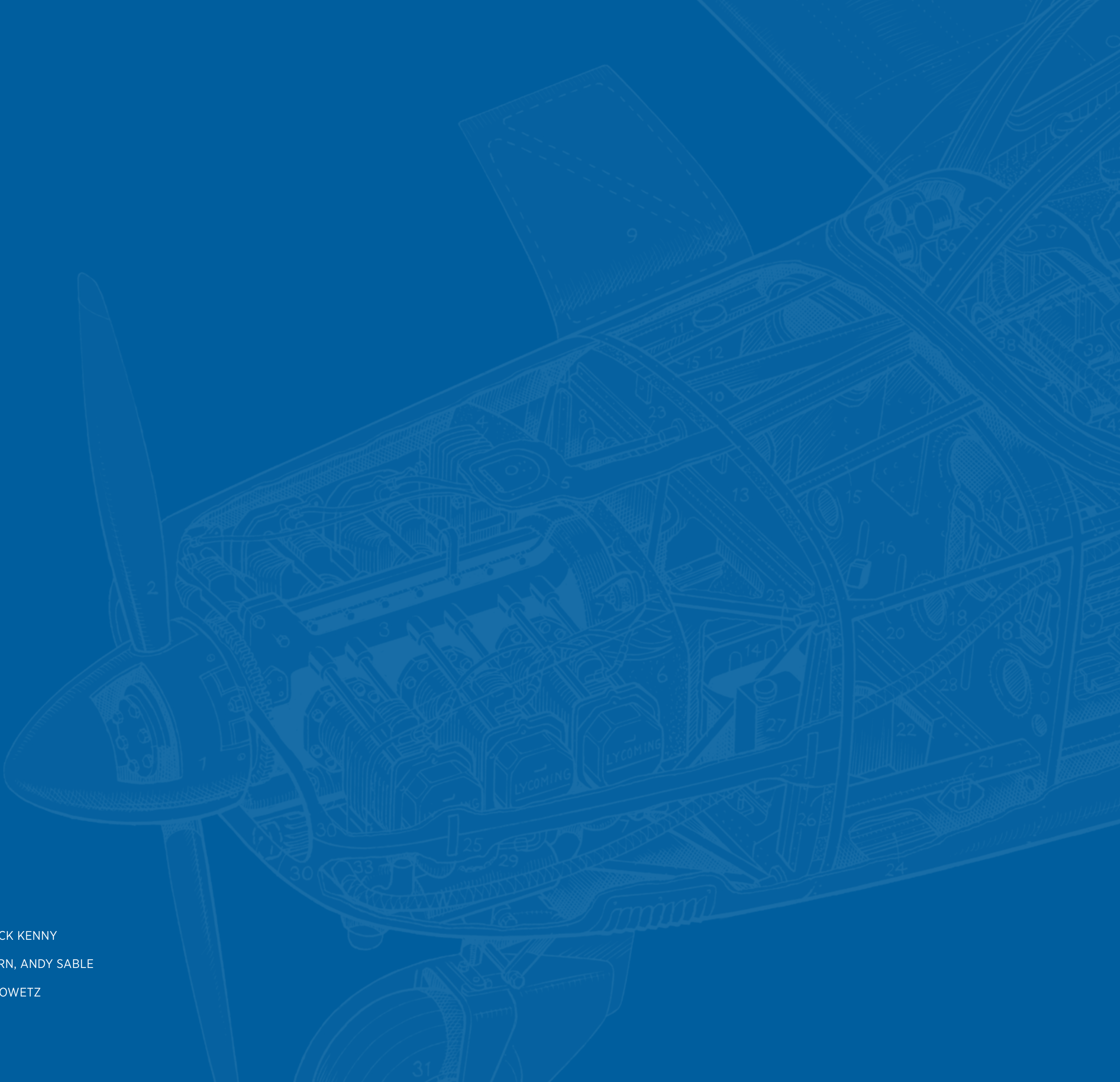
AOPA AIR SAFETY INSTITUTE

25TH JOSEPH T NALL REPORT
GENERAL AVIATION ACCIDENTS IN 2013



PUBLISHER: GEORGE PERRY

STATISTICIAN AND WRITER: DAVID JACK KENNY

EDITORS: BOB KNILL, TYLER PANGBORN, ANDY SABLE

GRAPHIC DESIGNER: SAMANTHA BANOWETZ

DEDICATION The *Joseph T. Nall Report* is the AOPA Air Safety Institute's (ASI's) review of general aviation (GA) accidents during the most recent year for which reasonably complete data are available. The report is dedicated to the memory of Joe Nall, a National Transportation Safety Board member who died as a passenger in an airplane accident in Caracas, Venezuela, in 1989.

INTRODUCTION: WHAT IS GENERAL AVIATION?

"General aviation" (GA) is all flight activity of every kind except that done by the uniformed armed services and the scheduled airlines. In addition to personal and recreational flying, it includes public-benefit missions such as law enforcement and fire suppression, flight instruction, freight hauling and passenger charters, crop-dusting, and other types of aerial work that range from news reporting to helicopter sling loads. In 2013, nearly 200,000 individual aircraft logged almost 23 million hours flying GA.

Following the pattern of recent years, this twenty-fifth edition of the *Nall Report* analyzes GA 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. Collectively, these account for about 99% of all GA flight activity. 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 Federal Aviation Regulations Part 91 by commercial operators.

INTERPRETING AVIATION ACCIDENT STATISTICS: ACCIDENTS VS. ACCIDENT RATES

Meaningful comparisons are based on equal exposure to risk. Since experience, proficiency, equipment, and flight conditions all have a safety impact, exposure alone doesn't determine the total risk. To evaluate those factors, or compare different airplanes, pilots, types of operations, etc., we must first "level the playing field" in terms of exposure. For that reason, the most informative measure is usually not the number of accidents but the accident rate, commonly expressed as the number of accidents per 100,000 flight hours. GA flight time is estimated using data from an annual aircraft activity survey conducted by the FAA, the General Aviation and Part 135 Activity Survey. This provides breakdowns by category and class of aircraft and purpose of flight, among other characteristics.

While the FAA has not been able to publish results from the 2011 survey, the 2012 and 2013 surveys were completed on schedule. For that reason, this edition of the *Nall Report* omits estimates of accident rates for 2011, but does present estimates for the years 2004-2010 and 2012-2013.

FINAL VS. PRELIMINARY STATISTICS

When the data were frozen for the current report, the NTSB had released its findings of probable cause for 1,154 of the 1,185 qualifying accidents (97.4%) that occurred in 2013, including 199 of 206 fatal accidents (96.6%). 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 **airsafetyinstitute.org/database**.

ASI gratefully acknowledges the technical support and assistance of the:

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

Financial support for the *Nall Report* comes from the Manuel Maciel Safety Research Endowment and **donations to the AOPA Foundation from individual pilots**.

