Bell 206L-1	minor	1 uninjured

The right landing ski moved beneath snow and separated on takeoff. The pilot flew the helicopter to its base and landed it without further incident.

Dec. 20, 1991	Texas[1]	Bell 206B	minor	4 uninjured

The helicopter struck a wire hidden by trees from the pilot's view while being flown at low altitude during a pipeline/power-line-inspection flight. The pilot landed the helicopter without further incident.

Dec. 29, 1991	Bedford, Michigan	Aerospatiale AS 365-N2	minor	4 uninjured

The helicopter was being landed in day VMC at the site of an automobile accident when rotor downwash caused a plastic sheet to enter the rotor system and tail-rotor shroud, damaging the rotor blades.

Jan. 24, 1992	Brown City, Michigan	Bell 206B-3	minor	1 uninjured

During engine cool-down, a forklift truck was driven into the rotating main-rotor blades.

Jan. 26, 1992	Lansing, Michigan	Aerospatiale AS 355F1	substantial	4 uninjured

The pilot conducted an emergency landing after he smelled smoke and observed the baggage-compartment fire/smoke warning light. An inspection showed a fatigue failure of the joint where the fuel-pipe assembly enters the right engine case.

Jan. 27, 1992	Kahului, Hawaii	Aerospatiale AS 350-B2	minor	7 uninjured

While being flown on an air-tour flight, the helicopter struck a tree. The pilot flew the helicopter to the departure site and landed without further incident.

Jan. 29, 1992	Gulf of Mexico	Bell 206L-3	destroyed	1 minor, 1 uninjured

The pilot attempted to fly the helicopter to an offshore platform in IMC. During the approach to the platform, the helicopter struck the water, rolled over and sank.

Feb. 14, 1992	Fort Worth, Texas	Bell 222U	minor	1 uninjured

The pilot was conducting an approach to a helipad when the tail-rotor blades struck an outer-perimeter landing light.

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
Feb. 15, 1992	Gulf of Mexico	Bell 206L-3	substantial	2 uninjured

The instrument-rated commercial pilot flew the helicopter into a fog bank at 500 feet. He was conducting a left turn in an attempt to return to VMC when he experienced spatial disorientation. The helicopter struck the water about one minute later. The pilot and his passenger were rescued after floating in the water for 3.5 hours. The report said that the pilot did not obtain a weather briefing prior to the flight.

Feb. 17, 1992	Gulf of Mexico	Bell 206L-1	minor	1 uninjured

The vertical fin and tail rotor struck a safety fence during a landing on an offshore platform with a higher-than-normal closure rate.

Feb. 28, 1992	Gulf of Mexico	Bell 206L-1	minor	1 uninjured

While landing the helicopter on a helideck, the pilot felt a jolt. The lower edge of the vertical fin was found damaged.

March 4, 1992	Tennessee[1]	Bell 222U	minor	4 uninjured

The hydraulic-failure warning light illuminated. The pilot conducted a precautionary low-speed running landing in a field, where the helicopter struck a concealed hump in the ground.

March 5, 1992	Gulf of Mexico	Bell 206L-3	none	1 fatal, 4 uninjured

The pilot landed the helicopter on an offshore platform because of adverse weather conditions. When the weather improved, the pilot boarded the passengers to continue the flight. Before starting the engine, the pilot experienced several convulsions and became unconscious. The passengers removed him from the cockpit and administered cardiopulmonary resuscitation (CPR). The pilot was transported to a hospital, where he was pronounced dead from ventricular fibrillation caused by acute coronary artery insufficiency, the report said.

March 19, 1992	Opana Point, Hawaii	Bell 206B	none	5 uninjured

The engine flamed out because of fuel starvation. The pilot conducted an autorotative landing in a field.

April 5, 1992	Aransas, Texas	Bolkow BO 105C	none	4 uninjured

The helicopter was flown into IMC. The pilot obtained clearance by ATC to conduct an airport surveillance radar (ASR) approach to the Corpus Christi, Texas, airport, then cancelled the instrument flight rules (IFR) operation.

April 9, 1992	Venice, Louisiana	Bell 206L-3	destroyed	2 fatal, 2 serious, 1 minor

The pilot became ill while flying the helicopter to an offshore platform. While descending to conduct a precautionary landing on the water, he became unconscious. The report said that food poisoning was caused by the pilot's ingestion of day-old fish that he had prepared for dinner the previous night.

April 13, 1992	Intracoastal City, Louisiana	Bolkow BO 105S	none	2 uninjured

The pilot shut down the no. 2 engine after the chip-detector warning light illuminated. The report said that improper shimming of the compressor caused the gear shaft to break.

April 25, 1992	Catalina Island, California	Aerospatiale AS 350D	none	7 uninjured

The engine malfunctioned, and the pilot conducted an autorotative landing on water. The report said that failure of the overspeed governor was suspected of causing the malfunction.

April 28, 1992	Valdez, Alaska	Bell 206B-2	substantial	1 minor, 3 uninjured

The pilot conducted a precautionary landing because of adverse weather conditions. After examining the area, he decided to continue the flight to the destination. During takeoff, the pilot was not able to maintain visual contact with the ground because of whiteout conditions and began to hover-taxi the helicopter back to the takeoff area. The helicopter drifted right, the right landing skid struck a small hill, and the helicopter rolled over.

May 6, 1992	Gulf of Mexico	Aerospatiale AS 355F1	minor	1 uninjured

The pilot was conducting a landing on an offshore platform when he heard a loud noise and shut down the engine. The report said that the first-stage-turbine wheel rim had failed.

May 11, 1992	Cleveland, Ohio	Sikorsky S-76A	minor	2 uninjured

The pilot was landing the helicopter for refueling when the left-main wheel entered a hole, breaking the landing gear.

May 30, 1992	Volcanoes National Park, Hawaii	Hughes 369D	substantial	5 uninjured

During an air-tour flight at 1,500 feet, the pilot observed an engine-chip warning light and began to conduct a precautionary landing. The helicopter was at 500 feet AGL when a loss of power occurred. The pilot began to conduct an autorotative landing. A tour bus obstructed the approach path, and the pilot altered course. During the subsequent hard landing, the tail boom was severed. Examination of the engine revealed that the no. 8 bearing had failed because of inadequate lubrication.

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
June 10, 1992	Polk Inlet, Alaska	MDD MD-500D	substantial	4 uninjured
The pilot landed the helicopter on unstable terrain. When the pilot and the front-seat passenger exited, with the rear-seat passengers in their seats, the helicopter rocked backwards, and the rotating tail-rotor blades struck the ground. The pilot examined the drive train for damage, found no damage and decided to fly the helicopter to its base of operations. During the flight, the tail-rotor drive shaft separated, and the pilot conducted an emergency landing on water.				
June 17, 1992	Des Moines, Iowa	MBB BK 117A-4	none	4 uninjured
The pilot observed a low-oil-pressure indication for the no. 2 engine, shut down the engine and conducted a precautionary landing.				
June 19, 1992	Waikoloa, Hawaii	Bell 206L-3	substantial	7 minor
After landing the helicopter on a helipad, the pilot reduced power to flight idle in preparation to deplane the six passengers. The rear-landing-gear cross tube failed, and the helicopter rolled over. The report said that the fracture surface was corroded.				
June 23, 1992	Honolulu, Hawaii	Hughes 369	none	2 uninjured
A U.S. Federal Aviation Administration (FAA) inspector rapidly reduced the throttle to simulate an engine failure. A loss of power occurred, and the pilot conducted an autorotative landing.				
June 25, 1992	Sellersburg, Indiana	Bell 206B	minor	3 uninjured
The helicopter yawed while being maneuvered, did not respond to control inputs by the pilot and struck treetops. The pilot then regained control of the helicopter.				
June 26, 1992	Corpus Christi, Texas	Bell 206L-1	none	3 uninjured
The pilot observed fluctuating oil pressure and torque, and conducted a precautionary landing in the Gulf of Mexico. The aircraft later rolled over.				
June 28, 1992	Phoenix, Arizona	MBB BK 117B-1	minor	4 uninjured
The tail rotor struck a parked helicopter on landing. The pilot said that bright lights had obstructed his vision of the other helicopter.				
June 28, 1992	Scipio, Utah	Bell 222UT	substantial	3 uninjured
The EMS helicopter encountered clear air turbulence while descending to pick up a patient. The helicopter's nose pitched up rapidly to about 20 degrees, activating the emergency locator transmitter (ELT). The pilot felt feedback through the controls and landed to reset the ELT. Later, the pilot observed mast-torque fluctuations and a zero reading on the gauge. A post-flight inspection showed that the transmission had contacted its mounts, severing several electrical leads, including the torque sensor.				
July 4, 1992	Barstow, California	Robinson R-22	substantial	1 minor, 1 uninjured
The helicopter was being used to film an off-road-vehicle race. The pilot said that he was following the vehicles and conducted a turn into a 20-knot tail wind at low altitude. Main-rotor speed decreased, and the helicopter descended onto a hillside and rolled over. The report said that the pilot's operating handbook for the helicopter says that the maximum demonstrated tail-wind component is 17 knots.				
July 19, 1992	Alaska[1]	Aerospatiale AS 350B	minor	1 uninjured
The helicopter was hovering in gusty winds when the door opened. A tail-rotor blade then struck a rock. The pilot flew to a landing zone and landed the helicopter without further incident.				
July 26, 1992	Gulf of Mexico	Bell 206B-3	destroyed	1 fatal
The pilot was conducting an approach to an offshore platform to pick up two passengers. The passengers observed a nose-high flare, and the tail-rotor blades struck a fence around the helideck. The tail-rotor assembly and gearbox separated from the helicopter, which then spun off the helideck and descended to the water.				
July 29, 1992	Adjuntas, Puerto Rico	Bell 47J2	destroyed	4 fatal
After hearing a loud bang, witnesses no longer heard the sound of the engine. The helicopter turned left and descended. As the helicopter neared the ground, engine noise became audible. The helicopter landed hard on top of a hill. The report said that the pilot had failed to ensure that the engine contained adequate oil and that the oil dipstick was secure before takeoff, and that he had failed to maintain adequate rotor speed during a precautionary landing following the loss of engine oil. "A factor which contributed to the accident was the pilot's impairment due to marijuana," the report said.				
Aug. 7, 1992	Hawaii[1]	Aerospatiale AS 350D	minor	7 uninjured
The pilot conducted a precautionary landing because of adverse weather conditions. The tail section and tail rotor were damaged during the landing.				
Aug. 11, 1992	Minnesota[1]	Bell 222B	minor	1 uninjured
During landing, the tail rotor struck the helipad safety fence.				

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
Aug. 15, 1992	Louisiana[1]	Bell 206L-1	minor	1 uninjured
The pilot was practicing autorotation and intended to terminate the maneuver at a high hover. The report said that the pilot misjudged altitude, and the tail stinger struck the ground.				
Aug. 16, 1992	Gulf of Mexico	MBB BO 105CBS-4	substantial	4 uninjured
The helicopter was in cruise flight when a loss of power from both engines occurred. The pilot conducted an autorotative landing on the water. The report said that the pilot had not selected the main fuel-boost pumps, which direct fuel to the engine-supply tank; 80 gallons (303 liters) of fuel remained in the main fuel tank.				
Sept. 8, 1992	Patterson, Louisiana	Bolkow BO 105S	none	1 uninjured
The hydraulic-system warning light illuminated, and the pilot experienced a control problem. The pilot flew the helicopter back to the departure site and landed without further incident. A broken wire in an electric cannon plug was found.				
Sept. 11, 1992	Eagle, Alaska	MDD 369E	destroyed	3 fatal
Soon after takeoff, the pilot radioed that he was returning because of marginal VMC. The helicopter last was observed circling the runway. About seven hours later, the wreckage was found 450 feet (137 meters) from the runway. One main-rotor blade had separated, and the attachment lugs for both the upper-blade-root fitting and the lower-blade-root fitting had fractured. The report said that inadequate maintenance and inspection, and a material defect were probable causes of the accident.				
Sept. 12, 1992	Honolulu, Hawaii	Hughes 369D	none	1 uninjured
A bolt shackle sheared while the helicopter lifted a 500-pound (227-kilogram) load. The load fell in a remote area of the airport.				
Sept. 13, 1992	Fairbank, Iowa	Aerospatiale AS 350B	none	2 uninjured
The hydraulic low-pressure warning light illuminated 15 minutes after takeoff from a pasture. The pilot landed the helicopter on a road. The hydraulic pump had malfunctioned.				
Sept. 13, 1992	Iowa[1]	Aerospatiale AS 350B	none	3 uninjured
The window in the pilot's door separated from the helicopter in flight. The pilot conducted a precautionary landing in a field.				
Sept. 16, 1992	Hana, Hawaii	Aerospatiale AS 350B	destroyed	7 fatal
The helicopter departed at about 1032 local time for a 45-minute air-tour flight. Adverse weather conditions, including thunderstorms, rain showers and low visibility, were reported near the accident site throughout the morning. A witness observed a helicopter flying in and out of clouds. The helicopter was in a 15-degree right bank when it struck sloping terrain.				
Sept. 19, 1992	Phoenix, Arizona	MBB BK 117B-1	minor	3 uninjured
The EMS helicopter began to settle rapidly during landing in day VMC. The pilot observed a decrease in N_2 (engine high-pressure-rotor speed). A hard landing resulted.				
Sept. 25, 1992	George Inlet, Alaska	Hughes 369D	substantial	2 minor, 2 uninjured
The helicopter was being flown along a shoreline at about 300 feet AGL when a passenger asked the pilot to fly in the opposite direction. The pilot turned the helicopter away from shore, toward the open water. During the turn, the helicopter descended and struck the water.				
Sept. 25, 1992	Alaska[1]	Aerospatiale AS 350B	minor	4 uninjured
The main rotor struck a tree during a fish-survey flight. The helicopter was flown back to base and was landed safely.				
Oct. 20, 1992	Texas[1]	Bell 206L-1	none	4 uninjured
The engine ingested a bird, causing a compressor stall. The pilot conducted a precautionary landing.				
Nov. 2, 1993	Pennsylvania[1]	MBB BK 117A-1	minor	4 uninjured
The pilot conducted a hard vertical landing at a hospital heliport. The landing gear and main-rotor blades were damaged.				
Nov. 24, 1992	Gulf of Mexico	Bolkow BO 105C	none	5 uninjured
The pilot felt a severe vibration and conducted an emergency landing on the water. Waves created by a moving boat capsized the helicopter.				
Dec. 4, 1992	Kamuela, Hawaii	Hughes 369C	substantial	2 minor, 2 uninjured
A loss of power occurred during an air-tour flight. The pilot conducted an autorotative landing on a nearby road. On touchdown, the helicopter yawed left and skidded off the road. An engine examination disclosed that the turbine wheels had sustained extensive heat distress, the fuel control exceeded service limits and the turbine-outlet-temperature indicator displayed lower-than-actual readings.				
Dec. 11, 1992	Aguila, Arizona	MBB BK 117B-1	minor	1 uninjured
A ground ambulance was driven under the helicopter to unload a patient. The helicopter's rotor blades struck an antenna on the ambulance.				

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
Dec. 14, 1992	Gulf of Mexico	Bolkow BO 105S	minor	1 uninjured
No. 1 engine torque decreased, and the pilot conducted a single-engine landing on an offshore platform. The engine drive shaft had failed.				
Dec. 21, 1992	Hilo, Hawaii	Hughes 369D	substantial	5 uninjured
The pilot felt the helicopter vibrate and yaw left. The engine gauges indicated decreasing power output and high turbine-outlet temperature, and the engine-chip light and engine-failure light illuminated. The pilot conducted a autorotative landing downwind. The main rotor severed the tail boom as the helicopter slid to a stop. The report said that the no. 1 bearing and no. 2 bearing in the compressor module had failed and that the operator had installed an unserviceable compressor module in the engine.				
Dec. 30, 1992	St. Paul, Minnesota	Sikorsky S-76A	none	5 uninjured
The pilot flew the helicopter into known icing conditions.				
Jan. 1, 1993	Louisiana[1]	Bolkow BO 105S	none	2 uninjured
After partial power losses from both engines, the pilot landed the helicopter safely.				
Jan. 3, 1993	Ogden, Utah	Bell 206B-3	destroyed	4 fatal
The pilot made three attempts to land the helicopter on a ridge to disembark skiers. During the third go-around, the helicopter struck the ridge at 8,500 feet. Witnesses described the area as being “socked in” by weather.				
Jan. 11, 1993	Idaho[1]	Bolkow BO 105C	minor	3 uninjured
The engine failed on takeoff. The pilot conducted an emergency landing on a road, and the helicopter struck a curb. No mechanical reason for the power loss was found.				
Jan. 12, 1993	Hayward, California	Bell 206B	destroyed	2 fatal
During a night cargo flight, the pilot received instructions to divert to another destination. Weather conditions in the area included low ceilings and reduced visibility in rain. A witness observed the helicopter descend below the level of the bridge that spanned a bay, where visibility was about 0.25 statute mile (0.40 kilometer) in rain. The helicopter struck the water about 1,200 feet (366 meters) from the bridge.				
Jan. 12, 1993	Reno, Nevada	Hughes 369D	minor	1 uninjured
The engine failed while the helicopter was being hover-taxied from a gate to a hangar. The pilot conducted an autorotative landing on an icy road, and the helicopter slid into a snow bank.				
Jan. 31, 1993	Chino, California	Bell 412	minor	5 uninjured
The EMS helicopter struck a power line during climbout in night VMC. The pilot conducted a precautionary landing, and the medical patients were transferred to another helicopter.				
Feb. 5, 1993	New York[1]	Bolkow BO 105C	none	2 uninjured
The left engine surged, and the pilot conducted a precautionary landing on a baseball field. A worn piece of cowling chafing strip had been ingested by the engine.				
Feb. 8, 1993	Gulf of Mexico	Bell 206L-1	substantial	3 minor
The pilot said that after liftoff from an offshore platform, he attained 60 knots of airspeed and climbed to 200 feet AGL before beginning a left turn. The helicopter began to settle during the turn and subsequently struck the water. Witnesses had observed the helicopter descend in a steep left bank and in a steep nose-down attitude until impact. No evidence of pre-impact failure or malfunction was found in the engine or rotor drive.				
Feb. 9, 1993	Texas[1]	Sikorsky S-76A	minor	2 uninjured
After observing sparks from a bundle of wires, the pilot landed the helicopter on a road. The wire bundle had been chafed by contact with a radar unit.				
Feb. 10, 1993	Louisiana[1]	Bell 206L-3	minor	1 uninjured
The tail rotor struck the roof of a vehicle while beginning to hover. The report said that the pilot misjudged his clearance from the vehicle.				
Feb. 20, 1993	Utah[1]	Aerospatiale SA 315B	minor	1 uninjured
The engine flamed out after takeoff. The pilot conducted an autorotative landing in a field. The report said that ice in the fuel filter might have caused the flameout.				
Feb. 22, 1993	Springfield, Missouri	Bolkow BO 105C	none	4 uninjured
The no. 2 engine flamed out in flight, and a precautionary landing was conducted. A ruptured “O” ring seal on a fuel-filter plug was discovered.				

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
March 16, 1993	New Mexico[1]	Bell 222U	none	3 uninjured
The no. 1 hydraulic system low-pressure warning light illuminated in flight. The pilot landed the helicopter safely. The line from the no. 1 module to the pressure manifold was found leaking.				
April 1, 1993	Aspen, Colorado	Aerospatiale SA 316B	destroyed	3 fatal, 1 serious
The helicopter was being flown at 150 feet AGL to 200 feet AGL when a passenger heard abnormal sounds. The helicopter then began a descending right turn and struck trees. Examination disclosed a fatigue failure of the flight-control-system lower mixing unit and a fatigue crack in the upper mixing unit.				
April 2, 1993	Hilo, Hawaii	Hughes 369D	minor	5 uninjured
A bird struck the windshield soon after takeoff. The pilot flew the helicopter back to the departure site and landed the helicopter without further incident.				
April 22, 1993	New Mexico[1]	Bell 222U	none	4 uninjured
The pilot became unconscious while helping to unload a burn victim.				
April 27, 1993	Myrtle Beach, South Carolina	Bell 206B	substantial	1 serious, 3 uninjured
After a hard landing, the pilot reported that he had attempted a steep approach with a tail wind, which resulted in insufficient power available to arrest the sink rate. The pilot said that the surface winds were six knots to 18 knots, with gusts to 27 knots.				
April 28, 1993	Gulf of Mexico	Bell 212	none	13 uninjured
The right-engine cowling separated in flight after the latch assembly failed. The pilot landed the helicopter on an offshore platform.				
May 10, 1993	Franksville, Wisconsin	Bell 222U	none	4 uninjured
When hydraulic pressure decreased to zero, the pilot diverted the flight and landed without further incident. A ruptured hydraulic line was discovered and replaced.				
May 17, 1993	Malina Bay, Alaska	Fairchild FH-1100	substantial	2 serious, 2 minor
The pilot conducted a low pass over an archaeological site on a beach and was climbing the helicopter over rising terrain and trees when he heard a bang and observed a decrease in engine speed. The pilot turned left toward a small clearing, and the helicopter struck treetops at the edge of the clearing. The report said that the engine-to-transmission drive shaft had failed.				
May 26, 1993	Louisiana[1]	Bell 206L-1	minor	2 uninjured
The rear-landing-gear cross tube separated when the engine was shut down.				
May 27, 1993	Cameron, Missouri	Aerospatiale AS 350B	destroyed	2 fatal, 2 serious
The EMS helicopter was en route in day VMC with a patient when the flight nurse heard a loud pop, followed by a clattering and a warning horn. Soon thereafter, the helicopter struck terrain. Witnesses said that the wind was strong and gusty. The report said a power loss had occurred because of failure of the labyrinth seal in the engine's second-stage turbine-nozzle guide vane.				
June 4, 1993	Alaska[1]	Bell 206L-1	none	4 uninjured
The chip-detector light illuminated when the engine was started. The pilot shut down the engine. Carbon was found on the chip-detector plug.				
June 6, 1993	St. Mary's, Pennsylvania	Aerospatiale SA 365N	minor	4 uninjured
After the engines were started in night VMC, the helicopter began an uncontrolled left turn and lifted off the platform. The pilot regained control, flew the helicopter back to the helipad and shut down the engines.				
June 14, 1993	Hawaii[1]	Aerospatiale AS 350B	minor	7 uninjured
After a loss of engine power, the pilot conducted an autorotative landing in a grove of trees. The report said that adjusting washers had not been installed on module no. 2 and module no. 3.				
June 17, 1993	Stoneyford, California	Bell 206B-3	substantial	1 uninjured
The pilot established a hover at a mountain landing zone and began to air-taxi the helicopter to an area where the cargo could be unloaded. The pilot said that a gust of wind buffeted the helicopter and the tail rotor struck the ground. The pilot was not able to maintain yaw control, and the helicopter settled hard into a creek.				
June 20, 1993	West Monroe, Louisiana	Bell 206L-3	substantial	3 minor
The EMS helicopter struck high-tension power lines on takeoff in day IMC from the median of a highway after boarding a patient who had been involved in a motor-vehicle accident. Reported weather conditions included a 500-foot overcast and four statute miles (six kilometers) visibility in fog and rain showers.				

