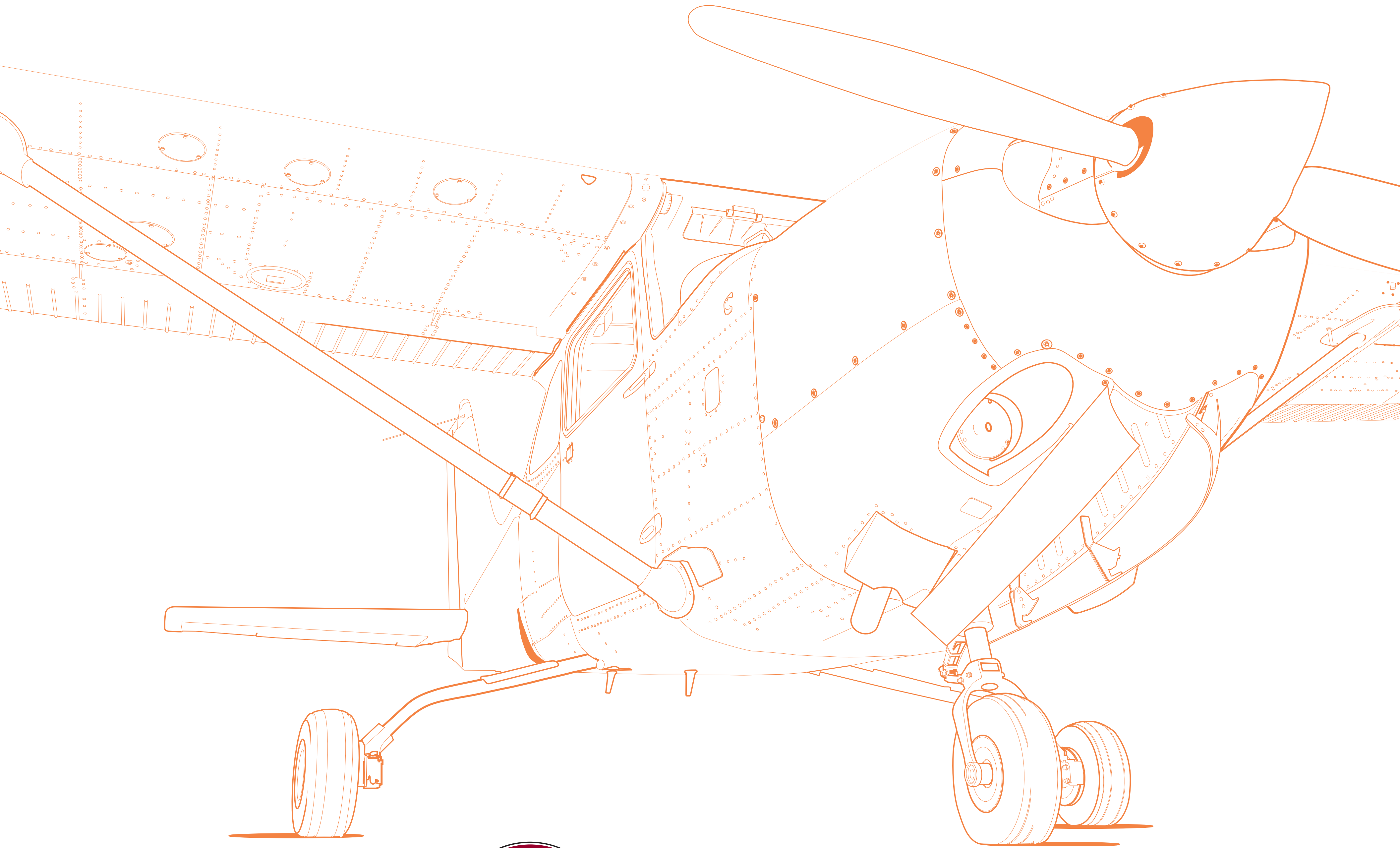

# 22ND JOSEPH T. NALL REPORT

## General Aviation Accidents in 2010

## DEDICATION

The *Joseph T. Nall Report* is the Air Safety Institute's (ASI's) annual review of general aviation aircraft accidents that occurred during the previous year. The report is dedicated to the memory of Joe Nall, an NTSB Board member who died as a passenger in an airplane accident in Caracas, Venezuela, in 1989.

## INTRODUCTION

Following the pattern of recent years, this twenty-second edition of the *Nall Report* analyzes general aviation accidents in United States national airspace and on flights departing from or returning to the U.S. or its territories or possessions. The report covers airplanes with maximum rated gross takeoff weights of 12,500 pounds or less and helicopters of all sizes. Other categories were excluded, including gliders, weight-shift control aircraft, powered parachutes, gyrocopters, and lighter-than-air craft of all types.

Accidents on commercial charter, cargo, crop-dusting, and external load flights are addressed separately from accidents on non-commercial flights, a category that includes personal and business travel and flight instruction as well as professionally flown corporate transport and positioning legs flown under FAR Part 91 by commercial operators.

## WHAT'S IN A NAME?

Last year's edition of the *Nall Report* focused on accidents that occurred in calendar year 2009. Following a long-standing tradition, it was called the *2010 Nall Report* even though it was not released until March 2011.

At the time that analysis was carried out, the National Transportation Safety Board had assigned probable cause to 83% of all general aviation accidents in 2009, but only 53% of fatal accidents. Air Safety Institute staff made provisional classifications of the rest based on the information available from NTSB preliminary reports. Reanalyzing the updated data six months later, after most 2009 investigations had been completed, ASI found that reliance on preliminary classifications had led to an overestimate of the number of accidents caused by mechanical problems and undercounts of several other categories of particular public-safety interest, including attempts to maintain flight by visual references in instrument meteorological conditions. ASI therefore decided not to undertake the next report until the NTSB had announced probable cause for at least 70% of all fatal accidents in 2010. That milestone was not reached until May 2012.

Previous *Nall Reports* have analyzed accidents from the year prior to the one listed in the title. Recent delays in data collection have pushed publication back into the following year (so that the "2010" report, covering 2009, appeared in 2011). With the current report not appearing until the third quarter of 2012, labelling it the "2011" report seemed inappropriate; ASI has taken the opportunity to remove any confusion or ambiguity by retitling it *The 22nd Joseph T. Nall Report: General Aviation Accidents in 2010*.

## FINAL VS. PRELIMINARY STATISTICS

When the data were frozen for the current report, the NTSB had released its findings of probable cause for 1,205 of the 1,377 qualifying accidents (87.5%) that occurred in 2010, including 182 of 244 fatal accidents (74.6%). All remaining accidents were categorized on the basis of preliminary information. As in the past, ASI will review the results after the NTSB has completed substantially all of its investigations to assess how the use of provisional classifications has affected this analysis.

As a supplement to the information contained in this report, ASI offers its accident database online. To search the database, visit **www.airsafetyinstitute.org/database**.

ASI gratefully acknowledges the technical support and assistance of:

National Transportation Safety Board
Federal Aviation Administration
Aircraft Owners and Pilots Association

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# TABLE OF CONTENTS


**President's View** 3

**Trends in General Aviation, 2001-2010** 4

**General Aviation Accidents in 2010** 4

**Non-Commercial Helicopter Accidents** 8

**Commercial Helicopter Accidents** 10

**Fixed-Wing Accidents Summary and Comparison** 12

**Non-Commercial Fixed-Wing Accidents** 12

Accident Causes: Flight Planning and Decision-Making 18
FUEL MANAGEMENT 18
WEATHER 19

Accident Causes: High-Risk Phases of Flight 23
TAKEOFF AND CLIMB 23
MANEUVERING 26
DESCENT AND APPROACH 27
LANDING 29

Mechanical/Maintenance 32

**Commercial Fixed-Wing Accidents** 36

**Amateur-Built and Experimental Light-Sport Aircraft** 39

**Unusual Accident Categories** 42

**Summary** 44

**Appendix** 45

General Aviation Safety vs. Airlines 45

What Is General Aviation? 46

What Does General Aviation Fly? 46

Interpreting Aviation Accident Statistics: What Is the Accident Rate? 47

NTSB Definitions 47

Accident/Incident (NTSB Part 830) 47

Aircraft Accident 48

Type of Flying 49

# PRESIDENT'S VIEW

The theme of this year's report might be "The more things change, the more they stay the same." The overall pattern of general aviation accidents in 2010 was similar to what we saw in 2009 and 2008.

One thing that just doesn't seem to change annually is the excess risk that some pilots are willing to take on for personal flights. They accounted for almost 80% of all fixed-wing accidents but barely 40% of the corresponding flight time. The accident rate on personal flights was almost double the overall fixed-wing rate. It was more than seven times higher than the rate on business flights, even though those were also made, predominantly in piston airplanes, by pilots who don't fly for a living.

Flight training also continued to be relatively safe thanks in part to a structured environment that reduces the scope of individual decision-making. The problem occurs afterward and then a very real question arises: "Did the teacher fail to teach or did the student fail to learn?" VFR into IMC and thunderstorm encounters are two areas that claim too many lives each year. Both are well covered in training as hazardous.

There is always the discussion about how to teach decision-making and helping people to make the right choice. The vagaries of human nature make this a really difficult problem to hand to flight schools and universities. The airlines depend on a system to avoid high risk where one person is never allowed to make a decision in a vacuum. But this is the essence of personal GA flight, especially among private owners.

Commercial and non-commercial, fixed-wing and helicopter, accident rates in 2010 were almost unchanged from 2009. However, helicopter safety has shown marked improvement during the past five years.

On the positive side, the accident rate among amateur-built and experimental light-sport aircraft showed its first real improvement in at least six years. The accident rate for traditional homebuilts dropped 9%, and the fatal accident rate was down 28% from 2009. Mechanical problems continue to account for disproportionate numbers of accidents in these aircraft, and a recent NTSB study confirms the elevated risk during the flight-test period.

On the negative side, fuel mismanagement accidents have crept back up for the second year in a row. In 2010 they were up almost 20% from the all-time low in 2008. Fuel exhaustion is easily avoidable and chances are you won't like the outcome of such an occurrence.

One thing that hasn't changed is the Air Safety Institute's dedication to improve GA safety through online courses, safety videos, live seminars, and publications. Increasing numbers of pilots are learning from the errors and misfortunes of others.

As always our gratitude is offered to our colleagues at the FAA and NTSB, our industry partners, and especially the individual pilots whose donations make these critical safety education programs possible.

Safe Flights,

Bruce Landsberg
President, AOPA Foundation

# TRENDS IN GENERAL AVIATION ACCIDENTS, 2001 – 2010

By FAA estimates, in 2010 flight activity in all four segments of general aviation (GA) increased from 2009 levels. Non-commercial fixed-wing activity rebounded 3% from the record lows of the year before; commercial fixed-wing and non-commercial helicopter flight time were up 4% and 7%, respectively. The most dramatic increase was in commercial helicopter flight, which jumped 21%.

Only the non-commercial helicopter record showed much change from the year before in either numbers of accidents **(Figure 1A)** or accident rates **(Figure 1B)**. The number of accidents decreased 22% despite increased activity, leading the accident rate to drop almost 30% to 5.29 per 100,000 hours. While the number of fatal accidents increased to 20 from the record low of 16 the year before, both total and fatal accident rates were still lower than the corresponding fixed-wing rates for the first time.

Twenty-one fewer non-commercial fixed-wing accidents than in 2009 (including 19 fewer fatal accidents) combined with a slight increase in estimated hours flown resulted in slight reductions of both overall and fatal accident rates, however, the resulting figures of 6.30 accidents and 1.16 fatal accidents per 100,000 hours were almost exactly in line with the ten-year averages. The increases in the number of accidents on commercial flights, both fixed-wing and helicopter, were proportionately smaller than the increases in estimated flight time, though a slightly larger share were fatal. Changes in both overall and fatal accident rates were negligible.

# GENERAL AVIATION ACCIDENTS IN 2010

In 2010, there were 1,377 general aviation accidents involving a total of 1,388 individual aircraft **(Figure 2)**. Only one collision involved aircraft of different categories; a Eurocopter EC 135 medevac helicopter landed safely at Shenandoah Valley Regional Airport in Virginia after colliding with a Cessna 172 on an instructional flight. Both men in the Cessna were killed.

A total of 420 individuals were killed in the 245 fatal accidents. This represents a 9% decrease from the previous year, primarily due to a 10% decrease in the number of fatalities in non-commercial fixed-wing accidents. Fluctuations in the small number of accidents in the other sectors produced a net increase of nine, from 51 deaths in 2009 to 60 in 2010. As usual, the vast majority of both fatal and non-fatal accidents took place on non-commercial fixed-wing flights, consistently the largest segment of U.S. general aviation, but for the first time it also had the highest total and fatal accident rates. It accounted for 75% of GA flight time, 84% of GA accidents, and 87% of fatal accidents.

