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Data Show 50 U.S.-registered Helicopters Involved In Wire-strike Accidents From 1996 Through 2000

In each of the accidents, the helicopter was either destroyed or damaged substantially. Fifteen accidents resulted in at least one fatality; nine other accidents resulted in serious injuries.

Joel S. Harris

Data show that, of 934 U.S.-registered helicopters involved in accidents from 1996 through 2000, 50 accidents (5.4 percent) were classified as wire-strike accidents.[1] The number of wire-strike accidents was highest in 1998, when 13 accidents (6.8 percent of the year's total of 191 helicopter accidents) were recorded. Fewer wire-strike accidents occurred in 2000 than any other year during the five-year period — nine accidents, or 4.4 percent of the 206 helicopter accidents that occurred that year (Figure 1, page 2).

Wires present particular risks to helicopters because helicopters often are flown at low altitudes and at off-airport sites for takeoff, landing and other purposes. Some of the types of wires that pilots may encounter are power transmission lines, guy wires (used to support other objects, such as towers) and communication cables.

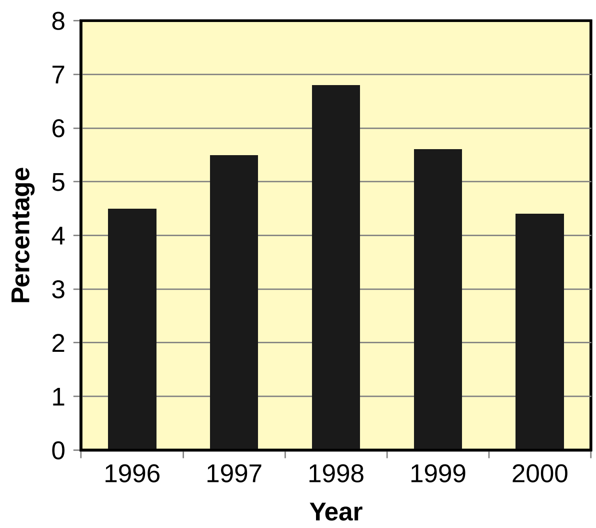
When crossing rivers and valleys, power transmission lines can be as high as several hundred feet above ground level (AGL). Guy wires that support towers may be almost invisible to pilots, even if the general location of the wires is known. Pilots' ability to see wires is affected by dirty windscreens, light conditions, the obscuring effects of terrain and changes in visual perspective that occur during climb and descent. In addition, accurately judging the helicopter's distance from unmarked wires is nearly impossible.

The data show that in every wire-strike accident from 1996 through 2000, the helicopter was either damaged substantially (33 accidents) or destroyed (17 accidents).

Fifteen of the 50 accidents resulted in at least one fatality, and nine accidents resulted in serious injuries (Figure 2, page 2). Ten other accidents resulted in minor injuries; in the remaining 16 accidents, there were no injuries. (An accident is classified according to the highest level of injury. For example, if one occupant is fatally injured and one receives minor injuries, the accident is classified as a fatal accident.)

Seven of the 50 accidents occurred at night; of the seven night accidents, four were fatal accidents, and in three of the four accidents, the helicopter was destroyed.

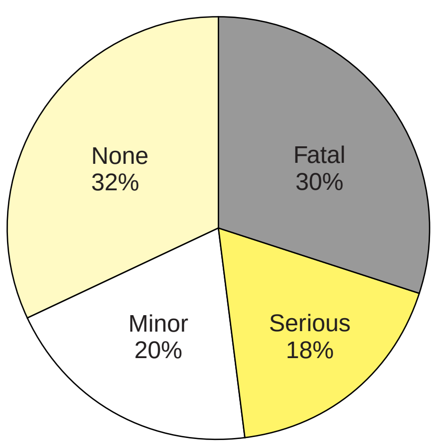
Wire-strike Accidents as a Percentage of All U.S. Helicopter Accidents, 1996–2001



Source: Joel S. Harris, from Helicopter Association International data

Figure 1

Types of Injuries Resulting From U.S. Helicopter Wire-strike Accidents, 1996–2001



Source: Joel. S. Harris, from Helicopter Association International data

Figure 2

One fatal accident occurred in dark-night conditions Dec. 14, 1997, near Littleton, Colorado.[2] A Bell 407, being operated as an emergency medical services (EMS) flight, struck wires after takeoff and fell inverted to the ground. All four people on board were killed. (Four of the 50 accidents involved EMS flights.)