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
July 4, 1993	Gulf of Mexico	Bell 206-B	none	1 uninjured
The engine failed during a repositioning flight, and the pilot landed the float-equipped helicopter on the water. The helicopter sank after several hours.				
July 7, 1993	Alaska[1]	Aerospatiale AS 350BA	minor	5 uninjured
The horizontal stabilizer struck the top of a tree during approach. The pilot landed the helicopter without further incident.				
July 11, 1993	Intracoastal City, Louisiana	Bell 214ST	minor	15 uninjured
A bright flash occurred in the cockpit, followed by electrical malfunctions and electrical damage to the instruments. The report said that a lightning strike is suspected of having caused the incident.				
July 11, 1993	Alaska[1]	Aerospatiale SA 315B	minor	2 uninjured
The engine failed because of fuel exhaustion during climb, and the pilot conducted an autorotative landing.				
July 23, 1993	Cordova, Alaska	Hughes 369D	substantial	3 uninjured
While hovering the helicopter with the toes of the landing skids against a 45-degree mountain slope, the pilot heard a loud noise and felt a jolt. The helicopter settled backward, and the tail struck the ground. The pilot said that a power loss occurred and he could not maintain the hover. The cause of the power loss was not determined.				
Aug. 7, 1993	Tusayan, Arizona	Bell 206L-3	substantial	3 serious, 9 minor, 2 uninjured
After returning from an air-tour flight, the pilot was cleared by the company control tower operator to hover-taxi past another company helicopter, a Bell 206L-1. The pilot of the 206L-1 had been told to hold for the inbound helicopter. The pilot of the 206L-3 said that when he was abeam the other helicopter, a gust of wind struck his helicopter and he meshed rotors with the other helicopter. The report said that less-than-FAA-recommended clearance existed between the heliport's five helipads; seven feet (two meters) of clearance existed between the main rotor of the 206L-3, the main rotor of the 206L-1 and a fence.				
Aug. 27, 1993	Mount Iliamna, Alaska	Hughes 369D	substantial	5 uninjured
After conducting a low pass over a work site in mountainous terrain, the pilot began a climbing right turn. The pilot said that he decided that the helicopter would not clear the steep terrain, so he began a left turn. The right skid struck the mountain and separated from the helicopter. The pilot flew the helicopter to a nearby base and landed on a makeshift support structure.				
Aug. 28, 1993	New York[1]	Hughes 369E	minor	5 uninjured
The left-rear landing gear struck the helipad deck when the aircraft settled on the helipad.				
Sept. 3, 1993	Teterboro, New Jersey	Aerospatiale AS 355F	minor	1 uninjured
Both side-door windows separated from the helicopter in flight. The pilot landed the helicopter without further incident. An inspection revealed a possible bullet hole in the door.				
Sept. 5, 1993	Topeka, Kansas	Bell 206L-1	minor	2 uninjured
A power loss occurred during cruise flight, and the pilot conducted an autorotative landing.				
Oct. 16, 1993	Patterson, Louisiana	Sikorsky S-76	minor	11 uninjured
Hydraulic pressure from the no. 2 engine decreased to zero, and the cyclic-control system developed a problem. The pilots landed the helicopter from a hover with an unsafe-nose-gear indication. A faulty hydraulic pump was found.				
Oct. 19, 1993	Hilo, Hawaii	Bell 206L-1	minor	6 uninjured
A power loss occurred in flight. The pilot conducted an autorotative landing.				
Oct. 21, 1993	Gulf of Mexico	Bell 206B	none	2 uninjured
A power loss occurred in flight. The pilot conducted an autorotative landing on the water and deployed the emergency raft.				
Oct. 25, 1993	Gulf of Mexico	Bell 206B	substantial	2 minor
The pilot said that on takeoff from an offshore platform, the helicopter pitched down and began to spin uncontrollably. The helicopter then struck the water. The operator said that the left-front tie-down strap had not been removed prior to takeoff.				
Nov. 10, 1993	Honolulu, Hawaii	Bell 206B	none	5 uninjured
A power loss occurred, and the helicopter was landed on a slope next to the helipad.				
Nov. 11, 1993	Fort Lauderdale, Florida	MBB BK 117A-1	minor	4 uninjured
The no. 1 engine fire-warning light illuminated during final approach. The pilot selected the fire-extinguishing system. The report said that the exhaust-duct band-clamp nut had become loose and the clamp had separated.				

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
Nov. 19, 1993	Portland, Maine	Bell 206L-1	destroyed	3 fatal, 1 serious

The EMS helicopter departed from Portland at night with sufficient fuel for two hours, 45 minutes of flight. The 97-nautical-mile (180-kilometer) flight normally was completed in less than one hour, but required one hour, 10 minutes because of wind conditions. After a medical patient was boarded, the helicopter was flown into IMC and encountered a head wind of 40 knots to 60 knots during the return flight to Portland. The pilot was receiving radar vectors from ATC when a power loss occurred. The pilot ditched the helicopter in rough water seven nautical miles (13 kilometers) from the airport. The report said that the company operations manual says, "The minimum acceptable weather is VFR conditions."

Dec. 7, 1993	Louisiana[1]	Bell 206L-1	minor	7 uninjured

The pilot heard a loud bang, and a power loss occurred. The pilot extinguished an engine fire and conducted an autorotative landing in a field. The first-stage turbine had failed.

Dec. 21, 1993	Virginia[1]	Bell 222B	minor	2 uninjured

The tail rotor struck a helipad landing light during landing.

Dec. 21, 1993	New Iberia, Louisiana	Sikorsky S-76A	none	8 uninjured

The no. 1 engine decelerated to flight idle, and the pilots conducted a precautionary landing at an airport. The report said that moisture in the engine-governor system was suspected of having caused the engine problem.

Dec. 27, 1993	Olean, New York	Bolkow BO 105C	none	4 uninjured

After a loss of power from the left engine occurred on climbout, the pilot flew the helicopter back to the departure site and landed without further incident. The no. 8 bearing in the turbine section had failed because of oil starvation.

Jan. 20, 1994	Lebec, California	Aerospatiale AS 350D	destroyed	2 fatal

The helicopter struck two power lines while being landed at an off-airport site. Mountainous terrain concealed from sight the unmarked power lines and support towers. The report said that the power lines were depicted on an aeronautical sectional chart and were not required to be marked.

Jan. 25, 1994	Texas[1]	Bell 412	none	2 uninjured

During final approach to a heliport, the no. 2 engine decelerated to flight idle. The crew selected the no. 2 engine-governor control to the emergency position, which restored normal operating power. The report said that the cause of the engine deceleration was an air leak in the governor system caused by a deteriorating "O" ring in a fitting.

Feb. 1, 1994	Caro, Michigan	Bolkow BO 105S	minor	2 uninjured

The pilot conducted an EMS flight to a hospital that did not have an approved helipad. The designated landing site for previous EMS flights was a field near the hospital; nevertheless, a portion of a circular driveway on hospital property had been designated as the landing site for this flight. The helicopter was near the landing site when the pilot was told to land at another site. Using the ground as a reference to maintain position, the pilot established a hover at approximately 10 feet above the circular drive while judging the feasibility of landing at the alternate site. Snow blown by the rotors partially obscured the pilot's view of the ground. A paramedic crewmember then grabbed the pilot's arm and told him to watch out for a light pole on the right side of the helicopter. The paramedic's actions startled the pilot and caused him to momentarily lose sight of his point of reference. The helicopter drifted and struck a light assembly, damaging the main-rotor blades. The pilot landed the helicopter without further incident.

Feb. 23, 1994	Humuula, Hawaii	Aerospatiale AS 350B	substantial	2 serious, 5 uninjured

The pilot was conducting a local air-tour flight in mountainous terrain. The pilot observed clouds in a mountain pass on the route of flight and decided to proceed to an alternate destination. While climbing the helicopter to 10,500 feet to avoid the clouds, the pilot allowed airspeed to decrease. The helicopter encountered a downdraft, and the pilot conducted a turn away from the mountain. The pilot was unable to maintain altitude, and the helicopter struck terrain.

Feb. 28, 1994	Huelo, Hawaii	Aerospatiale AS 350D	substantial	5 uninjured

The engine decelerated during a local air-tour flight. The pilot conducted an autorotative landing; a tree stump penetrated the belly of the helicopter. The fuel-control-unit line was found loose and leaking fuel. The report said that the operator had replaced the fuel-control unit two days before the accident.

March 4, 1994	Indianapolis, Indiana	MBB BK 117A-3	minor	1 uninjured

During a positioning flight in night VMC, the engine cowling separated from the EMS helicopter. The report said that the "old-style" latches had opened in flight.

March 13, 1994	Patterson, Louisiana	Bell 206L-3	none	4 uninjured

During a flight over the Gulf of Mexico, the pilot heard a grinding noise and felt a binding in the cyclic control. The pilot pulled the hydraulic-system circuit breaker, switched off the hydraulic system, flew the helicopter toward shore and landed on a beach. Investigation revealed that a hydraulic-pressure line had ruptured.

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
March 25, 1994	Hawaii National Park, Hawaii	Hughes 369D	substantial	2 minor
The pilot was not able to maintain visual contact with the ground when the helicopter encountered a steam cloud while hovering at five feet near a volcano vent. The pilot began a descent to regain visual contact with the ground. The left landing skid struck a rock; the helicopter rolled right and struck the ground.				
March 26, 1994	Wrangell, Alaska	Bell 206B	substantial	1 minor
The helicopter was being landed on a man-made platform at a remote logging site when the main-rotor blades struck a tree stump.				
March 28, 1994	New Mexico[1]	Aerospatiale AS 350B2	minor	3 uninjured
A duck struck the left side of the windshield. The pilot landed the helicopter at the destination without further incident.				
April 1, 1994	Telluride, Colorado	Aerospatiale AS 350B2	substantial	1 serious, 4 minor, 1 uninjured
While conducting a visual approach to a landing site at 12,800 feet in mountainous terrain, the pilot conducted a right turn to final approach, which placed the helicopter in a downslope-wind condition. The helicopter settled, turned left and struck terrain below the landing site.				
April 2, 1994	Nahiku, Hawaii	Aerospatiale AS 350D	none	6 uninjured
The engine decelerated in flight. The pilot landed the helicopter near a waterfall. The report said that the governor lever had not been seated properly.				
April 3, 1994	Lamoille, Nevada	Bell 206L-3	destroyed	4 fatal, 1 serious
The helicopter was landed at a remote site because of adverse weather conditions. Snow accumulated on the airframe. No external engine snow covers were available. The air-induction system had snow baffles and particle separators, but the engine was not equipped with an auto-ignition system. About one hour after landing, the pilot restarted the engine and operated it about five minutes. After discussing the situation with the company's director of operations, he took off. A power loss occurred soon after liftoff. The helicopter struck sloping terrain and rolled over.				
April 7, 1994	Hawaii[1]	Aerospatiale AS 350BA	minor	7 uninjured
The helicopter was being hovered out of ground effect near a waterfall when the main rotor struck a cliff. The pilot landed the helicopter without further incident.				
April 9, 1994	Valdez, Alaska	Hiller UH-12E	substantial	2 uninjured
During an aerial-photography flight, the pilot was flying the helicopter 40 feet over a mountain ridge when a power loss occurred. The helicopter descended, struck the ridge and rolled right. The report said that the fuel valve was found halfway between the "ON" and "OFF" positions.				
April 22, 1994	Blue Swan, Pennsylvania	MBB BK 117A-3	minor	2 uninjured
The cowling on the left side of the no. 1 engine separated during a training flight. The report said that the cowling had not been secured properly.				
May 9, 1994	Colorado[1]	Aerospatiale AS 350B2	minor	2 uninjured
The aircraft struck a power line during descent to a landing site. The helicopter was landed safely.				
May 11, 1994	Kahului, Hawaii	Bell 206B	minor	2 uninjured
The throttle lever was retarded to simulate an engine flameout. The pilot conducted an autorotative landing; the helicopter landed hard.				
June 20, 1994	Gulf of Mexico	Bell 206B	minor	2 uninjured
While hover-taxiing the helicopter, the pilot felt a bump. The tail skid was damaged.				
June 23, 1994	Louisiana[1]	Sikorsky S-76A	none	5 uninjured
The no. 1 engine fire-warning light illuminated in flight. The pilot shut down the engine, selected the fire-extinguishing system and landed the helicopter without further incident.				
June 23, 1994	Amarillo, Texas	Aerospatiale AS 350B	minor	4 uninjured
The EMS helicopter struck a wire on takeoff from a highway in day VMC, causing damage to the main rotor. The pilot conducted an immediate landing.				
July 13, 1994	Galveston, Texas	Aerospatiale AS 350	destroyed	4 fatal, 1 serious
The pilot said that the helicopter was climbing through 2,000 feet when he felt several bumps, similar to turbulence, and was not able to maintain control of the helicopter; the cyclic control and collective control did not respond to his control inputs. The helicopter struck the Gulf of Mexico approximately 11 nautical miles (20 kilometers) offshore. All major components, except the vertical fin and tail-rotor gearbox, were recovered. During reconstruction of the helicopter, the left lateral servo rod end was found disconnected from the servo extension. The threads on the rod end were intact and appeared undamaged; however, only remnants of the mating internal threads in the servo extension remained. The zero-time servo had been installed 416 flight hours before the accident. (The left lateral servo changes the attitude of the helicopter by changing the angle-of-attack of the main-rotor blades.)				

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
July 14, 1994	Kalaupapa, Hawaii	Aerospatiale AS 350B	substantial	1 serious, 6 uninjured

The helicopter was scheduled for an air-tour flight around the island of Maui. The pilot decided to tour the island of Molokai when weather conditions along the scheduled route deteriorated. The pilot did not tell the company about the route change. While in a hover approximately 150 feet (55 meters) from shore, rotor speed decreased. The pilot conducted an emergency landing on the water. The passengers donned life vests and swam to shore, where they spent the night.

July 14, 1994	Hanalei, Hawaii	Aerospatiale AS 350D	substantial	3 fatal, 4 uninjured

During an air-tour flight, the helicopter was being flown parallel to the shoreline when a complete loss of engine power occurred. The pilot conducted an autorotative landing on the water about 150 feet (46 meters) from a cliff. The helicopter was not equipped with floats. All occupants exited the helicopter as it sank. Life vests were aboard the helicopter but were not worn by the occupants. The pilot and two passengers drowned.

July 15, 1994	Gulf of Mexico	Aerospatiale AS 355F1	minor	4 uninjured

The pilot felt a slight yaw and a jolt, and landed the helicopter on a nearby offshore platform. The left lower baggage-compartment door had separated from the helicopter. The baggage-door-ajar warning light had been damaged and had not functioned properly.

July 19, 1994	Juneau, Alaska	Aerospatiale AS 350	substantial	7 uninjured

The pilot said that he landed the helicopter at the usual landing site on a glacier. While he was leaning out the door to check the position of the skids, the helicopter nosed down, and the main-rotor blades struck the surface of the ice. Examination of the landing site showed a crevasse near the touchdown point of the helicopter's right landing skid.

July 22, 1994	Gulf of Mexico	Bell 412	minor	11 uninjured

Passengers were boarding the helicopter, and the helicopter was being refueled, when the aft landing-skid cross tube separated.

July 29, 1994	Kenai, Alaska	Bell 206	substantial	2 serious, 3 uninjured

The helicopter struck terrain when the pilot attempted to land on the summit of an 11,070-foot mountain with the helicopter at or near the maximum authorized structural gross weight of 3,200 pounds (1,452 kilograms). The report said that under the existing conditions, the helicopter was limited to a maximum operating altitude of 9,000 feet.

Aug. 5, 1994	(location unspecified)[1]	Bell 206B	minor	1 uninjured

The tail rotor struck a wire barrier during a hover landing on a helipad.

Aug. 11, 1994	Kukuihaele, Hawaii	Aerospatiale AS 350D	substantial	7 uninjured

During an air-tour flight at 1,200 feet AGL, the pilot observed a decrease in main-rotor speed and began to conduct a precautionary landing on a rock-covered ledge about 50 feet (15 meters) from shore. The main-rotor blades and tail-rotor blades struck the rocks, and the helicopter rolled onto its right side. A subsequent engine examination revealed a fatigue crack in a steel "T" fitting that attaches the pneumatic accumulator to the power-turbine governor.

Aug. 12, 1994	Whiting, New Jersey	Bell 206L-4	destroyed	3 fatal

The non-instrument-rated commercial pilot was flying the helicopter at 2,000 feet at night when he told ATC that the helicopter had encountered IMC. About two minutes later, ATC no longer had radar contact with the helicopter. At about the same time, the pilot reported that he was "going inverted." The helicopter was in a steep descent when it struck terrain.

Aug. 14, 1994	Intracoastal City, Louisiana	Bolkow BO 105S	minor	2 uninjured

The helicopter began to yaw and vibrate on climbout. After landing the helicopter, the pilot discovered that the aft cowling had separated, damaging the tail rotors and fin. The report said that maintenance had been performed in the area of the cowling.

Aug. 15, 1994	Louisiana[1]	Bell 206L-3	minor	1 uninjured

The battery-compartment door opened in flight, and an antenna on the door cracked the windshield.

Aug. 30, 1994	Fitchburg, Wisconsin	Bell 206L-1	minor	4 uninjured

The EMS helicopter struck an unidentified object while being flown in IMC. The helicopter was landed without further incident.

Sept. 3, 1994	Volcano, Hawaii	Hughes 369E	substantial	1 minor, 4 uninjured

During an air-tour flight, a pilot encountered IMC and landed the helicopter on terrain at 7,500 feet to wait for the weather to clear. After the weather cleared, low battery charge prevented the pilot from starting the engine. A second helicopter (the accident helicopter), with a mechanic aboard, was dispatched to retrieve the passengers. During liftoff, the passengers heard the low-rotor-speed warning horn and observed the low-rotor-speed warning light. The helicopter yawed about 45 degrees right as it departed downslope; the left landing skid struck terrain, and the helicopter rolled over.

Sept. 28, 1994	Louisiana[1]	Aerospatiale AS 355F1	minor	1 uninjured

An uncommanded, slight yaw developed during cruise. After the helicopter was landed on an offshore platform, the rear cowling was found to have separated.