TABLE OF CONTENTS

PUBLISHER'S VIEW

In this 25th edition of the *Joseph T. Nall Report*, the AOPA Air Safety Institute looks back at general aviation accident data in an attempt to determine historical trends and focus on areas for improvement in GA safety. Most notably, for the first time in our 25 years of producing this cornerstone document, the fatal accident rate on non-commercial fixed-wing flights fell below 1.0 to 0.99 per 100,000 hours of flight time. This is a promising sign as this sector of GA safety has been relatively stagnant for many years. While one year's statistics may not necessarily be indicative of changes in long-term trends, for the past several years we have continued to see modest improvements in safety—and preliminary data from 2014 and 2015 are also positive. These are encouraging signs.

The *Nall Report* is much more than a retrospective analysis of the past. It helps us better identify areas of emphasis for safety improvement efforts going forward. For instance, we know that loss of control (LOC) and accidents in the takeoff, landing, and go-around phases of flight account for the vast majority of total accidents. As a result ASI created targeted educational content specifically to address those areas. In addition, through our nationwide safety seminars, ASI held in-person training programs to educate pilots on these high-risk areas. ASI is also working on several initiatives that will spur discussion about potential changes in initial and recurrent general aviation pilot training to better address LOC scenarios and achieve additional safety improvements.

Furthermore, we see opportunity in technological advancements by helping to create pathways to retrofit existing aircraft with modern, low-cost safety-enhancing technologies. With ASI's full support, the FAA's NORSEE (non-required safety enhancing equipment) program has already seen successes. This program has removed many of the traditional regulatory barriers and made it much easier for pilots to install angle of attack (AOA) and digital attitude indicating systems. We see these achievements as great first steps and are working with the FAA to expand this program to include items like low-cost autopilots with envelope protection. Hopefully one day soon under this program, pilots will have the ability to install inexpensive but highly capable digital primary flight displays that will provide safety enhancements such as synthetic vision along with real-time ADS-B traffic and weather. What's clear going forward is that it's vital for all of the GA industry, associations like AOPA, and the FAA to work together and make this vision a reality. These efforts will undoubtedly support our shared goal of improved safety and allow safety enhancing innovations to once again become commonplace.

The *Nall Report*, National Transportation Safety Board (NTSB) accident data, and list of top ten safety improvements tell us where to focus our efforts. I'm encouraged by the level of cooperation and the unity of effort I've seen. Whether it's regulatory reform with the long-awaited FAR Part 23 rewrite, programs like NORSEE that allow safety innovations into the cockpit, or the FAA's updated compliance philosophy, I can't recall a time where industry, government, and associations have been so well aligned to help improve general aviation safety. The AOPA Air Safety Institute will continue to do its part by working cooperatively with the government, industry, and other associations and by providing free safety education to hundreds of thousands of pilots each year.

There is good reason to be optimistic as general aviation moves forward. I am encouraged by the achievements to date and the positive safety trends that this *Nall Report* details. I want to close by extending a special word of thanks to safety-minded pilots everywhere, to our industry partners, and to our colleagues at the FAA and NTSB for helping the AOPA Air Safety Institute produce this 25th edition of the *Joseph T. Nall Report*. Together we are making a difference!

Safe flights,

George Perry
Senior Vice President, AOPA Air Safety Institute

GENERAL AVIATION ACCIDENTS IN 2013

In 2013, there were 1,185 general aviation accidents involving a total of 1,194 individual aircraft (FIGURE 1). None involved collisions between aircraft of different categories; in fact, no helicopters collided with any other aircraft.

A total of 363 individuals were killed in the 205 fatal accidents, 4% fewer than the year before. Fifty fewer deaths on non-commercial fixed-wing flights—a reduction of some 15%—were partly offset by increases in the other three sectors. There were 13 more deaths (45%) in non-commercial helicopter accidents, 20 more (250%) on fixed-wing commercial flights, and two more (33%) in commercial helicopter operations. However, only non-commercial helicopter fatalities have increased for two successive years. The 28 on commercial fixed-wing flights was equal to the number in 2011, while the eight on commercial helicopter flights is a 60% reduction from the 20 recorded in that year.

Non-commercial fixed-wing flights made up 73% of estimated GA activity in 2013, essentially unchanged from the year before. They were responsible for 81% of both all accidents and all fatal accidents, down from 83% and 88%, respectively, in 2012.

TRENDS IN GENERAL AVIATION ACCIDENTS, 2004–2013

According to FAA estimates, non-commercial flight time continued to decrease in 2013, falling 7% in airplanes and 10% in helicopters from the 2012 estimates. However, the number of accidents dropped even more sharply: by 18% and 17%, respectively (FIGURE 2A). There were 24% fewer fatal airplane accidents but the number in helicopters increased by one. Both the overall and fatal accident rates on non-commercial fixed-wing flights attained record lows of 5.77 and 0.99 per 100,000 hours, respectively (FIGURE 2B). While the overall rate of non-commercial helicopter accidents declined 7%, the fatal accident rate jumped some 23% to 1.48 per 100,000 hours, the highest since 2003.

Commercial fixed-wing activity grew 8% but helicopter traffic dropped some 18%. The number of fatal accidents in both categories of aircraft increased from the near-record lows recorded the previous year while the numbers of non-fatal accidents remained almost unchanged. The corresponding accident rates were within the prior decade's range.

FIGURE 1. GENERAL AVIATION ACCIDENTS IN 2013

	Non-Commercial		Commercial	
	Fixed-Wing	Helicopter	Fixed-Wing	Helicopter
Number of Accidents	958	105	81	41
Number of Aircraft*	967	105	81	41
Number of Fatal Accidents	166	20	12	7
Lethality (Percent)	17.3	19.0	14.8	17.1
Fatalities	285	42	28	8