**Figure 1A:** General Aviation Accident Trends, 2001-2010

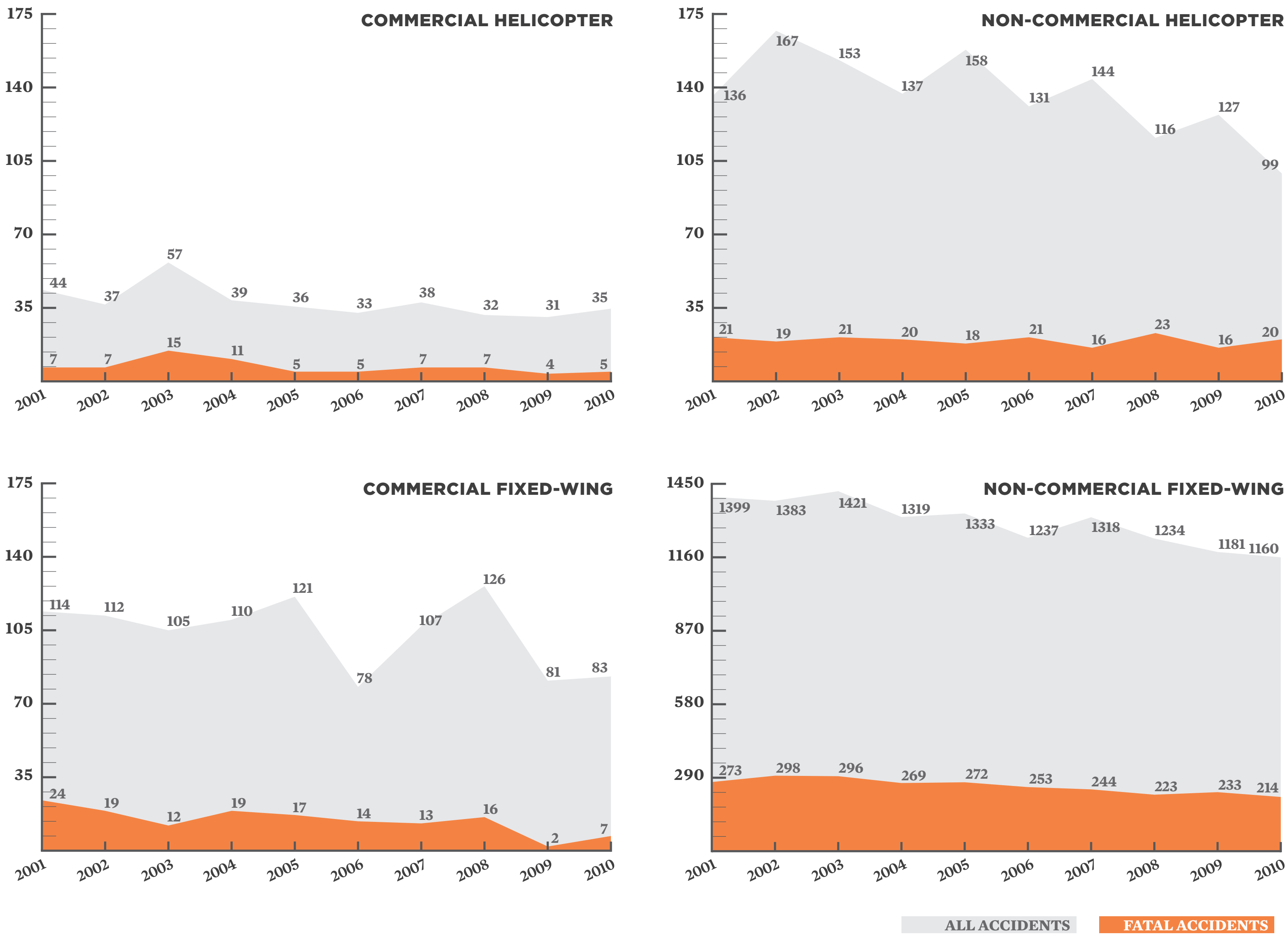


**Figure 1B:** General Aviation Accident Rates per 100,000 Flight Hours, 2001-2010

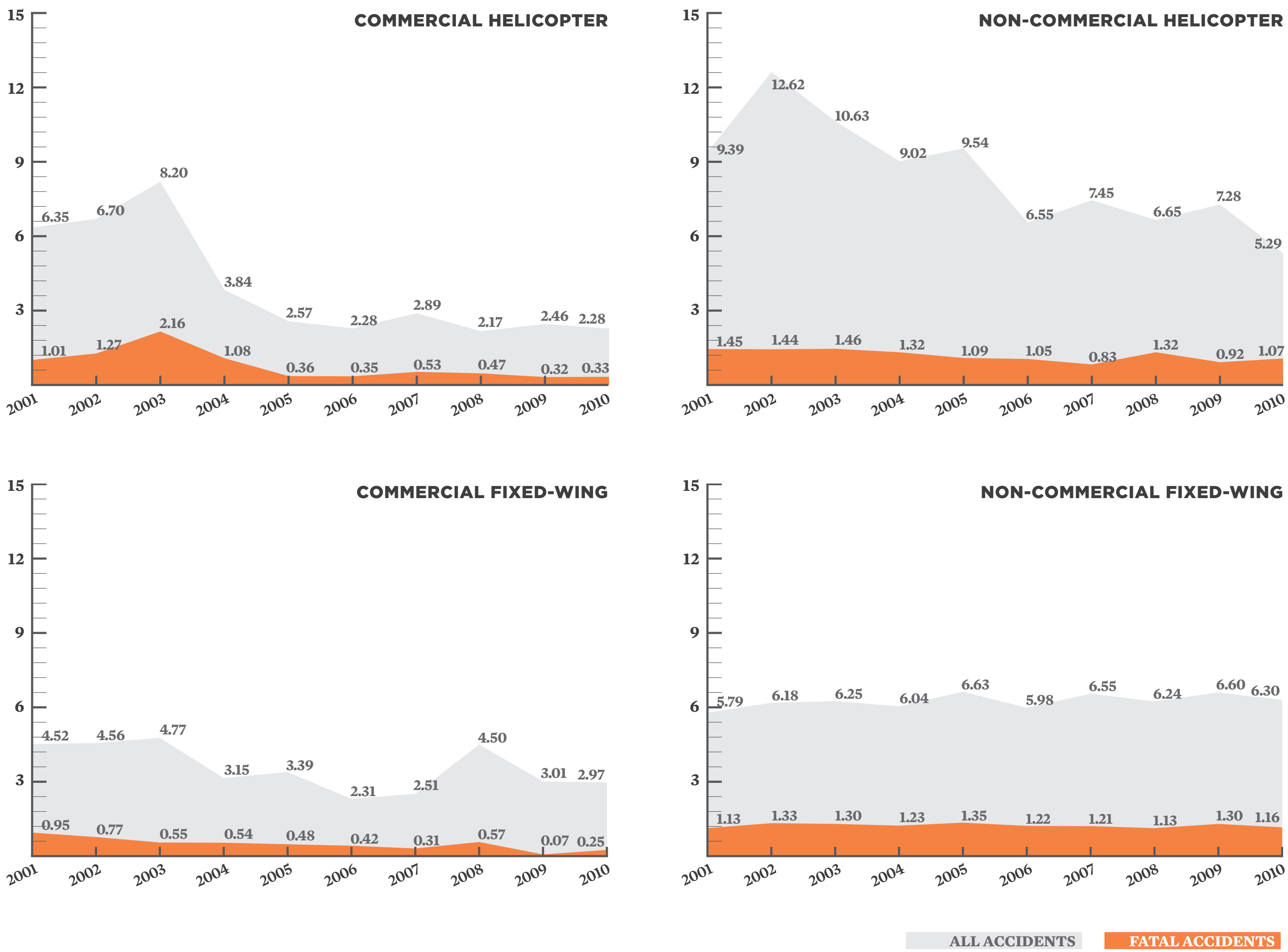
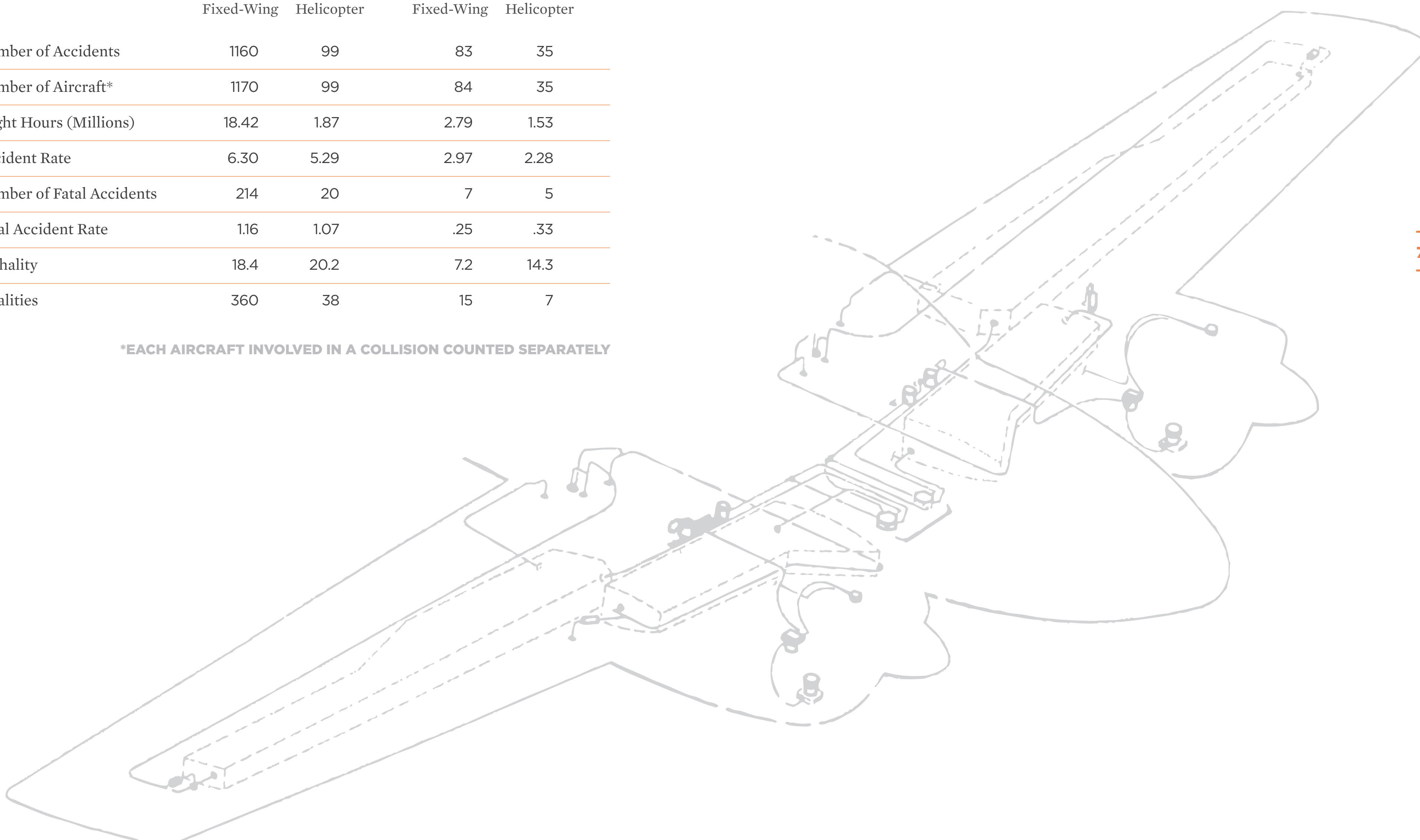


**Figure 2:** General Aviation Accidents in 2010

| | Non-Commercial | | Commercial | |
|---|---|---|---|---|
| | Fixed-Wing | Helicopter | Fixed-Wing | Helicopter |
| Number of Accidents | 1160 | 99 | 83 | 35 |
| Number of Aircraft* | 1170 | 99 | 84 | 35 |
| Flight Hours (Millions) | 18.42 | 1.87 | 2.79 | 1.53 |
| Accident Rate | 6.30 | 5.29 | 2.97 | 2.28 |
| Number of Fatal Accidents | 214 | 20 | 7 | 5 |
| Fatal Accident Rate | 1.16 | 1.07 | .25 | .33 |
| Lethality | 18.4 | 20.2 | 7.2 | 14.3 |
| Fatalities | 360 | 38 | 15 | 7 |

*EACH AIRCRAFT INVOLVED IN A COLLISION COUNTED SEPARATELY



# NON-COMMERCIAL HELICOPTER ACCIDENTS

The number of non-commercial helicopter accidents dropped from 127 in 2009 to 99 in 2010, a 22% decrease. This was the first year that has seen fewer than 100 in the three decades covered by the ASI accident database, and the first time both total and fatal accident rates on non-commercial flights have been lower for rotorcraft than airplanes.

**AIRCRAFT CLASS** As in prior years, just over 60% involved single-engine piston helicopters, including almost half the fatal accidents **(Figure 3)**. Single-engine turbines accounted for about one-third, while multiengine turbines were only involved in 6%.

**TYPE OF OPERATION** Personal flights consistently make up a much smaller share of helicopter than fixed-wing activity. Less than 7% of 2010's non-commercial rotorcraft time was logged on personal flights compared to 42% of fixed-wing time. In both sectors, though, disproportionate numbers of accidents occurred on personal flights, and the disparity was even greater in helicopters: 7% of flight activity produced one-third of all accidents, one-fourth of all fatal accidents, and more than a quarter of individual fatalities **(Figure 4)**.

After spiking in 2009, the number of instructional accidents returned to historical levels, dropping from 40 to 25. Only two were fatal, causing one casualty each: a student pilot flying solo in a Robinson R22, and an FAA examiner administering a CFI checkride in a Schweizer 269C-1. Accidents on positioning flights were unusually lethal in 2010; six of 14 were fatal, causing 12 deaths. This has not been the case in the recent past, and so may be a chance fluctuation.

There were no helicopter accidents in professionally flown executive transport, but five accidents (one fatal) occurred on business flights made by people not primarily employed as pilots.

**FLIGHT CONDITIONS** As in the past, the vast majority of helicopter accidents (89%) occurred in visual meteorological conditions (VMC) during daylight hours **(Figure 5)**, including 85% of all fatal accidents. More than half the rest took place in VMC at night, but none were fatal. In the same pattern that recurs throughout GA, lethality is far higher when accidents occur in instrument meteorological conditions (IMC); three of the five in IMC were fatal, which caused eight of the 38 individual fatalities (21%).

**PILOT QUALIFICATIONS** More than three-quarters of the accident pilots held either commercial or airline transport pilot certificates **(Figure 6)**. These included 75% of all fatal accidents and almost 85% of individual fatalities. Slightly under half were certificated flight instructors, and the 13% lethality of these accidents was almost one-third lower than the 18% in accidents involving ATPs or commercial pilots who did not hold flight instructor certificates. Fewer than half the accidents involving CFIs (20 of 47) occurred on instructional flights.

PERCENTAGES ARE PERCENT OF ALL ACCIDENTS, OF ALL FATAL ACCIDENTS, AND OF INDIVIDUAL FATALITIES, RESPECTIVELY

**Figure 3:** Aircraft Class—Non-Commercial Helicopter Accidents

| Aircraft Class | Accidents | | Fatal Accidents | | Fatalities | |
|---|---|---|---|---|---|---|
| Single-Engine Piston | 61 | 61.6% | 9 | 45.0% | 11 | 28.9% |
| Single-Engine Turbine | 32 | 32.3% | 8 | 40.0% | 20 | 52.6% |
| Multiengine Turbine | 6 | 6.1% | 3 | 15.0% | 7 | 18.4% |

**Figure 5:** Flight Conditions—Non-Commercial Helicopter Accidents

| Conditions | Accidents | | Fatal Accidents | | Fatalities | |
|---|---|---|---|---|---|---|
| Day VMC | 88 | 88.9% | 17 | 85.0% | 30 | 78.9% |
| Night VMC | 6 | 6.1% | 0 | | 0 | |
| Day IMC | 2 | 2.0% | 1 | 5.0% | 2 | 5.3% |
| Night IMC | 3 | 3.0% | 2 | 10.0% | 6 | 15.8% |

**Figure 4:** Type of Operation—Non-Commercial Helicopter Accidents

| Type of Operation | Accidents | | Fatal Accidents | | Fatalities | |
|---|---|---|---|---|---|---|
| Personal | 33 | 33.3% | 5 | 25.0% | 10 | 26.3% |
| Instructional | 25 | 25.3% | 2 | 10.0% | 2 | 5.3% |
| Positioning | 14 | 14.1% | 6 | 30.0% | 12 | 31.6% |
| Public Use | 8 | 8.1% | 2 | 10.0% | 5 | 13.2% |
| Aerial Observation | 4 | 4.0% | 1 | 5.0% | 3 | 7.9% |
| Business | 5 | 5.1% | 1 | 5.0% | 2 | 5.3% |
| Other Work Use | 7 | 7.1% | 2 | 10.0% | 2 | 5.3% |
| Other* | 3 | 3.0% | 1 | 5.0% | 2 | 5.3% |

*INCLUDES FLIGHT TESTS AND UNREPORTED

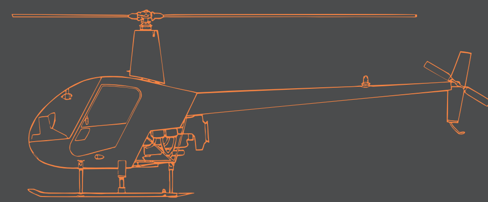
**Figure 6:** Pilots Involved in Non-Commercial Helicopter Accidents

| Certificate Level | Accidents | | Fatal Accidents | | Fatalities | |
|---|---|---|---|---|---|---|
| ATP | 19 | 19.2% | 5 | 25.0% | 7 | 18.4% |
| Commercial | 58 | 58.6% | 10 | 50.0% | 25 | 65.8% |
| None/Unknown | 2 | 2.0% | 1 | 5.0% | 1 | 2.6% |
| Private | 15 | 15.2% | 3 | 15.0% | 4 | 10.5% |
| Student | 5 | 5.1% | 1 | 5.0% | 1 | 2.6% |
| CFI on Board* | 47 | 47.5% | 6 | 30.0% | 13 | 34.2% |

*INCLUDES SINGLE-PILOT ACCIDENTS

## ACCIDENT CASE STUDY

**NTSB ACCIDENT NO. CEN10FA139**
**ROBINSON R22 BETA II, COTULLA, TX**
**TWO FATALITIES**



**HISTORY OF FLIGHT** The pilot had been engaged to take guests on aerial hog hunts on a private ranch. He told the hunters that he'd be operating "light on fuel" to improve maneuverability. After a short orientation flight with the ranch manager, he took three hunters for flights of about 20 minutes each, loading and unloading them with the engine running. He also carried out several "hot" refuelings, adding fuel from a tank on the back of his truck between flights. The tank did not have a gauge to measure the quantity dispensed. The hunting flights were made "at about the height of a telephone pole" and speeds of 25 mph or less.

About ten minutes after the helicopter took off on its sixth flight of the day, the rest of the party heard a sound similar to "a lawnmower bogging down in tall grass." The wreckage was found shortly afterwards. Only residual fuel remained in the tanks, which were not breached, and there was no sign of fuel blighting on the surrounding vegetation.

**PILOT INFORMATION** The 40-year-old pilot held a commercial certificate with instrument rating for rotorcraft helicopter. Partial records documented that he'd logged 498 hours of flight experience, including 303 in that make and model, nearly two years before the accident. The helicopter's owner estimated that at the time of the accident the pilot had about 1,000 hours of total flight experience that included 700 in the same make and model.

**WEATHER** At the Cotulla Airport, 12 nautical miles southeast of the accident site, the automated weather observation system reported wind from 130 degrees at 13 knots with 10 miles visibility and a broken ceiling at 1,700 feet.

**PROBABLE CAUSE** A loss of engine power due to fuel exhaustion as a result of the pilot's inadequate fuel planning. Contributing to the accident was the low-altitude operating environment that would not allow for a successful autorotation after the loss of engine power.

**ASI COMMENTS** A cornerstone of risk management is minimizing vulnerability to single-point failures. Operating at altitudes too low to carry out an autorotation makes avoiding sudden engine stoppage especially critical; the desire to reduce fuel weight puts a premium on preserving options for a successful emergency landing. By choosing to fly at unrecoverable altitudes with minimal fuel—and without precise measurement of his fuel supply—this pilot invited an emergency to which he had no good way to respond.

# COMMERCIAL HELICOPTER ACCIDENTS

**COMMERCIAL** There were 35 accidents on commercial helicopter flights in 2010, an increase of five (17%) from the year before. Five (14%) were fatal compared to four (13%) in 2009. Since flight activity increased 22%, total and fatal accident rates were almost unchanged **(see Figure 1B)**.

More than two-thirds took place on crop-dusting flights **(Figure 7)**, almost double the proportion of the previous year. Two of the pilots were killed. The only fatal accident on a Part 135 helicopter flight killed a medevac pilot and two paramedics during a simulated patient pick-up at night; the pilot's limited familiarity with night vision goggles is thought to have contributed to his loss of control. Two of the four accidents on external load flights were fatal. The victims were one of the accident pilots and an electrical lineman positioned on a skid while conducting transmission-line maintenance.

All external-load accidents, 23 of the 24 accidents during aerial application, and four of the seven accidents on Part 135 flights took place in VMC during the daytime. There were no commercial helicopter accidents in IMC during 2010. Three-quarters of the accident aircraft were single-engine turbine models. However, one-third of the crop-dusting accidents involved piston helicopters, and there was one non-fatal Part 135 accident in a multiengine turbine.



**Figure 7:** Summary of Commercial Helicopter Accidents

| | Accidents | | Fatal Accidents | | Fatalities | |
|---|---|---|---|---|---|---|
| **Aerial Application (Part 137)** | 24 | 68.6% | 2 | 40.0% | 2 | 28.6% |
| Single-Engine Piston | 8 | | 1 | | 1 | |
| Single-Engine Turbine | 16 | | 1 | | 1 | |
| Day VMC | 23 | | 2 | | 2 | |
| Night VMC* | 1 | | 1 | | 1 | |
| ATP | 1 | | 0 | | 0 | |
| Commercial | 23 | | 2 | | 2 | |
| **Charter or Cargo (Part 135)** | 7 | 20.0% | 1 | 20.0% | 3 | 42.9% |
| Single-Engine Turbine | 6 | | 1 | | 3 | |
| Multiengine Turbine | 1 | | 0 | | 0 | |
| Day VMC | 4 | | 0 | | 0 | |
| Night VMC* | 3 | | 1 | | 3 | |
| ATP | 4 | | 1 | | 3 | |
| Commercial | 3 | | 0 | | 0 | |
| **External Load (Part 133)** | 4 | 11.4% | 2 | 40.0% | 2 | 28.6% |
| Single-Engine Turbine | 4 | | 2 | | 2 | |
| Day VMC | 4 | | 2 | | 2 | |
| Commercial | 4 | | 2 | | 2 | |

*INCLUDES DUSK

# FIXED-WING ACCIDENTS SUMMARY AND COMPARISON

The causes of general aviation accidents may be grouped into three broad categories for analysis:

- **Pilot-Related**—accidents arising from the improper actions or inactions of the pilot.
- **Mechanical/Maintenance**—accidents arising from mechanical failure of a component or an error in maintenance.
- **Other/Unknown**—accidents for reasons such as pilot incapacitation, and those for which a specific cause has not been determined.