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
Oct. 24, 1994	Kaupo, Hawaii	Eurocopter AS 350D	substantial	4 minor
The pilot heard an explosion and the engine-failure warning horn, and observed the engine-chip light and a reading of 900 degrees Celsius (1,652 degrees Fahrenheit) on the engine-temperature gauge. The helicopter then struck trees. Examination revealed damage to the axial compressor, compressor stator vanes and impeller. The impeller blades showed signs of metal fatigue. The report said that daily compressor-wash procedures and maintenance inspections had not been performed.				
Oct. 27, 1994	Texas[1]	Bell 206L-1	minor	1 uninjured
The battery-compartment door opened during landing, and an antenna on the door broke the windshield.				
Nov. 15, 1994	Gulf of Mexico	Aerospatiale AS 355F1	minor	1 uninjured
The lower vertical fin struck safety netting during a landing on an offshore platform.				
Nov. 18, 1994	Gulf of Mexico	Bell 206L-1	minor	1 uninjured
The tail rotor struck an unidentified object during landing on an offshore platform.				
Nov. 20, 1994	Juneau, Alaska	Bell 206	none	1 fatal
The pilot landed the helicopter and locked the flight controls. The engine and rotors were turning at flight idle when the pilot exited and began refueling the helicopter. A company employee walked to the pilot and asked for a ride to the destination. After the discussion, the employee began to walk toward his truck, stooped to pass under the tail boom and was struck by the tail rotor.				
Nov. 22, 1994	Lincoln, Nebraska	MBB BK 117B-1	none	4 uninjured
The chip-detector light illuminated during an EMS flight in day VMC. The helicopter was landed at the nearest airport. The report said that the chip detector was cleaned and inspected.				
Nov. 25, 1994	Lafayette, Louisiana	Bell 412	none	2 uninjured
The pilot was hovering the helicopter in preparation for takeoff when a power loss from the no. 1 engine occurred. The pilot shut down the engine and landed the helicopter. A post-incident investigation indicated that the governor fuel control restricted maximum power to 85 percent.				
Dec. 7, 1994	Gulf of Mexico	Sikorsky S-76	minor	12 uninjured
The helicopter was being hover-taxied when a power loss occurred. The helicopter dropped to the ground, collapsing the left-main gear.				
Dec. 16, 1994	Gulf of Mexico	Sikorsky S-76A	none	3 uninjured
A burning odor was detected and smoke was observed during flight; the Loran navigation receiver failed soon thereafter. The report said that water had leaked into the Loran receiver, causing an electrical short circuit.				
Dec. 17, 1994	Gulf of Mexico	Sikorsky S-76A	none	8 uninjured
During takeoff from an offshore platform, the no. 2 hydraulic-system warning light illuminated and the landing gear collapsed. The pilot selected the emergency gear-extension system and landed the helicopter on the platform.				
Dec. 20, 1994	Pittsburgh, Pennsylvania	Aerospatiale AS 355F1	none	4 uninjured
The EMS crew heard a loud bang and diverted the flight to Pittsburgh. The report said that the cargo doors had not been secured properly before flight and had separated from the helicopter.				
Dec. 26, 1994	Louisiana[1]	Aerospatiale AS 350B1	none	3 uninjured
A passenger window blew out in flight.				
Dec. 27, 1994	Gulf of Mexico	Bell 412	none	13 uninjured
During takeoff, engine temperature was higher than normal. At reduced power, engine temperature remained higher than normal. The report said that the “left ATR transfer tube” had ruptured.				
Jan. 4, 1995	Gulf of Mexico	Bell 412	none	2 uninjured
The pilot flew the helicopter to a hover and was turning toward the landing pad when he observed the no. 2 engine surge momentarily to about 95 percent power, heard a loud pop and felt the aircraft yaw right. The pilot landed the helicopter without further incident. The report said that maintenance personnel performed a compressor-stall inspection and replaced the bleed valve in the no. 2 engine.				
Jan. 8, 1995	Gulf of Mexico	Bell 412	none	7 uninjured
A compressor stall occurred in the no. 1 engine during flight, and inlet-turbine temperature began to increase. The pilot reduced no. 1 engine power to idle and conducted a single-engine landing at a heliport.				

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
Jan. 13, 1995	Gulf of Mexico	Aerospatiale AS 355E	minor	4 uninjured

The no. 1 engine failed. The pilot secured the engine, flew the helicopter to the planned destination and conducted a single-engine landing on the offshore platform. Investigation revealed that a fractured oil cap had caused oil exhaustion.

Jan. 14, 1995	Los Angeles, California	Bell 206	destroyed	2 fatal, 2 serious

The pilot requested and received a special visual flight rules (SVFR) clearance to depart from the Burbank, California, airport in weather conditions including a 300-foot broken ceiling and 2.5 statute miles (4.0 kilometers) visibility in fog and light rain. ATC radar data indicated that the helicopter did not climb more than 300 feet after departure. The helicopter struck power lines at about 150 feet AGL.

Jan. 20, 1995	Adams Field, Arkansas	Bolkow BO 105A	none	4 uninjured

The no. 1 engine turbine-outlet temperature (TOT) increased to 800 degrees Celsius (1,472 degrees Fahrenheit). The pilot reduced power, lowering the TOT to 750 degrees Celsius (1,382 degrees Fahrenheit) and flew the helicopter to the planned destination. Maintenance personnel found a piece of fiberglass chafe tape partially obstructing the engine inlet.

Jan. 25, 1995	Gulf of Mexico	Bell 206B-3	minor	1 uninjured

While landing the helicopter on an offshore platform, the pilot heard a noise and felt a vibration. The pilot rejected the landing and hovered the helicopter over the platform. When the vibration did not stop, the pilot landed the helicopter and conducted an emergency engine shutdown. The report said that the tail rotor had struck the wire mesh on the helideck.

Jan. 26, 1995	New Orleans, Louisiana	Sikorsky S-76A	none	9 uninjured

Five minutes after takeoff, at 3,000 feet, the baggage-compartment smoke-warning light illuminated. The aircraft was landed at a nearby base. No evidence of fire was detected. Maintenance personnel found a loose connection inside the smoke detector, tightened it and returned the aircraft to service.

Jan. 28, 1995	Miami, Florida	Bell 206B-3	substantial	3 uninjured

The pilot was flying the helicopter about 800 feet over a football stadium when a power loss occurred. He conducted an autorotative landing. The helicopter landed hard, damaging the belly and transmission mounts. Examination of the engine revealed that the compressor-discharge line was loose at the fuel control.

Feb. 3, 1995	Gulf of Mexico	Aerospatiale AS 355F1	none	1 uninjured

During final approach to an offshore platform, the no. 1 engine fire-warning light illuminated. No sign of fire was found after the engines were shut down. Maintenance personnel found a loose pin in a cannon plug.

Feb. 7, 1995	Lafayette, Louisiana	Bolkow BO 105S	minor	5 uninjured

During a night flight with wildlife-management personnel aboard, the pilot decided to return to the departure airport because weather conditions were deteriorating. The pilot received an SVFR clearance to fly the helicopter into the airport area. Weather conditions included 100 feet sky obscured and 0.25 statute mile (0.40 kilometer) visibility in fog. When the pilot reduced engine power for landing, condensation formed on the windshield, restricting the pilot's forward vision and depth perception. The aircraft landed hard on the runway in a nose-up attitude and slid to a stop.

Feb. 13, 1995	Quinton, Kentucky	Sikorsky S-76	none	4 uninjured

During approach to a heliport, the pilot observed an unsafe-landing-gear indication. The pilot conducted the emergency procedures, but the indication did not change. The pilot flew the helicopter to the company's primary maintenance base and landed without further incident. Maintenance personnel adjusted the nose-gear-proximity switch; a subsequent gear-retraction check indicated normal operation.

Feb. 14, 1995	Patterson, Louisiana	Sikorsky S-76A	none	5 uninjured

During departure from an offshore platform, the pilot felt the anti-torque pedals bind and then deflect full left. The pilot flew the helicopter to the departure platform and landed without further incident. An inspection revealed absence of Teflon coating on a small area of the stainless steel anti-torque shaft.

Feb. 14, 1995	Gulf of Mexico	Bell 206L-4	destroyed	5 fatal

During a flight from an offshore platform, the pilot radioed several position reports; the last report indicated that the helicopter was 32 nautical miles (59 kilometers) from the destination: Intracoastal City, Louisiana. The pilot then declared mayday and said that the flight inadvertently had encountered IMC. The helicopter was not certificated for flight into IMC. When the helicopter did not arrive at the destination, a search was begun. Pieces of the helicopter were found on the water. The report said that the pilot, who had completed a VFR-only flight check, was told by other company pilots before takeoff that weather conditions were deteriorating.

Feb. 15, 1995	Gulf of Mexico	Bell 206L-4	none	2 uninjured

During flight, the engine-torque gauge began fluctuating between 70 percent and 78 percent, and the helicopter began to yaw left and right. The conditions continued at 10-second to 15-second intervals until the helicopter was landed. Maintenance personnel replaced the fuel control and governor. The helicopter was returned to service after an operational check flight.

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
Feb. 21, 1995	Intracoastal City, Louisiana	Bell 230	none	5 uninjured
During climbout, the lateral-isolation mount failed. The pilot flew the helicopter to the company's base and landed without further incident. The lateral-isolation mount was replaced, and the helicopter was returned to service.				
Feb. 23, 1995	Gulf of Mexico	Aerospatiale AS 355F1	minor	3 uninjured
About two nautical miles (four kilometers) from an offshore platform, the helicopter yawed right and the pilot heard a noise similar to metal contacting metal. The pilot observed that no. 2 engine torque was zero and shut down the engine. He landed the helicopter on the platform without further incident. Maintenance personnel discovered that the disk coupling at the transmission end of the input drive shaft had failed.				
Feb. 28, 1995	Venice, Louisiana	Sikorsky S-76C	none	9 uninjured
On short-final approach, the pilot observed a significant difference in engine-torque indications. No. 1 engine torque was low, and no. 2 engine torque was high. The report said that after the helicopter was landed, maintenance personnel sprayed contact cleaner on the droop-compensator amplifier and bias-motor cannon plugs. A post-maintenance check indicated normal engine operation.				
March 26, 1995	Arizona[1]	MBB BK 117B-2	none	4 uninjured
While hovering the helicopter for takeoff, the pilot was unable to match the engine-torque indications. After the helicopter was landed, the airflow modulator was replaced.				
March 29, 1995	Intracoastal City, Louisiana	Sikorsky S-76	minor	2 uninjured
After hearing a loud bang and feeling vibration, the pilots landed the helicopter on a beach. One-third of the ridge cap trailing edge was not on the helicopter.				
March 30, 1995	Gulf of Mexico	Bell 412	none	12 uninjured
The helicopter was being taxied for takeoff when the anti-torque pedals failed. The report said that the yaw-channel-control transducer was sticking. The transducer was cleaned and lubricated.				
March 30, 1995	Gulf of Mexico	Bell 412	none	12 uninjured
The right anti-torque pedal began moving fore and aft. The pilot flew the helicopter back to base, and the anti-torque-rotor servo was replaced.				
April 1, 1995	Intracoastal City, Louisiana	Bolkow BO 105C	none	1 uninjured
The pilot was unable to maintain main-rotor speed. He flew the helicopter back to base and conducted a running landing without further incident. The report said that fuel contamination caused the incident.				
April 2, 1995	Intracoastal City, Louisiana	Bolkow BO 105C	none	5 uninjured
The pilot could not maintain engine speed and main-rotor speed in the normal operating ranges, so he flew the helicopter back to base and landed without further incident. Maintenance personnel replaced the governor and fuel control on the no. 1 engine. Further investigation revealed that fuel contamination caused the incident.				
April 4, 1995	Intracoastal City, Louisiana	Bolkow BO 105C	none	5 uninjured
When the pilot increased power to terminate the approach, no. 2 engine torque stagnated at 55 percent, no. 1 engine torque decreased to 55 percent and rotor speed decreased to below the normal operating range. The pilot landed the helicopter safely. The report said that fuel contamination caused the incident.				
April 10, 1995	Lakefront, Louisiana	Bell 206L-1	none	4 uninjured
While en route, the oil-transmission warning light illuminated. The pilot landed the helicopter without further incident.				
April 10, 1995	Gulf of Mexico	Bell 412ST	none	16 uninjured
The oil-cooler blower-motor warning light illuminated. The pilot selected an alternate system and landed the helicopter safely.				
April 12, 1995	Louisiana[1]	Sikorsky S-76A	none	6 uninjured
The no. 1 servo warning light illuminated during landing. The pilot rejected the landing and reset the servo circuit breaker. The warning light extinguished.				
May 2, 1995	Venice, Louisiana	Bell 206L-3	destroyed	1 fatal, 2 serious
During final approach to an offshore platform, the helicopter was flown into the exhaust of a flare boom that was burning excess gas. When the pilot attempted to increase power to reduce the rate of descent and bring the helicopter to a hover for landing, the engine did not respond. The helicopter settled, struck the edge of the platform and descended inverted into the water. The pilot and front-seat passenger exited the helicopter and were picked up by the occupants of a boat. The rear-seat passenger did not get out of the helicopter and drowned.				

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
May 3, 1995	Sea Bright, New Jersey	Eurocopter AS 350D	substantial	2 uninjured
The helicopter was at 1,000 feet when a power loss occurred. The pilot conducted an autorotation and deployed the floats. During the flare, the tail rotor struck the water and separated from the tail boom. An engine teardown revealed that the inner race of the position 19 bearing, which supported the high-speed gearshaft, had failed from fatigue. With the gears disengaged, there was no drive to the fuel pump, rendering it incapable of delivering fuel to the fuel control.				
May 4, 1995	Sabine, Texas	Bell 412	minor	2 uninjured
The helicopter was being flown to an offshore platform when the pilot heard a muffled pop and felt a vibration. The pilot flew the helicopter back to base. Inspection revealed that the stainless-steel vent fitting on the no. 2 engine-exhaust ejector had become loose, causing damage to the main-rotor blades and the tail-rotor blades.				
May 9, 1995	Sabine, Texas	Bell 412	minor	11 uninjured
Fuel began to leak into the door. The pilot flew the helicopter to the departure site and conducted an uneventful landing.				
May 9, 1995	Phoenix, Arizona	MBB BK 117B-1	minor	3 uninjured
The pilot's sliding window separated in flight and struck the fuselage.				
May 10, 1995	Gulf of Mexico	Bolkow BO 105C	none	4 uninjured
The pilot observed a split in the engine-torque indications and a decrease in rotor speed. The pilot landed the aircraft on an offshore platform. A hole was found in the bottom right transfer tube.				
May 13, 1995	Intracoastal City, Louisiana	Bell 206L-3	none	3 uninjured
A loud pop was heard during flight. The helicopter yawed, and there was a fluctuation in the torque indication. The pilot conducted a precautionary landing. The report said that a bleed valve was replaced.				
May 15, 1995	Intracoastal City, Louisiana	Aerospatiale AS 350B2	none	1 uninjured
The oil-pressure warning light illuminated. The pilot flew the helicopter back to the departure site. Engine torque fluctuated and decreased to zero upon landing. One quart (one liter) of oil was found in the sump; the rest of the oil had blown out through the exhaust.				
May 17, 1995	Sabine, Texas	Bell 412	none	11 uninjured
The pilot was bringing the helicopter to a hover when the torque indicators split. The pilot rejected the takeoff. The report said that the governor on the no. 2 engine was replaced.				
May 25, 1995	Gulf of Mexico	Bell 412	none	10 uninjured
No. 1 hydraulic-system pressure was low. The pilot conducted a precautionary landing on a nearby offshore platform.				
May 31, 1995	Skagway, Alaska	Aerospatiale AS 350B2	substantial	7 uninjured
The passengers and the pilot boarded the helicopter, which was parked on a glacier. After the occupants were strapped into their seats, the helicopter began sliding forward on the ice at increasing speed. The pilot said that the speed did not exceed that of a brisk walk. The helicopter turned left, struck a depression in the ice and rolled onto its left side.				
May 31, 1995	Louisiana[1]	Sikorsky S-76A	none	10 uninjured
The oil-pressure warning light illuminated. The pilots observed a low-oil-pressure indication, smelled oil, shut down the engine and landed the helicopter without further incident. A defective oil-filler cap was found.				
June 2, 1995	Gulf of Mexico	Sikorsky S-76A	none	10 uninjured
The helicopter was being flown from an offshore platform when electrical shorts occurred to the wire for the no. 1 hydraulic light and to the wire for the fire light.				
June 2, 1995	Wailua, Hawaii	Aerospatiale AS 350BA	none	7 uninjured
A loud bang from the engine was heard, and the pilot landed the helicopter on a road. The report said that a bleed valve was inoperative.				
June 7, 1995	Galveston, Texas	Bell 206L-3	minor	2 uninjured
The passengers' sliding vent window separated in flight. The helicopter was flown to an onshore base, where the window was replaced.				
June 8, 1995	Sabine, Texas	Sikorsky S-76A	none	12 uninjured
The no. 1 engine fuel-pressure warning light illuminated, and the engine surged. The pilot shut down the engine and landed the helicopter at a private airstrip. No defects were found, and the fuel controls were replaced.				
June 10, 1995	Loraine, Ohio	Sikorsky S-76	none	5 uninjured
No. 2 engine oil-pressure indication fluctuated, and the pilots landed the helicopter at an airport, where a seal on the starter-generator drive was replaced.				

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
June 11, 1995	Lihue, Hawaii	Aerospatiale AS 350B	minor	1 minor, 6 uninjured
A passenger was embarked from a wheelchair, which then rolled into the idling tail rotor. Debris struck another passenger.				
June 12, 1995	Gulf of Mexico	Bolkow BO 105S	none	4 uninjured
During a landing at an offshore platform, the no. 2 engine fuel-boost pump failed. The pilot flew the helicopter to an onshore base, where the pump was replaced.				
June 12, 1995	Gulf of Mexico	Bell 214ST	none	20 uninjured
During flight, the no. 2 engine overheated. The pilot shut down the engine, flew the helicopter to the destination and restarted the no. 2 engine for landing. The report said that the plugs and pins were cleaned.				
June 12, 1995	Gulf of Mexico	Bell 206L-3	none	2 uninjured
The helicopter was on a flight between offshore platforms when the hydraulic pump began making noises and then failed. The helicopter was landed on a platform. A flat "O" ring in the pump was found leaking.				
June 21, 1995	Des Moines, Iowa	Bell 222UT	substantial	3 uninjured
The EMS helicopter was en route at 1,700 feet in night VMC to pick up a patient when the pilot felt a yaw and observed that the no. 1 engine had failed. The pilot secured the failed engine and diverted the flight to the Des Moines airport. While on base leg to Runway 13, the left-engine fire-warning light illuminated. The pilot selected the fire-extinguishing system, and the fire-warning light extinguished. An uneventful single-engine landing was conducted. The report said that the engine-air-inlet duct had collapsed internally because of delamination.				
June 22, 1995	Louisiana[1]	Aerospatiale AS 355F1	none	6 uninjured
The helicopter yawed on takeoff, and the chip-detector light illuminated. The no. 1 engine oil-pressure gauge read zero. The pilot flew the aircraft to base, where both chip detectors were found covered with metal.				
June 26, 1995	Highland, California	Hughes 369D	substantial	1 serious, 3 minor
The helicopter was being flown in mountainous terrain with three doors removed when the pilot heard a loud noise and was not able to maintain tail-rotor control. The pilot flew the spinning helicopter over power lines and onto a ridge. The helicopter landed hard and rolled about 150 feet (46 meters). The report said that baggage belonging to a passenger had exited the cabin and struck the tail rotor.				
July 18, 1995	Paxson, Alaska	Hughes 500D	substantial	2 uninjured
The pilot was transporting a geologist in a remote area. After departing from a site at 5,000 feet, the pilot observed a decrease in main-rotor speed and engine power. The pilot turned the helicopter toward lower terrain and into the wind, then conducted an autorotative landing. The helicopter landed hard, and the tail boom was severed by the main-rotor blades. An inspection of the engine fuel-control assembly revealed the presence of acrylamide contamination in the fuel-inlet filter.				
July 23, 1995	Gulf of Mexico	Bell 206L-3	minor	1 uninjured
During a landing on an offshore platform, the tail rotor and vertical fin struck the guard-rail fencing.				
Aug. 1, 1995	Sabine, Texas	Sikorsky S-76A	none	2 uninjured
After no. 1 engine fuel pressure fluctuated and the engine surged, the pilot flew the helicopter back to the departure site, where a defective fuel-selector valve was found.				
Aug. 4, 1995	Venice, Louisiana	Bell 212	none	11 uninjured
A difference in engine-torque indications was observed during flight over the Gulf of Mexico. The crew flew the helicopter to a maintenance base, where an engine governor was found to be inoperative.				
Aug. 6, 1995	Mesa, Arizona	MBB BK 117B-2	none	4 uninjured
While landing, the pilot smelled fuel. A cracked fuel-manifold line was found.				
Aug. 11, 1995	Alaska[1]	Enstrom F-28A	minor	1 uninjured
The pilot was conducting a downwind landing when the tail veered left and struck a bank.				
Aug. 16, 1995	Houma, Louisiana	Bell 206L-3	none	3 uninjured
A hydraulic failure occurred on takeoff. The pilot conducted the emergency procedures and landed the helicopter without further incident.				
Aug. 16, 1995	Morgan City, Louisiana	Bell 412	none	11 uninjured
The governor on the no. 2 engine failed. The pilot used manual control and returned to the departure site for an uneventful landing.				