**Each aircraft involved in a collision is counted separately.*

FIGURE 2A. GENERAL AVIATION ACCIDENT TRENDS, 2004-2013

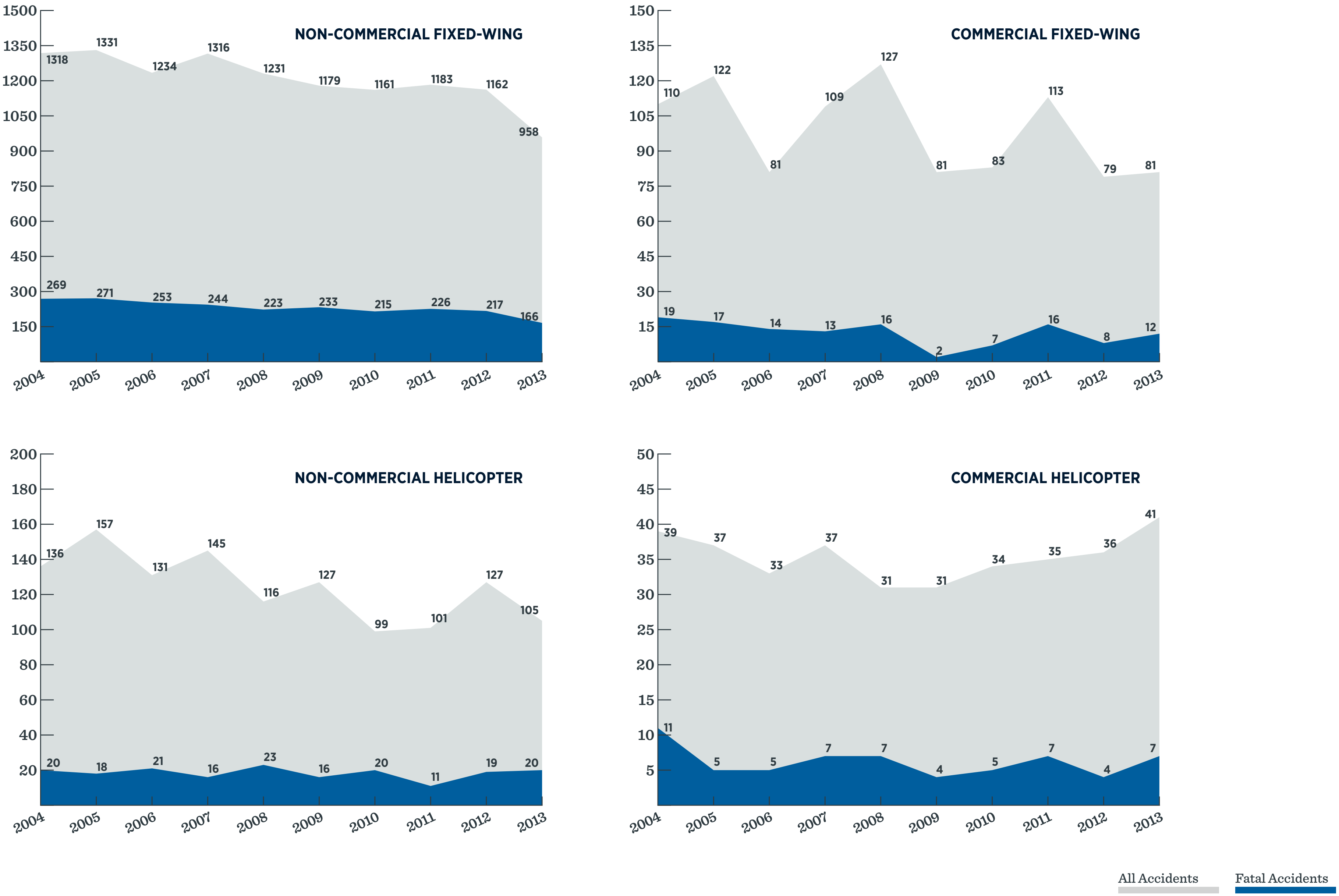
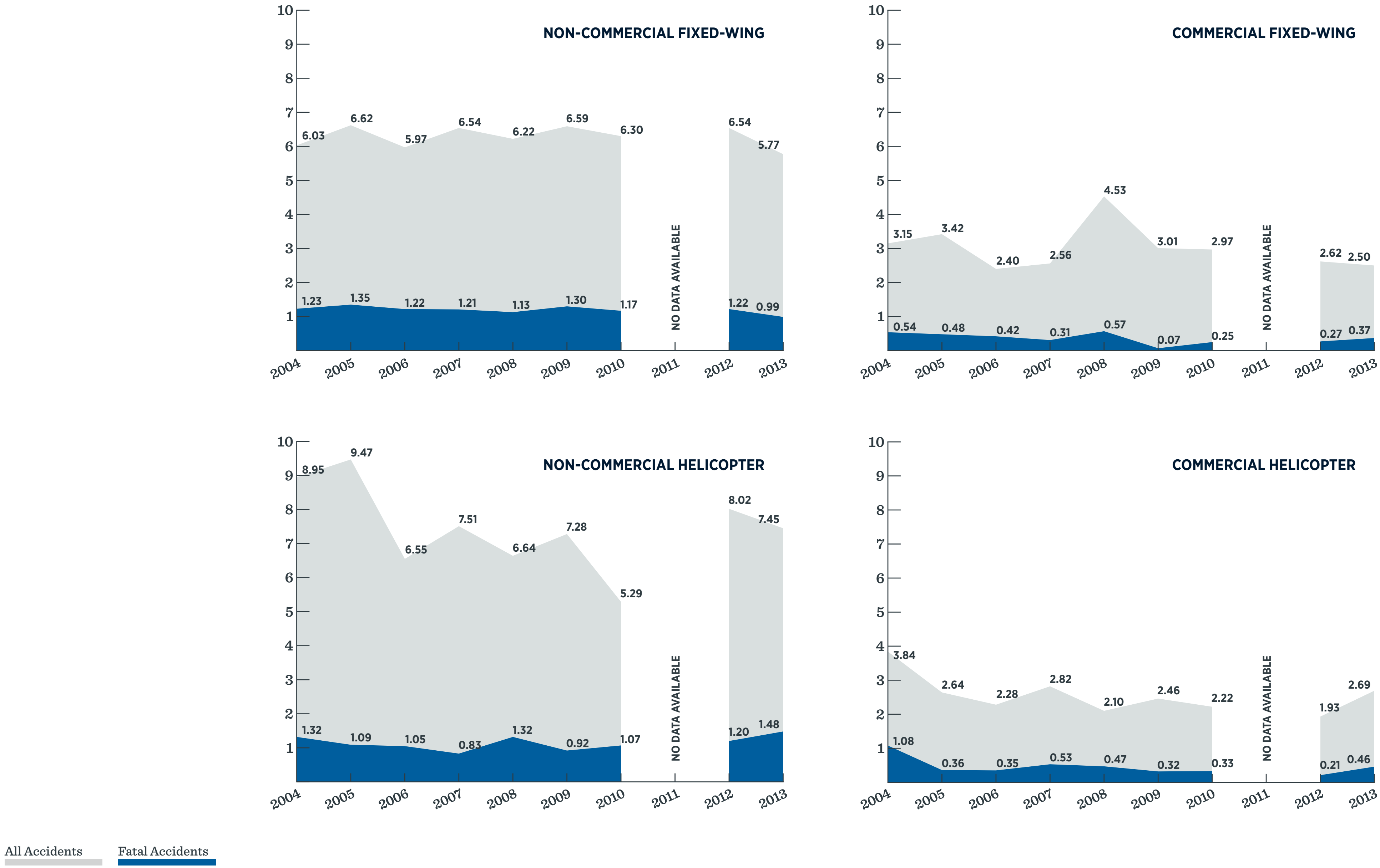


FIGURE 2B. GENERAL AVIATION ACCIDENT RATES, 2004-2013



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 bird strikes and unexplained losses of engine power, plus those for which a specific cause has not been determined.

2013 saw the return of the pattern that had characterized fixed-wing accidents through 2010: Pilot-related causes led to a larger share of non-commercial than commercial accidents (FIGURE 3). The proportion caused by known mechanical failures was almost twice as high on commercial flights. However, non-commercial flights enjoyed a sharp reduction in the number of both fatal and survivable accidents compared to the prior year. In commercial activity, the overall number of accidents rose by two and the number of fatal accidents increased by four.