The U.S. National Transportation Safety Board (NTSB) said, in the final report on the accident, that the helicopter had been flown to the site of a fatal automobile accident from the northeast and that the pilot had circled the area before conducting a north-to-south approach to landing. Lights from emergency response vehicles on the ground illuminated the landing area.

After the patient was on board, the pilot, a former U.S. Army helicopter pilot with more than 4,000 hours of helicopter flight time, conducted a departure to the south and circled to the right, remaining at a low altitude. The NTSB report said that the pilot's company policy, which was "promulgated through documents and training," included "landing-zone departure procedures, which instructed the pilot to climb straight ahead in a near-vertical climb to a minimum of 300 feet AGL before turning."

About 630 feet (192 meters) west of the takeoff point, the helicopter struck unmarked power lines.

The report said, "Existence of the power lines was unknown to the fire-rescue on-scene commander, and the light conditions prevented the pilot from seeing anything outside the lighted area."

The power lines were supported by two towers 622 feet (190 meters) apart and located on a riverside golf course.

"The unmarked power lines did not meet obstruction-lighting criteria and were not marked," the report said. "In addition, they were not depicted on sectional or topographic maps."

Wire placement, as measured at the southwest tower from top to bottom, consisted of two static wires at the 106-foot level and six power-transmission lines at the 87-foot level, the 71-foot level, and the 55-foot level sequentially.

The report said that the accident helicopter was equipped with a wire-strike protection system designed to help protect the helicopter in the event of inadvertent flight into horizontally strung wires or cables. The equipment consists of a windshield deflector, an upper cutter/deflector and a lower cutter/deflector. (The cutter/deflectors are sharp blades above the windshield and below the nose of the aircraft). Each cutter consists of high-tensile-steel cutting blades designed to cut through the wires, thus preventing them from catching the mast, flight controls or landing gear and preventing them from slicing through the cockpit.

The report said, "The wire cutter on the lower-forward portion of the nose section was gouged on the cutting edge and had … marks associated with the gouge areas."

The top portion of the vertical fin (about one foot [0.31 meter]) was missing, and the fracture "was smooth and exhibited knife-cut-type characteristics," the report said. The report also said that the forward outboard portion of the right skid contained chafe marks and electrical burn marks and that "several (rotor) blades had electrical-arc damage at the blade grip bolt on the upper surface."

The report said that the probable cause of the accident was "the pilot's inability to maintain adequate visual lookout due to the lighting conditions and his failure to follow company procedures for departure from a landing zone. Factors were dark-night conditions, bright lights in the landing zone, which prevented vision beyond the zone, and [the fact that information about] the power line existence was not available on charts to either the pilot or ground personnel."

Although the wire-strike protection system did not prevent this accident, in other occurrences, the equipment has been effective.

For example, the pilot of a state highway patrol Bell OH-58 Kiowa that was equipped with a wire-strike protection system described an accident in which his helicopter struck a power line during a search for an escaped convict:[3]

> We had flown the 14-[nautical-]mile [26-kilometer] stretch down and back. Along the way, both times, I had noted three sets of power lines draped across the river. … As we flew along, I would note the location and keep an eye out to ensure I had enough altitude to clear each one as we passed them. …
>
> We concluded that we weren't going to locate anything, so we decided to [return]. I took one glance forward to clear the area, nosed the aircraft forward slightly, applied some power and accelerated to about 20 knots. As I did this, I looked back down [at the ground] for one quick, last-minute look. As I did, I felt the aircraft suddenly stop in midair. The nose pitched up, and the helicopter began to shake violently. In an instant, I looked forward and immediately realized what had happened, as I saw each individual strand of a power line cutting into my windshield. As I fought to keep control, I felt the tail trying to come around. I applied left pedal, and all I could think to do was shove the cyclic forward. Suddenly, I felt the aircraft break free. …
>
> "[After an emergency landing,] I … saw that the damage was minimal. There were striations in one of the main-rotor blades, a long gash in the front-top cowling, and the windshield was cracked all the way down from the OAT [outside air temperature] gauge, which was torn out. It was then I realized [that] the wire-strike protection system had saved our lives. …
>
> "[The wire-strike protection system] managed to cut three of the four lines that were across my path. … It almost took my breath away to know that if I had been two inches [5.1 centimeters] lower, the wire would have struck the mast and probably flipped us over."