In 2010, as in the previous year, the accident rate on non-commercial fixed-wing flights was more than double the commercial rate, and the fatal accident rate was more than four times higher **(Figure 2)**. Moreover, a larger share of non-commercial accidents were attributed to pilot-related causes **(Figure 8)**, meaning that non-commercial flights suffered two and a half times as many pilot-related accidents per 100,000 hours flown (4.65 vs. 1.86). The combined rate of all other accidents was 45% higher on non-commercial flights (1.64 per 100,000 hours compared to 1.13). The rate of fatal pilot-related accidents was 4.5 times higher (0.80 compared to 0.18), about the same as the difference in fatal accident rates overall.

# NON-COMMERCIAL FIXED-WING ACCIDENTS

2010 saw both a modest increase in flight activity (about 3%) and a continued decrease in the number of accidents, with 21 fewer than the year before (including 19 fewer fatal accidents). The year-end totals of 1,160 accidents with 214 fatal were the lowest in more than three decades. However, with estimated hours flown remaining near 2009's lows, the accident rate decreased less than 5% to 6.30 per 100,000 hours, in line with the ten-year moving average of 6.25. The fatal accident rate dropped 11% to 1.16 per 100,000 hours, not significantly lower than the ten-year moving average of 1.24 or the rates estimated for four of the preceding nine years.

As has consistently been the case in the past, more than 70% were attributed to pilot-related causes, and only about 15% to documented mechanical failures.

**AIRCRAFT CLASS** More than 70% of the accident aircraft were single-engine fixed-gear (SEF) airplanes **(Figure 9)**, which were involved in 54% of all fatal accidents. The increasing speed and weight associated with greater complexity have consistently been noted as contributing to greater lethality in single-engine retractable (SER) and multiengine (ME) airplanes. More than 40% of the SEF airplanes involved in accidents were equipped with conventional landing gear. Fatalities were almost one-third less common in tailwheel airplanes, in part because of their greater susceptibility to landing accidents, the category least likely to prove fatal. At the other extreme, one-third of the 87 accidents in multiengine piston airplanes were fatal. FAA estimates suggest that these aircraft see more use at night and in instrument conditions than piston singles, circumstances long associated with increased lethality in all categories and classes of aircraft.

Only 36 non-commercial accidents (3%) involved turbine-powered airplanes, which accounted for more than 20% of non-commercial flight time. In addition to the greater capability of the aircraft themselves, jets and turboprops are almost always flown by more experienced pilots, and more often operate with the presumed safety advantage of a two-pilot crew. More than half the non-commercial turbine time was reported by corporate flight departments, which consistently boast the best safety record in all of general aviation.

**TYPE OF OPERATION** Personal flights accounted for 42% of non-commercial fixed-wing activity in 2010 but resulted in 78% of the accidents **(Figure 10)**, including 79% of fatal accidents. The accident rate on personal flights was more than two and a half times greater than that on instructional flights and more than five times the combined rate for all other types of flights. Fatal accident rates were also more than five times higher. Year after year, the excessive number of accidents on personal flights drives up overall accident rates for non-commercial fixed-wing flight.

Corporate and executive transport represents the opposite extreme. Only three accidents, none of them fatal, occurred in more than 2.5 million hours. The combined advantages of high-end equipment, professional crews, more flights made at altitudes above most hazardous weather, and logistical and dispatch assistance make this the sector of general aviation that is most comparable to the scheduled airlines, and its safety history reflects that. Flight instruction also maintained a relatively good record in 2010, with less than 12% of all accidents in more than 17% of flight time.

**FLIGHT CONDITIONS** The pattern noted in previous years was maintained in 2010: Barely 5% of all accidents occurred in IMC, but these included 18% of all fatal accidents **(Figure 11)**. Almost two-thirds of all accidents in IMC were fatal compared to about 15% of those in VMC during daylight hours and 20% of those in VMC at night.

**Figure 8:** Major Causes—Fixed-Wing General Aviation Accidents

| | Non-Commercial All Accidents | | Non-Commercial Fatal Accidents | | Commercial All Accidents | | Commercial Fatal Accidents | |
|---|---|---|---|---|---|---|---|---|
| Pilot-Related | 857 | 73.9% | 148 | 69.2% | 52 | 62.7% | 5 | 71.4% |
| Mechanical | 174 | 15.0% | 22 | 10.3% | 19 | 22.9% | 0 | |
| Other or Unknown | 129 | 11.1% | 44 | 20.6% | 12 | 14.5% | 2 | 28.6% |

**Figure 10:** Type of Operation—Non-Commercial Fixed-Wing Accidents

| Type of Operation | Accidents | | Fatal Accidents | | Fatalities | |
|---|---|---|---|---|---|---|
| Personal | 908 | 77.6% | 170 | 78.7% | 287 | 79.7% |
| Instructional | 138 | 11.8% | 14 | 6.5% | 24 | 6.7% |
| Business | 36 | 3.1% | 10 | 4.6% | 16 | 4.4% |
| Positioning | 16 | 1.4% | 3 | 1.4% | 3 | 0.8% |
| Public Use | 14 | 1.2% | 3 | 1.4% | 6 | 1.7% |
| Aerial Observation | 5 | 0.4% | 2 | 0.9% | 4 | 1.1% |
| Other Work Use | 30 | 2.6% | 9 | 4.2% | 15 | 4.2% |
| Other* | 23 | 2.0% | 5 | 2.3% | 5 | 1.4% |

*INCLUDES CORPORATE, AIR SHOWS, FLIGHT TESTS, AND UNREPORTED

**Figure 9:** Aircraft Class—Non-Commercial Fixed-Wing Accidents

| Aircraft Class | Accidents | | Fatal Accidents | | Lethality |
|---|---|---|---|---|---|
| Single-Engine Fixed Gear | 827 | 70.7% | 117 | 54.2% | 14.1% |
| SEF, Conventional Gear | 353 | | 37 | | 10.5% |
| Single-Engine Retractable | 242 | 20.7% | 68 | 31.5% | 28.1% |
| Single-Engine Turbine | 22 | | 5 | | 22.7% |
| Multiengine | 101 | 8.6% | 31 | 14.4% | 30.7% |
| Multiengine Turbine | 14 | | 2 | | 14.3% |

**Figure 11:** Flight Conditions—Non-Commercial Fixed-Wing Accidents

| Light and Weather | Accidents | | Fatal Accidents | | Fatalities | |
|---|---|---|---|---|---|---|
| Day VMC | 1009 | 86.2% | 156 | 72.2% | 239 | 66.4% |
| Night VMC* | 98 | 8.4% | 20 | 9.3% | 39 | 10.8% |
| Day IMC | 47 | 4.0% | 28 | 13.0% | 60 | 16.7% |
| Night IMC* | 15 | 1.3% | 11 | 5.1% | 20 | 5.6% |
| Unknown | 1 | 0.1% | 1 | 0.5% | 2 | 0.6% |

*INCLUDES DUSK

**Figure 12:** Pilots Involved in Non-Commercial Fixed-Wing Accidents

| Certificate Level | Accidents | | Fatal Accidents | | Lethality |
|---|---|---|---|---|---|
| ATP | 160 | 13.7% | 29 | 13.4% | 18.1% |
| Commercial | 330 | 28.2% | 65 | 30.1% | 19.7% |
| Private | 574 | 49.1% | 110 | 50.9% | 19.2% |
| Sport | 18 | 1.5% | 4 | 1.9% | 22.2% |
| Student | 67 | 5.7% | 5 | 2.3% | 7.5% |
| None/Unknown | 21 | 1.8% | 3 | 1.4% | 14.3% |
| Second Pilot On Board | 141 | 12.1% | 34 | 15.7% | 24.1% |
| CFI On Board* | 281 | 24.0% | 51 | 23.6% | 18.1% |
| Instrument-Rated Pilot On Board* | 635 | 54.3% | 128 | 59.3% | 20.2% |

*INCLUDES SINGLE-PILOT ACCIDENTS

**Figure 14:** Pilot-Related Accident Rates Per 100,000 Flight Hours, 2001-2010

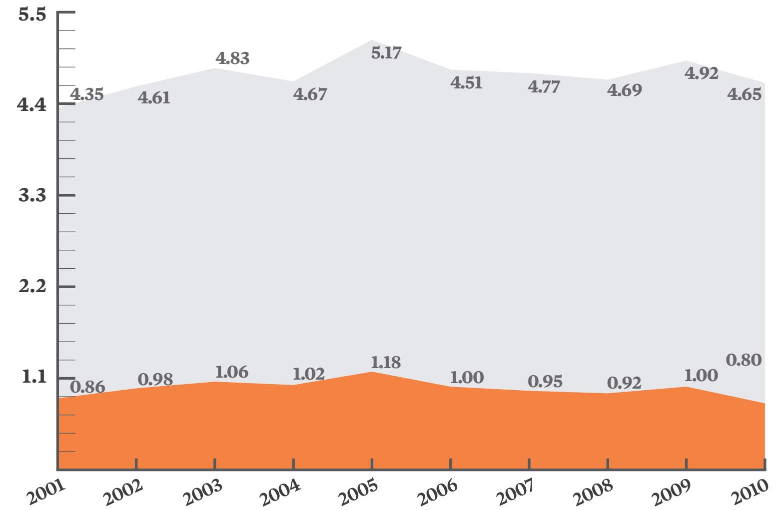



**Figure 13:** Pilot-Related Accident Trend

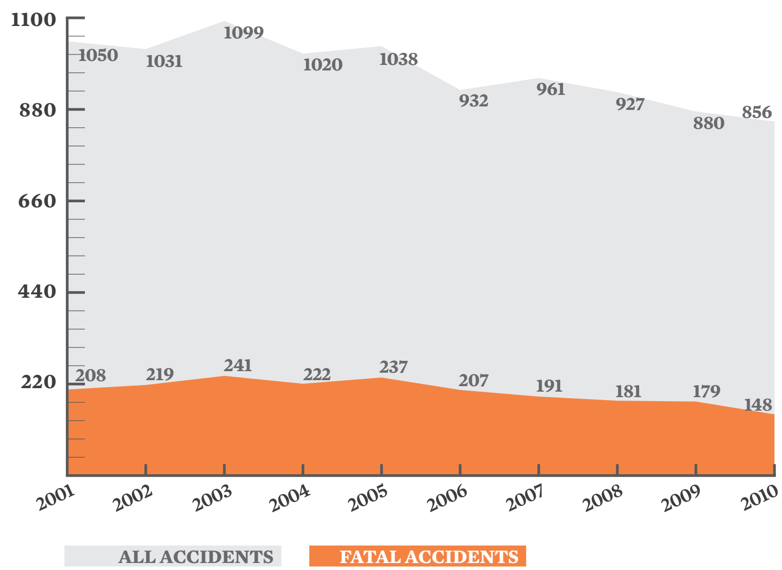
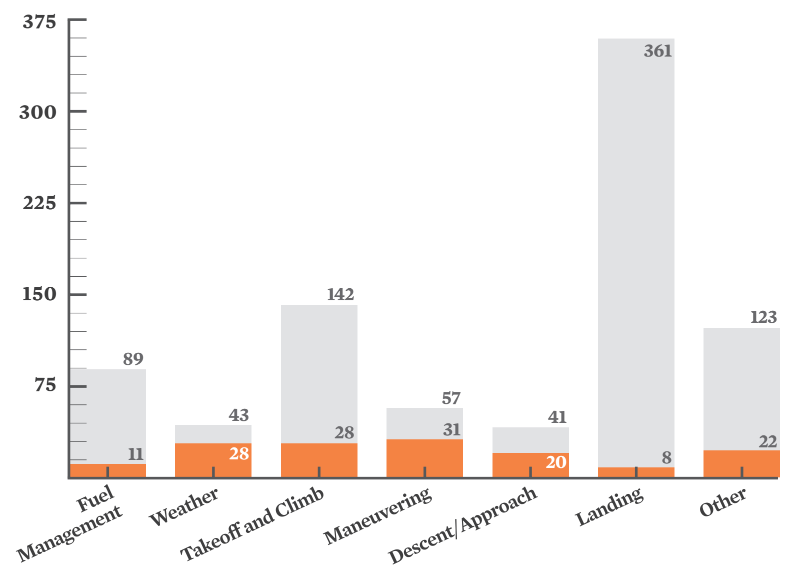



**Figure 15:** Types of Pilot-Related Accidents



However, because the overwhelming majority of all accidents (more than 85%) took place in daytime VMC, more than 70% of all fatal accidents and two-thirds of individual fatalities occured in VMC during daylight hours.

The circumstances of one fatal accident remain unknown: There is no record of the aircraft's whereabouts for several days between its last known landing and the discovery of the wreckage.

**PILOT QUALIFICATIONS** About half of all accident flights, fatal and non-fatal alike, were commanded by private pilots **(Figure 12)**. This is the same pattern seen in earlier years, and is thought to be roughly proportionate to their overall level of involvement in non-commercial fixed-wing GA; however, no reliable estimate of flight activity by certificate level exists. More than 60% of all pilots with private or higher certificates hold instrument ratings, but that figure includes commercial and airline transport pilots who do little or no GA flying beyond positioning legs flown under Part 91 in company aircraft. Those uncertainties suggest that the 54% of all accidents and 59% of fatal accidents involving instrument-rated pilots are no lower than their share of the relevant population, and might in fact be higher.

Among those with at least sport-pilot certificates, lethality showed little variation between certificate levels. Accidents on student solos were fatal less than half as often, largely due to their greater vulnerability to landing mishaps. The tight restrictions and extra precautions characteristically imposed on student solos may also have a protective effect.

Only one-third of all accidents involving CFIs occurred on instructional flights, and only 12 of the 93 (13%) were fatal. Nearly half (137 of 281) were personal flights, and these included 27 of 51 fatal accidents. The rest were on working flights of various kinds. Sport pilots are still almost absent from the accident record, but FAA figures show that they made up less than 1% of the pilot population in 2010. Sixty-five percent of the fatal accidents involving two-pilot crews took place on personal flights; the lethality of these accidents was 43% even though almost all took place in daytime VMC.

**ACCIDENT CAUSES** After excluding accidents due to mechanical failures or improper maintenance, accidents whose causes have not been determined, and the handful due to circumstances beyond the pilot's control, all that remain are considered pilot-related. Most pilot-related accidents reflect specific failures of flight planning or decision-making or the characteristic hazards of high-risk phases of flight. Six major categories of pilot-related accidents consistently account for large numbers of accidents overall, high proportions of those that are fatal, or both. Mechanical failures and an assortment of relatively rare occurrences (such as taxi collisions or accidents caused by discrepancies overlooked during preflight inspections) make up most of the rest.

**PILOT-RELATED ACCIDENTS** *(856 TOTAL / 148 FATAL)* Pilot-related causes consistently account for about 75% of non-commercial fixed-wing accidents, a pattern that continued in 2010 **(Figure 13)**. At present, these appear to include fewer than 70% of the fatal accidents. Based on recent experience, this figure is likely to increase as more fatal accident investigations are concluded and probable cause determined. Likewise, the apparent dip in the pilot-related fatal accident rate to 0.80 per 100,000 hours **(Figure 14)** may well be revised upward once the data are complete. The overall rate of pilot-related accidents remains near the center of its recent range.

The relative frequency of different types of pilot-related accidents followed the familiar pattern **(Figure 15)**. Landing accidents were the most common at more than 30%, but only 2% of them were fatal. The largest number of fatal accidents (31) occurred during low-altitude maneuvering, though this was only slightly more than in weather accidents and takeoffs gone wrong (28 each). Sixty-five percent of the accidents attributed to adverse weather were fatal; maneuvering accidents and accidents during descent and approach incurred lethalities close to 50%. Fewer than 20% of the accidents in any of the other major categories were fatal.

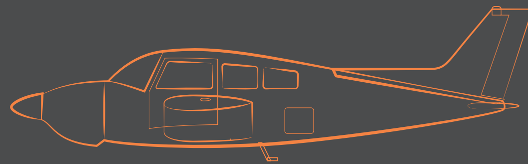
The "Other" category of pilot-related accidents includes:

- 36 accidents (six fatal) attributed to inadequate preflight inspections
- 35 accidents during attempted go-arounds, four of which were fatal
- 24 non-fatal accidents while taxiing
- 10 accidents in which loss of engine power during cruise was blamed on the pilot's failure to use carburetor heat; two were fatal
- Six instances, three fatal, of pilot incapacitation blamed on alcohol and/or drugs
- Five accidents caused by the pilot's physical incapacitation; four were fatal
- Three fatal midair collisions, two between airplanes and one between an airplane and a helicopter, as well as a non-fatal midair collision between two floatplanes in Alaska
- Three non-fatal collisions on the ground.

Accidents caused by fuel mismanagement or adverse weather generally give reasonable warning to the pilot. As such, they can be considered failures of flight planning or in-flight decision-making. Takeoff and landing accidents in particular tend to happen very quickly, focusing attention on the pilot's airmanship (though the decision-making that leads airmanship to be tested can usually be called into question).

## ACCIDENT CASE STUDY

**NTSB ACCIDENT NO. ERA10FA150**
**BEECH C23, WINTER HAVEN, FL**
**TWO FATALITIES**



**HISTORY OF FLIGHT** The airplane crossed the departure end of the runway at an altitude of about 150 feet in what appeared to be "a normal VY climb." About five seconds later—at an altitude estimated to be between 200 and 300 feet—the engine "just stopped." The airplane's pitch attitude decreased by about five degrees as it began a 30-degree bank to the right; after it disappeared behind trees, witnesses heard the sound of impact. Investigators found no evidence of pre-impact abnormalities in the engine, which was run successfully on a test stand. Each tank contained approximately 22 gallons of fuel, but the fuel selector was found in the "OFF" position. A guard to prevent inadvertently setting the selector to "OFF" had been installed as required by Airworthiness Directive (AD), but the markings specified by the AD had not been made on the valve housing. Investigators also found that enough fuel leaked through the valve in the "OFF" position to run the engine at 2,250 rpm for at least two minutes. Replacing the valve's internal O-rings stopped the leakage.