NON-COMMERCIAL FIXED-WING ACCIDENTS

The unprecedented decrease of nearly 18% in the number of non-commercial fixed-wing accidents, from 1,162 in 2012 to 958 in 2013 (FIGURE 2A), included a drop of nearly 24% in fatal accidents (from 217 to 166). The number of individual fatalities fell by 50, or 15%, to 285. Flight activity also declined, but by a relatively modest 7%. The result was the lowest accident rate in the 25-year history of the *Nall Report*: 5.79 per 100,000 hours of flight (FIGURE 2B). The rate of fatal accidents fell below 1 per 100,000 hours for the first time on record. The improvement seems to have been across the board rather than concentrated in one or two specific hazards. Nearly 75% were attributed to pilot-related causes (FIGURE 3) and less than 15% to documented mechanical failures, almost exactly the same as the year before and the years preceding that.

AIRCRAFT CLASS More than 70% of the accident aircraft were single-engine fixed-gear (SEF) models (FIGURE 4), but these included just 51% of the fatal accidents. More than 40% of SEF airplanes were conventional-gear (tailwheel) models. Lethality increased progressively from SEF to single-engine retractable-gear to multiengine and turbine aircraft, a relationship that's been consistent for many years. Some of that difference can be attributed to the typically greater experience and more advanced credentials of pilots who fly higher-performance models, making them less vulnerable to runway excursions, hard landings, and similar low-energy mishaps.

TYPE OF OPERATION Personal flights resulted in 75% of 2013's accidents (FIGURE 5) and 78% of fatal accidents. Both proportions were almost unchanged from 2012, and typify the pattern that's characterized at least the past 20 years. Instructional flights continue to make up the second largest category. They accounted for more than half of the remainder, just under 15% of the total, but only 9% of fatal accidents. Flight instruction in both airplanes and helicopters enjoys among the lowest lethality rates in general aviation. Three of the five accidents on corporate and executive transport flights were fatal, causing a total of nine deaths. However, gauged against the more than 2.4 million hours that corporate flight departments logged during 2013, their fatal accident rate was only one-third that of commercial fixed-wing general aviation.

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

FIGURE 3. MAJOR CAUSES: FIXED-WING GENERAL AVIATION ACCIDENTS

	Non-Commercial				Commercial			
	All Accidents		Fatal Accidents		All Accidents		Fatal Accidents	
Pilot-Related	709	74.0%	121	72.9%	52	64.2%	10	83.3%
Mechanical	141	14.7%	15	9.0%	23	28.4%	1	8.3%
Other or Unknown	108	11.3%	30	18.1%	6	7.4%	1	8.3%

**Each aircraft involved in a collision is counted separately.*

FIGURE 4. AIRCRAFT CLASS: NON-COMMERCIAL FIXED-WING

Aircraft Class	Accidents		Fatal Accidents		Lethality
Single-Engine Fixed-Gear	698	72.2%	87	51.5%	12.5%
SEF Tailwheel	289		30		10.4%
Single-Engine Retractable	186	19.2%	46	27.2%	24.7%
Single-Engine Turbine	19		5		26.3%
Multiengine	83	8.6%	36	21.3%	43.4%
Multiengine Turbine	16		12		75.0%

FIGURE 5. TYPE OF OPERATION: NON-COMMERCIAL FIXED-WING

Type of Operation	Accidents		Fatal Accidents		Fatalities	
Personal	728	75.3%	131	77.5%	222	77.9%
Instructional	144	14.9%	16	9.5%	23	8.1%
Public Use	1	0.1%	0			
Positioning	11	1.1%	3	1.8%	3	1.1%
Aerial Observation	9	0.9%	1	0.6%	2	0.7%
Business	27	2.8%	9	5.3%	16	5.6%
Executive/Corporate	5	0.5%	3	1.8%	9	3.2%
Other Work Use	23	2.4%	2	1.2%	3	1.1%
Other or Unknown	19	2.0%	4	2.4%	7	2.5%

FIGURE 6. FLIGHT CONDITIONS: NON-COMMERCIAL FIXED-WING

Light and Weather	Accidents		Fatal Accidents		Fatalities	
Day VMC	846	88.3%	117	70.5%	189	66.3%
Night VMC*	63	6.6%	15	9.0%	24	8.4%
Day IMC	26	2.7%	23	13.9%	51	17.9%
Night IMC*	21	2.2%	10	6.0%	19	6.7%
Unknown	2	0.2%	1	0.6%	2	0.7%

**Includes dusk.*

FIGURE 7. PILOTS INVOLVED IN NON-COMMERCIAL FIXED-WING ACCIDENTS

Certificate Level	Accidents		Fatal Accidents		Lethality
ATP	149	15.4%	27	16.0%	18.1%
Commercial	261	27.0%	49	29.0%	18.8%
Private	444	45.9%	84	49.7%	18.9%
Sport	23	2.4%	2	1.2%	8.7%
Student	74	7.7%	5	3.0%	6.8%
Other or Unknown	16	1.7%	2	1.2%	12.5%
Second Pilot on Board	154	15.9%	32	18.9%	20.8%
CFI on Board*	232	24.0%	46	27.2%	19.8%
IFR Pilot on Board*	536	55.4%	106	62.7%	19.8%