In a 2001 survey conducted by the Helicopter Association International and the U.S. National EMS Pilots Association, 121 EMS helicopter pilots said that each of the aircraft they flew was equipped with wire-strike protection equipment. Sixty-one respondents said that their aircraft did not have wire-strike protection equipment and needed it.[4]

More wire-strike accidents occurred during aerial-application flights (13 accidents) than flights conducted for any other purpose. Of these accidents — all of which occurred during daylight — one resulted in a fatality and five resulted in serious injury. Four aircraft were destroyed, and nine aircraft were damaged substantially.

One wire-strike accident involving an aerial-application flight conducted under U.S. Federal Aviation Regulations Part 137 occurred at 0845 local time May 25, 2000.[5] A commercial pilot was operating a Sikorsky S-58 near Buhl, Idaho, when the helicopter struck wires and was destroyed; the pilot was seriously injured.

The pilot said that he had conducted a takeoff from a staging area with 320 gallons (1,211 liters) of a diluted pesticide mixture on the sixth flight of the day. He said that he had flown the helicopter over television antennas, radio antennas and two sets of power lines on each of the previous trips.

NTSB said, in the final report on the accident, that on this trip, the pilot was "distracted by a radio call from another pilot. The pilot looked down at a map to verify a field location, and when he looked back up, he did not see the power lines that he knew were along his flight path and [that he] had flown over on previous flights."

The helicopter struck the power lines, which were 75 feet AGL to 100 feet AGL, then pitched nearly straight up, leveled slightly and struck the ground in a tail-low attitude.

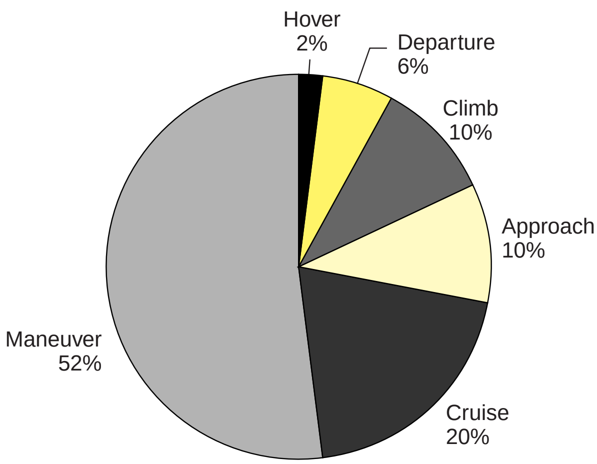
The pilot said that there were water drops on the windshield, which was dirty, and that the sky was overcast, which reduced visibility.

Seven of the 50 wire-strike accidents involved public use aircraft being flown for a variety of purposes, including fish survey, border patrol, fire fighting, police operations and drug eradication. During a Sept. 22, 1999, drug-eradication flight, a Bell 206L-1 LongRanger II operated by the New York State Police was substantially damaged, and the commercial pilot and passenger were injured seriously after the helicopter struck power lines near Randolph, New York.[6]

NTSB, in the final report on the accident, said that the helicopter was being flown in a valley and into the sun about 200 feet AGL when the helicopter struck utility wires. An inspector for the U.S. Federal Aviation Administration said that the towers, which supported the wires, were below the tree line, but the wires were depicted on the current aeronautical sectional chart.