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
Aug. 21, 1995	New Orleans, Louisiana	Sikorsky S-76A	none	2 uninjured
The crew encountered a problem with the no. 1 engine and diverted the flight to New Orleans.				
Aug. 24, 1995	Phoenix, Arizona	Bolkow BO 105C	none	3 uninjured
Smoke began to enter the cabin after the pilot selected the environmental-control unit. The unit was turned off, and the cabin cleared.				
Aug. 26, 1995	Pittsford, New York	Bell 206L-1	none	3 uninjured
The chip-detector light illuminated during an EMS flight in day VMC. The pilot conducted a precautionary landing at the nearest airport, and the patient was transported by ground ambulance. The report said that the chip detector was cleaned, and no engine anomalies were discovered.				
Aug. 27, 1995	Oklahoma City, Oklahoma	Bell 206L-1	substantial	4 uninjured
After landing the EMS helicopter at a hospital-rooftop helipad, the pilot was told that the hospital's elevator was inoperative and the stairway would not accommodate the medical equipment. On takeoff, a power loss occurred because of a governor failure, and the pilot began an autorotative landing. Below the helicopter were a parking lot full of vehicles, a street and trees. The pilot flared the helicopter over the trees and lowered collective pitch and applied forward cyclic in an attempt to regain rotor speed and airspeed. The helicopter touched down in an uneven field and skidded 90 feet (28 meters) before stopping.				
Sept. 2, 1995	Gulf of Mexico	Sikorsky S-76	minor	10 uninjured
During a landing on an offshore platform, the main-landing gear collapsed.				
Sept. 2, 1995	Freeport, Texas	Bell 206B-3	minor	2 uninjured
The pilot observed a low transmission-oil-pressure indication and conducted a precautionary landing on a beach. The oil pump had failed.				
Sept. 3, 1995	Intracoastal City, Louisiana	Bell 206L-3	none	4 uninjured
The pilot heard a loud noise and felt hydraulic-control boost begin to decrease. By the time the helicopter was landed, control boost was zero. An investigation revealed a failure of a hydraulic hose.				
Sept. 7, 1995	Venice, Louisiana	Bell 206L-3	none	5 uninjured
A hydraulic failure occurred during a flight from an offshore platform. The pilot conducted a landing without further incident at the company's maintenance base.				
Sept. 18, 1995	Lafayette, Louisiana	Bolkow BO 105C	none	2 uninjured
The report said that a "cyclic hardover" occurred during a training flight. On approach to the airport, the helicopter abruptly and violently pitched nose-down. The pilots pulled aft on the cyclic control to level the helicopter and landed without further incident. The no. 1 hydraulic pack had failed.				
Oct. 3, 1995	Sabine, Texas	Bell 206B	none	4 uninjured
The helicopter was being flown from an offshore platform when compressor stalls occurred and an engine-chip light illuminated. The pilot landed the helicopter on a beach. The report said that the no. 1 engine bearing had failed.				
Oct. 11, 1995	Hana, Hawaii	Hughes 369HS	substantial	4 minor, 1 uninjured
During departure, the pilot felt an airframe vibration and observed a fuel-filter caution light and an engine-power warning light. A power loss occurred, and the pilot conducted an autorotative landing. The helicopter landed hard, and the main rotor severed the tail boom. An investigation revealed that there was a leak in the fuel-filter bypass switch that permitted air to enter the suction-fed engine fuel system.				
Oct. 29, 1995	Tampa, Florida	MBB BO 105A	minor	2 uninjured
The EMS helicopter was on approach to landing at a hospital helipad in night VMC when the pilot smelled fuel. Post-flight investigation revealed that a fuel-tank-supply-hose clamp had failed.				
Oct. 30, 1995	Gulf of Mexico	Bell 214	none	19 uninjured
The flight crew heard a "swooshing" noise and felt a severe vibration. The pilot flew the helicopter to an offshore platform and landed without further incident.				
Nov. 1, 1995	Venice, Louisiana	Bell 214	none	19 uninjured
The helicopter was in cruise flight when a loss of pressure in the no. 2 hydraulic system occurred. The pilot returned to Venice and landed the helicopter without further incident. Subsequent investigation revealed that a high-pressure hydraulic hose had ruptured.				
Nov. 7, 1995	Houma, Louisiana	Sikorsky S-76A	minor	10 uninjured
The pilot felt a strong vibration and conducted a precautionary landing in a marsh. Maintenance personnel found that a tip weight had separated from a tail-rotor blade.				

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
Nov. 26, 1995	Morgan City, Louisiana	Bell 206L-1	minor	2 uninjured
The pilot was conducting a takeoff when he heard a loud grinding noise and a squeal emanating from the engine. The pilot conducted a precautionary landing. Examination of the engine showed that a turbine wheel had seized and that there was a large quantity of metallic contamination on the magnetic chip plugs.				
Dec. 7, 1995	Carlsbad, Texas	Aerospatiale AS 365	minor	3 uninjured
The EMS helicopter was being landed at an accident site when the tail rotor struck a mesquite tree.				
Dec. 14, 1995	Bennet, Nebraska	MBB BK 117A-4	none	5 uninjured
The pilot conducted a precautionary landing on a gravel road because of a low-fuel indication. An investigation revealed that the primary fuel-quantity indicator was malfunctioning; the indicator was replaced.				
Dec. 26, 1995	Morgan City, Louisiana	Bell 214	minor	20 uninjured
The emergency floats inadvertently inflated during cruise flight, and the helicopter pitched nose-down. The crew conducted the emergency checklist and conducted a precautionary landing on an offshore platform.				
Dec. 28, 1995	Chicago, Illinois	Aerospatiale AS 365N-2	none	4 uninjured
The no. 2 engine-speed indication fluctuated. The pilot declared an emergency and conducted a precautionary landing.				
Feb. 10, 1996	Gulf of Mexico	MBB BO 105	destroyed	2 fatal
The helicopter was reported missing on a flight from an offshore platform to another offshore platform 44 nautical miles (82 kilometers) northwest. The helicopter was found 18 days later when the wreckage became entangled in the net of a shrimp boat six nautical miles (11 kilometers) south of the destination. The helicopter had struck the water at high speed, in a near-level pitch attitude and slightly right-skid-down. Weather conditions at the time of the accident included intermittent sky obscuration by fog.				
Feb. 19, 1996	Surprise, Arizona	Bolkow BO 105C	minor	3 uninjured
The pilot was attempting to land the helicopter to board an accident victim when the tail rotor struck a wire. The pilot had been told by a police officer on the ground that there were no wires.				
Feb. 24, 1996	Volcano Village, Hawaii	Aerospatiale AS 350BA	none	1 minor, 5 uninjured
The engine oil-pressure warning light illuminated during flight. The pilot conducted a precautionary landing. Smoke was observed emanating from the engine after shutdown. One passenger received a minor ankle injury exiting the aircraft.				
March 10, 1996	Colorado[1]	Bell 206B	minor	2 uninjured
During a search mission, the helicopter struck a power line, causing minor damage to the main rotor. The pilot flew the helicopter to the main base, where it was repaired.				
March 25, 1996	Springtown, Texas	Bell 222U	minor	3 uninjured
The pilot was attempting to land the helicopter on a highway for an EMS operation in day VMC when the main-rotor blades struck a power line.				
March 26, 1996	Reno, Nevada	MDD MD-900	none	4 uninjured
The pilot conducted an emergency running landing on gravel because of an over-temperature condition that had required shutdown of the no. 2 engine. The cause of the engine problem was a faulty wiring harness.				
April 11, 1996	Kahului, Hawaii	Hughes 369D	minor	5 uninjured
After the second landing of the day, the pilot moved the throttle control to ground idle in preparation to disembark the passengers. The helicopter vibrated and rolled left, and the tail rotor struck the ground. The left-rear landing gear had failed.				
April 27, 1996	Olean, New York	Bolkow BO 105	minor	4 uninjured
While en route to Buffalo, New York, the helicopter struck a bird, which damaged the left-front windshield. A precautionary landing was conducted at the Olean airport.				
May 14, 1996	Oklahoma City, Oklahoma	Bell 206L-1	none	1 uninjured
The pilot conducted two precautionary landings after the transmission-chip light illuminated. The report said that no foreign material was found on the chip-detector plug.				
May 29, 1996	Lafayette, Louisiana	Bell 412	minor	12 uninjured
When the helicopter was landed and the throttle control was moved to ground idle, the aft cross tube broke and the aircraft rolled over.				

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
June 3, 1996	Houma, Louisiana	Bolkow BO 105C	none	1 uninjured

The pilot began a normal takeoff from a hover. An uncommanded downward movement of the collective control occurred, and the helicopter struck the ground. After the accident, the collective control operated normally.

June 21, 1996	Cleveland, Ohio	Sikorsky S-76A	none	3 uninjured

The no. 2 engine failed, and the pilot diverted the flight to the nearest airport and landed the helicopter. The starter-generator-drive seal was found leaking.

June 21, 1996	Sabine Pass, Texas	MBB BO 105	destroyed	4 fatal

The helicopter took off from Sabine Pass to fly to an offshore platform 90 nautical miles (167 kilometers) south. The pilot told company dispatch that he had departed at 0711 local time with 2.5 hours of fuel. The pilot made a routine position report at 0744, saying that the helicopter was 38 nautical miles (70 kilometers) from the destination. No further radio transmissions were received from the pilot. The report said that the helicopter struck the Gulf of Mexico vertically and at a high rate of descent. Inspection of the main transmission revealed that the sun gear had failed, causing loss of drive to the main-rotor system.

June 24, 1996	Gulf of Mexico	Bell 412	minor	1 uninjured

While landing the helicopter on an offshore platform, the pilot heard a loud crack upon lowering the collective control. The cross tube had broken.

June 27, 1996	Gulf of Mexico	Bell 412	none	1 uninjured

A power loss occurred during departure from an offshore platform. The pilot flew the helicopter to an onshore base, where internal engine damage was found.

July 22, 1996	Sabine Pass, Texas	Bell 206L-1	none	1 uninjured

While cruising at 1,500 feet AGL, the pilot heard a growling noise and felt the controls stiffen. The pilot landed the helicopter at the first available landing site. Maintenance personnel found a pinhole in a hydraulic line.

July 24, 1996	Warren, Idaho	Bell 206B	destroyed	1 fatal, 2 minor

The helicopter was landed at a remote site in mountainous terrain to board two timber cutters. The timber cutters had constructed a landing platform by felling a tree, slicing it in two and placing the two sections about seven feet (two meters) apart on sloping terrain. After examining the landing site, the pilot landed the helicopter on the makeshift platform. The timber cutters loaded their equipment and boarded while the helicopter was standing with the rotors turning. The pilot said that the forward section of the platform began to move, and the helicopter pitched nose-down. A main-rotor blade struck terrain, and the helicopter rolled over onto its right side. The report said that the timber cutters had received no formal training on helipad construction.

July 28, 1996	Oceanside, California	Bell 222U	minor	3 uninjured

The main-rotor blades struck the upper deflector of the helicopter's wire-strike-protection system.

July 31, 1996	Houma, Louisiana	Sikorsky S-76A	minor	2 uninjured

While the pilot was taxiing the helicopter for takeoff, the left-main landing gear rolled off the taxiway and was damaged.

Aug. 4, 1996	Healy, Alaska	MDD MD-369D	substantial	4 minor, 5 uninjured

The helicopter was being flown in an easterly direction at about 400 feet. The pilot said that he was looking down for potential landing sites and that when he looked up, he saw an airplane traveling head-on to the helicopter. The airplane and the helicopter collided, severing the helicopter's tail-rotor-drive shaft. The helicopter began to spin. The pilot conducted a partially controlled landing in brushy terrain. The pilot of the airplane, a Cessna 185, continued the flight to the destination and conducted an uneventful landing; the airplane's lower fuselage had been damaged and the tail wheel had broken off during the collision. The helicopter pilot told investigators that his forward vision had been partially restricted by sun glare.

Aug. 21, 1996	Lafayette, Louisiana	Bell 206L-1	minor	1 uninjured

The helicopter's main-rotor blades struck tree branches during takeoff from a heliport.

Aug. 29, 1996	New York, New York	Bell 206L	minor	1 uninjured

A ground crewman untied the main-rotor blade and turned the blade 90 degrees. When he released the blade, the opposite blade lowered and struck the main rotor of another helicopter parked with its engine running.

Sept. 1, 1996	Sabine Pass, Texas	Bell 206B	none	1 uninjured

Approximately 15 minutes into the flight, the pilot observed an indication of a substantial loss of fuel. The pilot landed the helicopter and found fuel flowing from the fuel-filter drain. Maintenance personnel found that the drain valve was open.

Sept. 8, 1996	Grand Canyon, Arizona	Bell 206L-1	none	7 uninjured

The pilot heard a loud bang, and the collective control moved almost fully down. The pilot conducted a shallow approach to an open area and landed the helicopter. The report said that a retaining nut was loose.

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
Sept. 13, 1996	Cantwell, Alaska	Bell 206B	substantial	1 serious, 1 minor, 1 uninjured

Weather conditions along the intended route of flight over mountains included low ceilings, snow and fog. The area forecast included an advisory for marginal VFR conditions and temporary IFR conditions. The pilot received several weather briefings and decided to fly through a small mountain pass. During the flight through the pass, he encountered whiteout conditions and began a turn to reverse course. The pilot became disoriented, and the helicopter struck snow-covered terrain at an elevation of about 5,300 feet.

Sept. 13, 1996	Morgan City, Louisiana	Bell 206L-1	substantial	1 minor, 5 uninjured

About five minutes into a flight to an offshore platform, the pilot heard loud continuous chattering and felt a violent vibration. During the emergency landing, the vibration ceased and the helicopter began turning right. The pilot began an autorotation and deployed the floats. The helicopter touched down on the water in a level attitude and came to rest on its side. One tail-rotor blade was found sheared from the leading edge to the trailing edge at the outboard end. X-ray analysis revealed that the blade had been struck by an unidentified object.

Sept. 16, 1996	Lafayette, Louisiana	Bolkow BO 105A	minor	1 uninjured

The tail wind was 15 knots when the pilot attempted to ground-run the engines for a compressor wash. The helicopter became airborne and then landed hard, causing stress wrinkles on the tail boom.

Oct. 5, 1996	Gulf of Mexico	Bell 412	none	2 uninjured

The pilot observed a difference in engine torque indications and the no. 2 engine chip light. The pilot landed the helicopter on the nearest oil platform.

Oct. 6, 1996	Venice, Louisiana	Bolkow BO 105C	none	1 uninjured

After the no. 2 engine chip light illuminated for the third time, oil pressure dropped into the yellow range of the indicator, and the pilot shut down the engine. Maintenance personnel found metal on the plugs and replaced the engine.

Oct. 6, 1996	Lafayette, Louisiana	Bolkow BO 105S	none	1 uninjured

The pilot felt a slight vibration in the anti-torque pedals and diverted the flight to a nearby airport. Maintenance personnel found a failed bearing in the tail-rotor pitch-change link.

Oct. 14, 1996	Venice, Louisiana	Bell 206L-3	substantial	4 uninjured

During takeoff, the pilot heard a loud pop and felt the helicopter vibrate. During the emergency landing, a main-rotor blade flexed down and severed the tail boom. An examination by the operator revealed that frogs had been ingested into the engine.

Oct. 20, 1996	Rockwall, Texas	Bell 222U	minor	4 uninjured

An unauthorized vehicle struck the tail stinger while the pilot was preparing to take off for an EMS flight in day VMC.

Nov. 12, 1996	Hana, Hawaii	MDD MD-369D	substantial	5 uninjured

During flight, the pilot heard a loud noise from the engine compartment and the engine-out warning horn, accompanied by the engine-out warning light. He conducted an autorotative landing on mountainous terrain; the helicopter rolled over during touchdown. Disassembly of the engine revealed that the forward splines of the spur-adapter gearshaft, which connects the compressor and turbine module shafts, had fractured and the compressor module had disconnected from the turbine section.

Nov. 13, 1996	Rock Rapids, Iowa	Bell 222U	minor	5 uninjured

The EMS helicopter was en route at 2,500 feet in night VMC when the no. 1 engine flamed out. The no. 2 engine would not produce sufficient power to continue flight, so an autorotative landing was conducted on a farm field.

Nov. 22, 1996	Tampa, Florida	MBB BO 105A	minor	3 uninjured

During a hover takeoff, the no. 2 engine failed and parts from the engine separated from the helicopter. The pilot landed the helicopter safely. The first-stage turbine wheel had failed.

Nov. 28, 1996	Gulf of Mexico	Eurocopter AS 350B2	destroyed	3 fatal

The helicopter departed from an offshore platform at 1504 to fly to another offshore platform. At 1526, the pilot radioed that the tail-rotor gearbox chip light had illuminated and that he felt a vibration which lessened at slower airspeed; he said that he was diverting the flight to another platform three nautical miles (six kilometers) away. At 1531, the pilot radioed that during his first attempt to land on the platform, he was not able to control the tail rotor; he said that he would attempt another landing and, if unable to land on the platform, would divert to Galveston, Texas. No further radio transmissions were received from the pilot. The wreckage of the helicopter was found in the water near the platform. Examination of the tail-rotor system revealed that one pitch-change link had disconnected.

Dec. 5, 1996	Gulf of Mexico	Bell 206B-3	none	2 uninjured

A passenger was trying to close the left rear window during flight when the window separated and struck the tail rotor. No maintenance defects were found.

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
Dec. 9, 1996	Gulf of Mexico	Aerospatiale AS 350	substantial	2 uninjured

The pilot hovered the helicopter about three feet above the helipad on an offshore platform and began a pedal turn to keep the tail rotor clear of a stairwell and to position the helicopter into the wind for landing. Wind velocity was 10 knots, gusting to 18 knots. During the turn, the tail rotor struck a crane and one tail-rotor blade separated. The helicopter rotated more than 90 degrees as the pilot conducted an autorotative landing on the helipad.

Dec. 12, 1996	Penn Yan, New York	MBB BO 105CBS	destroyed	3 fatal

The pilot landed the helicopter in an open field to board a medical patient and to fly the patient to a hospital about 40 nautical miles (74 kilometers) northwest. About two minutes after takeoff, while the pilot was obtaining time and distance information from the global positioning system (GPS) receiver for a report to the company dispatcher, the helicopter struck rising terrain about one nautical mile (two kilometers) northwest of the departure site. Witnesses described a dark night with no discernible horizon. Winds were reported as strong and gusty from the south-southeast.

Jan. 31, 1997	Gulf of Mexico	Bell 206L-1	minor	3 uninjured

A loss of tail-rotor effectiveness occurred while the helicopter was being maneuvered at low altitude for aerial photography. Emergency procedures were initiated, and a safe landing was conducted on the water.

Feb. 5, 1997	Texas[1]	Bell 214ST	none	1 uninjured

During flight, a window pane separated from the left side of the cabin. The window frame remained attached to the window assembly.

Feb. 6, 1997	Gulf of Mexico	Bell 206B	minor	1 uninjured

The pilot was checking the power plant before takeoff from an offshore platform when the main-rotor blades struck a parked, unmanned helicopter.

Feb. 17, 1997	Pennsylvania[1]	Bell 206L-1	minor	3 uninjured

The pilot conducted an emergency landing in a river after the tail rotor failed as a result of a wire strike.

Feb. 20, 1997	Medina, Ohio	Sikorsky S-76A	none	2 uninjured

During cruise flight in day VMC, the no. 2 engine-oil-pressure indication began to fluctuate. When the pilot reduced power to flight idle, oil pressure decreased. The pilot shut down the engine and conducted a safe landing at a nearby airport.

Feb. 21, 1997	Milolii, Hawaii	Hughes 369D	substantial	3 serious, 1 minor

Soon after departure, the pilot heard a loud bang and felt a slight shudder in the anti-torque pedals. A passenger observed debris fly past the left side of the helicopter. The tail rotor did not respond to control inputs. The pilot conducted an autorotative landing on rough terrain. The report said that the tail-rotor assembly had separated from the helicopter.

Feb. 24, 1997	Mountain Spring, Nevada	Bell 206B	destroyed	1 serious, 2 minor

The pilot encountered turbulent wind conditions on short-final approach to a mountain helipad. He rejected the first two approaches and attempted a third approach, during which he began a turn downslope to avoid the upsloping terrain. During the turn, the helicopter struck vegetation and then the ground.

March 2, 1997	Houma, Louisiana	Bell 412	none	8 uninjured

Five minutes after departure, the helicopter began to vibrate. The pilot conducted a landing without further incident.

March 4, 1997	Jamaica Beach, Texas	Bell 206L-1	destroyed	1 minor, 4 uninjured

During flight about three nautical miles (six kilometers) from shore, the pilot encountered low ceilings and low visibilities. He reduced airspeed and descended the helicopter to about 50 feet above the water. He began a right turn to reverse course and further decreased airspeed. During the turn, the aircraft began to vibrate. The pilot applied collective control and forward-left cyclic to level the helicopter. The vibrations increased, and the helicopter began an uncommanded right turn. The pilot followed the turn with cyclic control and allowed the helicopter to descend. He reduced power, and the spin stopped. Before the pilot could inflate the floats, the helicopter struck the water, rolled onto its right side and sank. The occupants floated in a raft in dense fog for about 3.5 hours before the raft was washed ashore.

April 6, 1997	Houma, Louisiana	Bolkow BO 105A	none	1 uninjured

The exhaust stack separated from the helicopter during takeoff. Maintenance personnel found the exhaust clamp broken.

April 8, 1997	Gulf of Mexico	Bell 206L-1	substantial	2 minor

The pilot was not able to maintain tail-rotor control during takeoff from an offshore platform. The helicopter struck the water and sank.

May 9, 1997	Reno, Nevada	MDD MD-900	minor	3 uninjured

During an approach to a medical-center heliport, the pilot observed that the helicopter was hovering in a nose-low attitude. The pilot landed the helicopter without incident. An inspection revealed that the adjustable collective-drive-link assembly had failed. Subsequently, a service bulletin and an airworthiness directive were issued.

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
June 12, 1997	Weston, Colorado	Bell 206L-3	substantial	5 uninjured

The pilot began a 360-degree climbing turn to clear a ridge. During the turn, the helicopter was struck by a gust of wind from the rear, settled into trees and rolled over.