**Includes single-pilot flights.*

FIGURE 9. PILOT-RELATED ACCIDENT RATES, 2004-2013

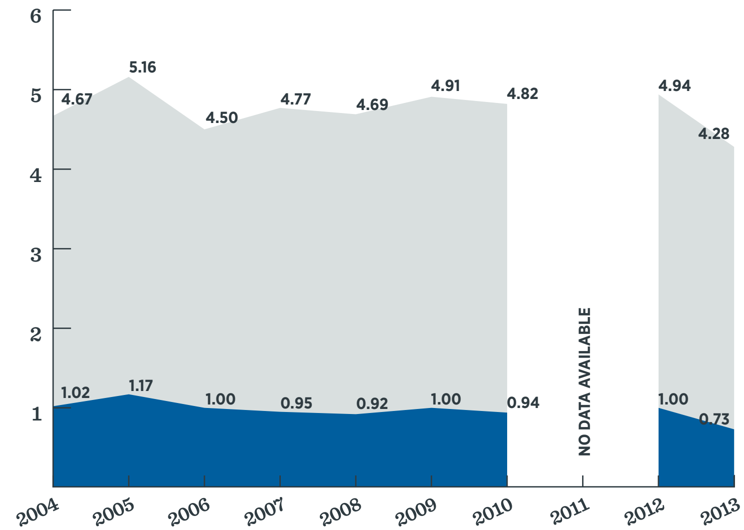


FIGURE 8. PILOT-RELATED ACCIDENT TREND

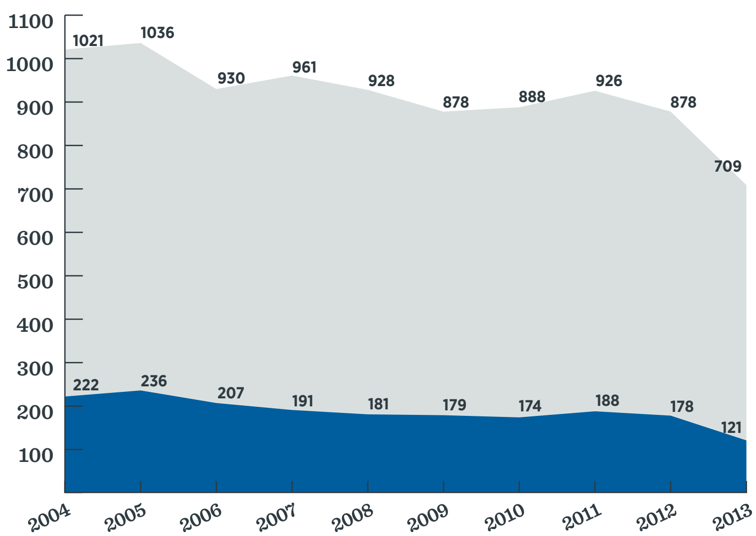
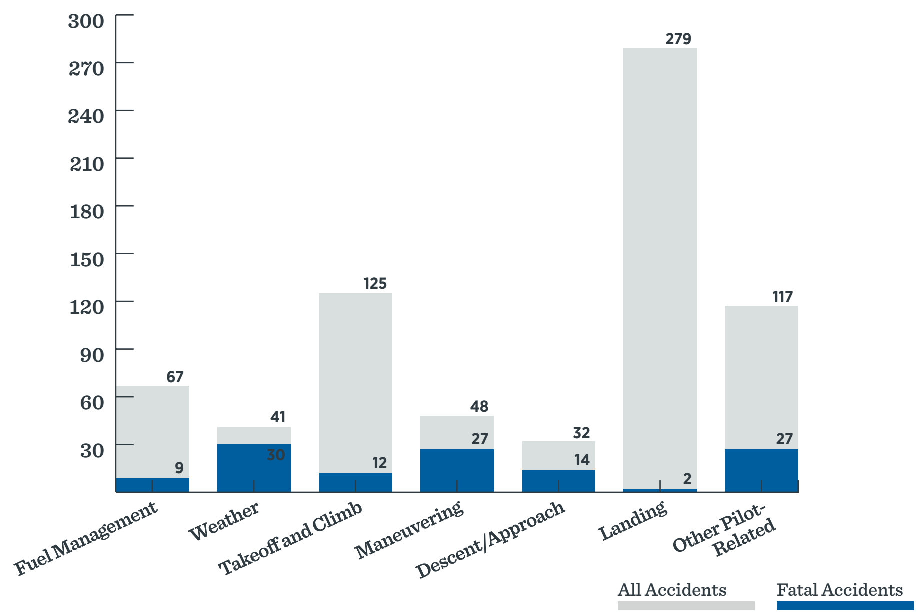


FIGURE 10. TYPES OF PILOT-RELATED ACCIDENTS



NTSB ACCIDENT NO. CEN14FA035

ACCIDENT CASE STUDY: FUEL MANAGEMENT

BEECH C90, SPRINGDALE, ARKANSAS | TWO FATALITIES

HISTORY OF FLIGHT The King Air took off from Pine Bluff, Arkansas at about 4:50 p.m. on a VFR flight to Bentonville. At normal cruise speed, it should have covered the straight-line distance of 172 nautical miles in well under an hour. The pilot obtained flight following and the trip progressed routinely until 5:40, when he told the Fort Smith tower controller that low fuel required him to change his destination to Fayetteville. On learning that Fayetteville was nine miles away, he requested a closer airport and was vectored to Springdale, four miles ahead. Thirty seconds later he transmitted that he'd be unable to make the field; witnesses saw the airplane stall and crash nose-first after a sudden pull-up to avoid power lines.

Investigators found no fuel stains around the wreckage and no usable fuel on board even though the airplane's fuel totalizer indicated that 123 gallons were available. Investigators determined that the pilot had not bought fuel on the leg before the accident flight; on the flight before that, he'd taken on 50 gallons. His request for diversion came at the time that the low fuel pressure annunciators would be expected to have illuminated.

PILOT INFORMATION The 72-year-old pilot held a private pilot certificate with single- and multiengine airplane and instrument ratings and a current third-class medical certificate. His medical application listed 3,367 total hours, including 53 in the preceding six months. His logbook was not recovered, so his make-and-model experience is not known.

WEATHER Six minutes after the accident, the Springdale AWOS reported winds from 310 degrees at 7 knots gusting to 14, 10 statute miles visibility, and a few clouds at 6,500 feet. The temperature was 16 degrees Celsius with a dew point of 5; the altimeter setting was 29.90 inches of mercury.

PROBABLE CAUSE A total loss of power to both engines due to fuel exhaustion. Also causal were the pilot's reliance on the fuel totalizer rather than the fuel quantity gauges to determine the fuel on board and his improper fuel planning.

ASI COMMENTS The air of precision attached to digital fuel monitors should not obscure the fact that they depend on accurate pilot input of the amounts loaded. There is no substitute for directly confirming available fuel visually or with a dipstick before flight. Regularly topping off the tanks in order to start with a known quantity is also a wise precaution.

FLIGHT CONDITIONS Less than 5% of all accidents occurred in instrument meteorological conditions (IMC), but these included nearly 20% of all fatal accidents and almost 25% of individual deaths (FIGURE 6). More than 70% of all accidents in IMC were fatal compared to less than 15% of those in visual meteorological conditions (VMC) during daylight hours and 23% of those in VMC at night. However, since the overwhelming majority of all accidents (some 88%) took place in daytime VMC, it still accounted for more than 70% of all fatal accidents and nearly two-thirds of individual fatalities. This, too, is a familiar pattern; despite the overall decline in accidents and fatalities, these proportions are nearly identical to those from each of the past six years.

PILOT QUALIFICATIONS Half of all fatal accidents, and 47% of accidents overall, were on flights commanded by private pilots (FIGURE 7). Commercial pilots flew 27%, and 15% were commanded by airline transport pilots (ATPs). Fifty-five percent of all accident pilots were instrument-rated, well below the 70% of pilots with private or higher certificates who held that rating in 2013. However, that population includes commercial and airline transport pilots who do little or no GA flying beyond positioning legs flown under Part 91 in company aircraft. Restricting the comparison to private pilots shows similarly small differences but in the opposite direction: One-third of the accident pilots were instrument-rated compared to 28% of private pilots nationwide.

Unlike 2011 and 2012—but similar to prior years—lethality differed very little between private pilots and those with advanced certificates but was sharply lower for solo students. Only five of the 74 accidents on student solos were fatal.

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 (709 TOTAL / 121 FATAL) Pilot-related causes consistently account for about 75% of non-commercial fixed-wing accidents. This was true again in 2013 (FIGURE 3) when they led to 73% of fatal and 74% of non-fatal accidents. This was the first year since 2002 in which pilot-related accidents did not suffer greater lethality than other types. While the 18% decrease in the number of pilot-related accidents was similar to the overall improvement in the non-commercial fixed-wing sector (FIGURE 8), the 32% decrease in fatal accidents was actually one-third greater than the overall reduction.

The rates of pilot-related accidents as scaled by estimated flight time also reached new lows after a decade characterized by remarkable stability (FIGURE 9).

Stability continued to prevail among the types of pilot-related accidents, however (FIGURE 10). Landing accidents remained the most common, outnumbering takeoff accidents by more than two to one. Adverse weather again caused the largest number of fatal accidents, though by a narrow margin over low-altitude maneuvering and the catch-all "other pilot-related" categories. Weather accidents consistently suffer the highest lethality, but more than 55% of maneuvering accidents and over 40% of all accidents during descent and approach were also fatal.