The data show that more than half of the helicopter wire-strike accidents occurred during the maneuvering phase of flight (26 of the 50 accidents). Ten accidents occurred during cruise, five accidents occurred during climb, five accidents occurred during approach, three accidents occurred during departure, and one accident occurred during hover (Figure 3).

U.S. Helicopter Wire-strike Accidents by Phase of Flight, 1996–2001



Source: Joel S. Harris, from Helicopter Association International data

Figure 3

Not all of the 50 accidents characterized as wire-strike accidents actually involved striking wires or cables. In an accident that occurred near Bartow, Florida, on July 9, 1996, a Bell 47G helicopter pilot was conducting a survey of alligator nests along a canal when his passenger warned of utility lines ahead.[7] As the pilot executed a quick stop maneuver to avoid striking the wires, the helicopter tail rotor struck the ground. The helicopter was destroyed, and the pilot and the passenger received minor injuries.

The pilot said that a better scanning technique and a slightly higher altitude might have prevented the accident.

Specialists say that a variety of actions by helicopter pilots can help prevent wire-strike accidents.

"Pilots need to educate themselves thoroughly on the dynamics of the area," said Robert Feerst, president of Utilities/Aviation Specialists, who teaches courses in wire-strike avoidance. "Until you have a basic understanding of what can get you into trouble, it's a very lethal place to be."[8]

In addition to reviewing aeronautical charts and talking with pilots who are familiar with the area, a pilot who is about to begin low-altitude operations first should conduct a reconnaissance flight at a higher altitude, Feerst said. Nevertheless, those precautions may not be adequate for detecting all wires.

Wires are difficult to see, partly because of the way the human eye functions and partly because of the effects of some backgrounds and light angles in camouflaging wires, Feerst said.

"The eye starts to lose its visual acuity at three degrees off-center," he said. "Unless you are looking straight at a wire, you are unlikely to see it."[9]

The movement of wires in the sunlight and changing sunlight patterns can obscure wires, Feerst said. Wires also may be difficult to see because as they age, their color often changes. For example, copper wires oxidize with age, acquiring a greenish color that makes them difficult to distinguish from grass and trees in the background. The exact location of specific wires may change throughout the day because of fluctuating ambient temperatures, which may cause wires to sag or to tighten within several hours; sagging wires may be blown by wind.

In addition, optical illusions involving wires are common, Feerst said.

If a pilot is unable to avoid a wire strike, Feerst recommends maintaining the helicopter in straight and level flight with no abrupt maneuvers and landing as soon as possible to inspect the helicopter for damage.[10]

In some instances, spherical wire markers and wire-detection devices may help pilots see wires. The following are examples of some of the products on the market to help identify power lines and prevent aircraft from colliding with them:

- Spherical markers sometimes are used to mark power lines, communications lines and guy wires at airports or helicopter approach areas and at locations where wires cross rivers and canyons. These markers often are orange, but in some instances, other colors are used because they may be more visible, depending on the surrounding terrain. Some spherical markers used on electrical power lines are designed to glow as a result of the power line's electrical field[11]; other spherical markers are patterned for improved visibility or equipped with flashing lights;[12]

- Several wire-detection systems developed in recent years have been installed in aircraft to warn pilots when they are near wires. For example, Safe Flight Instrument Corp.'s Powerline Detection System senses the electromagnetic field generated by live electrical power lines and emits an audible alert through the aircraft's audio system — a clicking sound that increases in frequency as the aircraft is flown nearer to a "live" electric power line (a line carrying electric current) — and illuminates a red warning light in the cockpit. The warnings are provided regardless of whether the helicopter is approaching the power line from above, below or at an oblique angle. The system does not alert pilots to wires that are not live, however;[13]

- The Hellas (helicopter laser radar) system, developed by Dornier, a subsidiary of the European Aeronautic Defence and Space Co., uses eye-safe laser radar to scan the environment for wires and other flight obstacles and provides optical signals and acoustic signals to warn pilots about their presence. The first deliveries of the Hellas system were in September 2001 to the German Federal Border Guard helicopter squadron;[14] and,

- During flight tests in which the locations of power lines were included in a computer database, Honeywell's Enhanced Ground-proximity Warning System (EGPWS) — which warns pilots of rising terrain and obstacles that are 100 feet or more above ground level (AGL) — delivered warnings of approximately 30-seconds to pilots that their helicopters were approaching the power lines, said Andrew J. Cindric Jr., manager of business development of Honeywell's EGPWS helicopter programs.[15]

  Nevertheless, although the system is capable of delivering the warnings, its database lacks the required information, which generally has not been available from utilities and other organizations that control wires.