**PILOT INFORMATION** After a five-year period in which his logbook showed no flight time, the 45-year-old private pilot had resumed flying 15 months before the accident. His logbook showed a total of 469 hours of flight experience, including five flights totalling 5.7 hours in the accident airplane. All five were made in a ten-day period about two months earlier. No record of check-out training in the C23 was found in the pilot's logbook, though the aircraft's operator requires make-and-model check-outs as standard practice.

**WEATHER** A METAR recorded 34 minutes before the accident reported wind was from 330 degrees at 13 knots with clear skies.

**PROBABLE CAUSE** The pilot's improper placement of the fuel selector valve during takeoff, and his failure to maintain adequate airspeed following a total loss of engine power resulting in an inadvertent stall. Contributing to the accident was the failure of maintenance personnel to detect the lack of proper markings on the fuel selector stop and fuel selector valve shroud at the last 100-hour inspection.

**ASI COMMENTS** The first step in fuel management is familiarity with the aircraft's systems. The Beech C23's fuel selector has a long handle used to turn the valve that is opposite the short indicator marked with a white arrow that shows the position chosen (left tank, right tank, or one of the two "OFF" positions opposite them). In many other popular models, including comparably sized Cessna and Piper singles, the long arm of the selector handle indicates the tank selected. Assuming that the pilot did verify the selector position before takeoff, his lack of make-and-model experience (and perhaps of systematic check-out training) may have been the crucial link in the accident chain.

## ACCIDENT CAUSES: FLIGHT PLANNING AND DECISION-MAKING

### FUEL MANAGEMENT *(89 TOTAL / 11 FATAL)*

The decline in fuel management accidents through 2008 was one of the rare success stories in GA safety, showing a 50% decrease in 10 years. Since then, fuel management accidents have become more frequent again, increasing from 75 to 89 in 2010 even as the overall number of fixed-wing accidents has decreased **(Figure 16)**. Fuel mismanagement caused just over 6% of the accidents in 2008, but almost 8% of those in 2010. There is no direct proof that increasing fuel prices have played a significant role in that increase.

Inadequate flight planning—failures to determine the amount of fuel required for the flight or the amount actually on board, or to verify the rate of fuel consumption en route—accounted for the largest share (48%), but errors in operating the aircraft's fuel system (choosing an empty tank or the incorrect use of boost or transfer pumps) were almost as widespread, implicated in 43% **(Figure 17)**. Eight accidents were attributed to fuel contamination, six of them by water. Seven of those airplanes were more than 20 years old, and at least three had been tied down outdoors for extended periods during which they were not flown regularly.

Greater system complexity did not appear to be a risk factor for fuel mismanagement; more than 70% of the accident airplanes were fixed-gear singles, about the same proportion as in all non-commercial fixed-wing accidents. The credentials of the accident pilots also showed no obvious differences from other types of accidents; just over half involved private pilots, while more than 40% were flown by commercial or airline transport pilots. However, a quarter of fuel-management accidents took place at night **(Figure 18)**, almost three times the proportion seen in other accident categories.

**WEATHER** *(43 TOTAL / 28 FATAL)* Fatal weather accidents are among the most difficult to investigate, and weather accidents are the most consistently fatal. The preliminary data used in the *2010 Nall Report* did not contain enough detail to definitively identify 20 of 2009's 46 fatal weather accidents. Experience suggests that the apparent drop in weather accidents in 2010 **(Figure 19)** is largely the

**Figure 16:** Fuel Management Accident Trend

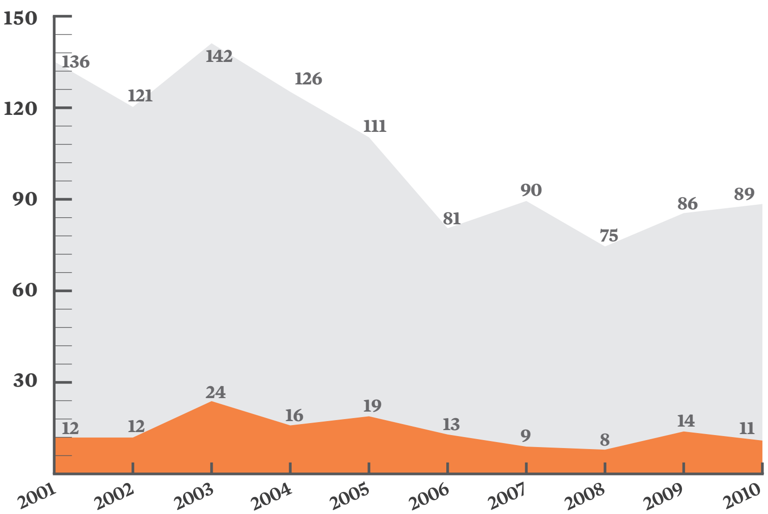



**Figure 17:** Types of Fuel Management Accidents

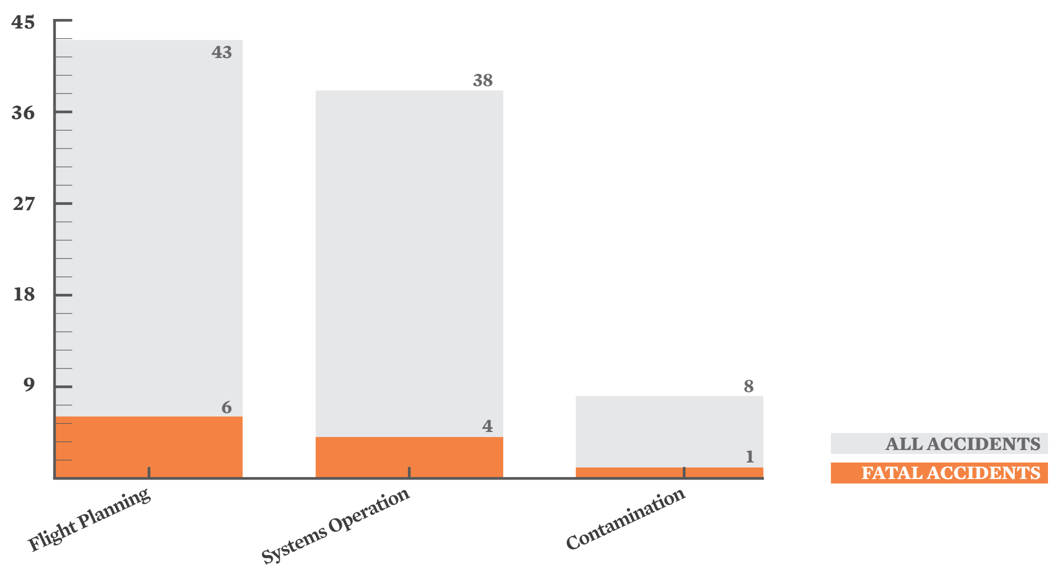


**Figure 18:** Flight Conditions of Fuel Management Accidents—Non-Commercial Fixed-Wing

| Light and Weather | Accidents | | Fatal Accidents | | Lethality |
|---|---|---|---|---|---|
| Day VMC | 66 | 74.2% | 7 | 63.6% | 10.6% |
| Night VMC | 22 | 24.7% | 3 | 27.3% | 13.6% |
| Night IMC | 1 | 1.1% | 1 | 9.1% | 100.0% |

**Figure 19:** Weather Accident Trend

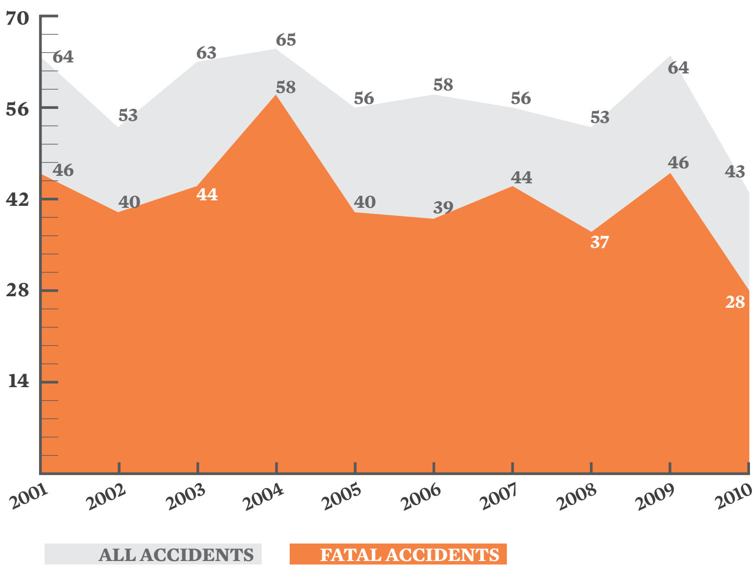



**Figure 20:** Types of Weather Accidents

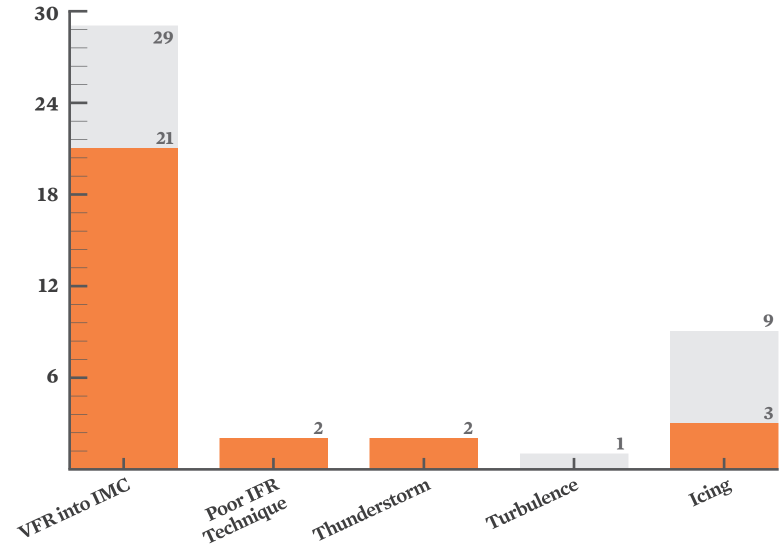



**Figure 21:** Flight Conditions of Weather Accidents—Non-Commercial Fixed-Wing

| Light and Weather | Accidents | | Fatal Accidents | | Lethality |
|---|---|---|---|---|---|
| Day VMC | 11 | 25.6% | 6 | 21.4% | 54.5% |
| Night VMC | 2 | 4.7% | 1 | 3.6% | 50.0% |
| Day IMC | 21 | 48.8% | 14 | 50.0% | 66.7% |
| Night IMC | 9 | 20.9% | 7 | 25.0% | 77.8% |

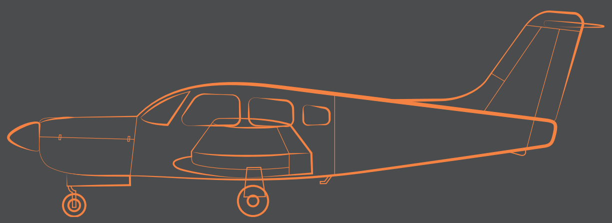
**Figure 22:** Aircraft Involved in Weather Accidents—
Non-Commercial Fixed-Wing

| Aircraft Class | Accidents | | Fatal Accidents | | Lethality |
|---|---|---|---|---|---|
| Single-Engine Fixed Gear | 23 | 53.5% | 9 | 32.1% | 39.1% |
| Single-Engine Retractable | 14 | 32.6% | 13 | 46.4% | 92.9% |
| Multiengine | 6 | 14.9% | 6 | 21.4% | 100.0% |

**Figure 23:** Pilots Involved in Weather Accidents—
Non-Commercial Fixed-Wing

| Certificate Level | Accidents | | Fatal Accidents | | Lethality |
|---|---|---|---|---|---|
| ATP | 1 | 2.3% | 1 | 3.6% | 100.0% |
| Commercial | 12 | 27.9% | 7 | 25.0% | 58.3% |
| Private | 28 | 65.1% | 19 | 67.9% | 67.9% |
| Sport | 1 | 2.3% | 1 | 3.6% | 100.0% |
| Student | 1 | 2.3% | 0 | | |
| CFI On Board* | 5 | 11.6% | 2 | 7.1% | 40.0% |
| Instrument-Rated Pilot On Board* | 22 | 51.2% | 16 | 57.1% | 72.7% |

*INCLUDES SINGLE-PILOT ACCIDENTS



# ACCIDENT CASE STUDY

**NTSB ACCIDENT NO. ERA10FA359**
**PIPER PA-28RT-201, NORTH MYRTLE BEACH, SC**
**THREE FATALITIES**

**HISTORY OF FLIGHT** Because he was not night current, the pilot had been instructed to return before dark, but he delayed his departure while waiting for thunderstorms to pass. Advised that a large cell was located just west of the departure airport, he filed an instrument flight plan that included a northeast departure and subsequent turn to the west. He was cleared “as filed,” instructed to maintain 2,000 feet on course, and took off 16 minutes after his planned arrival time. The pilot made contact with departure control and acknowledged the instruction to proceed on course but made no further transmissions. Radar data showed the airplane initially proceeding in a northeasterly direction, then varying between north and northeast as it climbed to 2,300 feet. Six minutes after takeoff it began a descending right turn, disappearing from radar about five miles northeast of the airport at an altitude of 1,800 feet. No evidence of mechanical or instrument failure was found in the wreckage, which was compressed into a 45-foot debris field oriented on a 225-degree heading.

**PILOT INFORMATION** The 54-year-old private pilot held ratings for airplane single-engine land and instrument airplane. His logbook showed slightly less than 700 hours of total flight time, including 112 hours of night flight, 24 hours in actual instrument conditions, and 69 hours of simulated instrument flight. His most recent flight in actual IMC had taken place more than five months earlier. During a one-hour check-out flight in the accident airplane, he’d claimed to have “about 100 hours in Piper Arrows.”

**WEATHER** A convective SIGMET was in effect for the entire state of North Carolina and extended south beyond Myrtle Beach. The largest cell was located just west of the departure airport and west of the filed route of flight. The reported weather at the departure airport included wind from 220 degrees at 11 knots with 10 miles visibility under a broken ceiling at 1,100 feet and an overcast layer at 2,000. Temperature was 29 degrees Celsius with a dew point of 26, with lightning reported west of the airport. The accident occurred 27 minutes after sunset, one minute before the end of civil evening twilight.

**PROBABLE CAUSE** The pilot’s failure to maintain aircraft control while maneuvering in IMC around a thunderstorm. Contributing to the accident was the pilot’s lack of recent actual instrument experience.

**ASI COMMENTS** Challenges that are manageable individually may become overwhelming in combination. Circumventing a thunderstorm in daytime VMC, flying cross-country at night in good weather, and an instrument flight in benign conditions in daylight were probably all within this pilot’s capabilities. Given his lack of recent instrument or night flying experience, though, attempting to skirt a thunderstorm in IMC after dark was asking too much of himself. And pressure, whether self-imposed or external, to return an aircraft on schedule rarely contributes to good decision-making. Getting an aircraft back late is always preferable to not getting it back at all.

artifact of the delay in resolving these difficult cases, and will diminish or disappear when the data are more complete.

Available data do suggest that, as always, attempts to fly by visual references in instrument conditions accounted for the lion's share of fatalities **(Figure 20)**. The unusually low number ascribed to deficient execution of instrument procedures by appropriately rated pilots in properly equipped aircraft merits re-examination after the data are more complete.

Not surprisingly, almost three-quarters of all weather accidents took place in instrument conditions and/or at night **(Figure 21)**. However, lethality was at least 50% in all conditions, including daytime VMC. Multiengine airplanes and retractable singles accounted for relatively higher proportions **(Figure 22)**. Even allowing for the increasing number of high-performance fixed-gear singles, it's reasonable to expect that as a class, twins and retracts do more foul-weather flying.

Private pilots made up about two-thirds of those involved in identified weather accidents, while only 30% held commercial or airline transport pilot certificates **(Figure 23)**. More than half of all pilots in known weather accidents held instrument ratings, including 16 of the 28 in fatal accidents, but flight instructors were on board fewer than one-eighth of the accident flights. Of course, most flight instruction takes place close to home, usually under benign conditions.

## ACCIDENT CAUSES: HIGH-RISK PHASES OF FLIGHT



**TAKEOFF AND CLIMB** *(142 TOTAL / 28 FATAL)* Takeoffs consistently see the second-highest number of pilot-related accidents and account for more than 10% of fatalities. 2010 was no exception: While the number of takeoff accidents decreased **(Figure 24)**, the number of fatal accidents increased by two, and the proportion of non-commercial fixed-wing accidents blamed on takeoff errors remained above the ten-year moving average. The corresponding proportion of fatal accidents was as high as at any time in the past decade.

Losses of aircraft control accounted for nearly half of all accidents during takeoff and climb (43%) and one-quarter of the fatal accidents **(Figure 25)**. Most were losses of directional control during the takeoff roll, but the category also includes pitch and roll excursions after lift-off. Departure stalls accounted for more than half the fatal accidents in this category; settling back onto the runway due to premature rotation was usually survivable, while stalls after the airplane had succeeded in climbing were frequently lethal. Collisions after takeoff; attempts to use soft, contaminated, or otherwise unsuitable runways; and errors in setting flaps, fuel mixtures, and other details of aircraft configuration caused about equal numbers of accidents but few fatalities.