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

- 29 accidents (seven fatal) attributed to inadequate preflight inspections
- 33 accidents during attempted go-arounds, six of which were fatal
- 25 non-fatal accidents while taxiing, including three collisions between aircraft on the ground
- Seven non-fatal accidents in which loss of engine power during cruise was blamed on the pilot's failure to use carburetor heat
- Three episodes of controlled flight into terrain during cruise flight; no deaths resulted
- Two cases, one of them fatal, of pilot impairment by alcohol and/or drugs
- Two successful and one unsuccessful suicide attempts
- Eight accidents triggered by physical incapacitation of the pilots involved; seven were fatal
- Three fatal and three non-fatal mid-air collisions, all between airplanes on non-commercial flights
- A prop strike that killed a member of a runway maintenance crew.

Accidents caused by poor fuel management or hazardous weather usually follow some 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 pilots' airmanship. Of course, having allowed a test of airmanship to develop in the first place may raise legitimate questions about a pilot's judgement.

ACCIDENT CAUSES: FLIGHT PLANNING AND DECISION-MAKING

FUEL MANAGEMENT (67 TOTAL / 9 FATAL) The number of fuel-mismanagement accidents fell for the second consecutive year (FIGURE 11). After dropping 18% from 2011 to 2012, it decreased another 16% to 67 in 2013. 2013 also marked only the third year to see fewer than 10 fatal accidents caused by fuel mismanagement, though the sharp reduction in total fatalities meant that the proportion due to fuel mismanagement edged back up above 5%.

More than 60% resulted from flight-planning deficiencies (inaccurate estimation of fuel requirements or failure to monitor fuel consumption in flight) that caused complete fuel exhaustion (FIGURE 12). This has

FIGURE 11. FUEL MANAGEMENT ACCIDENT TREND

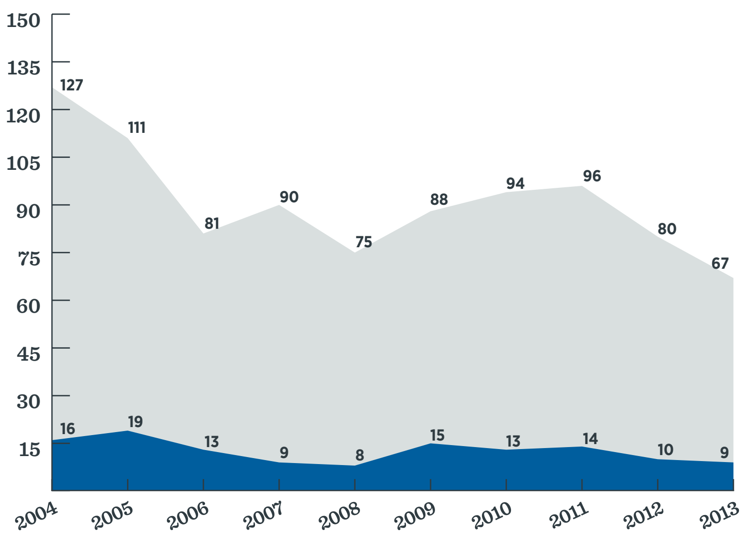


FIGURE 12. TYPES OF FUEL MANAGEMENT ACCIDENTS

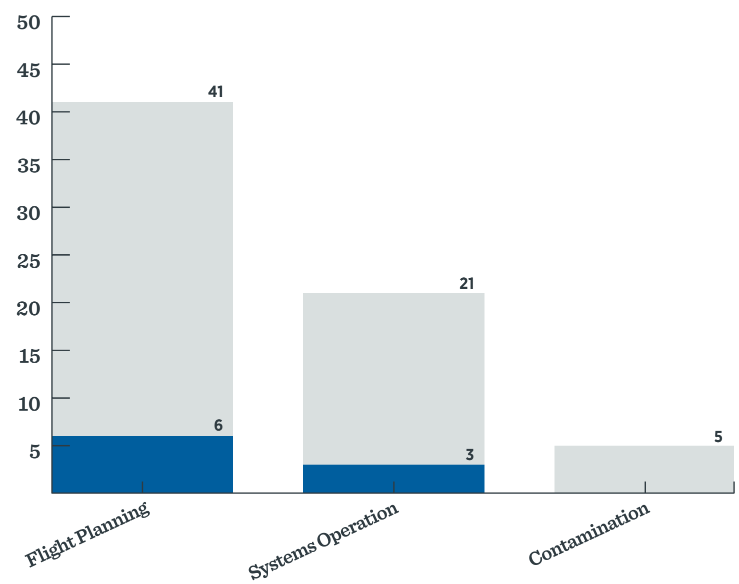


FIGURE 13. AIRCRAFT INVOLVED IN FUEL MANAGEMENT ACCIDENTS: NON-COMMERCIAL FIXED-WING

Aircraft Class	Accidents		Fatal Accidents		Lethality
Single-Engine Fixed-Gear	37	55.2%	5	55.6%	13.5%
SEF Tailwheel	6		0		
Single-Engine Retractable	23	34.3%	3	33.3%	13.0%
Multiengine	7	10.4%	1	11.1%	14.3%
Multiengine Turbine	3		1		33.3%

FIGURE 14. FLIGHT CONDITIONS OF FUEL MANAGEMENT ACCIDENTS: NON-COMMERCIAL FIXED-WING

Light and Weather	Accidents		Fatal Accidents		Lethality
Day VMC	53	79.1%	6	66.7%	11.3%
Night VMC*	12	17.9%	2	22.2%	16.7%
Night IMC*	2	3.0%	1	11.1%	50.0%

**Includes dusk.*

FIGURE 15. PILOTS INVOLVED IN FUEL MANAGEMENT ACCIDENTS: NON-COMMERCIAL FIXED-WING

Certificate Level	Accidents		Fatal Accidents		Lethality
ATP	11	16.4%	2	22.2%	18.2%
Commercial	24	35.8%	2	22.2%	8.3%
Private	27	40.3%	4	44.4%	14.8%
Sport	1	1.5%	0		
Student	3	4.5%	0		
Other or Unknown	1	1.5%	1	11.1%	100.0%
Second Pilot on Board	14	20.9%	1	11.1%	7.1%
CFI on Board*	20	29.9%	1	11.1%	5.0%
IFR Pilot on Board*	43	64.2%	6	66.7%	14.0%