June 24, 1997	Fresh Water City, Louisiana	Bell 206L-1	minor	1 uninjured

The pilot diverted a flight over the Gulf of Mexico because of adverse weather conditions. The tail boom oscillated when the pilot landed the helicopter on a slope. The tail boom, tail-rotor drive shaft and cowling were damaged.

July 26, 1997	Pollock Pines, California	Bell 206B	substantial	1 serious, 4 uninjured

After landing the helicopter at a private helipad, the pilot reduced power to ground idle and told his passenger that it was safe to exit. Another passenger, waiting to board the helicopter, walked toward the helicopter from the rear. The passenger became distracted by blowing dust and walked into the rotating tail-rotor blades.

Aug. 19, 1997	Florence, South Carolina	MBB BK 117A-3	minor	1 uninjured

The helicopter struck a bird during cruise flight in day VMC. The bird went through the windshield and shattered the aft greenhouse.

Aug. 20, 1997	Dillingham, Alaska	Bell 206B	destroyed	1 fatal, 1 serious, 2 minor

The helicopter departed from a mountaintop site in near-zero visibility, rain and strong winds. The pilot attempted to fly the helicopter in a hover down the mountain until clear of the clouds. The passenger seated behind the pilot had his arm out the rear window and was holding the pilot's door open as the pilot, who was not wearing a shoulder harness, leaned out of the helicopter to look down. The front-seat passenger had disconnected his shoulder harness prior to departure so that he could wipe condensation off the inside of the pilot's windshield. The helicopter did not have a functioning windshield-defogging system; it had a cabin heater, which was not being used. The helicopter was airborne about five minutes before striking a ridge. The pilot was killed, and the front-seat passenger was seriously injured. The report said that the takeoff site was equipped with a survival shelter, heater, stove and sleeping bags.

Aug. 26, 1997	Hawley, Minnesota	Bell 222U	minor	2 uninjured

The EMS helicopter struck a wire while on approach to the site of an automobile accident. A medical crewmember had observed the wire and had shouted "wire." The pilot conducted a go-around and flew the helicopter back to the hospital helipad.

Aug. 31, 1997	Alaska[1]	Bell 206L-1	none	3 uninjured

The engine-torque indication began to fluctuate from zero to 70 percent, and oil pressure dropped from 115 pounds per square inch (psi) to 30 psi. The pilot conducted a precautionary landing, during which a large volume of white smoke was observed coming from the exhaust. An emergency shutdown of the engine was conducted. An examination of the engine showed that a turbine-bearing sump was clogged with caked oil.

Sept. 12, 1997	Boise, Idaho	Bell 206B	minor	4 uninjured

During an aerial survey of flood damage, the toe of the left-landing-gear skid slid under a power line. The pilot slowly backed the helicopter away from the wire and conducted a precautionary landing.

Sept. 12, 1997	Brinkley, Arkansas	MDD MD-369HS	substantial	4 uninjured

The pilot was transporting a television crew to several high-school football games. He had removed the left-rear door to facilitate aerial photography. During cruise at approximately 500 feet AGL, the pilot heard a loud bang, and the helicopter yawed right. The pilot said that the anti-torque system did not respond to control inputs. He conducted a running landing. The helicopter struck two levees, and the right landing skid separated. An examination revealed that the tail-rotor drive shaft had separated. One of the tail-rotor blades had seven small indentations near the tip.

Sept. 15, 1997	Salt Lake City, Utah	Bell 206L-3	minor	4 uninjured

The helicopter was lifting off from a helipad in a right turn when the tail rotor struck a parked ambulance. The pilot landed the helicopter on the helipad without further incident.

Sept. 18, 1997	Fourchon, Louisiana	Bell 407	substantial	4 minor, 1 uninjured

The helicopter departed from a platform in the Gulf of Mexico for a flight to a helicopter base in Venice, Louisiana. Approximately eight minutes into the flight, at 800 feet, the pilot felt a violent motion and heard a loud bang and a grinding sound. The helicopter turned right and pitched nose-down. The pilot conducted an emergency water landing. Examination of the helicopter revealed that the tail boom had been severed aft of the horizontal stabilizer. The tail-rotor drive shaft and the tail-rotor-shaft cowling also had been severed.

Sept. 27, 1997	Morgan City, Louisiana	Bell 412	none	9 uninjured

Twenty minutes into the flight, the no. 1 engine flamed out. The pilot conducted a single-engine landing. An inspection revealed internal spline failure of the pump and coupling drive.

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
Oct. 6, 1997	Gulf of Mexico	Bolkow BO 105C	none	4 uninjured

During cruise flight, the no. 2 engine fire-warning light illuminated. As the pilot approached an offshore platform, the engine began to malfunction. The pilot deployed the floats and landed the helicopter on the water.

Oct. 12, 1997	Sago, West Virginia	Bell 206B	destroyed	4 fatal

The helicopter was being used to transport passengers to a remote site when it descended in a level attitude and struck trees. Examination of the engine revealed an uncommanded shutdown. During bench testing, the power-turbine governor failed to limit fuel flow. The report said that improper overhaul of the turbine governor by the manufacturer resulted in the loss of power.

Nov. 1, 1997	Gulf of Mexico	Bell 206L-3	minor	2 uninjured

While in level flight, the pilot heard a loud bang from the rear of the aircraft. The pilot verified that the engine had shut down and conducted an autorotative landing on water. Inspection of the engine showed that the first-stage-turbine wheel had burst and that the debris had been contained by the containment-ring assembly.

Nov. 5, 1997	Fourchon, Louisiana	Bell 214	minor	18 uninjured

While in cruise flight, the copilot's window separated. The crew decreased airspeed and altitude, and continued the flight without further incident.

Nov. 13, 1997	Anchorage, Alaska	Aerospatiale AS 350B1	minor	2 uninjured

During final approach, the main-rotor blades struck a tree.

Dec. 6, 1997	Gulf of Mexico	Bell 206L-1	substantial	3 uninjured

The helicopter was being landed on an offshore platform when the vertical fin struck the platform, causing extensive damage requiring replacement of the tail boom.

Dec. 14, 1997	Littleton, Colorado	Bell 407	destroyed	4 fatal

After taking off in night VMC from an automobile-accident site with a patient aboard, the pilot was conducting a climbing right turn when the EMS helicopter struck unmarked power lines. The helicopter then struck the ground in an inverted attitude. The report said that the power lines were not depicted on navigational charts. Company landing-zone departure procedures were to climb straight ahead in a near-vertical climb to a minimum of 300 feet AGL before turning.

Jan. 11, 1998	Sandy, Utah	Bell 222UT	destroyed	4 fatal

The EMS helicopter was dispatched in night IMC to transport a skier injured in an avalanche. Snow was not falling when the helicopter departed from the hospital, but there were gusty winds and light-to-moderate snow when the helicopter arrived at the landing zone. The dispatcher telephoned the pilot to tell him that weather conditions at the hospital had deteriorated because of a fast-moving front. She said that it was "snowing really hard," the winds were gusting to 37 knots and visibility was less than 300 feet (92 meters). A sheriff's deputy said that the helicopter took off from the landing zone in blizzard conditions, circled the landing zone and then turned and flew out of view. Seconds later, the sheriff's deputy heard a muffled boom. He said that the weather conditions had deteriorated and that snow was falling heavily. The wreckage was found on mountainous terrain.

Jan. 19, 1998	Sabine Pass, Texas	Bell 206L-1	minor	3 uninjured

Seven minutes after takeoff, the engine-chip light illuminated. The pilot heard a loud engine noise, felt the helicopter yaw and turned the helicopter toward shore. The pilot conducted an emergency landing in a marsh. The report said that the engine had failed catastrophically.

Jan. 30, 1998	Gulf of Mexico	Sikorsky S-76A	minor	14 uninjured

The left-main landing gear struck a safety fence while the helicopter was being landed on an offshore platform. The landing gear collapsed, causing minor damage to the lower fuselage.

Jan. 30, 1998	Gulf of Mexico	Bell 206L-1	minor	5 uninjured

While landing on an offshore platform, the pilot was not able to maintain directional control but conducted a successful autorotative landing. Inspection revealed that the tail-rotor drive shaft had failed.

Feb. 5, 1998	Gulf of Mexico	Bell 206B	minor	3 uninjured

The no. 7 bearing in the turbine failed because of oil starvation.

Feb. 16, 1998	Galveston, Texas	Bell 206B	none	1 uninjured

A partial loss of engine power occurred about two minutes after takeoff from an offshore platform. The pilot could not maintain flight and landed the helicopter in the water after inflating the floats.

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
April 17, 1998	Cameron, Louisiana	Bell 206B	substantial	5 uninjured
The engine malfunctioned during final approach, and the helicopter landed hard. The main-rotor blades flexed and severed the tail boom. Examinations of the engine and fuel system revealed no anomalies.				
April 20, 1998	Los Angeles, California	Bell 206L-1	substantial	2 uninjured
A power loss occurred during an approach to a rooftop helipad. During the subsequent hard landing, the tail boom was severed. Examination of the engine revealed a fractured first-stage-turbine wheel. The report said that both turbine wheels showed signs of operation at temperatures in excess of 2,000 degrees Fahrenheit (1,093 degrees Celsius).				
April 24, 1998	Patterson, Louisiana	Sikorsky S-76A	minor	3 uninjured
The pilots reported that the rotor brake was dragging.				
April 25, 1998	Wellsboro, Pennsylvania	Aerospatiale SA 365N	minor	3 uninjured
The belly panel separated from the EMS helicopter in flight. The panel was not found.				
April 29, 1998	Sabine, Texas	Bell 412	none	2 uninjured
While in cruise flight, the pilot observed a reduction in oil quantity and conducted a precautionary landing. An inspection revealed an internal oil-seal failure.				
May 10, 1998	Jackson, Ohio	MBB BK 117A-1	minor	4 uninjured
During a night flight in IMC, the left-side engine cover came loose, struck the main-rotor blades and separated from the helicopter.				
May 13, 1998	Gulf of Mexico	Bell 407	minor	5 uninjured
When several caution lights illuminated, the pilot reduced power and checked the instruments and gauges. The full-authority digital engine control (FADEC) system had failed. The pilot conducted a precautionary landing on the water. An investigation revealed that a microcapacitor on the power-supply circuit board had been installed backward.				
May 20, 1998	Lanai City, Hawaii	MDD MD-520N	destroyed	1 minor, 4 uninjured
The engine-chip light illuminated; about 10 seconds later, the engine-out warning light illuminated. As the pilot was conducting an autorotative landing, he heard a loud bang. The helicopter landed on uneven terrain, rolled onto its side and was consumed by fire. A turbine wheel was not found in the wreckage. Investigation revealed an oil-starvation failure of the no. 5 bearing and subsequent overload failure of the no. 3 bearing, followed by an uncontained overspeed failure of the power-turbine wheel.				
May 25, 1998	Indian Trail, North Carolina	Bell 206L-3	destroyed	5 fatal
The pilot was transporting passengers from the Charlotte (North Carolina) Motor Speedway to various destinations in the Charlotte area. At 0025, during the last scheduled flight of the day, the pilot radioed that he was flying the helicopter along a highway. Witnesses observed the helicopter flying low, in fog, with its lights on. Weather conditions at a nearby airport included a 300-foot overcast and 1.75 statute miles (2.82 kilometers) visibility in mist. At about 0032, the landing skids struck a power line at about 150 feet AGL; the helicopter then struck the ground.				
May 30, 1998	Juneau, Alaska	Aerospatiale AS 350B2	substantial	1 serious, 5 uninjured
The helicopter was being flown at 2,100 feet during an air-tour flight when it collided with a Cessna 172RG airplane. One of the helicopter passengers was seriously injured during the collision. The helicopter continued flying. The airplane struck water; both occupants were killed. After the helicopter was landed, an 18-inch (46-centimeter) section of the airplane's right wing was found attached to the helicopter.				
June 7, 1998	Corpus Christi, Texas	Bell 206B	substantial	4 uninjured
The tail-rotor drive shaft failed when the helicopter was on final approach. The pilot conducted an autorotative landing. Examination revealed that two of the tail-rotor drive-shaft segments were fractured and that one of the two bolts connecting the aft end of a disc coupling was missing.				
June 9, 1998	Gulf of Mexico	Aerospatiale AS 355F1	minor	1 uninjured
The helicopter developed a severe vibration during touchdown on an offshore platform. The report said that ground resonance (caused by oscillation of the main-rotor blades) might have caused the vibration.				
June 15, 1998	Gulf of Mexico	Bell 206B	none	3 uninjured
A power loss occurred during flight. The pilot conducted an autorotative landing on the water. The occupants boarded life rafts before the helicopter rolled over and sank, and were rescued by the U.S. Coast Guard. The aircraft was not recovered; the cause for the engine power loss was not determined.				
June 16, 1998	Pennsylvania[1]	MBB BK 117B-2	minor	4 uninjured
The pilot heard a loud bang, observed sparks near the main rotor and felt the helicopter vibrate during an EMS flight. The report said that the engine cowling had not been fastened properly and had separated from the helicopter.				

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
June 17, 1998	Lihue, Hawaii	Aerospatiale AS 350BA	minor	6 uninjured

The pilot did not latch the transmission cowling after his preflight inspection of the helicopter. After takeoff, the pilot was told by an airport-tower controller that the cowling was open. The pilot flew the helicopter back to the airport and landed without further incident.

June 25, 1998 Mount Waialeale, Hawaii Eurocopter AS 350BA destroyed 6 fatal

During a VFR sightseeing flight, the pilot flew the helicopter into IMC. The helicopter struck a mountain 200 feet (61 meters) below the crest.

June 29, 1998 Lake Charles, Louisiana Sikorsky S-76A none 2 uninjured

A loss of oil pressure in the no. 1 engine occurred during cruise flight. The pilot shut down the engine and conducted a precautionary landing. An investigation revealed that the gasket in the oil-cooler assembly was leaking.

June 30, 1998 Honolulu, Hawaii Bell 206B none 4 uninjured

The pilot heard a noise emanating from the main rotor and conducted a precautionary landing in an open field. Inspection of the main rotor revealed that part of the metal skin on the rotor blades was coming loose because of corrosion.

July 16, 1998 Kahului, Hawaii Aerospatiale AS 355F1 minor 7 uninjured

The helicopter was observed landing with the left-engine cowling flapping. The engine-cowling forward-latching mechanism had been torn off, and the rear-latching mechanism was broken. The main-rotor blades had been damaged by the cowling.

July 16, 1998 Ketchikan, Alaska Bell 206B minor 1 uninjured

A blade strike occurred during a landing in a confined area.

July 25, 1998 Skwentna, Alaska Enstrom F-28 substantial 2 uninjured

The pilot was conducting a salmon-survey flight that required him to hover the helicopter over a stream while the passenger, a biologist, counted fish. The pilot said that while the helicopter was in a hover above the stream, he felt a slight vibration that was followed by a partial loss of engine power. He said that while hover-taxiing the helicopter to a suitable landing area, the engine continued to lose power and he had to conduct an autorotative landing downwind. As the helicopter touched down, the main-rotor blades flexed and struck the tail boom. A fractured intake manifold flange was found on the no. 3 cylinder assembly.

July 26, 1998 Kansas City, Missouri MBB BK 117A-3 none 1 uninjured

During an EMS flight, the engine failed. The pilot declared an emergency and was told by ATC to fly the helicopter directly to the Kansas City airport. The pilot conducted a running landing without further incident. The report said that an “O” ring inside the low-side governor had failed.

Oct. 6, 1998 Hana, Hawaii Aerospatiale AS 350BA none 7 uninjured

While conducting a local sightseeing flight, the pilot observed an indication of low oil pressure. The pilot conducted an emergency landing. An inspection revealed that the loss of oil pressure had been caused by failure of the rear engine bearing.

Oct. 28, 1998 Fourchon, Louisiana Bell 206L-3 minor 5 uninjured

During cruise flight, the pilot heard a loud bang. The pilot conducted a precautionary landing at the nearest suitable location. Subsequent investigation revealed that a lifting device attached to the main-rotor system had not been removed after maintenance was performed; the lifting device had separated in flight and damaged the main-rotor blades. The report said that the pilot had failed to detect the lifting device during his preflight inspection of the helicopter.

Nov. 3, 1998 Pioche, Nevada Bell 206L-3 substantial 1 minor, 2 uninjured

The pilot was flying the helicopter at about 25 feet AGL when a loss of tail-rotor control occurred. He conducted an autorotative landing on a ridge, and the helicopter rolled onto its left side. The report said that the loss of tail-rotor control had been caused by the installation of incorrect pitch links by the maintenance facility.

Nov. 12, 1998 Gulf of Mexico Bell 407 minor 1 uninjured

While landing the helicopter on the helideck of an offshore platform, the pilot conducted a right pedal turn to move the tail rotor away from a stairwell. The tail rotor struck a heater-exhaust vent eight feet (three meters) from the edge of the helideck and five feet (two meters) above the helideck.

Nov. 29, 1998 Idaho City, Idaho MDD MD-900 substantial 4 uninjured

The EMS helicopter was dispatched in dark-night VMC to pick up a traffic-accident victim in a remote canyon. Before landing, the pilot asked ground crewmembers about wires and was told that there were none. After landing, the pilot used a flashlight to check for obstructions in the direction of takeoff. The pilot observed no obstructions except trees and then conducted a vertical takeoff because of the narrowness of the canyon. At about 150 feet, the pilot transitioned into forward flight at approximately 20 knots. The crew heard a loud noise and observed a bright white light. The helicopter had struck unmarked transmission lines. Because of risks in attempting to land again in the canyon, the pilot completed the flight and conducted a normal landing at the hospital.

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
Dec. 1, 1998	Lawtell, Louisiana	Bolkow BO 105S	none	1 uninjured

The pilot said that the cyclic control momentarily jammed while the helicopter was in a right bank during a landing approach. Maintenance personnel determined that a momentary failure of the hydraulic control pack might have caused the problem.

Jan. 26, 1999	Arizona[1]	MBB BK 117B-2	minor	3 uninjured

En route to pick up a patient, the pilot felt what he thought was turbulence followed by a sound similar to rushing air. The pilot slowed the helicopter and checked for the cause of the noise. The pilot then continued the flight to the destination and, after landing, found that the no. 2 engine cowling had separated from the helicopter, causing minor damage to the rotor blades. The report said that the pilot did not secure the engine cowling during his preflight inspection of the helicopter.

Jan. 27, 1999	Henderson, Nevada	Bell 222	minor	10 uninjured

The pilot was repositioning the helicopter for takeoff. During a ground-taxi turn, the main-rotor blades struck a hangar.

Feb. 1, 1999	Grand Canyon Park, Arizona	Aerospatiale AS 350B	substantial	7 uninjured

During an air-tour flight, the left-side bubble window separated from the helicopter and struck a tail-rotor blade. The pilot conducted a precautionary landing in a canyon without further incident. The report said that the window had been replaced 4.5 months before the incident flight because it was cracked.

Feb. 9, 1999	Avery, Idaho	Hughes 369E	minor	none[2]

During an elk survey, the pilot pitched the helicopter nose-down to increase airspeed. A power loss occurred, and the pilot conducted an emergency landing on an icy road. As the helicopter slid to a stop, the right-rear landing-gear leg broke.

Feb. 13, 1998	Hockley, Texas	Eurocopter BK 117B-1	substantial	5 uninjured

Two helicopters were dispatched in day VMC to the site of an automobile accident. During the approach, the accident pilot observed power lines parallel to the road. After the patients were boarded, the pilot of the other helicopter conducted a "safety walk-around" of the departing helicopter. He watched the helicopter lift off and drift toward the power lines; the main-rotor blades struck the power lines. The accident pilot said that during the takeoff, he had observed "trash blowing around" and "the sun shining directly into the windscreen." The pilot felt a slight shudder but no loss of control and set the helicopter back down in a field adjacent to the road.

Feb. 17, 1999	Millsburg, Pennsylvania	MBB BK 117B-1	none	2 uninjured

The EMS helicopter was cruising at 4,000 feet on an IFR flight when the pilot smelled an odor, shut off the cabin heater, declared an emergency and conducted a precautionary landing.

Feb. 28, 1999	Kahului, Hawaii	Aerospatiale AS 350BA	minor	7 uninjured

The baggage door opened in flight and damaged the right side of the helicopter.

March 17, 1999	Girdwood, Alaska	Eurocopter AS 350B2	substantial	1 uninjured

The day before the accident, the area received about six inches (15 centimeters) of light, powdery snow. Just before the accident, the pilot transported photographers to the top of a mountain; he was returning to the base of the mountain to pick up skiers. The pilot was hovering the helicopter near the landing area when he became disoriented in whiteout conditions. The helicopter drifted right, the right landing skid struck the snow, and the helicopter rolled onto its right side.

March 17, 1999	Gulf of Mexico	Eurocopter AS 350	destroyed	2 fatal, 2 serious

The pilot was conducting his third takeoff of the day from an offshore platform. He flew the helicopter to a hover at two feet. The helicopter pitched nose-down and yawed left. The pilot tried to land on the platform, but the helicopter would not respond to his control inputs. The helicopter then rolled inverted and descended into the water. Witnesses on the platform below the helideck had heard a loud metallic noise and observed falling debris and the helicopter falling inverted. The pilot and front passenger were rescued by occupants of a boat.