**Figure 24:** Takeoff and Climb Accident Trend

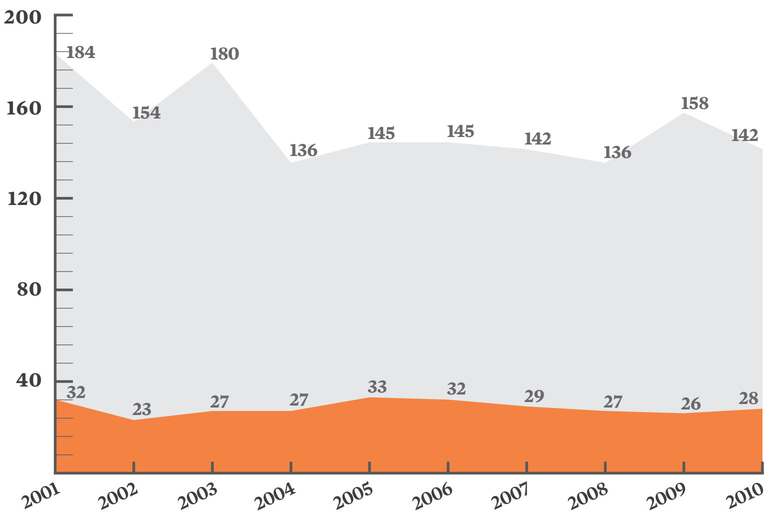



**Figure 26:** Pilots Involved in Takeoff and Climb Accidents—Non-Commercial Fixed-Wing

| Certificate Level | Accidents | | Fatal Accidents | | Lethality |
|---|---|---|---|---|---|
| ATP | 21 | 14.8% | 2 | 7.1% | 9.5% |
| Commercial | 41 | 28.9% | 9 | 32.1% | 22.0% |
| Private | 67 | 47.2% | 15 | 53.6% | 22.4% |
| Sport | 1 | 0.7% | 0 | | |
| Student | 11 | 7.7% | 2 | 7.1% | 18.2% |
| None/Unknown | 1 | 0.7% | 0 | | |
| CFI On Board* | 32 | 22.5% | 4 | 14.3% | 12.5% |
| Instrument-Rated Pilot On Board* | 74 | 52.1% | 12 | 42.9% | 16.2% |

*INCLUDES SINGLE -PILOT ACCIDENTS

**Figure 25:** Types of Takeoff and Climb Accidents

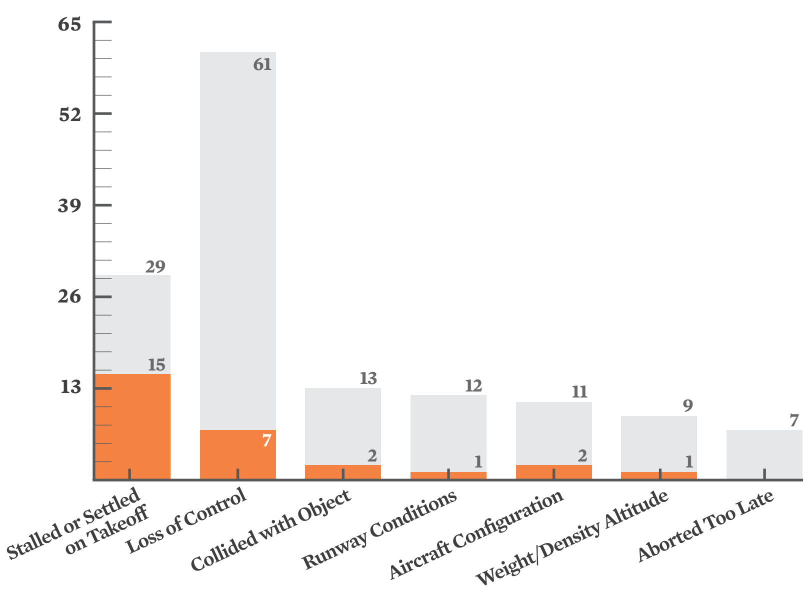



**Figure 27:** Maneuvering Accident Trend

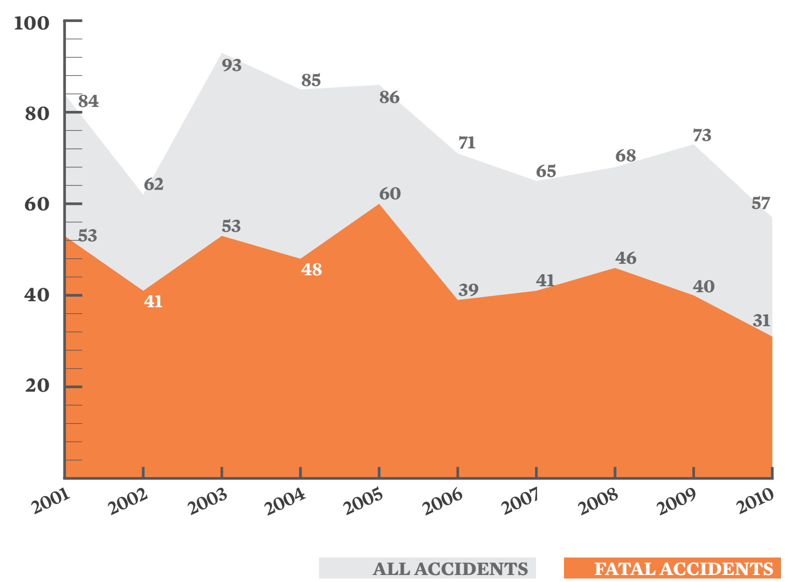


**Figure 28:** Types of Maneuvering Accidents

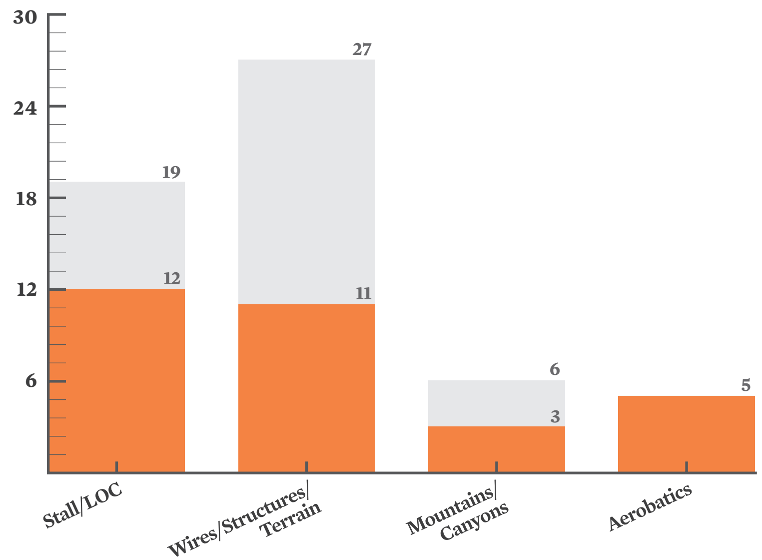



**Figure 29:** Pilots Involved in Maneuvering Accidents— Non-Commercial Fixed-Wing

| Certificate Level | Accidents | | Fatal Accidents | | Lethality |
|---|---|---|---|---|---|
| ATP | 8 | 14.0% | 5 | 16.1% | 62.5% |
| Commercial | 18 | 31.6% | 12 | 38.7% | 66.7% |
| Private | 25 | 43.9% | 11 | 35.5% | 44.0% |
| Student | 3 | 5.3% | 1 | 3.2% | 33.3% |
| None/Unknown | 3 | 5.3% | 2 | 6.5% | 66.7% |
| CFI On Board* | 14 | 24.6% | 9 | 29.0% | 64.3% |
| Instrument-Rated Pilot On Board* | 29 | 50.9% | 20 | 64.5% | 69.0% |

*INCLUDES SINGLE-PILOT ACCIDENTS

**Figure 30:** Descent and Approach Accident Trend

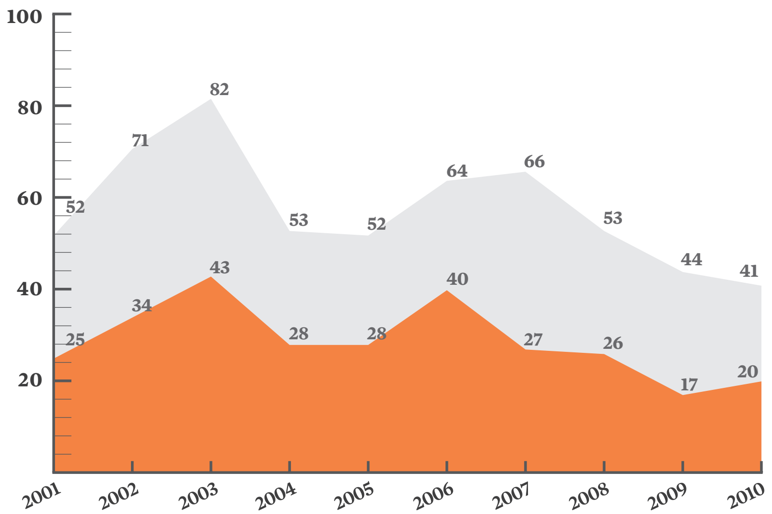



**Figure 31:** Types of Descent and Approach Accidents

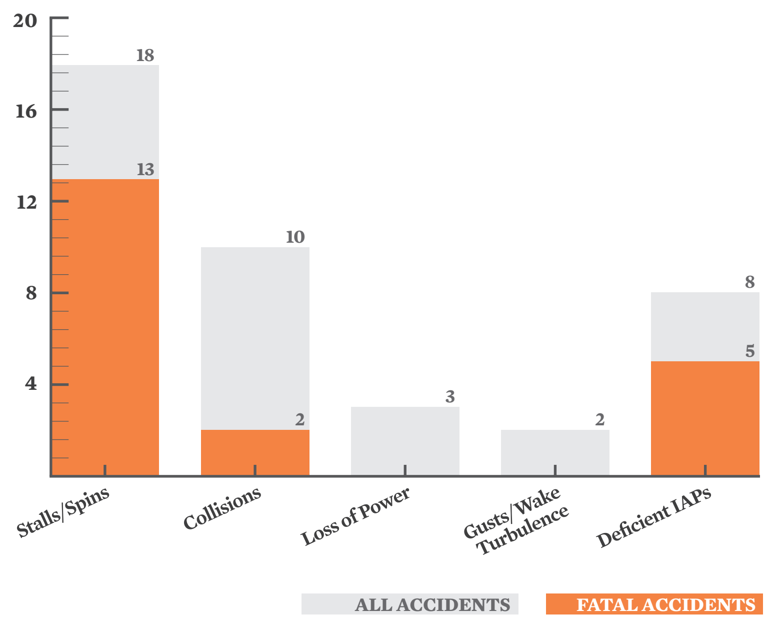


**Figure 32:** Aircraft Involved in Descent and Approach Accidents—Non-Commercial Fixed-Wing

| Aircraft Class | Accidents | | Fatal Accidents | | Lethality |
|---|---|---|---|---|---|
| Single-Engine Fixed Gear | 23 | 56.1% | 9 | 35.0% | 39.1% |
| SEF, Conventional Gear | 9 | | 2 | | 22.2% |
| Single-Engine Retractable | 11 | 26.8% | 8 | 20.0% | 72.7% |
| Multiengine | 7 | 17.1% | 3 | 15.0% | 42.9% |

**Figure 33:** Flight Conditions of Descent and Approach Accidents—Non-Commercial Fixed-Wing

| Light and Weather | Accidents | | Fatal Accidents | | Lethality |
|---|---|---|---|---|---|
| Day VMC | 26 | 63.4% | 11 | 55.0% | 42.3% |
| Night VMC | 4 | 9.8% | 3 | 15.0% | 75.0% |
| Day IMC | 7 | 17.1% | 4 | 20.0% | 57.1% |
| Night IMC | 4 | 9.8% | 2 | 10.0% | 50.0% |

One of the nine accidents attributed to aircraft weight and/or density altitude was fatal, but no deaths resulted from the seven accidents arising from delayed decisions to abort takeoff attempts. Overruns tend to be safer than trying to force an aircraft to fly.

Almost 80% of takeoff accidents were in SEF aircraft, and 93% took place in daytime VMC. While these suggest that inexperience might be a risk factor, more than 40% of the pilots involved held commercial or airline transport pilot certificates **(Figure 26)**. CFIs were only present on 32 of the accident flights, and only 11 of those were categorized as instructional.

**MANEUVERING** *(57 TOTAL / 31 FATAL)* While the number of maneuvering accidents appears to have decreased in 2010 **(Figure 27)**, it still remained the leading cause of pilot-related fatalities. Unlike the year before, a larger share were attributed to controlled flight into wires, structures, terrain, or other obstructions than to unintentional stalls at altitudes too low to allow recovery **(Figure 28)**, but CFIT accidents were actually the most survivable category. Lethality in all types of maneuvering accidents exceeded 40%, and was often much higher; 12 of 19 accidents involving stalls and all five that occurred while attempting aerobatics were fatal.

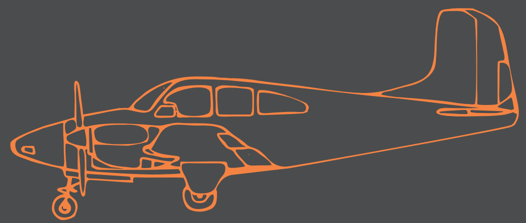
Just two maneuvering accidents, both fatal, were classified as having taken place in IMC. Six were in VMC at night and 49 (86%) were in day VMC. Day or night, about half the maneuvering accidents in VMC were fatal.

Only four involved multiengine airplanes, but three were fatal, as were 12 of the 13 in single-engine retractables. Almost 70% of maneuvering accidents were in fixed-gear singles; 41% of these (16 of 39) caused fatalities, including four of the 16 in fixed-gear singles with conventional gear. Private pilots commanded 25 of the accident flights (44%), while 26 were flown by either commercial pilots or ATPs **(Figure 29)**.

**DESCENT AND APPROACH** *(41 TOTAL / 20 FATAL)* Descent and approach accidents are defined as those that occur between the end of the en route phase of flight and either entry to the airport traffic

## ACCIDENT CASE STUDY

**NTSB ACCIDENT NO. ERA10FA178**
**BEECH B95, LAGRANGE, NY**
**ONE FATALITY**



**HISTORY OF FLIGHT** After a takeoff roll that one witness described as unusually long, the airplane climbed to an altitude of about 50 feet, then yawed to the left. It returned to straight flight and continued to climb; at 300 feet above ground level, it yawed left again and began a left bank. The airplane's nose then dropped "to approximately a perpendicular position with reference to the surrounding terrain," and the airplane completed one to one and a half turns of an apparent spin before dropping out of sight behind a row of trees. Much of the wreckage was consumed by the post-crash fire, but investigators were able to establish continuity from all flight control surfaces to the cockpit, and both engines produced compression on all cylinders. The fuel selectors were partially melted away, but after study the NTSB Materials Laboratory concluded that both had been set to the corresponding main tanks.

**PILOT INFORMATION** The 54-year-old pilot held a commercial certificate with instrument rating for multiengine airplanes and private pilot privileges for single-engine airplanes. His most recent logged flight was made six months before the accident; at that time, his logbook showed 1,027 hours of total flight time that included at least 231 hours of make-and-model experience.

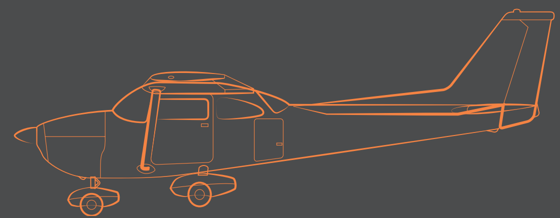
**WEATHER** One minute before the accident, the Dutchess County Airport eight miles from the accident site reported calm wind and clear skies, with 10 miles visibility and a temperature of 16 degrees Celsius.

**PROBABLE CAUSE** The pilot's failure to maintain adequate airspeed during takeoff, which resulted in an aerodynamic stall.

**ASI COMMENTS** The condition of the wreckage precluded any determination of whether both engines were in fact producing full power at the time of the accident. The repeated yaws to the left followed by an apparently uncommanded roll and spin would be consistent with a loss of power in the left (critical) engine, an exceptionally dangerous emergency in a light twin just after takeoff. With both engines operating, an excessive angle of attack at low airspeed would still produce strong left-turning tendencies while limiting the rudder authority available to counter the adverse yaw. In either case, maintaining sufficient airspeed is the first requirement for successful departures in any light airplane.

# ACCIDENT CASE STUDY

**NTSB ACCIDENT NO. CEN11LA082**
**CESSNA 172M, VELMA, OK**
**ONE FATALITY**



**HISTORY OF FLIGHT** The patrol pilot was circling a pipeline leak while attempting to guide ground crews to that location. Witnesses reported that he made several circles at an altitude of about 150 feet before breaking off, briefly flying straight and level, and then reversing course and beginning to circle again. This time he completed "four tight circles around the location," all to the left, and was beginning a fifth when the airplane suddenly rolled hard to the left, stalled, and rolled inverted, crashing into power lines about 30 feet off the ground.

**PILOT INFORMATION** The 48-year-old commercial pilot held ratings for single- and multiengine airplane and a flight instructor certificate with instrument rating. His logbooks were not recovered, but based on the combination of an insurance application and company records, his total flight experience was estimated at 1,269 hours. He had flown pipeline patrols for about four months but had no previous patrol experience.

**WEATHER** The nearest airport, located approximately 20 miles west of the accident site, reported wind from 210 degrees at 15 knots with gusts to 19, clear skies with 10 statute miles visibility, and a temperature of 27 degrees Celsius.

**PROBABLE CAUSE** The pilot's failure to maintain control of the airplane while maneuvering, which resulted in an inadvertent stall and subsequent impact with terrain. Contributing to the accident was the pilot's relative inexperience in pipeline patrols.

**ASI COMMENTS** Even experienced pilots should be wary of unfamiliar situations that provide little margin for error. The trainer who'd taught the accident pilot to do pipeline work noted that it required specialized techniques not encompassed by his prior experience as a flight instructor. He told investigators, "You never circle a location more than twice without flying out from it and coming back, due to the fact that you're flying through your own vortices and prop wash, and being in such tight turns, your airspeed and energy are constantly dropping. Add to that some strong gusty winds, divided attention between flying, staying on the location you're circling, talking on the radio to your ground crews, it's a lot to handle…."

pattern (if VFR) or the missed approach point or decision height of an instrument approach procedure on an IFR flight. The number of descent/approach accidents peaked in 2003 and has declined since 2007 **(Figure 30)**, both in absolute terms and as a percentage of all non-commercial fixed-wing accidents. However, they remain one of the deadliest accident categories; about half typically prove fatal. In 2010, they made up 3.5% of all accidents but included more than 9% of fatal accidents.

Inadvertent stalls were implicated in 44% (18 of 41), including 13 of the 20 fatal accidents **(Figure 31)**. Errors in executing instrument approach procedures by appropriately rated pilots were almost as lethal, with five of eight resulting in fatalities. In eight out of 10 collisions with wires, structures, terrain, or other solid objects, everyone on board the aircraft survived. Five non-fatal accidents were the results of wake turbulence, wind gusts, or unexpected losses of engine power.