**Includes single-pilot flights.*

FIGURE 17. TYPES OF WEATHER ACCIDENTS

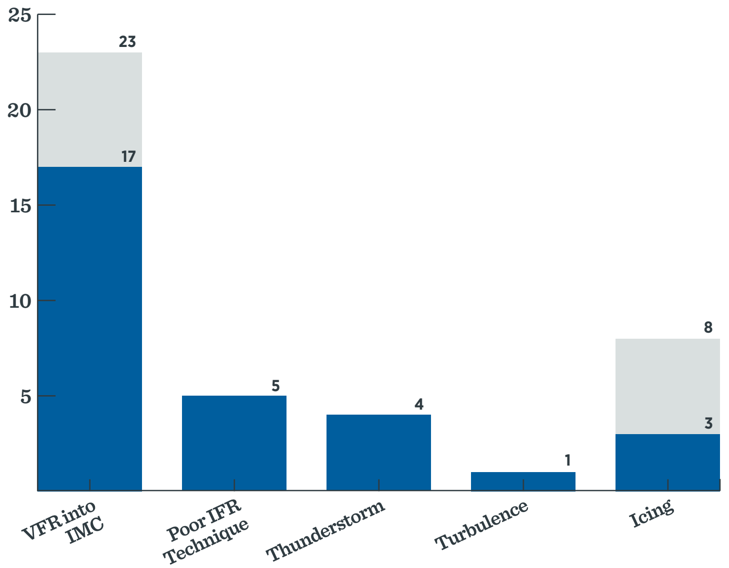


FIGURE 16. WEATHER ACCIDENT TREND

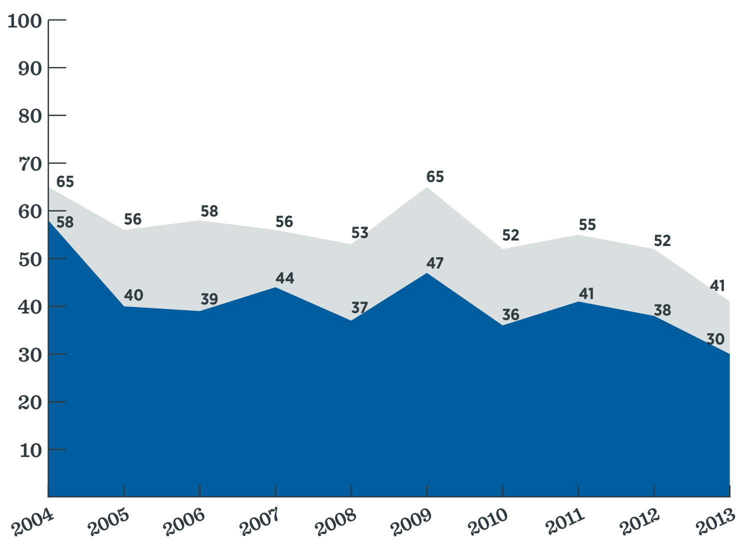


FIGURE 18. AIRCRAFT INVOLVED IN WEATHER ACCIDENTS: NON-COMMERCIAL FIXED-WING

Aircraft Class	Accidents		Fatal Accidents		Lethality
Single-Engine Fixed-Gear	19	46.3%	9	30.0%	47.4%
SEF Tailwheel	4		1		25.0%
Single-Engine Retractable	12	29.3%	12	40.0%	100.0%
Single-Engine Turbine	2		2		100.0%
Multiengine	10	24.4%	9	30.0%	90.0%

All Accidents   Fatal Accidents

NTSB ACCIDENT NO. CEN13FA130

ACCIDENT CASE STUDY: WEATHER

BEECH 58, MAXWELL, NEBRASKA | FOUR FATALITIES

HISTORY OF FLIGHT Shortly before 3:00 p.m., the pilot called Flight Service to file two IFR flight plans. He received an abbreviated weather briefing that included an airmet for icing conditions and turbulence below 8,000 feet and replied that he'd "expected those conditions to develop." The Baron was certified for flight into known icing. At 3:45, it took off from North Platte, Nebraska on an IFR flight plan to York, Nebraska at a planned cruising altitude of 9,000 feet.

Seven minutes after takeoff, the pilot asked the Denver Center controller for any reports on the heights of the tops; there were none. One minute later, the controller heard a "Mayday" call. Radar indicated that the Baron began descending from 7,100 feet at a rate that accelerated past 3,000 feet per minute before contact was lost. The "extensively fragmented" wreckage was subsequently found 11 miles northeast of the North Platte airport.

A King Air operated by the U.S. Army encountered icing at 9,000 feet during an approach to North Platte. At 5,000 feet, it became heavy to severe. Two flights of Army Blackhawk helicopters that landed at North Platte immediately after the accident encountered "light freezing rain and mist which changed to a combination of freezing rain, ice pellets, and snow with increasing winds." No sigmet or Center Weather Advisory for severe icing had been issued.

PILOT INFORMATION The 54-year-old private pilot held ratings for airplane single-engine land, multiengine land, and instrument airplane. Investigators estimated that he had accumulated 1,377 hours that included 457 hours in multiengine airplanes and 171 hours of instrument flight. Of 103 hours flown in the preceding year, 80 were in the accident airplane.

WEATHER Ten minutes before takeoff, surface conditions reported at the departure airport included winds from 350 degrees at 14 knots, 4 miles visibility in mist, overcast ceilings varying between 700 and 1,300 feet, a temperature of -2 Celsius, and a dew point of -4 with an altimeter setting of 29.42 inches. An update recorded at the time of the accident listed winds from 340 degrees at 14 knots with gusts to 20, visibility of 3 miles in light freezing rain and mist, a broken layer at 900, and an altimeter setting of 29.45. Temperature and dew point remained unchanged. Remarks indicated that the freezing rain began at 3:46 with barometric pressure rising rapidly.

PROBABLE CAUSE The pilot's inadvertent encounter with severe icing conditions, which resulted in structural icing and the subsequent loss of airplane control.

ASI COMMENTS Severe icing can overcome the ice-protection equipment on any light airplane, and icing forecasts remain inexact. Even on a known-ice-certified airplane, any evidence of continuing ice accumulation should be considered an imminent threat requiring immediate and decisive action, including declaring an emergency and requesting a deviation or a diversion for landing if necessary.

usually been the most prevalent cause in the past, though that pattern was briefly interrupted in 2012. Errors in operating the aircraft's fuel system (choosing an empty tank or the incorrect use of boost or transfer pumps) caused 31%, while in four out of five accidents blamed on fuel contamination, the contaminant was water. Particulate matter clogged the engine's fuel filter in the fifth. None of those five was fatal, but about 15% of those due to fuel exhaustion, starvation, or engine flooding were.

Retractable-gear and multiengine models made up 45% of the airplanes involved in fuel-management accidents (FIGURE 13). This is more than one and a half times their proportion of non-commercial fixed-wing accidents overall, in which they accounted for less than 30%. Only three involved turboprops, including the only fatal fuel-management accident in a multiengine airplane. That King Air 90, which crashed during an emergency diversion in Arkansas, is the subject of the fuel management case study.

Twenty-one percent took place at night (FIGURE 14), double the proportion of the preceding year. For the third year in a row, only two occurred in IMC. The higher proportion of complex and multiengine airplanes involved in this type of accidents helps explain why only three occurred on student solos (FIGURE 15); 42% were on flights commanded by commercial or airline transport pilots.

WEATHER (41 TOTAL / 30 FATAL) Because weather accidents are the most consistently fatal, and fatal weather accidents are among the most difficult and time-consuming to investigate, some have usually remained unresolved at the time each edition of the *Nall Report* has been published. For that reason, apparent short-term decreases in weather accidents in earlier years have often had to be adjusted upward after more complete data became available. However, the 21% decrease in weather accidents from 2012 to 2013 is similar to the overall drop in the accident rate, and the lethality of these accidents is in line with previous years. This increases confidence that a meaningful reduction did occur in 2013. Compared to the beginning of the decade, in 2004, the overall number of weather accidents fell by 37% and the number that were fatal dropped by almost half (48%).