March 18, 1999	Covington, Kentucky	MBB BK 117B-1	none	1 uninjured

The EMS pilot said that as he began the descent, the collective control became stiff and then jammed. The pilot could not move the collective up or down. He conducted a precautionary landing in a field.

April 1, 1999	Beaumont, Texas	Aerospatiale AS 350B2	none	2 uninjured

The pilot was not able to maintain tail-rotor control. He conducted a running landing on a runway without further incident. An investigation revealed that the tail-rotor-pitch-change spider bearing apparently had seized and severed the pitch-control mechanism.

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
April 1, 1999	Fairbanks, Alaska	Robinson R-22	substantial	2 uninjured

The helicopter turned downwind at 30 feet AGL. Wind velocity was between 15 knots and 30 knots. Main-rotor speed decreased, and the pilot was unable to regain rotor speed by lowering the collective control, disengaging the engine-speed governor and increasing throttle. During the forced landing, the helicopter bounced and rolled onto its side.

April 5, 1999 Shawnee, Oklahoma Bell 206L-1 substantial 6 uninjured

The engine spooled down when the pilot attempted to set cruise power during departure from an airport. The pilot conducted an autorotative landing in a muddy field. The helicopter landed hard, and the main-rotor blades struck and severed the tail boom. The engine was tested, and the fuel-scheduling unit was found incorrectly set, causing turbine-outlet temperature to exceed the maximum limit.

April 12, 1999 Grande Isle, Louisiana Bell 206L-3 minor 3 uninjured

The report said that the pilot failed to maintain adequate rotor clearance from a parked helicopter. The helicopter was in a hover when the main-rotor blades struck a main-rotor blade on the parked helicopter.

April 30, 1999 Gulf of Mexico Bell 206B none 1 serious, 3 uninjured

As the pilot flew the helicopter toward an offshore platform, he observed a crane operating on the platform. He circled the platform until the crane operator indicated that he had visual contact with the helicopter and ceased crane operations. The pilot maneuvered the helicopter so that it approached the platform into the wind and clear of the crane. After landing, the tail rotor was above a stairwell. The pilot said that while the helicopter was still "light on the skids," he began to reposition the helicopter so that the tail rotor would not be over the stairwell. A passenger exited the cabin without receiving authorization from the pilot. The pilot immediately stopped maneuvering the helicopter. After a few seconds, he felt a "nick in the pedals." A platform worker had walked into the turning tail-rotor blades. The worker received a three-inch (eight-centimeter) laceration to his head and a fractured skull.

June 1, 1999 Glennallen, Alaska Robinson R-22 substantial 2 uninjured

During departure from atop a 4,200-foot mountain, rotor speed decreased and the low-rotor-speed warning horn sounded. The pilot said that he increased power, increased collective pitch and lowered the nose to gain airspeed, but rotor speed continued to decrease. The helicopter struck uneven terrain and rolled over. The report said that a downdraft was a factor in the accident.

June 9, 1999 Juneau, Alaska Aerospatiale AS 350BA destroyed 7 fatal

The helicopter departed for a 50-minute air-tour flight over mountainous glaciers. About 10 minutes after the accident pilot made a routine radio transmission, another pilot observed the wreckage of the helicopter on a snow-covered glacier. The report said that the pilot had continued VFR flight into adverse weather, had become spatially disoriented and had failed to maintain aircraft control; factors in the accident were pressure by the company to continue flight in marginal weather and flat lighting conducive to whiteout conditions.

June 9, 1999 Juneau, Alaska Bell 206B substantial 2 minor, 1 uninjured

The pilot landed the helicopter in a confined area on a narrow dirt road in close proximity to boulders and other obstructions. After the passengers boarded, the pilot lifted the helicopter into a hover. The left landing skid struck a boulder, and the pilot was not able to maintain control of the helicopter, which then struck terrain.

June 25, 1999 Gulf of Mexico Bell 412 minor 8 uninjured

The pilot's door separated from the helicopter during cruise flight. The pilot conducted a landing on an offshore platform without further incident. Investigation revealed failures of the door-latch-retention spring and the door-hinge pins.

July 8, 1999 Deadhorse, Alaska Bell 206B substantial 4 uninjured

After boarding a passenger at a remote biological survey site, the pilot began to start the engine. A tie-down strap was still attached to one of the main-rotor blades. As the rotor blades began to turn, the strap struck the vertical stabilizer.

July 9, 1999 Columbia, South Carolina Bell 407 minor 1 uninjured

The helicopter was being repositioned in a hover at a hospital helipad when the vertical fin struck a fire-extinguisher box.

Aug. 5, 1999 Acadiana, Louisiana Bell 407 none 6 uninjured

During departure from New Iberia, Louisiana, the FADEC warning horn sounded. The pilot reduced power to 90 percent, and the FADEC changed to manual mode. The pilot turned back toward New Iberia. About two nautical miles (four kilometers) from the airport, the engine surged and the helicopter yawed. The low-rotor-speed warning light illuminated. The pilot said that the power plant was making very strange noises, as if the engine was flaming out and relighting. The pilot conducted an autorotative landing in a cane field. Investigation revealed a faulty electronic-control unit.

Aug. 10, 1999 Gulf of Mexico MBB BO 105 substantial 4 uninjured

The pilot increased power for takeoff and was adjusting the volume of the radios when the helicopter began spinning left. The helicopter struck a parked Bell 206, which fell from the offshore platform into the water. The accident helicopter came to rest upright in the safety wire at the edge of the platform. Wind velocity was 30 knots.

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
Aug. 14, 1999	Pompey, New York	Bolkow BO 105S	minor	2 uninjured

The EMS helicopter was being maneuvered in a hospital landing zone when it struck telephone wires, damaging both tail-rotor blades.

Aug. 16, 1999	Ann Arbor, Michigan	Sikorsky S-58T	minor	2 uninjured

The pilots observed the no. 2 fuel-filter-bypass caution light flickering. They opened the crossfeed valve to feed fuel to both engines from the front tank. About five nautical miles (nine kilometers) northeast of Ann Arbor, both engines failed. The pilot-in-command conducted an autorotative landing on a grass median between highway lanes. The helicopter rolled onto and across a lane and came to rest on a berm. The report said that no fuel was found in the forward tank and several hundred pounds of fuel were found in the rear tank.

Aug. 24, 1999	Kahului, Hawaii	Aerospatiale AS 350BA	substantial	5 uninjured

For noise-abatement purposes, the pilot conducted a downwind approach to an open area at a ranch. He said that he misjudged the wind velocity and the helicopter was slower and lower than he had planned as he turned from base to final approach. The helicopter began to settle. The pilot attempted to turn the helicopter into the wind, but the helicopter continued to descend and landed hard.

Aug. 26, 1999	Gulf of Mexico	Bell 206L-3	substantial	1 serious, 1 minor

The helicopter was facing downwind when the pilot increased power to take off from an offshore platform. Wind velocity was 25 knots. The helicopter began to slide across the platform. The pilot decreased power, and the helicopter stopped momentarily, but then began to slide again. As the helicopter neared the edge of the helipad, the pilot applied full power and collective control to take off. The helicopter began to bounce, yawed right, slid over the edge of the helipad and struck the deck below.

Sept. 10, 1999	Juneau, Alaska	Eurocopter AS 350B2	destroyed	1 serious, 5 minor

Returning from an ice-field sightseeing flight, the pilot was conducting a gradual descent over a large, featureless and snow-covered field when a localized snow shower momentarily reduced his forward vision. The pilot slowed the helicopter to about 70 knots and attempted to use a mountain range on the left for visual reference. Flat light conditions contributed to his inability to recognize any topographical features. The descent continued until the helicopter struck terrain, slid about 150 feet (46 meters) and nosed over. The report said that the pilot did not have an instrument rating.

Sept. 18, 1999	Gulf of Mexico	Bell 206B	none	3 uninjured

The pilot conducted an emergency landing on water after losing power. Examination of the engine disclosed that the power-turbine fuel governor had failed.

Nov. 17, 1999	Neihart, Montana	Bell 206L-1	substantial	4 uninjured

With trees ahead during departure from a remote ski site, the pilot elected to turn left, hover to an open area and take off downslope. After the helicopter moved left about 20 feet to 30 feet (six meters to nine meters), the pilot felt the tail abruptly move left. The pilot applied left pedal, which slowed the rotation, but did not stop the rotation. He then attempted to return to the landing zone. During the maneuver, the helicopter drifted, and the tail rotor struck a ski tower. The rotation increased. The pilot reduced power to idle and utilized collective control to cushion the landing, which was hard. The report said that gusting wind conditions were a factor in the accident.

Dec. 5, 1999	Gulf of Mexico	Bell 206L-1	destroyed	1 serious

The helicopter was en route between offshore platforms when a power loss occurred. The pilot conducted an autorotative landing on the water. The helicopter landed hard but remained upright and afloat long enough for the pilot to deploy and board the emergency raft. The helicopter then rolled over and sank.

Jan. 2, 2000	Kalispell, Montana	Bell 206L-3	minor	2 uninjured

The pilot boarded the victim of a skiing accident. During departure, a main-rotor blade struck a small tree branch, resulting in minor damage to the blade-tip cap.

Jan. 6, 2000	Gulf of Mexico	Sikorsky S-76A	minor	8 uninjured

The pilot-in-command conducted a visual approach to the helideck on an offshore platform. The approach was terminated with a hover. The copilot said, “You’re over the deck.” The pilot then landed the helicopter. The crew felt the helicopter move slightly rearward and quickly settle. The left-main landing gear had penetrated the helideck safety fence.

Jan. 30, 2000	Kahului, Hawaii	Sikorsky S-61	none	27 uninjured

The pilot was not able to maintain tail-rotor control during landing. Full left pedal was applied with insufficient control to prevent a spin to the right. The aircraft was landed with no damage or injuries. The report said that the helicopter had been returned from service after an inspection without the tail rotor’s negative-force-gradient rigging, which resulted in inadequate tail-rotor thrust to sustain a controlled hover at gross weight.

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
March 10, 2000	Dalhart, Texas	Eurocopter BO 105CBS-5	destroyed	4 fatal

The helicopter was en route on a dark night from its hospital base for a 120-nautical-mile (222-kilometer) flight to another hospital to pick up a medical patient for transport back to the base hospital. The pilot landed the helicopter 15 nautical miles (28 kilometers) south of the destination hospital because of fog. The patient was transported via ambulance to the helicopter. Witnesses said that the helicopter departed with its lights on and was flown away at an altitude between 10 feet AGL and 75 feet AGL. They reported that visibility was about 0.25 statute mile (0.40 kilometer) in dense fog and that the ceiling was very low. About 0.25 inch (6.4 millimeters) of ice had formed on ground-vehicle mirrors and antennas. The report said that the helicopter struck terrain in a near-45-degree nose-low attitude.

March 18, 2000	(location unspecified)[1]	Bell 212	none	1 uninjured

During takeoff, the pilot attempted to move the collective control, but it would not move. The pilot rejected the takeoff. Maintenance personnel found that the lower rod end of the collective servo had backed out from the lower piston because of a sheared washer.

March 20, 2000	Gulf of Mexico	Bell 206B-3	destroyed	3 minor

The pilot conducted an initial approach to an offshore platform from the north, heading into the wind, which was from the south-southeast at 20 knots to 25 knots. The pilot then began a right turn to fly around the platform at 300 feet AGL to 400 feet AGL and 70 knots to 80 knots. Approximately three-quarters of the way around the platform, the helicopter began to spin right. The pilot applied left pedal, but there was no tail-rotor response. The pilot attempted to recover from the spin by lowering the nose, but the spin continued until the helicopter struck the water.

March 26, 2000	Patterson, Louisiana	Sikorsky S-76	minor	2 uninjured

Seven minutes after engine start, a fire occurred in the engine cowling. The fire was discovered and extinguished by ground personnel. Burned bird-nest remnants were found near the no. 1 engine-exhaust ejector. The heat generated by the fire had caused disintegration of the engine-plenum dividers, oil-cooler return hoses and cowling.

March 29, 2000	Manokotak, Alaska	Bell 206B	substantial	2 uninjured

The pilot boarded a radio technician at a remote radio-repeater site. After departure, the pilot flew the helicopter about 500 feet over a flat, snow-covered delta. Weather conditions included a 700-foot overcast and visibility of 1.0 statute mile to 2.0 statute miles (1.6 kilometers to 2.6 kilometers). Snow squalls were moving through the area. The pilot used a line of shrubs ahead of the helicopter for visual reference but could see nothing beyond the line of shrubs. He began a right turn to reverse course. During the turn, he was not able to maintain visual contact with the ground. He observed the attitude indicator showing that the helicopter was in a 45-degree right bank and a 10-degree nose-low attitude. He leveled the helicopter and raised the nose to begin a climb. The helicopter then struck terrain and came to rest on its right side.

April 6, 2000	Las Vegas, Nevada	Aerospatiale AS 350B2	minor	none[2]

The pilot flew the helicopter to a hover, completed a 180-degree pedal turn and accelerated between two helicopters parked on the ramp. The pilot then conducted a right turn to depart along a taxiway. During the turn, the main rotor struck the vertical fin of a parked helicopter.

April 16, 2000	Grand Canyon, Arizona	Bell 407	substantial	6 uninjured

About five minutes after takeoff, the pilot heard a grinding noise and felt the helicopter shake violently. He conducted an autorotative landing. During the landing flare, the tail rotor and tail stinger struck the ground. Examination of the engine revealed a failed bearing at the oil-cooler-fan forward hanger.

April 18, 2000	Grand Canyon, Arizona	Bell 206L-3	destroyed	6 serious, 1 minor

The helicopter was departing for a local air-tour flight when a power loss occurred. The pilot began autorotation and maneuvered the helicopter to avoid striking wires. The helicopter landed hard. The report said that the helicopter had been parked overnight in a snowstorm without engine covers and that the cause of the power loss was ingestion of snow into the engine.

April 21, 2000	Kahului, Hawaii	Eurocopter AS 350BA	substantial	6 uninjured

The pilot attempted a running landing in an open area after a loss of engine power occurred over rough terrain. The helicopter bounced on touchdown and came to a sudden stop after a skid struck a ditch. The report said that the power loss had been caused by the failure of the manufacturer to ensure proper quality control of the ignition-solenoid-housing chamfer area, which allowed for loss of fuel and loss of engine power.

April 23, 2000	Las Vegas, Nevada	Bell 206B	minor	none[2]

The report said that the pilot failed to remove an engine-exhaust plug during his preflight inspection of the helicopter because he was distracted by the refuelers. During takeoff, the engine plug detached and struck a tail-rotor blade.

May 1, 2000	Homer, Alaska	Bell 206B	substantial	3 uninjured

The pilot conducted an approach to a lake-gauging station using the station as a visual reference. The station was surrounded by snow-covered terrain. Flat light conditions existed, and light drizzle was falling. During the approach, the pilot flew past the station and had no other visual references. The landing skids struck the snow, and the pilot attempted to lift the helicopter into a hover. The helicopter began to drift forward and left. The left landing skid struck the snow, and the helicopter rolled onto its left side.

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
May 3, 2000	Circle, Alaska	Robinson R-22	minor	2 uninjured

The pilot was maneuvering the helicopter at 3,800 feet in gusty and turbulent winds on the lee side of a mountain during a caribou-tracking flight. A downdraft caused the helicopter to descend. During recovery, the helicopter struck rocks, which sheared off the landing skids. The pilot then landed the helicopter on its belly in the tundra.

May 6, 2000	Eckerman, Michigan	Bell 206B	destroyed	2 minor, 2 uninjured

After a loss of tail-rotor control occurred, the pilot attempted to land the helicopter in a field. The main rotor struck trees, and the helicopter rolled over on its right side. A fire erupted, and the helicopter was consumed by fire.

May 23, 2000	Peach Springs, Arizona	Aerospatiale AS 350BA	minor	none[2]

The pilot brought the helicopter to a hover over the intended landing site — a remote, unimproved helipad. The pilot then was making a pedal turn when the bottom of the fin assembly struck a small rock.

May 24, 2000	Patterson, Louisiana	Aerospatiale AS 350B2	substantial	2 minor

During a flight at 1,000 feet to an offshore platform in the Gulf of Mexico, the helicopter yawed left. The pilot moved the anti-torque pedals, but the tail rotor did not respond. The pilot diverted the flight to Patterson Memorial Airport and conducted three approaches to reduce the fuel load and to determine how the helicopter would respond to control movements. While turning left to downwind during the fourth go-around, the pilot had difficulty controlling the left yaw and determined that the helicopter's hydraulic system had failed. The pilot conducted a downwind autorotative landing. The helicopter landed hard, and a main-rotor blade struck the tail boom, separating the tail boom from the fuselage. The helicopter came to rest on its side.

May 31, 2000	Cocodrie, Louisiana	Bell 206B	substantial	1 serious

As the helicopter began to take off from an offshore platform, the nose pitched up. Subsequently, the helicopter fell off the platform and struck two crew boats that were tied to the platform's dock. Examination of the platform revealed that the helicopter's tail stinger had become entangled with the safety fence.

June 11, 2000	Asheboro, North Carolina	MBB BK 117B-1	minor	none[2]

After landing on a highway at the site of an automobile accident, the helicopter was struck by an automobile that was being driven north on the southbound lane. The automobile struck the bottom tip cap of the right horizontal stabilizer. The police had erected barricades to stop traffic traveling south in the southbound lane.

June 14, 2000	Gulf of Mexico	Bell 407	none	1 uninjured

While cruising at 700 feet, the pilot heard a loud grinding noise from the engine area. The pilot declared an emergency and attempted to fly the helicopter to a small offshore platform. The pilot determined, however, that he could not complete the flight to the platform; he deployed the floats and conducted an autorotative landing on the water.

June 27, 2000	Gulf of Mexico	Bell 214	minor	17 uninjured

The flight crew felt a vibration soon after takeoff from an offshore platform. They returned to the platform and landed the helicopter without incident. An inspection of the helicopter revealed that one set of tail-rotor counterweights was missing and one tail-rotor blade had significant leading-edge damage. The report said that the counterweight bellcrank mounting stud on the tail-rotor crosshead had failed at the cotter-pin hole.

July 8, 2000	Gulf of Mexico	Bell 206L-1	minor	1 uninjured

The report said that the pilot misjudged altitude during an approach to an offshore platform. The helicopter was in a nose-high attitude when the landing skids struck the platform and the tail rotor struck a solar panel.

July 12, 2000	Gulf of Mexico	Bell 206L-3	minor	none[2]

The helicopter was being flown at 2,500 feet when a position light separated from the tail cone and struck a tail-rotor blade. The pilot landed the helicopter without further incident on the nearest offshore platform.

July 21, 2000	Kahului, Hawaii	Aerospatiale AS 355F1	destroyed	7 fatal

During an air-tour flight, the helicopter struck a slope at 2,900 feet. The pilots of three other company helicopters had flown within 2.0 nautical miles (3.7 kilometers) of the accident site but had changed their tour routes to avoid the area because of inclement weather conditions.

Aug. 17, 2000	Grand Isle, Louisiana	Bell 206L-3	none	1 uninjured

After encountering limited tail-rotor control, the pilot conducted an emergency landing. Examination of the helicopter revealed that a tail-rotor pitch-change drive pin had become lodged in the pitch-control mechanism.

Appendix
U.S. Federal Aviation Regulations Part 135 Helicopter Accidents and Incidents, 1991–2000 *(continued)*

Date	Location	Helicopter Type	Damage	Injuries
Aug. 24, 2000	Hilo, Hawaii	Aerospatiale AS 350BA	none	none[2]

A hydraulic-system failure occurred during approach. The pilot conducted an emergency landing on a grass area between the runway and the control tower. An inspection revealed that the hydraulic pump had failed.

Aug. 25, 2000	Coolin, Idaho	Hughes 369E	substantial	3 uninjured

During takeoff, the helicopter stopped climbing and the pilot observed engine-failure indications. The pilot began a running landing. After touching down, the helicopter slid about 80 feet to 90 feet (24 meters to 28 meters). When the pilot used collective control to reduce groundspeed, the main-rotor blades struck and severed the tail boom. The turbine-outlet-temperature indicating system was found to be out of calibration, which had resulted in over-temperature operation of the turbine assembly.

Sept. 18, 2000	Hoover Dam, Arizona	Sikorsky/Orlando S-55	substantial	7 minor

The ex-military helicopter had undergone modifications including replacement of the reciprocating engine with a turbine engine. The pilot said that all engine indications were normal before a power loss occurred. The pilot then conducted an emergency landing. The report said that maintenance personnel had not complied with a service bulletin addressing potential failure of engine-drive gears and had ignored oil analyses that indicated impending engine failure.

Sept. 19, 2000	Ojai, California	Bell 206B-3	substantial	2 serious, 1 uninjured

The pilot was transporting personnel to several flood-control-monitoring stations. After landing on a ridge at an elevation of 5,000 feet, the pilot decided to reposition the helicopter closer to the station. He hover-taxied to another landing area. As the landing skids touched down, the pilot felt the helicopter slide right. He flew the helicopter into a hover and decided to return to the original landing site. The helicopter began to yaw right, and the pilot could not correct the yaw. The helicopter then landed hard. The report said that density altitude, which was 8,000 feet, was a factor in the accident.