Almost half the aircraft involved (18 of 41) were single-engine retractables (11) or multiengine (7). More than 60% of the accidents in those aircraft were fatal **(Figure 32)** compared to only 22% of those in fixed-gear singles with tailwheels. More than a third (36%) occurred at night and/or in IMC **(Figure 33)**, but even accidents in day VMC were two and a half times as likely to be fatal as day VMC accidents in general. As might be expected in a category involving instrument approaches, an unusually high proportion (66%) of the accident pilots held instrument ratings. Otherwise, the distribution of certificate levels was very similar to that in non-commercial fixed-wing accidents overall, with the one exception that none of the 41 accidents occurred on a student solo.

**LANDING** *(361 TOTAL / 8 FATAL)* Year after year, far and away the largest number of fixed-wing accidents result from pilots' attempts to land their airplanes, and almost all those pilots live to try again. 2010 was no exception. There were actually nine more landing accidents than the year before **(Figure 34)** even though the total number of accidents dropped by 21. These made up 31% of all accidents, more than twice the proportion of any other pilot-related category, a figure entirely consistent with the historical record.

**Figure 34:** Landing Accident Trend

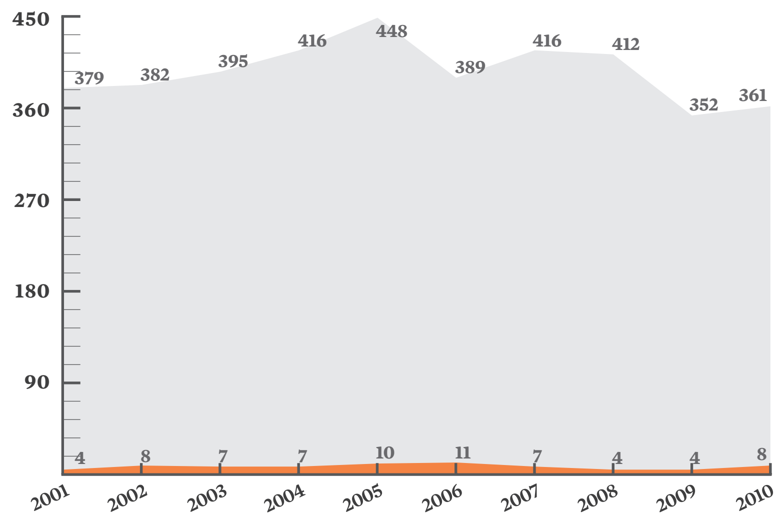
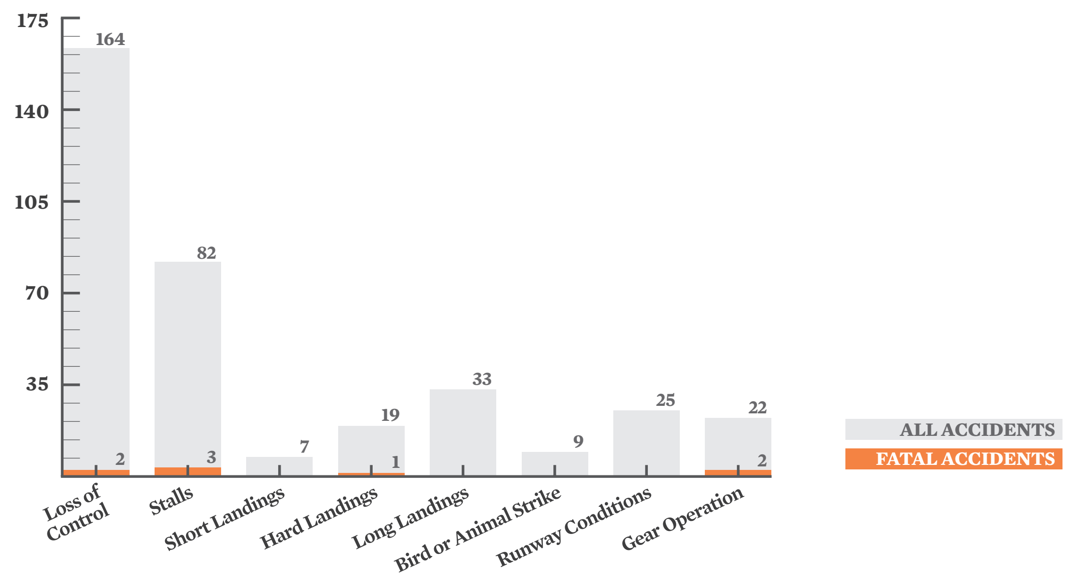
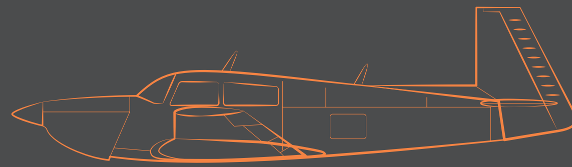



**Figure 35:** Types of Landing Accidents



# ACCIDENT CASE STUDY



**NTSB ACCIDENT NO. CEN11FA124**
**MOONEY M20E, COLORADO SPRINGS, CO**
**TWO FATALITIES**

**HISTORY OF FLIGHT** The pilot was cleared to fly the ILS approach to Runway 17L. While he was still above the cloud layer, the approach controller advised him of visibilities below minimums, with runway visible range dropping from 1,600 to 800 feet over the course of 10 minutes, and also of two pilot reports from departing jets of icing in the clouds. The pilot chose to continue the approach, telling the controller, "If we start picking up anything we're gonna pop back up and go … missed … but if not we're gonna continue down." Following handoff to the control tower, the pilot told the tower controller that he was entering the clouds at 8,500 msl (2,300 feet above ground level). At 6,400 msl, just above decision height, he reported that he was "going missed … we got down to sixty-four hundred and, uh, nothing." No further transmissions were received after he read back the missed approach instructions. Twelve minutes later the wreckage was found 440 feet south of the runway threshold and 400 feet east of its centerline.

**PILOT INFORMATION** The 25-year-old pilot flew B1-B bombers for the U.S. Air Force. On his last military mission and instrument flight review, conducted some eight months before the accident, he had been rated "exceptionally qualified." He held a commercial pilot certificate with instrument rating for airplane single-engine land and multiengine land (limited to centerline thrust) and a flight instructor's certificate with instrument rating. His 913 hours of total flight time included 658 hours in single-engine airplanes, 38 hours in actual instrument conditions and 78 hours of simulated instrument time, and 58 hours in the accident make and model.

**WEATHER** An extensive area of low stratiform clouds covered the region, with a strong frontal inversion between 8,000 and 9,000 feet and more than an 80% probability of light to moderate rime icing below 10,000. Temperatures between the surface and 8,500 feet ranged from -6.5 to -1.5 degrees Celsius. An AIRMET ZULU advised of moderate icing between the freezing level and flight level 240. The freezing level ranged from the surface to 10,000 feet. Several pilot reports confirmed icing conditions below 8,000 feet at COS. Five minutes before the accident, Colorado Springs issued a METAR reporting visibility less than 1/4 mile in freezing fog, with visual range varying between 700 and 1,200 feet on runway 17L, vertical visibility of 100 feet, temperature -3 degrees Celsius, and dew point -4 degrees Celsius. Tower visibility was reported at 1/4 mile.

**PROBABLE CAUSE** The pilot's decision to initiate an approach into weather conditions where the ceiling and visibility were below the minimums for the approach and where reported icing existed, in an airplane not certified for flight in icing conditions, and his failure to maintain control of the airplane during the missed approach.

**ASI COMMENTS** Part 91 allows pilots to attempt instrument approaches when the weather is reported to be below minimums, but that doesn't necessarily make it wise. Attempting the approach when conditions are solidly below minimums increases exposure to ground hazards while reducing fuel range for the diversion to an alternate that must be expected. Attempting a below-minimums approach in known icing conditions in an aircraft not suitably equipped jeopardizes the chances of executing a missed approach at all. Even superb training and exceptional skill can't be counted on to shepherd an aircraft safely through conditions for which it was never designed.

Eight (2%) were fatal, a more typical number than the four in each of the two preceding years. All eight took place in VMC during daylight hours, as did 94% of landing accidents overall.

As in the past, losses of directional control remain the most common problem, accounting for almost half **(Figure 35)**. Stalls and hard landings made up almost a third, including half of the eight with fatalities. There were nearly five times as many overruns as landings that came up short, but together they only made up 11% of the total. Runway conditions and errors operating retractable gear were each implicated in about 6%, and nine aircraft suffered substantial damage in collisions with birds or other animals.

Landing accidents consistently involve an unusually high proportion of SEF airplanes. In 2010, they accounted for 79% of landing accidents **(Figure 36)** compared to 67% of all other types. In part this is because most tailwheel airplanes are fixed-gear singles. Forty-five percent of SEF landing accidents were in conventional-gear models; official estimates are not available, but this seems well out of proportion to their prevalence in the fleet.

In the past, the share of landing accidents in fixed-gear singles has also been driven up by the number that took place on student solos, most of which are conducted in fixed-gear single-engine airplanes. That effect was less pronounced in 2010, when only 33 student pilots had landing accidents **(Figure 37)** compared to 57 in 2009. The percentage of landing accidents involving solo student pilots dropped by almost half, from 16% in 2009 to 9% in 2010, and for the ninth straight year, none of these were fatal.

The data provide little support for the suggestion that the prevalence of SEF aircraft reflects generally lower experience among these pilots, at least as indexed by certificate level. Private, sport, and student pilots accounted for 62% of landing accidents compared to 58% of all other types; 36% of landing accidents involved commercial pilots and ATPs compared to 41% of all other accidents.

**Figure 36:** Aircraft Involved in Landing Accidents—Non-Commercial Fixed-Wing

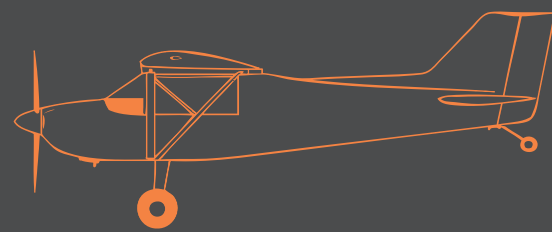
| Aircraft Class | Accidents | | Fatal Accidents | | Lethality |
|---|---|---|---|---|---|
| Single-Engine Fixed Gear | 285 | 78.9% | 7 | 87.5% | 2.5% |
| SEF, Conventional Gear | 127 | | 4 | | 3.1% |
| Single-Engine Retractable | 53 | 14.7% | 1 | 12.5% | 1.9% |
| Multiengine | 23 | 6.4% | 0 | | |

**Figure 37:** Pilots Involved in Landing Accidents—Non-Commercial Fixed-Wing

| Certificate Level | Accidents | | Fatal Accidents | | Lethality |
|---|---|---|---|---|---|
| ATP | 38 | 10.5% | 3 | 37.5% | 7.9% |
| Commercial | 91 | 25.2% | 1 | 12.5% | 1.1% |
| Private | 186 | 51.5% | 3 | 37.5% | 1.6% |
| Sport | 5 | 1.4% | 1 | 12.5% | 20.0% |
| Student | 33 | 9.1% | 0 | | |
| None/Unknown | 8 | 2.2% | 0 | | |
| CFI On Board* | 77 | 21.3% | 2 | 25.0% | 2.6% |
| Instrument-Rated Pilot On Board* | 170 | 47.1% | 4 | 50.0% | 2.4% |

*INCLUDES SINGLE-PILOT ACCIDENTS

## ACCIDENT CASE STUDY



**NTSB ACCIDENT NO. ERA10LA158**
**RANS S-6S, MAYAGUEZ, PUERTO RICO**
**ONE FATALITY**

**HISTORY OF FLIGHT** The pilot was following a friend in another airplane on a flight to Arecibo, Puerto Rico, when they decided to land at Mayaguez instead of crossing the mountains. The other pilot made a left downwind entry to Runway 9, and after landing, radioed the accident pilot to advise that he continue to Arecibo rather than try to land in the stiff, gusty crosswind. The accident pilot replied that he would make an approach. His first attempt ended in a go-around, after which he reentered the downwind, and his friend again advised him to go on to Arecibo. The pilot's second approach appeared to be fast, and when he flared for landing the airplane pitched up 45 degrees. The airplane climbed to an altitude of about 75 feet as its airspeed decayed, then stalled and spun to the left. The friend advised him to add power, and just before the impact he heard the engine rev up. The airplane crashed nose-down and left wing low, then nosed over inverted.

**PILOT INFORMATION** The 55-year-old sport pilot had received his certificate six months before the accident. His logbook showed 48 hours of total flight experience, including 25 hours in the Rans S-6S and 5.25 hours as pilot in command.

**WEATHER** The last METAR recorded before the accident reported winds from 160 degrees at 10 knots gusting to 20, with 10 miles visibility under a broken ceiling at 3,000 feet.

**PROBABLE CAUSE** The sport pilot's failure to maintain adequate airspeed during landing in crosswind conditions resulting in an aerodynamic stall.

**ASI COMMENTS** This accident illustrates the interplay between deficiencies of skill and lack of judgement. The reported crosswinds were strong enough to challenge a more experienced aviator, but the pilot failed to recognize that landing in them required airmanship beyond his current skills.

## MECHANICAL/MAINTENANCE

*(174 TOTAL /22 FATAL)* Documented mechanical failures or errors in aircraft maintenance caused 15% of all non-commercial fixed-wing accidents in 2010 **(Figure 38)**, including 10% of fatal accidents. This is in line with the well-established pattern of recent years; the apparent uptick in 2009 described in the *2010 Nall Report* included about 30 accidents classified on the basis of preliminary reports that were reclassified into other categories after probable cause was established.

Seventy-four of the 174 accidents (43%) were attributed to powerplant failures **(Figure 39)**, traditionally the most common cause. However, 28 of these were classified on the basis of preliminary reports; some may eventually be categorized as fuel system failures, fuel mismanagement, or unexplained losses of power after probable cause has been determined.

Landing gear or brake problems caused 35 accidents (20%) but no fatalities. Breakdowns in powerplants or fuel systems jointly caused 14 fatal accidents, two-thirds of the total; six of the remaining eight were due to airframe or flight-control failures.

The relative frequency of the different types of mechanical accidents has remained very stable over time, as has the fact that accidents due to failures of flight instruments or vacuum systems are very rare but usually fatal.

More than a third of all mechanical accidents took place in SER aircraft **(Figure 40)**, almost double the proportion of SERs in non-mechanical accidents (18%). However, only eight of 59 involved landing-gear malfunctions. Gear and brake problems were actually more prevalent in taildraggers, where they were implicated in 15 accidents out of 42 (36%). Only five accidents (3%) involved turbine aircraft, but this was almost exactly their prevalence in the accident fleet overall. Likewise, multiengine airplanes were involved in about the same share of mechanical and non-mechanical accidents.

While they're assumed to be random events, mechanical accidents involved disproportionate numbers of commercial and airline transport pilots **(Figure 41)**, 54% compared to a combined 40% of all accidents of other types. The reasons are not obvious. They did not fly a higher proportion of the accident fleet's single-engine retractables, and while

**Figure 38:** Mechanical Accident Trend

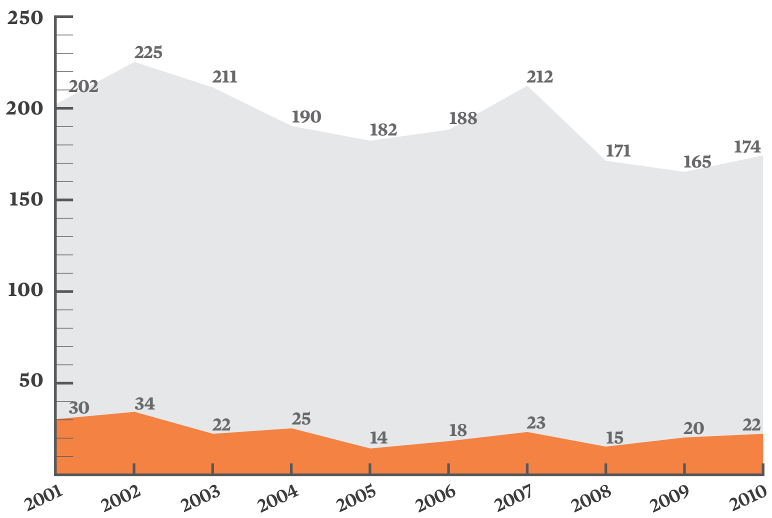
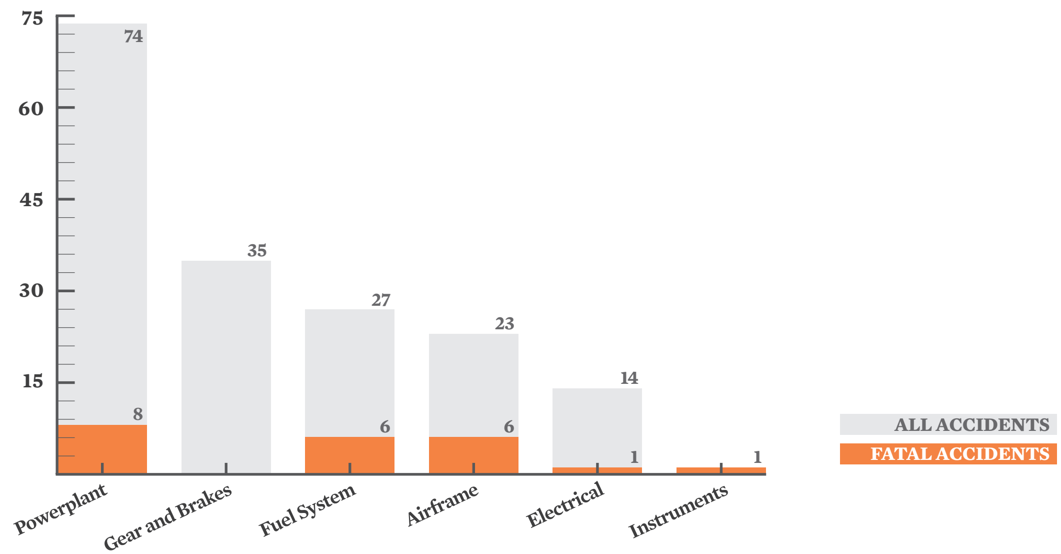



**Figure 39:** Types of Mechanical Accidents



those working as active CFIs might see greater exposure to equipment failures, only 12% of mechanical accidents took place on training flights—the same share as in all non-commercial fixed-wing accidents—while 75% occurred on personal flights.