  "The database is the pacing factor," Cindric said.

  He said that, if helicopter operators can obtain information in their communities about the locations of wires that are 100 feet AGL or higher and supply the information to Honeywell, the helicopter EGPWS database will be updated to include wire information.

Nevertheless, because most helicopters are not equipped with wire-detection systems and because not all wires are marked, wires continue to present risks. Specialists generally agree that the best methods of reducing those risks are pilots' education about the environment in which they will be flying and their vigilance in the cockpit.♦

Notes

1. The data were obtained from the Helicopter Association International online accident database <www.rotor.com>.

2. U.S. National Transportation Safety Board (NTSB). Accident report no. FTW98FA068. Dec. 14, 1997.

3. Bell Helicopter Textron. "There I Was …" *Heliprops* Volume 12 (No. 4, 2000): 4–5. (Information was not included about the location and date of the accident.)

4. U.S. National Emergency Medical Services [EMS] Pilots Association. *2001 EMS Line Survey.* <www.nemspa.org>. June 10, 2002.

5. NTSB. Accident report no. SEA00LA092. May 25, 2000.

6. NTSB. Accident report no. NYC99GA234. Sept. 22, 1999.

7. NTSB. Accident report no. ATL96LA106. July 9, 1996.

8. Feerst, Robert. Telephone interview by Werfelman, Linda. Alexandria, Virginia, U.S. June 13, 2002. Flight Safety Foundation, Alexandria, Virginia, U.S.

9. Civil Aviation Authority of New Zealand. "Wire Strike!" *Review* 1998 (Issue 6): 1–2.

10. Feerst.

11. Richard Milton, the developer of this power-line marker, in 1993 received the Adm. Luis de Florez Flight Safety Award, presented by Flight Safety Foundation, for this achievement.

12. Reynolds, Barbara S.; Ivey, Rebecca H.; Johnson, Parley P.; Rash, Clarence E. "Researchers Develop New Power-line Marker to Help Avoid Wire Strikes in Low Light." *Helicopter Safety* Volume 23 (March–April 1997).

13. Safe Flight Instrument Corp. "Safe Flight Certifies Powerline Detection System." News release. Dec. 19, 2001.

14. EADS European Aeronautic Defence and Space Co. "Hellas Obstacle-warning System from EADS/Dornier Increases Safety for Federal Border Guard Helicopters." News release. Sept. 21, 2001.

15. Cindric, Andrew J. Jr. Telephone interview by Werfelman, Linda. Alexandria, Virginia, U.S. June 24, 2002. Flight Safety Foundation, Alexandria, Virginia, U.S.

About the Author

Joel S. Harris holds an airline transport pilot certificate and a flight instructor certificate with ratings in helicopters and airplanes. He has served as a U.S. Federal Aviation Administration designated pilot proficiency examiner, a U.S. Federal Aviation Regulations Part 135 check airman, and a safety counselor. He is the assistant director of standards for quality assurance at FlightSafety International. Harris has administered more than 10,000 hours of flight, simulator and ground school training to professional pilots.

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Flight Safety Foundation Heroism Award

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The award is presented only in years in which a nominee clearly meets the award's standard for heroism.

Since 1978, the award has been sponsored by the company now known as Kidde Aerospace and Defense; in that same year, Wilkinson Sword Ltd. was commissioned to craft a permanent symbol of the award — The Graviner Sword, a 4.2-foot (1.3-meter) Scottish highland clan broadsword, modeled after a 15th-century two-handed battle sword. The award includes a miniature replica of The Graviner Sword, US$1,000 and a handsome, wood-framed, hand-lettered citation.

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