Oct. 7, 2000	Mesa, Arizona	Bell 206L-1	minor	none[2]

The pilot was landing the helicopter on a city street to pick up an accident victim when a rotor blade struck a speed-limit sign.

Oct. 14, 2000	Grand Canyon, Arizona	Bell 206L-1	substantial	4 minor

The pilot landed the helicopter in a clearing surrounded by trees and terrain to pick up a person who had been seriously injured in a fall. During departure, the pilot was not able to maintain tail-rotor control when he turned the helicopter into the wind at 80 feet AGL to 100 feet AGL. The helicopter continued rotating and descended into trees.

Nov. 5, 2000	Minnesota[1]	Robinson R-44	minor	3 uninjured

During a power-line-patrol flight, the pilot rejected an approach after determining that the area was unsuitable for a landing. While conducting a turn, the pilot was not able to maintain visual contact with a tower guide wire because of sun glare. The pilot tried to bank the helicopter away from the wire, but the rotor-blade tips struck the wire. The pilot then conducted a precautionary landing.

Nov. 11, 2000	Girdwood, Alaska	Eurocopter AS 350B2	substantial	2 uninjured

The pilot was maneuvering the helicopter over snow-covered terrain along a mountain ridge during an aerial-photography flight. The end of the ridge was in shadow. While flying the helicopter in the area in shadow, the pilot began to lose depth perception and increased engine power to move away from the ridge. The left landing skid struck snow on the ridge, and the pilot felt a vibration. He landed the helicopter on lower terrain and shut down the engine. A subsequent inspection of the helicopter disclosed internal damage to the tail-rotor spars and a torsional twist in the tail-rotor drive shaft.

Nov. 14, 2000	Intracoastal City, Louisiana	Bolkow BO105S	substantial	none[2]

The helicopter was in cruise flight when the right-forward window and lower track assembly on the pilot's door separated and struck the main-rotor blades.

Dec. 26, 2000	Gulf of Mexico	Bell 206B	destroyed	1 fatal

The report said that as of April 2002, an extensive search had failed to locate the wreckage of the helicopter, which was reported missing during a flight between offshore platforms. VMC had prevailed for the night cross-country flight, and a company flight plan had been filed for the route. The report said that, except for the pilot's life vest, there was no overwater-survival equipment aboard the float-equipped helicopter.

[1]The report did not specify the accident/incident location.

[2]The report did not include details about occupant injuries

MBB = Messerschmitt-Bolkow-Blohm MDD = McDonnell Douglas

Source: Patrick R. Veillette, Ph.D., from reports by the U.S. National Transportation Safety Board and the U.S. Federal Aviation Administration

U.K. Accident Trend for 1992–2001 Passenger Operations Shows Improvement

There were no fatal accidents in large-aircraft passenger operations. The reportable-accident rate and the fatal-accident rate increased significantly for cargo operations, U.K. CAA said.

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FSF Editorial Staff

During the period 1992–2001, there were no fatal accidents among United Kingdom (U.K)-registered or U.K.-operated airplanes having greater than 5,700 kilograms (12,500 pounds) maximum takeoff weight authorized (MTWA) engaged in airline (passenger) operations. During the period, U.K airlines conducted 8.3 million flights, flew 18.9 million revenue hours and carried about 802 million passengers, said the U.K. Civil Aviation Authority (CAA).[1]

Among passenger flights, there were 133 reportable accidents during the period.[2] The annual numbers of accidents ranged from three in 1994 to 20 in 1993 and in 1995 (Figure 1, page 58). The overall trend in reportable accidents for passenger flights improved during the period — from a three-year moving average of 8.5 accidents per million revenue hours flown in 1992–1994 to 4.0 in 1999–2001.

The highest three-year moving average of reportable accidents per million revenue hours flown was 9.4 in the 1993–1995 period (Figure 2, page 58). Revenue flight hours in passenger operations increased 71 percent during the period.

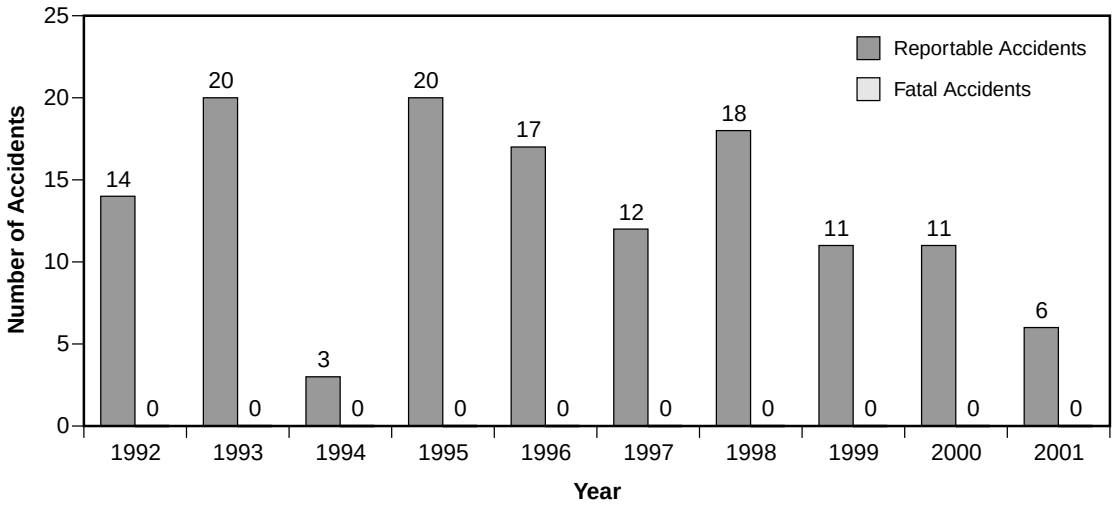
Among reportable accidents during passenger operations in the 1992–2001 period, there were no fatalities (excluding U.K. third-party fatal accidents[3]), nine serious injuries among crewmembers and six serious injuries among passengers (Table 1, page 59).[4] Minor injuries totaled 19 among crewmembers and 85 among passengers, with 68 minor injuries resulting from one accident in 1999.[5]

There were four fatal accidents in airline cargo operations involving U.K.-registered or U.K.-operated airplanes with MTWA greater than 5,700 kilograms during 0.3 million flights and 0.4 million revenue flight hours (excluding U.K. third-party fatal accidents) during the 1992–2001 period (Figure 3, page 59). The average annual fatal-accident rate was 10.35 per million revenue hours flown. The fatal-accident rate increased in the more recent years, partly because of a decrease in utilization in 2000 and 2001 and partly because of fatal accidents in each of the last three years of the period, CAA said.

The trend showed an increase in the three-year moving average of fatal accidents from 9.3 fatal accidents per million revenue hours flown in 1992–1994 to 24.8 in 1999–2001. The average annual rate of reportable accidents was 46.6 per million revenue hours flown. CAA said that the three-year moving average of reportable accidents also was significantly higher at the end of the period (57.9) than at the beginning (37.4, Figure 4, page 60). The three-year moving average for fatal accidents increased from 9.3 in 1992–1994 to 24.8 in 1999–2001.

During the 10-year period, there were six fatalities, two serious injuries and no minor injuries in these cargo operations (Table 2, page 60).♦

Fatal and Reportable Accidents, U.K. Airline (Passenger) Operations, 1992–2001[1]

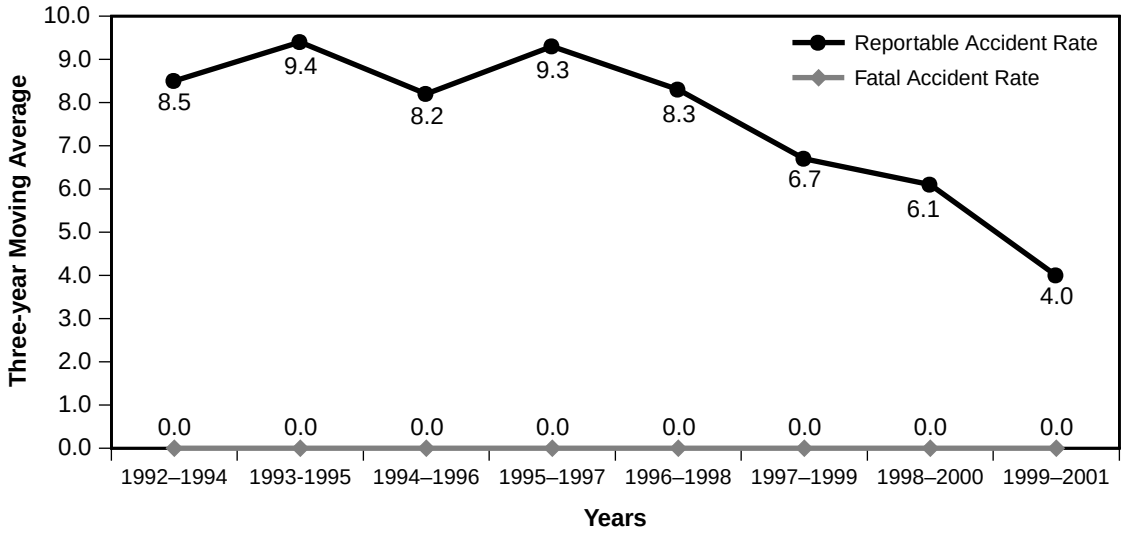


[1]Data are for United Kingdom (U.K.)-registered or U.K.-operated airplanes having maximum takeoff weight authorized greater than 5,700 kilograms (12,500 pounds).

Source: U.K. Civil Aviation Authority

Figure 1

Fatal and Reportable Accidents per Million Revenue Hours Flown, U.K. Airline (Passenger) Operations, 1992–2001[1]



[1]Data are for United Kingdom (U.K.)-registered or U.K.-operated airplanes having maximum takeoff weight authorized greater than 5,700 kilograms (12,500 pounds).

Source: U.K. Civil Aviation Authority

Figure 2

Notes

1. U.K. Civil Aviation Authority (CAA), Strategic Safety and Analysis Unit, Safety Regulation Group. *Aviation Safety Review 1992–2001* (CAP 735). October 2002.
2. CAA defines a reportable accident as "an occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, in which a person suffers a fatal or

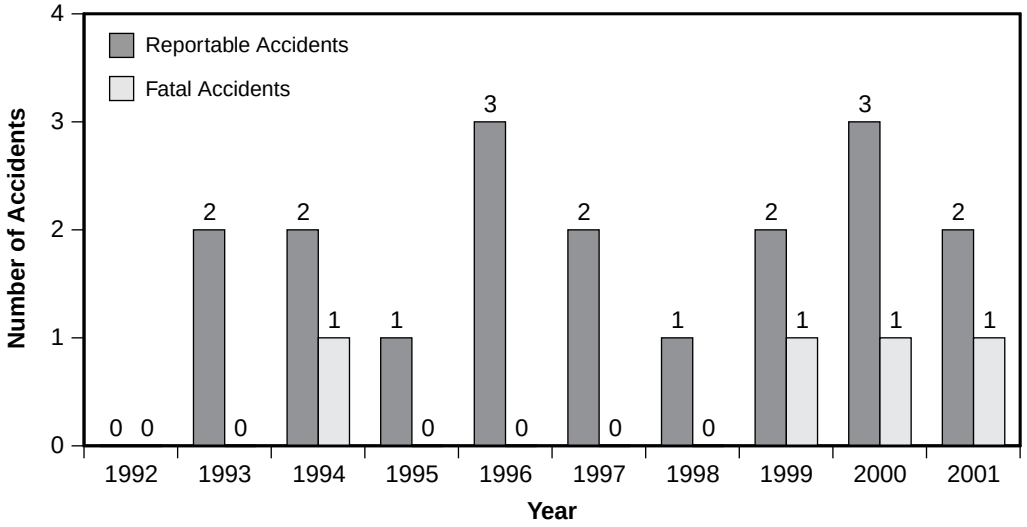
Table 1
Injuries Sustained in Reportable Accidents, U.K. Airline (Passenger) Operations, 1992–2001[1]

Injury	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Total
Crewmembers											
Fatal	0	0	0	0	0	0	0	0	0	0	**0**
Serious	2	3	1	2	1	0	0	0	0	0	**9**
Minor	0	0	2	2	1	4	0	0	10	0	**19**
Total	**2**	**3**	**3**	**4**	**2**	**4**	**0**	**0**	**10**	**0**	**28**
Passengers											
Fatal	0	0	0	0	0	0	0	0	0	0	**0**
Serious	1	0	0	0	0	0	1	3	1	0	**6**
Minor	0	0	2	5	0	6	0	68	4	0	**85**
Total	**2**	**3**	**3**	**4**	**2**	**4**	**0**	**0**	**10**	**0**	**91**

[1]Data are for United Kingdom (U.K.)-registered or U.K.-operated airplanes having maximum takeoff weight authorized greater than 5,700 kilograms (12,500 pounds).

Source: U.K. Civil Aviation Authority

Fatal and Reportable Accidents, U.K. Airline (Cargo) Operations, 1992–2001[1]



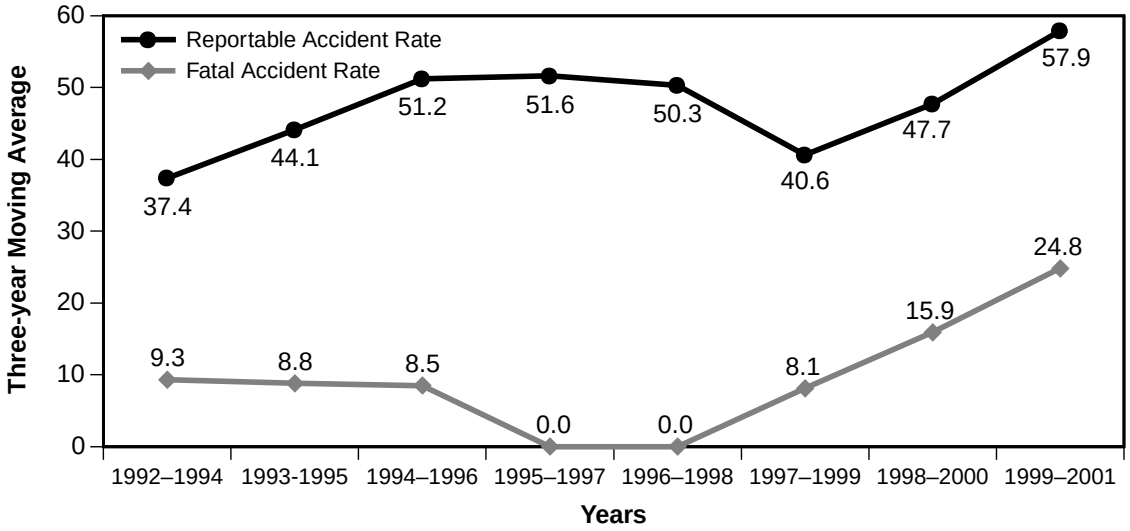
[1]Data are for United Kingdom (U.K.)-registered or U.K.-operated airplanes having maximum takeoff weight authorized greater than 5,700 kilograms (12,500 pounds).

Source: U.K. Civil Aviation Authority

Figure 3

serious injury as a result of being in or upon the aircraft, direct contact with any part of the aircraft, including parts which have become detached from the aircraft, or direct exposure to jet blast, except when the injuries are from natural causes, self-inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to the passengers and crew; or the aircraft sustains damage or structural failure which adversely affects the structural strength, performance or flight characteristics of the aircraft, and would normally require major repair or replacement of the affected component, except for engine failure or damage, when the damage is limited to the engine, its cowlings or accessories, or for damage limited to propellers, wing tips, antennas, tires, brakes, fairings, small dents or puncture holes in the aircraft skin; or the aircraft is missing or

Fatal and Reportable Accidents per Million Revenue Hours Flown, U.K. Airline (Cargo) Operations, 1992–2001[1]



[1]Data are for United Kingdom (U.K.)-registered or U.K.-operated airplanes having maximum takeoff weight authorized greater than 5,700 kilograms (12,500 pounds).

Source: U.K. Civil Aviation Authority

Figure 4

Table 2
Crewmember Injuries Sustained in Reportable Accidents, U.K. Airline (Cargo) Operations, 1992–2001[1]

Injury	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Total
Fatal	0	0	1	0	0	0	0	2	1	2	**6**
Serious	0	0	1	0	0	0	0	0	1	0	**2**
Minor	0	0	0	0	0	0	0	0	0	0	**0**
Total	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**2**	**2**	**2**	**8**

[1]Data are for United Kingdom (U.K.)-registered or U.K.-operated airplanes having maximum takeoff weight authorized greater than 5,700 kilograms (12,500 pounds).

Source: U.K. Civil Aviation Authority

completely inaccessible. Reportable accidents include fatal accidents."

3. CAA said that a third-party accident is "an accident which involves injury to third parties only, such as people on the ground, in another aircraft or [in another] vehicle."

4. A serious injury, as defined in International Civil Aviation Organization (ICAO) Annex 13, *Aircraft Accident and Incident Investigation*, is "an injury which is sustained by a person in a reportable accident and which requires their stay in hospital for more than 48 hours commencing within seven days from the date on which the injury was received; results in a fracture of any bone (except simple fractures of fingers, toes or nose); involves lacerations which cause nerve, muscle or tendon damage or severe hemorrhage; involves injury to any internal organ; involves second-[degree burns] or third-degree burns or any burns affecting more than 5 percent of the body surface; or involves verified exposure to infectious substances or injurious radiation."

5. CAA defines a minor injury as "an injury, other than fatal or serious, which is sustained by a person in a reportable accident."

Publications Received at FSF
Jerry Lederer Aviation Safety Library

Wildlife-control Procedures Manual Updated

The latest edition of the manual from Transport Canada surveys the full range of wildlife-strike threats to aircraft and offers detailed strategies for reducing the risks.

FSF Library Staff

Reports

Wildlife Control Procedures Manual. Transport Canada, Safety and Security Aerodrome Safety Branch. Document TP11500E. Third edition. 2002. 142 pp. Tables, appendixes, glossary, bibliography, photographs. Available from Transport Canada.*

The manual considers wildlife control to be both an art and a science. Wildlife management programs are as varied and unique as the airports and airlines they serve. Such programs have a significant economic impact on airlines. Airlines incur direct costs for repair and replacement of damaged parts, but indirect costs are usually much greater and are associated with aborted takeoffs, rescheduled flights, passenger and crew accommodations, missed connection adjustments, and airline reputation.

Bird strikes can cause cracks, shattering and penetration on the undersides of fuselages and forward-facing parts of aircraft and engines. Large-mammal activities in the vicinity of airports are often responsible for missed approaches and aborted takeoffs. Since 1912, 223 people have been killed in at least 37 bird-strike-related civil aircraft accidents worldwide.

The manual covers the following aspects of wildlife management in sufficient detail to improve awareness of wildlife-management issues and educate airport wildlife personnel on wildlife-management techniques and their effectiveness:

- National and international overviews of wildlife management;
- Wildlife-strike statistics, including date, geographic location, aircraft type and part struck, bird type and weight, and injuries and fatalities;
- Passive management techniques, such as habitat modification;
- Implications of land-use activities near airports;
- Active management using dispersal, exclusion and removal methods;

- Profiles of bird and mammal species, including biological descriptions, food and other attractants, and control methods;
- Information on implementation and assessment of wildlife-control programs;
- Wildlife-strike reporting forms; and
- Canadian Aviation Regulations and proposed regulations relevant to management of wildlife hazards at airports.

The manual was designed to be a tactical guide in managing wildlife risk at airports around the world and a complement to the book, *Sharing the Skies: An Aviation Industry Guide to the Management of Wildlife Hazards* (TP13549).

Risk Perception and Risk Tolerance in Aircraft Pilots. Hunter, David R. Federal Aviation Administration (FAA) Office of Aerospace Medicine (OAM). DOT/FAA/AM-02/17. September 2002. 26 pp. Tables, references. Available on the Internet at <www.cami.jccbi.gov> or through NTIS.**

The report says that there is no human state or action that is without risk (the possibility of injury or loss of life), although some states and actions carry more risk than others. In aviation, risk assessment and risk management are components of pilot decision making.

According to the report, risk perception (recognition of risk inherent in a situation) and risk tolerance (the amount of risk that an individual is willing to accept) can significantly affect pilot decision making. Inaccurate risk perception can lead to misinterpretation of external cues or events that demand immediate, effective decisions to avoid hazardous situations. Personal tolerance for high risk can lead to actions that increase the potential for accidents.

Behavioral specialists differ in explanations of risk perception and risk tolerance and of their relationship in specific events. The report describes major theories that attempt to explain human behavior in the presence of risk and reviews major studies that have assessed pilots' estimates of global risk levels in life. In this particular study, risk perception and risk tolerance were measured in aviation situations.

Pilots completed aviation-related exercises, designed to measure risk perception and risk tolerance in various scenarios, on a U.S. Federal Aviation Administration Internet site. The study found that risk tolerance was not significantly related to hazardous events.

The report suggests that "it is risk misperception, not high risk tolerance, that is associated with exposure to hazardous aviation events." The report also suggests that risk misperception results from differences in pilots' cognitive skills needed for accurate risk perception, rather than differences in underlying personality traits related to risk tolerance. The report says that this is an encouraging finding, because deficiencies in cognitive skills can be addressed with training interventions.