Only three took place in instrument conditions, though two of those were fatal. Eight were in visual conditions at night, while 94% (including 19 of the 22 fatal accidents) were in VMC during the daytime.

**OTHER, UNKNOWN, OR NOT YET DETERMINED** *(130 TOTAL / 44 FATAL)* Six percent of all non-commercial fixed-wing accidents (71) arose from losses of engine power for reasons that could not be determined after the fact **(Figure 42)**: Adequate amounts of fuel were present, and examination of the engines found no evidence of malfunctions prior to impact. Many of those that escaped serious accident damage were successfully test-run during the investigations.

Thirty-eight accidents could not be classified for this report; 32 of them were fatal. These included nine (six fatal) in which the NTSB was unable to determine probable cause, officially attributing the crashes to "unknown reasons," and 29 in which the preliminary reports did not provide enough information to support even provisional classification.

The remaining 21 caused no fatalities. They included 14 instances of bird or animal strikes, three in-flight fires of unknown origin, two instances of unapproved aircraft modifications or neglected maintenance by owners, one aircraft ditched after an in-flight collision with an unknown object, and one loss of control caused by a passenger inadvertently applying the right brake during the takeoff roll.

**Figure 40:** Aircraft Involved in Mechanical Accidents—
Non-Commercial Fixed-Wing

| Aircraft Class | Accidents | | Fatal Accidents | | Lethality |
|---|---|---|---|---|---|
| Single-Engine Fixed Gear | 103 | 59.2% | 8 | 36.4% | 7.8% |
| SEF, Conventional Gear | 43 | | 1 | | 2.3% |
| Single-Engine Retractable | 59 | 33.9% | 12 | 54.5% | 20.3% |
| Single-Engine Turbine | 4 | | 1 | | 25.0% |
| Multiengine | 12 | 6.9% | 2 | 9.1% | 16.7% |
| Multiengine Turbine | 1 | | 0 | | |

**Figure 41:** Pilots Involved in Mechanical Accidents—
Non-Commercial Fixed-Wing

| Certificate Level | Accidents | | Fatal Accidents | | Lethality |
|---|---|---|---|---|---|
| ATP | 31 | 17.8% | 4 | 18.2% | 12.9% |
| Commercial | 64 | 36.8% | 6 | 27.3% | 9.4% |
| Private | 67 | 38.5% | 12 | 54.5% | 17.9% |
| Sport | 4 | 2.3% | 0 | | |
| Student | 5 | 2.9% | 0 | | |
| None/Unknown | 3 | 1.7% | 0 | | |
| CFI On Board* | 56 | 32.2% | 7 | 31.8% | 12.5% |
| Instrument-Rated Pilot On Board* | 112 | 64.4% | 18 | 81.8% | 16.1% |

*INCLUDES SINGLE-PILOT ACCIDENTS

**Figure 42:** Other and Unclassified Accidents—
Non-Commercial Fixed Wing

| Major Cause | Accidents | | Fatal Accidents | | Lethality |
|---|---|---|---|---|---|
| Unexplained Loss of Power | 71 | 54.6% | 12 | 27.3% | 16.9% |
| Not Yet Determined | 38 | 29.2% | 32 | 72.7% | 84.2% |
| Other | 21 | 16.2% | 0 | | |

# COMMERCIAL FIXED-WING ACCIDENTS

The number and rate of commercial fixed-wing accidents in 2010 were almost identical to those in 2009. A total of 56 accidents on aerial application flights resulted in the deaths of three of the pilots **(Figure 43)** compared to 52 accidents (two fatal) the year before.

Twenty-eight accidents occurred on cargo and charter flights made under Part 135, down two from the previous year, but four were fatal, claiming 12 lives in all. Five people were killed in the crash of a Cessna 421 conducting a medical transport shortly after takeoff from Alpine, Texas; two Alaskan accidents in de Havilland Beavers caused the deaths of three passengers and both pilots; and the pilot and only passenger were killed when a turbine-powered Beech 18 crashed into the ocean on approach to Nassau, Bahamas. Still, 2010 saw the second-fewest fatal Part 135 accidents on record (2009 had none).

**AIRCRAFT CLASS** All of the crop-dusting accidents were in single-engine tailwheel models **(Figure 44)**, which carry out the vast majority of these operations. Thirty were powered by reciprocating engines and 26 were turboprops. Part 135 accidents were almost evenly divided between singles (15) and twins (13), with two fatal accidents in each. The ditching of a modified Beech 18 off Nassau was the only fatal accident among the six in turboprops.

**FLIGHT CONDITIONS** All but one aerial application accident (including all three fatal) were in daytime VMC. (The other was in VMC at night.) Three-quarters of Part 135 accidents also occurred in daytime VMC, including two of the four fatals. One of three in night VMC was fatal, as was one of the two in IMC during the day, but there were no fatalities in the two accidents in IMC at night.

**PILOT QUALIFICATIONS** Five of the pilots in aerial application accidents held airline transport pilot certificates **(Figure 45)**; all survived. The fatalities were three of the 46 commercial pilots who were not CFIs. Part 135 accident pilots were evenly divided between commercial pilots and ATPs, and six at each certificate level also held flight instructor certificates. Both of the CFIs involved in fatal accidents were ATPs. Only one accident flight operated with a two-pilot crew, but crewed flights are generally believed to be rare in Part 135 operations in light airplanes.

**ACCIDENT CAUSES** Aerial application flights consist almost entirely of low-altitude maneuvering, so it is scarcely surprising that it consistently causes the largest single share of crop-dusting accidents, including all three of the fatalities in 2010 **(Figure 46)**. In all, 16 of 56 accidents occurred during maneuvering flight. Takeoffs—characteristically while heavily loaded and often from unimproved strips—likewise involve greater risks than in most other types of operations, and accounted for nearly 20% of aerial application accidents. The combination of documented mechanical failures (12) and unexplained losses of engine power (7) caused

19 between them, while just four (7%) were landing accidents. The remaining six were scattered among five different categories.

Mechanical problems were the single leading cause of Part 135 accidents in 2010, accounting for one-quarter of the total (seven of 28); none, however, were fatal. Another non-fatal accident was blamed on a loss of engine power for no apparent reason. Two of the three unclassified accidents were fatal; in both, aircraft were lost at sea under circumstances that remain mysterious. Of the other two fatal accidents, one was a loss of control just after takeoff (blamed in part on pilot fatigue and the resulting failure to configure the aircraft for climb), while the other involved continued flight into weather hazards including turbulence and reduced visibility.

Four accidents apiece involved errors during taxi, takeoffs, or landings. Fuel mismanagement only caused one (as well as one during aerial application), and there were two during descent and approach.

**Figure 43:** Type of Operation—Commercial Fixed Wing

| Type of Operation | Accidents | | Fatal Accidents | | Fatalities | |
|---|---|---|---|---|---|---|
| Agricultural | 56 | 66.7% | 3 | 42.9% | 3 | 20.0% |
| Charter: Non-Medical | 27 | 32.1% | 3 | 42.9% | 7 | 46.7% |
| Charter: Medical | 1 | 1.2% | 1 | 14.2% | 5 | 33.3% |

**Figure 44:** Aircraft Class—Commercial Fixed-Wing

| Aircraft Class | Accidents | | Fatal Accidents | | Lethality |
|---|---|---|---|---|---|
| **Part 137** | | | | | |
| SEF, Conventional Gear | 56 | 100.0% | 3 | 100.0% | 5.4% |
| Single-Engine Piston | 30 | 53.6% | 1 | 33.3% | 3.3% |
| Single-Engine Turbine | 26 | 46.4% | 2 | 66.7% | 7.7% |
| **Part 135** | | | | | |
| Single-Engine Fixed-Gear | 13 | 35.7% | 2 | 50.0% | 15.4% |
| SEF, Conventional Gear | 3 | | 2 | | 66.7% |
| Single-Engine Retractable | 2 | 7.1% | 0 | | |
| Single-Engine Turbine | 2 | | 0 | | |
| Multiengine | 13 | 3.6% | 2 | 50.0% | 15.4% |
| Multiengine Turbine | 4 | | 1 | | 25.0% |

**Figure 45:** Certificate Levels Involved in Accidents—Commercial Fixed-Wing

| Certificate Level | Accidents | | Fatal Accidents | | Lethality |
|---|---|---|---|---|---|
| **Part 137** | | | | | |
| ATP | 5 | 8.9% | 0 | | |
| Commercial | 51 | 91.1% | 3 | 100.0% | 5.9% |
| Flight Instructors | 8 | 14.3% | 0 | | |
| **Part 135** | | | | | |
| ATP | 14 | 50.0% | 2 | 50.0% | 14.3% |
| Commercial | 14 | 50.0% | 2 | 50.0% | 14.3% |
| Two-Pilot Crews | 1 | 3.6% | 0 | 0.0% | 0.0% |
| Flight Instructors | 12 | 42.9% | 2 | 50.0 | 16.7% |

**Figure 46:** Types of Accidents—Commercial Fixed-Wing

| Accident Type | Accidents | | Fatal Accidents | | Lethality |
|---|---|---|---|---|---|
| **Part 137** | | | | | |
| Descent/Approach | 1 | 1.8% | 0 | | |
| Fuel Management | 1 | 1.8% | 0 | | |
| Landing | 4 | 7.1% | 0 | | |
| Maneuvering | 16 | 28.6% | 3 | 100.0% | 18.8% |
| Mechanical | 12 | 21.4% | 0 | | |
| Other | 2 | 3.6% | 0 | | |
| Other (Power Loss) | 7 | 12.5% | 0 | | |
| Preflight | 1 | 1.8% | 0 | | |
| Takeoff | 11 | 19.6% | 0 | | |
| Taxi | 1 | 1.8% | 0 | | |
| **Part 135** | | | | | |
| Descent/Approach | 2 | 7.1% | 0 | | |
| Fuel Management | 1 | 3.6% | 0 | | |
| Landing | 4 | 14.3% | 0 | | |
| Mechanical | 7 | 25.0% | 0 | | |
| Other | 3 | 10.7% | 2 | 50.0% | 66.7% |
| Other (Power Loss) | 1 | 3.6% | 0 | | |
| Takeoff | 4 | 14.3% | 1 | 25.0% | 25.0% |
| Taxi | 4 | 14.3% | 0 | | |
| Weather | 2 | 7.1% | 1 | 25.0% | 50.0% |

# AMATEUR-BUILT AND EXPERIMENTAL LIGHT-SPORT AIRCRAFT

**FIXED-WING** *(198 TOTAL / 47 FATAL—INCLUDES 19 E-LSA / 9 FATAL);* **HELICOPTER** *(5 TOTAL / 2 FATAL)* 2010 saw a dramatic reduction in the number of accidents in amateur-built and experimental light-sport aircraft **(Figure 47)**, both in raw numbers and as a percentage of all non-commercial accidents. In all, there were 20% fewer than the year before, while the number of fatal accidents dropped by one-third. Both reached their lowest levels since 2004, and while they made up a larger share of the overall accident record than six years ago, the percentage of all accidents that involved homebuilts and E-LSAs was 19% lower than in the preceding year. The proportion of fatal accidents involving these aircraft declined by 26%, in part because the lethality of amateur-built and experimental light-sport accidents decreased from 28% in 2009 to 23% in 2010. More urgent educational efforts by the Experimental Aircraft Association (EAA), the increased focus put on homebuilt safety by the community's involvement in the joint EAA-NTSB safety study, and the continued attention given to the subject by ASI and the aviation press may all have made some contribution to this improvement.

Nineteen of the accident aircraft (9%) were classified in the experimental light-sport category **(Figure 48)**. Reporting for this group has been problematic due to its diversity. The E-LSA category includes previously unregistered ultralight trainers grandfathered in when registration was required in January 2008; owner-built versions of models produced either fully assembled as special light-sport aircraft or in kits that may or may not meet the so-called "51% rule" defining experimental amateur-built status; and traditional amateur-built airplanes that qualify for operation under the sport pilot rules. The FAA's requirement for triennial re-registration has both clarified the current composition of the fleet and confused comparisons with earlier years.

The FAA's annual *General Aviation and Part 135 Activity Survey* began estimating flight time in light-sport aircraft as a separate category in calendar year 2008. E-LSAs were first broken out as a separate category in the 2009 report. Their accident history cannot readily be disentangled from that of the "pure" amateur-built group in earlier years.

In 2009, 38 aircraft identified as E-LSAs (15% of the total) were included in the analysis of "amateur-built aircraft." They accounted for 13 fatal accidents (19% of the total) for a lethality of 34%. The number of E-LSA accidents dropped by half in 2010, but these included nine of the 49 fatal accidents (18% of the total). The resulting 47% lethality was the highest in this category, but it's not clear whether this represents a real change from 2009, a chance fluctuation, or merely the continued refinement of definitions.

The number of accidents in "traditional" amateur-built aircraft dropped 15% in 2010, and the number of fatal accidents fell by one-third, from 57 to 38. By FAA estimates, the number of hours flown by experimental amateur-built aircraft also declined, but only by 7%. Accident rates for traditional homebuilts declined from 21.5 per 100,000 flight hours in 2009 to 19.6 in 2010, a drop of 9%. The fatal accident rate declined by 28%, from 5.8 to 4.2. The accident rate in these aircraft remains more than three times higher than the rates for comparable manufactured aircraft, and the fatal accident rate is more than four times as high. Some of the risk is intrinsic in the nature of "experimental amateur-built aircraft," but—especially in light of the increased attention the FAA and NTSB have recently given GA accidents in general—it seems reasonable to ask whether the difference remains disproportionate.

The estimated accident rate in E-LSAs dropped from 22.2 to 11.0 in the same year, but the magnitude of the decrease as well as the uncertainties of tracking this category suggest regarding both estimates with great caution. Estimated fatal accident rates were very similar in the E-LSA and traditional homebuilt categories.

Despite the improvement in 2010, E-LSAs were still involved in accidents nearly twice as often as might have been expected from their share of overall flight activity **(Figure 49)**; their involvement in fatal accidents was more than four times as high. Traditional amateur-built aircraft show up in the accident record more than three times as often as the activity survey might lead one to expect.

Not surprisingly, 192 of the 198 aircraft involved (97%) were piston singles. These included 46 of the 47 fatal accidents. Four others (including one fatal accident) were single-engine turboprops, and the other two were multiengine piston aircraft.

Unlike accidents in certified fixed-wing aircraft, mechanical problems were very nearly as common as landing errors **(Figure 50)**. Emergencies during takeoff and climb were also more common in this segment of the fleet, accounting for more than one accident out of eight and more than 20% of all fatal accidents. Eight of the 10 accidents during visual descents or instrument approaches were fatal, as was the only accident caused by adverse weather. There were only eight low-altitude maneuvering accidents, a 60% reduction from the 20 recorded the year before. Four were fatal compared to 13 in 2009.

The 18 "other pilot-related" accidents included four caused by deficiencies that should have been detected during preflight, two on-ground and two midair collisions, and four losses of control while attempting go-arounds. Two cases of pilot incapacitation were blamed on over-the-counter drugs and one was due to alcohol. Failure to use carburetor heat caused two losses of power in flight, and an Air Cam holding short of the runway was flipped over by the rotor wash of a hovering Chinook helicopter. The fatalities occurred in two of the go-around accidents, two cases of pilot incapacitation, and one midair, preflight discrepancy, and lack of carburetor heat apiece.

**Figure 47:** Fixed-Wing Amateur-Built and Experimental Light Sport Accidents

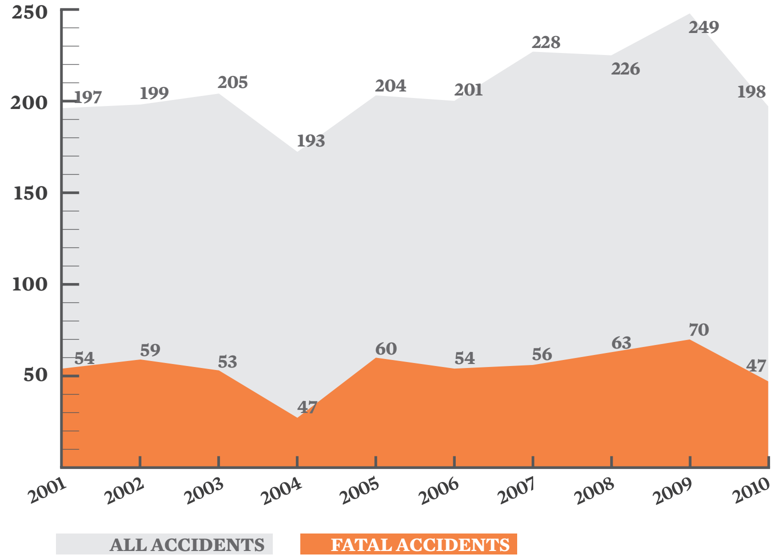



**Figure 49:** Percentages of Non-Commercial Accidents

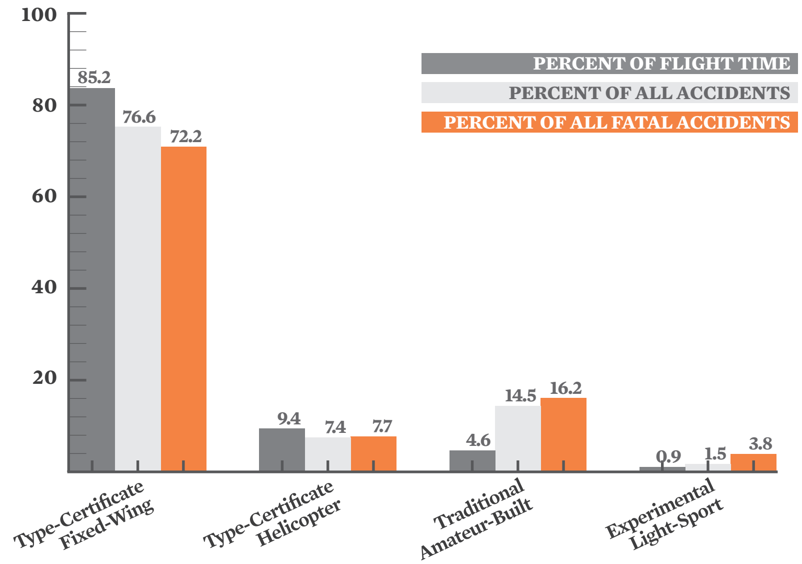



**Figure 48:** Types of Amateur-Built and Experimental Light-Sport Aircraft Involved in Accidents

| Aircraft Class | Accidents | | Fatal Accidents | | Lethality |
|---|---|---|---|---|---|
| E-LSA | 19 | 9.4% | 9 | 18.4% | 47.4% |
| Single-Engine Fixed-Gear | 144 | 70.9% | 30 | 61.2% | 20.8% |
| SEF, Conventional Gear | 85 | | 15 | | 17.6% |
| Single-Engine Retractable | 33 | 16.3% | 8 | 16.3% | 29.6% |
| Multiengine | 2 | 1.0% | 0 | | |
| Helicopter | 5 | 2.5% | 2 | 4.1% | 40.0% |

**Figure 50:** Types of Fixed-Wing Amateur-Built Accidents

| Accident Type | Accidents | | Fatal Accidents | | Lethality |
|---|---|---|---|---|---|
| Mechanical | 50 | 25.3% | 4 | 8.5% | 8.0% |
| Fuel Management | 12 | 6.1% | 1 | 2.1% | 8.3% |
| Weather | 1 | 0.5% | 1 | 2.1% | 100.0% |
| Take-Off and Climb | 25 | 12.6% | 10 | 21.3% | 40.0% |
| Maneuvering | 8 | 4.0% | 4 | 8.5% | 50.0% |
| Descent/Approach | 10 | 5.1% | 8 | 17.0% | 80.0% |
| Landing | 50 | 25.3% | 1 | 2.1% | 2.0% |
| Other (Pilot-Related) | 18 | 9.1% | 7 | 14.9% | 38.9% |
| Other or Unknown | 24 | 12.1% | 11 | 23.4% | 45.8% |

Fifteen of the 24 accidents classified as "other or unknown" involved unexplained engine stoppages, a chronic problem area for amateur-built aircraft. All told, the combination of known mechanical breakdowns and unexplained power failures caused nearly a third (33%) of all the accidents in this group of aircraft compared to 19% of those in certified fixed-wing aircraft. The causes of the remaining nine remain undetermined.

## UNUSUAL ACCIDENT CATEGORIES

Fourteen fatal accidents and another 17 that were not fatal arose from circumstances too rare to support tabulation as separate categories for statistical analysis. In part because they were so unusual, however, many received extensive coverage in the general media.

**COLLISIONS** *(12 TOTAL / 3 FATAL)* There were four midair collisions in 2010. Three were fatal, causing eight deaths between them. Three people were killed when a Piper Pawnee doing a glider tow was struck by a Cirrus SR20 near Boulder, Colorado; the glider pilot detached the tow rope and landed safely with two passengers. The Florida collision of a Piper Lance and an amateur-built RV-6 killed everyone on both aircraft. The crew of a Eurocopter EC135 P2 medevac helicopter survived its collision with a Cessna 172 near the Shenandoah Valley Airport in Virginia, but the flight instructor and student on the Cessna died. Both pilots were injured when two Piper PA-18 Super Cub floatplanes collided near Dillingham, Alaska, but both survived.

No serious injuries resulted from any of the eight collisions on the ground. All involved fixed-wing airplanes, including one involving two Beech Queen Airs operated by the same Part 135 cargo carrier.

**ALCOHOL AND DRUGS** *(6 TOTAL / 3 FATAL)*
Three accidents, one fatal, were blamed on the pilots' impairment by alcohol. The only fatality was one of the accident pilots. Three other accidents were attributed to the sedating effects of over-the-counter medications; two of these pilots were killed, and the third was seriously injured. All of the accident flights were made under FAR Part 91, and none caused any injuries to anyone on the ground. These numbers are typical of the recent record; the number of accidents caused by drugs and/or alcohol has been between five and eight every year since 2000.

**PHYSICAL INCAPACITATION** *(5 TOTAL / 4 FATAL)* The Alaska crash of a de Havilland DHC-3 that killed five of the nine on board, including former U.S. Senator Ted Stevens, was one of five believed to have been caused by physical incapacitation of the pilot. The four survivors of that accident all suffered serious injuries; the reason for the pilot's impairment could not be determined. One other pilot who suffered incapacitation of unknown origin was also killed, as were two pilots believed to have suffered heart attacks in flight. A Twin Comanche pilot who found himself unable to steer his airplane or use the brakes during the landing roll underwent emergency surgery for a subdural hematoma later that night. One of the fatal accidents occurred on a public-use flight, and the DHC-3 accident was classified as "other work use" under Part 91. The rest were on personal flights.

The five pilots involved represented less than one one-thousandth of one percent (.001%) of the active U.S. pilot population of more than 627,000.

### OFF-AIRPORT GROUND INJURIES

*(4 ACCIDENTS / 2 GROUND FATALITIES)*

A total of four events killed two people on the ground and seriously injured two others. One pilot was also killed when he deliberately crashed his Piper Dakota into an Austin, Texas, office building, an act that cannot really be considered an "accident." One worker in the building was also killed. The other fatality was a runner who was hit by the wing of a Lancair that made an emergency landing on the beach at Hilton Head Island after its propeller departed in flight.

Another Dakota pilot made an impulsive decision to buzz a friend's car on the road by the airport; the friend was injured after the Dakota's main gear shattered the car's windshield. A Beech B19 Sundowner lost power shortly after takeoff while doing touch-and-goes and crashed into the parking lot of an industrial building. The student pilot, his CFI, and one person in the building all suffered serious injuries.

### ON-AIRPORT GROUND INJURIES/PROPELLER AND ROTOR STRIKES

*(4 ACCIDENTS / 2 FATAL )* Propeller and rotor strikes caused the only on-airport ground injuries in 2010. A Massachusetts CFI was killed attempting to help a colleague close the canopy of a light-sport airplane; climbing out of the cabin with the engine running, he fell or stepped off the leading edge of the wing and was hit by the propeller. The passenger in a Beech Bonanza suffered severe injuries as the consequence of attempting to remove wheel chocks while the engine was running.

An attempt to position a Robinson R44 helicopter on a flatbed trailer ended with the helicopter's main rotor blades striking a pick-up truck. Fragments killed one ground crewman and seriously hurt another. The pilot and passenger also suffered significant injuries when the helicopter rolled over, ejecting the passenger, and then caught fire. A Bell 206 doing aerial application work took off from a hot refuel stop with the fuel hose still attached; a member of the ground crew survived being struck by the main rotor blade during the rollover that ensued.

# SUMMARY

General aviation accident rates in 2010 showed little change from recent years. A 28% reduction in the rate of non-commercial helicopter accidents was not accompanied by any improvement in their fatal accident rate. Slight declines in non-commercial fixed-wing rates only brought them closer to the ten-year moving averages, while commercial accident rates, both fixed-wing and helicopter, remained almost unchanged.

The number of accidents in amateur-built and E-LSA aircraft dropped dramatically. There were only half as many E-LSA accidents as in 2009, and one-third fewer fatal accidents. Traditional homebuilt aircraft saw 15% fewer accidents and one-third fewer fatal accidents, even though estimated flight activity only decreased by 7%. The amateur-built accident rate dropped 9% and its fatal accident rate decreased 28% from the previous year, though both remained several times as high as in certified fixed-wing aircraft.

Pilot-related accidents were two and a half times more frequent on non-commercial than commercial fixed-wing flights. Almost 60% were takeoff or landing accidents, consistently the two largest categories, and once again takeoffs ranked second among causes of fatal accidents.

After decreasing for five straight years, the number of fuel management accidents on non-commercial fixed-wing flights has increased for two years in a row even as the total number of accidents has decreased. There were almost 20% more fuel-management accidents in 2010 than in 2008, and the proportion of fatal accidents blamed on fuel mismanagement increased by more than 40%, from 3.6% to 5.1%.

More than 60% of accidents involving inadvertent stalls during takeoff, descent to pattern altitude, or low-altitude maneuvering in or out of the pattern were fatal. On the other hand, there were only three fatal landing accidents among the 82 blamed on stalls.

Mechanical failures caused about 15% of fixed-wing accidents, including about 10% of fatal accidents. Both figures are consistent with the record of recent years, as is the 6% of accidents due to losses of engine power for reasons that could not be determined.

Fewer landing accidents occurred on student solos than at any time in the recent past, a decrease of more than 40%.

Other details of the accident record were notable for their lack of change from previous years, including the excess number of accidents on personal fixed-wing flights, the favorable safety record of training flights, the high number but low lethality of crop-dusting accidents, and the sharply higher lethality of accidents in IMC and/or at night.

# APPENDIX

## GENERAL AVIATION SAFETY VS. AIRLINES

GA accident rates have always been higher than airline accident rates. People often ask about the reasons for this disparity. There are several:

- **Variety of missions**—GA pilots conduct a wider range of operations. Some operations, such as aerial application (crop-dusting, in common parlance) and banner towing, have inherent mission-related risks.

- **Variability of pilot certificate and experience levels**—All airline flights are crewed by at least one ATP (airline transport pilot), the most demanding rating. GA is the training ground for most pilots, and while the GA community has its share of ATPs, the community also includes many new and low-time pilots and a great variety of experience in between.

- **Limited cockpit resources and flight support**—Usually, a single pilot conducts GA operations, and the pilot typically handles all aspects of the flight, from flight planning to piloting. Air carrier operations require at least two pilots. Likewise, airlines have dispatchers, mechanics, loadmasters, and others to assist with operations and consult with before and during a flight.

- **Greater variety of facilities**—GA operations are conducted at about 5,300 public-use and 8,000 private-use airports, while airlines are confined to only about 600 of the larger public-use airports. Many GA-only airports lack the precision approaches, long runways, approach lighting systems, and the advanced services of airline-served airports. (There are also another 6,000 GA-only landing areas that are not technically airports, such as heliports and seaplane bases.)

- **More takeoffs and landings**—During takeoffs and landings aircraft are close to the ground and in a more vulnerable configuration than in other phases of flight. On a per hour basis, GA conducts many more takeoffs and landings than either air carriers or the military.

- **Less weather-tolerant aircraft**—Most GA aircraft cannot fly over or around weather the way airliners can, and they often do not have the systems to avoid or cope with hazardous weather conditions, such as ice.

**Figure 51:** What Does General Aviation Fly?

| Aircraft Class | Commercial | | Non-Commercial | |
|---|---|---|---|---|
| Piston Single-Engine | 2,711 | 23% | 136,808 | 66% |
| Piston Multiengine | 1,149 | 10% | 14,751 | 7% |
| Turboprop Single-Engine | 1,822 | 16% | 2,392 | 1% |
| Turboprop Multiengine | 846 | 7% | 4,309 | 2% |
| Turbojet | 1,726 | 15% | 9,758 | 5% |
| Helicopter | 3,163 | 27% | 6,939 | 3% |
| Experimental | 191 | 2% | 24,593 | 12% |
| Light Sport | 0 | | 6,528 | 3% |
| Total | 11,608 | | 206,078 | |

## WHAT IS GENERAL AVIATION?

Although GA is typically characterized by recreational flying, it encompasses much more. Besides providing personal, business, and freight transportation, GA supports diverse activities such as law enforcement, forest fire fighting, air ambulance, logging, fish and wildlife spotting, and other vital services. For a breakdown of GA activities and their accident statistics, see “Type of Flying” on page 49.

## WHAT DOES GENERAL AVIATION FLY?

General aviation aircraft are as varied as their pilots and the types of operations flown.

The following aircraft categories and classes are included in this year’s *Nall Report*:

- Piston single-engine
- Piston multiengine
- Turboprop single-engine
- Turboprop multiengine
- Turbojet
- Helicopter
- Experimental
- Light Sport

The following aircraft categories, classes, and operations are not included in this year's *Nall Report*:

- FAR Part 121 airline operations
- Military operations
- Fixed-wing aircraft weighing more than 12,500 pounds
- Weight-shift control aircraft
- Powered parachutes
- Gyroplanes
- Gliders
- Airships
- Balloons

Figure 51 shows the FAA's estimate of the number of powered GA aircraft that were active in 2010, sorted by category and class, separately for aircraft primarily operated commercially and other GA users. The estimates of total flight time used in this report are based on 99.2 percent of the GA fleet.

## INTERPRETING AVIATION ACCIDENT STATISTICS: WHAT IS THE ACCIDENT RATE?

Meaningful comparisons are based on equal exposure to risk. However, this alone does not determine total risk. Experience, proficiency, equipment, and flight conditions all have a safety impact. To compare different airplanes, pilots, types of operations, etc., we must first "level the playing field" in terms of exposure to risk. The most common way to do this is to compare accidents per 100,000 flight hours. GA flight hours are estimated using data from an annual aircraft activity survey conducted by the FAA. In the last few years, the FAA has made a considerable investment to improve both the accuracy and sample size of the activity survey. Whether this survey accurately reports the total hours has been debated for years, but even with likely inaccuracies, the relationships between accident categories will remain constant. For instance, landing accidents will still account for the majority of minor injury mishaps, while weather and maneuvering flight will still claim the most lives.

Accident investigators and safety researchers determine the probability that a given accident was the result of a particular cause or sequence of events. This report shows the percentage of accidents attributed to a particular accident category and the percentage of accident sequences that began in a particular phase of flight. Thus we can identify and concentrate on accidents that carry the greatest risk.

# NTSB DEFINITIONS

## ACCIDENT/INCIDENT (NTSB PART 830)

The following definitions of terms used in this report have been extracted from 49 CFR Part 830 of the Federal Aviation Regulations. It is included in most commercially available FAR/AIM digests and should be referenced for detailed information.

## AIRCRAFT ACCIDENT

An occurrence incidental to flight in which, "as a result of the operation of an aircraft, any person (occupant or non-occupant) receives fatal or serious injury or any aircraft receives substantial damage."

- **A fatal injury** is one that results in death within 30 days of the accident.

- **A serious injury** is one that:
  1 - Requires hospitalization for more than 48 hours, commencing within seven days from the date the injury was received.
  2 - Results in a fracture of any bone (except simple fractures of fingers, toes, or nose).
  3 - Involves lacerations that cause severe hemorrhages, nerve, muscle, or tendon damage.
  4 - Involves injury to any internal organ. Or
  5 - Involves second- or third-degree burns, or any burns affecting more than five percent of body surface.

- **A minor injury** is one that does not qualify as fatal or serious.

- **Destroyed** means that an aircraft was demolished beyond economical repair, i.e., substantially damaged to the extent that it would be impracticable to rebuild it and return it to an airworthy condition. (This may not coincide with the definition of "total loss" for insurance purposes. Because of the variability of insurance limits carried and such additional factors as time on engines and propellers, and aircraft condition before an accident, an aircraft may be "totaled" even though it is not considered "destroyed" for NTSB accident-reporting purposes.)

- **Substantial damage**—As with "destroyed," the definition of "substantial" for accident reporting purposes does not necessarily correlate with "substantial" in terms of financial loss. Contrary to popular misconception, there is no dollar value that defines "substantial" damage. Because of the high cost of many repairs, large sums may be spent to repair damage resulting from incidents that do not meet the NTSB definition of substantial damage.
  1 - Except as provided below, substantial damage means damage or structural failure that adversely affects the structural strength, performance, or flight characteristics of the aircraft, and which would normally require major repair or replacement of the affected part.
  2 - Engine failure, damage limited to an engine, bent fairings or cowling, dented skin, small puncture holes in the skin or fabric, ground damage to rotor or propeller blades, damage to landing gear, wheels, tires, flaps, engine accessories, brakes, or wing tips are not considered "substantial damage."

- Minor damage is any damage that does not qualify as "substantial," such as that in item 2 - under substantial damage.

## TYPE OF FLYING

The purpose for which an aircraft is being operated at the time of an accident:

- **On-Demand Air Taxi**—Revenue flights, conducted by commercial air carriers operating under FAR Part 135 that are not operated in regular scheduled service, such as charter flights and all non-revenue flights incident to such flights.

- **Personal**—Flying by individuals in their own or rented aircraft for pleasure or personal transportation not in furtherance of their occupation or company business. This category includes practice flying (for the purpose of increasing or maintaining proficiency) not performed under supervision of an accredited instructor and not part of an approved flight training program.

- **Business**—The use of aircraft by pilots (not receiving direct salary or compensation for piloting) in connection with their occupation or in the furtherance of a private business.

- **Instruction**—Flying accomplished in supervised training under the direction of an accredited instructor.

- **Corporate**—The use of aircraft owned or leased, and operated by a corporate or business firm for the transportation of personnel or cargo in furtherance of the corporation's or firm's business, and which are flown by professional pilots receiving a direct salary or compensation for piloting.

- **Aerial Application**—The operation of aircraft for the purpose of dispensing any substance for plant nourishment, soil treatment, propagation of plant life, pest control, or fire control, including flying to and from the application site.

- **Aerial Observation**—The operation of an aircraft for the purpose of pipeline/power line patrol, land and animal surveys, etc. This does not include traffic observation (electronic newsgathering) or sightseeing.

- **Other Work Use**—The operation of an aircraft for the purpose of aerial photography, banner/glider towing, parachuting, demonstration or test flying, racing, aerobatics, etc.

- **Public Use**—Any operation of an aircraft by any federal, state, or local entity.

- **Ferry**—A non-revenue flight for the purpose of
  1 - returning an aircraft to base,
  2 - delivering an aircraft from one location to another, or
  3 - moving an aircraft to and from a maintenance base. Ferry flights, under certain terms, may be conducted under terms of a special flight permit.

- **Positioning**—Positioning of the aircraft without the purpose of revenue.

- **Other**—Any flight that does not meet the criteria of any of the above.

- **Unknown**—A flight whose purpose is not known.

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