Human Factors Associated With the Certification of Airplane Passenger Seats: Seat Belt Adjustment and Release. DeWeese, Richard; Gowdy, Van. U.S. Federal Aviation Administration (FAA) Office of Aerospace Medicine (OAM). DOT/FAA/AM-02/11. June 2002. 11 pp. Figures, tables, references. Available on the Internet at <www.cami.jccbi.gov> or through NTIS.**

This report describes two separate studies conducted concurrently in a mock aircraft-evacuation setting. The first related to seat-belt-tension adjustment during normal flight and simulated-emergency-landing conditions; the second concerned the effects of lift-latch-release angles of seat-belt buckles on passenger egress from aircraft seats.

Certification requirements can include impact tests on anthropomorphic test dummies (ATDs) restrained by lap belts. According to the report, the amount of pretest tension in the belts is affected by the judgment, experience, technique and strength of the technicians preparing the test. With a lack of uniform tension settings, the study asked two questions: What is the belt tension produced by a typical passenger when adjusting his or her lap belt? How does that tension compare to a lap belt tightened over an ATD?

The report noted that lap-belt buckle-release angle is not specifically addressed by U.S. Federal Aviation Regulations (FARs), although buckles designed for the U.S. aviation market are released when the lever is raised 30 degrees to 45 degrees. The United Kingdom (U.K.) Civil Aviation Authority requires that lift latches release at an angle of 70 degrees to 95 degrees. "The presumed intent of the larger angle is to prevent inadvertent release during turbulence or emergency landing scenarios," says the report.

Both studies were conducted at the FAA Civil Aerospace Medical Institute's Protection and Survival Laboratory. A total of 1,182 men and women participated in the lap-belt tension-adjustment study. Personal anthropometric statistics of participants and tension readings from instrumentation were analyzed. Results indicated that 90 percent of passengers tightened their lap belts to a tension of less than seven pounds (three kilograms) during "normal flight" and increased the tension to less than 10 pounds (4.5 kilograms) when anticipating an "emergency." Therefore, lap belts restraining ATDs during certification tests should not exceed ten pounds of tension to approximate normal belt tension in a typical aircraft setting, the report said.

Two hundred one men and women participated in the lift-latch release-angle test. Personal anthropometric statistics of participants and readings from instrumentation and video camera recordings were used to record the time and effort each

participant needed to release three different lift latch configurations and egress from the seats. Results showed that most of the participants pulled the lift lever more than 90 degrees when attempting to release the buckle quickly. Variations in seat-egress times by lift-latch-release angles were negligible.

Books

The Instrument Flight Manual: The Instrument Rating and Beyond. Sixth edition, Kershner, William K. Ames, Iowa, U.S.: Iowa State Press, 2002. 283 pp. Figures, appendix, bibliography, chart.

As with previous editions, this book primarily focuses on the general aviation pilot interested in obtaining an instrument rating from the U.S. Federal Aviation Administration or refreshing general knowledge of instrument flying.

The author has made several significant revisions in this edition, updating information about terminal instrument procedures (TERPS); air traffic control procedures and terminal area radar computer systems; aircraft instrumentation and avionics; U.S. Federal Aviation Regulations (FARs) Part 61.65 requirements for instrument rating; conversion to the meteorological aviation report/terminal aviation forecasts (METAR/TAF) weather-reporting and weather-forecasting system; and the global positioning system (GPS). The author added a syllabus for an instrument flight manual training course that students can use as a checklist in preparing for the instrument rating.

Regulatory Materials

Guidelines for the Certification, Airworthiness and Operational Approval of Electronic Flight Bag Computing Devices. U.S. Federal Aviation Administration (FAA) Advisory Circular (AC) 120-76. July 9, 2002. Table, appendixes. 34 pp. Available from GPO.***

Traditionally, a flight bag is a pilot's briefcase, containing charts, manuals, reference guides, fuel requirements and special notices and data provided to the flight crew by an airline flight dispatch department. Today, some of these materials are included in electronic flight bags (EFBs), which are portable electronic devices or computing devices installed in aircraft that display a variety of aviation data or perform basic calculations. EFBs can reduce or can eliminate paper reference materials on the flight deck.

This AC defines three functional classes of EFB systems used by flight crewmembers or cabin crewmembers and provides guidance for certification, airworthiness, installation and operational approval for these classes. The AC says that class 1 systems and class 2 systems are portable and generally are "commercial off-the-shelf–based computer operating systems and application programs that are used for aircraft operations."

Class 1 EFB systems do not attach to an aircraft-mounting device and do not require an administrative control process for use in the aircraft. Class 2 EFB systems require attachment and an administrative control process while the aircraft is in operation. Class 3 EFB systems are considered installed equipment and may provide additional functions, such as global positioning systems or automatic dependent surveillance-broadcast.

The AC covers EFB criteria, human factors considerations and risk-mitigation or backup procedures and contains extensive examples of EFB system applications and a reading list.

Systems and Equipment Guide for Certification of Part 23 Airplanes. U.S. Federal Aviation Administration (FAA) Advisory Circular (AC) 23-17A. June 27, 2002. Figures, tables, appendixes. 244 pp. Available from GPO.***

This AC describes one acceptable method of complying with U.S. Federal Aviation Regulations (FARs) Part 23 for the certification of systems and equipment in normal-category airplanes, utility-category airplanes, acrobatic-category airplanes and commuter-category airplanes. The AC addresses FARs Part 23.671, Subpart D — *Design and Construction*, including sections on control systems, landing gear, personnel accommodations and cargo accommodations, pressurization, fire protection, and electrical bonding and lightning protection. The AC also addresses Subpart F — *Equipment*, including sections on instrument installations, electrical systems and electrical equipment, lights, safety equipment, electronic equipment, hydraulic systems and pneumatic systems, oxygen equipment and oxygen systems, and flight data recorders and cockpit voice recorders.

[This AC cancels AC 23-17, *Systems and Equipment Guide for Certification of Part 23 Airplanes*, dated April 25, 2000.]♦

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Place de Ville, Tower C
Ottawa ON K1A 0N8 Canada
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5285 Port Royal Road
Springfield, VA 22161 U.S.
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Fatigue, Sleep Inertia Cited in Pilot's Report of Incorrect Flight Level

The incident, which occurred on a transcontinental night flight in Australia, led to changes in the operator's policies on controlled-rest periods for pilots.

FSF Editorial Staff

The following information provides an awareness of problems through which such occurrences may be prevented in the future. Accident/incident briefs are based on preliminary information from government agencies, aviation organizations, press information and other sources. This information may not be entirely accurate.

Misstatement of Airplane's Altitude Prompted ATC Traffic Advisories

Boeing 737-800. No damage. No injuries.

The airplane was being flown on a night transcontinental flight in Australia when the first officer told air traffic control (ATC) that the airplane was maintaining flight level (FL) 390 (approximately 39,000 feet). He later said that the airplane was maintaining FL 370 and, when questioned, confirmed that the airplane was at FL 370. (The crew initially had been assigned an altitude of FL 370; approval to climb to FL 390 was given during the first officer's period of controlled rest. After the controlled rest and before assuming control of the airplane, the first officer received a briefing from the captain that included a statement that the airplane was at FL 390.)

A Boeing 747 also was being flown at FL 370, and its crew estimated that the airplane would cross a reporting point about two minutes after the B-737.

The incident report said that proper separation required that "aircraft at the same level on intersecting tracks required 15 minutes between their respective intersection estimates." ATC issued traffic information to flight crews of the two airplanes. During a later position report, the B-737 captain corrected the first officer when he again reported the aircraft as level at FL 370. (Subsequent analysis of the B-737 flight data recorder showed that the airplane had maintained FL 390 and that there was no infringement of separation standards.)

The incident report said that the operator of the B-737 had a policy allowing the "controlled rest" of flight crewmembers while they were on the flight deck as "an effective method of

improving levels of crew alertness for critical phases of flight." Company guidelines required that controlled rest could be used only during the cruise phase of flight and only on sectors of more than two hours. Controlled rest periods were not to exceed 30 minutes per crewmember per sector, with an additional 10 minutes before a crewmember resumed flight deck duties.

During the 48 hours before the incident, the first officer had about nine hours of sleep. He said later that he had felt rested before beginning the incident flight.

Nevertheless, the report said, "That small period of sleep suggests that the [first officer] may have been fatigued at the time of the incident, despite feeling adequately rested. Fatigue may lead to impaired physical and mental performance in people."

The report said that the first officer probably "was suffering from the cumulative effects of fatigue and sleep inertia," a term used to describe the "period of mental dullness or sluggishness immediately after awakening."

The report said that the first officer was "newly rated on the B-737-800" and that he had said that scanning the altitude indicator "took longer and required additional conscious effort." He said that, in responding to the ATC inquiry about the airplane's flight level, he had "relied on his memory of the information in the position report, rather than re-checking the altitude indicator on the flight-instrument display."

After the incident, the operator changed its controlled-rest procedures to require that both crewmembers be on duty for changes in flight level. The Australian Transport Safety Bureau suggested that all operators have strategies to mitigate the effects of sleep inertia among flight crewmembers.

Section of Rudder Missing After Flight

BAE Systems/EADS (European Aeronautic Defense and Space Co.) Concorde. Minor damage. No injuries.

The airplane was being flown through 45,500 feet and accelerating through Mach 1.817 over the northern Atlantic Ocean during a midday flight from England to the United States when the flight crew heard what they believed was "an engine-related pop surge," a preliminary incident report said.

The flight crew activated the flight-recorder event marker and continued the flight to the destination airport. The remainder of the flight was uneventful except that, during deceleration from Mach 1.14 to Mach 0.89, there was continuous light vibration.

After landing, an examination of the airplane revealed that a section of the lower rudder was missing.

Airplane Damaged by Refueling Truck

Airbus A320-200. Minor damage. No injuries.

The airplane was being refueled at an airport in England. After completing the task, the refueler drove the hydrant-refueling vehicle away without disconnecting the nozzle from the airplane. He was unaware of the occurrence until after his arrival at the refueling organization's parking area.

The airplane was taken out of service for repairs to its refueling adapter ring and was returned to service the following day.

An investigation by the refueling organization revealed that the refueler had not complied with the vehicle's checklist or the refueling organization's operations manual, which required that he ensure that all hoses were secure on the refueling vehicle before driving the vehicle away.

Examination of the refueling vehicle revealed a bent actuating rod on the aircraft refueling nozzle. The incident report said that the defect caused the interlock system to sense that the nozzle was correctly stowed at all times. When functioning properly, the system prevents the vehicle's engine from being started unless all nozzles are stowed correctly. The interlock system was reported to have been functioning properly at the previous weekly check.

The refueler said that his typical routine had been interrupted by a paperwork problem and, as a result, he believed that he had disconnected the refueling hoses even though he had not done so.

Event Prompts Alert to Spurious Terrain Warnings

Airbus A320-200. No damage. One serious injury.

The airplane was being flown on descent to an airport in Ireland after a public transport charter flight from the Canary Islands. The flight crew received clearance to descend to 4,000 feet, but as they descended through 4,200 feet — while 18 nautical

miles (33 kilometers) south of the airport — the enhanced ground-proximity warning system (EGPWS) produced a visual warning and audio warnings of "terrain, terrain – whoop, whoop – pull up, pull up."

The flight crew performed the standard EGPWS terrain-avoidance maneuver, and the airplane pitched up, causing a cabin crewmember to fall and break her collarbone.

About one month later, another Airbus A320 operated by the same company was involved in a similar event in about the same location.

An investigation revealed that in the area where these events occurred, the terrain includes peaks between 2,352 feet and 2,788 feet. The local sector safety altitude is 4,100 feet. There is no terrain above 2,000 feet within 12 nautical miles (22 kilometers) of the airport.

The report said, "The relevant EGPWS mode in these circumstances is Mode 2A, excessive terrain-closure rate, with the aircraft not in the landing configuration and not on the glide-slope beam. … The warnings are triggered by high rates of descent measured by the radio altimeter, which is active below 2,450 feet above local ground level. The activation trigger is dependent upon the actual airspeed and rate of descent combination."

Radar data showed that the incident airplane was descending near a 2,385-foot peak at an indicated airspeed of about 298 knots, passing through 4,200 feet with a descent rate of 1,500 feet per minute.

"However, due to the rapidly changing nature of the terrain being traversed at the time, the radio altimeter measured 2,200 feet above the local terrain with a peak rate of closure of about 9,000 feet per minute. This rate was within the EGPWS Mode 2A activation envelope, so the aural alert and 'PULL UP' warnings were generated. At no time during the event did the aircraft actually descend to less than 1,700 feet above the local terrain, so the prescribed minimum terrain separation was not lost."

The report said that because the problem is not limited to one operator, all pilots should be warned of the possibility of false GPWS and EGPWS warnings during operations in this area.

Wing Tip Damaged During Landing in Gusty Winds

Bombardier Canadair CL-600 Challenger. Minor damage. No injuries.

Visual meteorological conditions and strong surface winds prevailed for the afternoon approach to an airport in England. The flight crew obtained automatic terminal information service (ATIS) information recorded at 1355 local time that reported surface winds from 250 degrees at 23 knots. The airplane's crosswind limit was 27 knots, and the designated runway was Runway 33. The flight crew considered using Runway 24, but because of performance limitations, they selected Runway 33.

When the airplane reached 1,000 feet, the captain took control and disengaged the autopilot. Air traffic control told the crew, when the airplane was at 700 feet, that winds were from 250 degrees at 22 knots and, when the crew was cleared to land, that winds were from 250 degrees at 20 knots. The captain said later that he had maintained the correct approach path without difficulty but that airspeed was difficult to control. (The crew had calculated that they would fly the airplane at 149 knots, which was 10 knots faster than landing reference speed [V_{REF}], and reduce speed to 139 knots over the runway threshold.)

"As the aircraft approached the ground, the turbulence increased, but neither pilot became unduly concerned," the report said. "Just prior to landing, the [captain] applied right rudder to align the aircraft with the runway centerline and simultaneously applied lateral control to maintain the wings level. He recalled that at about the time the aircraft touched down, the left wing began to rise rapidly, and he applied full-left lateral control to correct this roll."

The crew was unaware of any problem, but maintenance personnel later told the captain that the lower skin on the left wing tip was damaged.

An investigation revealed that the flight crew was not told of the most recent prevailing surface wind and had increased their selected approach airspeed because of turbulence. ATIS information about surface winds was updated three times after the flight crew obtained the information and before they landed the airplane. The updates included the information that maximum recorded wind gusts had reached 36 knots. The crew was unaware of that information.

The accident report said that the U.K. Civil Aviation Authority was reviewing information about semi-automatic meteorological observing systems.

Runway-edge Light Found Damaged After Takeoff In Blowing Snow

Raytheon Beech 1900. Minor damage. No injuries.

Visibility was reported as one statute mile (1.6 kilometers) in blowing snow when the flight crew conducted the takeoff from Runway 32 at an airport in Canada. Winds were from 040 degrees to 060 degrees at 10 knots. When the airplane reached

an indicated airspeed between 80 knots and 100 knots, it drifted off the runway to the left.

The flight crew said that they felt "a couple of bumps," and the captain asked airport personnel to inspect the runway for debris. An inspection revealed that a runway-edge light had been knocked down.

The airplane was flown to its destination airport, where an inspection revealed minor damage to the left-brake deicing manifold.

Airplane Strikes Terrain After Pilot Cancels IFR Clearance

Cessna 310L. Destroyed. One fatality.

Night instrument meteorological conditions prevailed during the approach to an airport in the United States. The pilot had begun the flight under visual flight rules but later requested instrument flight rules (IFR) handling from air traffic control. He received clearance to conduct a very-high-frequency omnidirectional radio (VOR) approach and asked an air traffic controller to advise him when the airplane was over the final approach fix. The controller said that he could not provide that notification because of a lack of radar coverage, and the pilot canceled his IFR clearance. About five minutes later, the airplane struck trees and terrain about 5.5 nautical miles (10 kilometers) south of the airport.

One witness said that she had observed the airplane about two nautical miles (3.7 kilometers) south of the accident site being flown on a northerly heading at about 300 feet above ground level (AGL) or 500 feet AGL, below clouds. Another witness observed the airplane about 0.75 nautical mile (1.4 kilometers) south of the accident site at about 80 feet AGL.

A preliminary investigation revealed that weather at the destination airport five minutes after the accident included visibility of four statute miles (6.4 kilometers) and a ceiling of 3,200 feet. Fourteen minutes after the accident, weather at an airport 15 nautical miles (28 kilometers) southwest of the accident site included visibility of 0.5 statute mile (0.8 kilometer) in rain and vertical visibility of 200 feet.

Unqualified Pilot Flies Airplane Into IMC

Cessna 210B. No damage. No injuries.

The airplane was being flown on an evening flight to an airport in Canada when the pilot radioed air traffic control (ATC) that he unintentionally had entered instrument meteorological conditions, was not qualified for instrument flight rules flight and was unable to land at the destination airport because of adverse weather.

The pilot flew the airplane above the cloud layer to an airport reporting visual meteorological conditions, received vectors for an approach and landed without incident.

Rudder Yoke Separates During Test Flight

Europa Aircraft Europa. Substantial damage. No injuries.

The pilot of the experimental home-built airplane had conducted a taxi test and a short test flight from an airport in Sweden. After a landing on a grass landing strip, the pilot inspected the airplane and then conducted another takeoff.

After liftoff, at about three feet, the airplane yawed left, and the pilot's application of right rudder did not stop the yaw.

The accident report said, "At this point, [the pilot] realized that something was amiss and discontinued the takeoff by setting the aircraft back onto the strip. After bouncing back into the air, the aircraft landed crossways."

An investigation revealed that the rudder yoke had separated from the rudder assembly because of a "clean break within the epoxy glue that secures the yoke laminate with the rudder shell."

The report said that the rudder yoke attachment laminating was "carried out as well as possible using the allotted construction method. The result, however, did not completely correspond with the theoretical blueprint of the attachment, which had not taken into consideration the fact that woven fiberglass must have a radius when it is bent down into a 90-degree corner."

The modification was recommended by the construction-kit manufacturer. The report said that experimental aircraft authorities have said that the Europa's rudder system requires further modification.

Airplane Strikes Truck During Landing in Marsh

Canadair F-86. Destroyed. One fatality.

Visual meteorological conditions prevailed for departure from an airport in the Dominican Republic for a flight to the United States. During initial climb, with wings level and at an estimated airspeed of 250 knots, witnesses observed "a large ball of fire" from the airplane's tailpipe. The airplane had lost power, and the pilot began a turn back to the departure airport.

The airplane touched down in a marshy area, and during the landing roll, a wing reportedly struck an abandoned truck. A fire resulted.

Airplane Rolls Into Ditch After Pilot Fails to Set Brakes

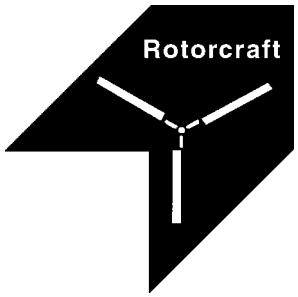
Reims Cessna F-150L. Minor damage. No injuries.

The pilot, whose last flight had occurred two years before the accident flight, was told to conduct a pre-flight inspection, start the engine and wait for the instructor, who was preparing for the flight from an airport in England to renew the private pilot's license privileges.

The pilot said that he complied with checklist procedures to start the engine but that he inadvertently advanced the throttle too far and did not set the handbrake. The pilot's seat was positioned "such that his feet could not reach far enough to apply the toe brakes," although his feet were on the rudder pedals.

The accident report said, "When the engine started, the aircraft accelerated rapidly forward. The pilot closed the throttle, but he was unable to apply the toe brakes."

The airplane traveled about 50 meters (164 feet) and stopped after the nosewheel entered a drainage ditch.



Tail Boom Severed as Instructor Demonstrates 'Engine-off' Landing

Robinson R22 Beta. Substantial damage. No injuries.

The helicopter was being flown at an airport in England by a flight instructor to demonstrate a practice "engine off" landing for a student pilot — the seventh such practice landing of the morning. During the run on, a main-rotor blade struck the tail boom. As a result, the tail boom separated from the helicopter, and the tail-rotor drive shaft was damaged.

The landing was conducted on the grass helicopter strip heading into the wind, which was from 230 degrees at 24 knots. The accident report said that the initial ground contact occurred when the left side skid touched the right edge of the landing strip, whose boundary was marked with a raised mound of earth. The report said that the flight instructor believed that the skid's contact with the raised earth "destabilized the run on, and his subsequent attempted corrections led to large control inputs at a low main-rotor speed."

The flight instructor said that he felt vibration and heard a change in rotor sound after the event but that there were no cockpit indications of any problem.

Loss of Power Results in Water Landing

Bell 206L-1 LongRanger II. Substantial damage. No injuries.

Visual meteorological conditions prevailed for an afternoon flight between two landing sites in the Gulf of Mexico. During the flight, an uncommanded power loss occurred, and the pilot began an autorotation. As the helicopter touched down on the water, a main-rotor blade struck the tail boom, resulting in separation of a section of the tail-rotor drive shaft and damage to both vertical winglets. The pilot and passengers were rescued by occupants of a boat.

The helicopter was placed on a barge and transported to the operator's base. An examination of the fuel system revealed debris in the main fuel tanks. Discolored fuel was found in the fuel line to the fuel filter; clear fuel was found in the fuel line from the fuel filter to the fuel control. Examination of the fuel system was continuing.♦

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