The characteristics of weather accidents, however, changed very little. As usual, attempts to fly by visual references in instrument conditions ("VFR into IMC") accounted for the lion's share of fatalities in 2013 (FIGURE 17). However, accidents attributed to thunderstorm penetration, non-convective turbulence, or deficient instrument technique during IFR flight were exceptionally lethal: There were no survivors in any of the 10. In-flight icing accidents were more forgiving, with fatalities in three of eight.

Only two turboprop airplanes, both single-engine models, were involved in weather accidents, but both were fatal. So were nine out of 10 in piston twins and all those in retractable-gear piston singles (FIGURE 18). Single-engine fixed-gear models fared relatively well in 2013, with fatalities in fewer than 50% (including just one of four in tailwheel models).

Almost 70% of all weather accidents took place in instrument conditions and/or at night (FIGURE 19), and nearly 80% of those were fatal. Those included 16 of the 17 in daytime IMC compared to 58% of those in visual conditions in daylight. Curiously, the lowest lethality was actually in IMC at night, most likely an artifact of the small numbers involved.

Private pilots made up 56% of those involved in identified weather accidents (FIGURE 20), down 10 percentage points from the year before. The number involving ATPs climbed nine points to 15%, while 24%

FIGURE 19. FLIGHT CONDITIONS OF WEATHER ACCIDENTS: NON-COMMERCIAL FIXED-WING

Light and Weather	Accidents		Fatal Accidents		Lethality
Day VMC	12	29.3%	7	23.3%	58.3%
Night VMC*	4	9.8%	3	10.0%	75.0%
Day IMC	17	41.5%	16	53.3%	94.1%
Night IMC*	8	19.5%	4	13.3%	50.0%

**Includes dusk.*

FIGURE 20. PILOTS INVOLVED IN WEATHER ACCIDENTS: NON-COMMERCIAL FIXED-WING

Certificate Level	Accidents		Fatal Accidents		Lethality
ATP	6	14.6%	4	13.3%	66.7%
Commercial	10	24.4%	7	23.3%	70.0%
Private	23	56.1%	18	60.0%	78.3%
Student	2	4.9%	1	3.3%	50.0%
Second Pilot on Board	4	9.8%	4	13.3%	100.0%
CFI on Board*	8	19.5%	6	20.0%	75.0%
IFR Pilot on Board*	23	56.1%	17	56.7%	73.9%

**Includes single-pilot flights.*

FIGURE 21. TAKEOFF AND CLIMB ACCIDENT TREND

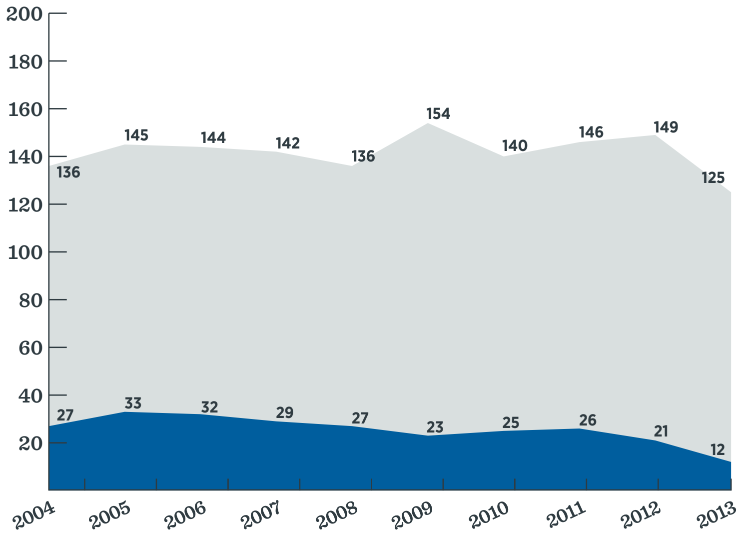


FIGURE 22. TYPES OF TAKEOFF AND CLIMB ACCIDENTS

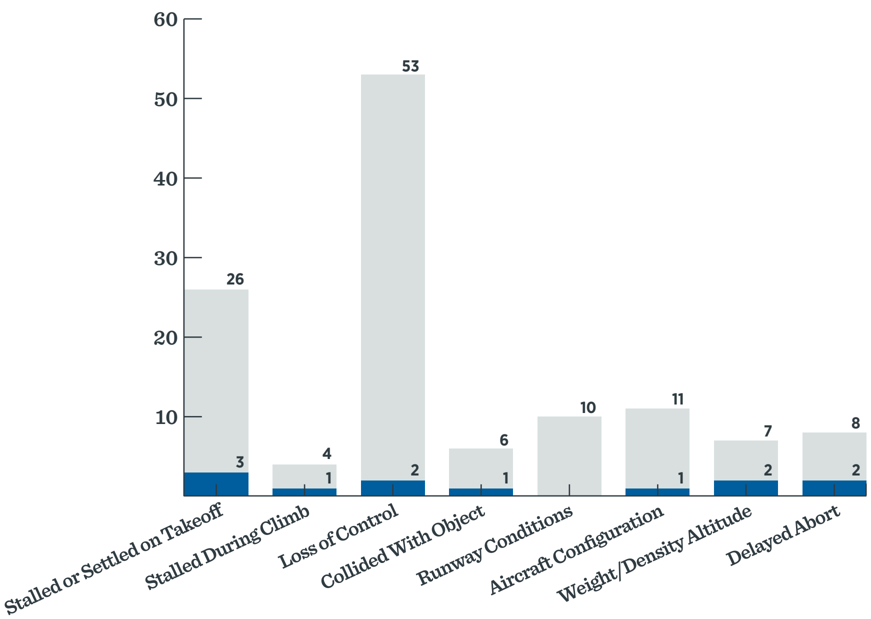


FIGURE 23. AIRCRAFT INVOLVED IN TAKEOFF AND CLIMB ACCIDENTS: NON-COMMERCIAL FIXED-WING

Aircraft Class	Accidents		Fatal Accidents		Lethality
Single-Engine Fixed-Gear	94	75.2%	6	50.0%	6.4%
SEF Tailwheel	48		3		6.3%
Single-Engine Retractable	22	17.6%	3	25.0%	13.6%
Single-Engine Turbine	1		0		
Multiengine	9	7.2%	3	25.0%	33.3%
Multiengine Turbine	1		1		100.0%

FIGURE 24. FLIGHT CONDITIONS OF TAKEOFF AND CLIMB ACCIDENTS: NON-COMMERCIAL FIXED-WING

Light and Weather	Accidents		Fatal Accidents		Lethality
Day VMC	120	96.0%	10	83.3%	8.3%
Night VMC*	4	3.2%	1	8.3%	25.0%
Night IMC*	1	0.8%	1	8.3%	100.0%

**Includes dusk.*

FIGURE 25. PILOTS INVOLVED IN TAKEOFF AND CLIMB ACCIDENTS: NON-COMMERCIAL FIXED-WING

Certificate Level	Accidents		Fatal Accidents		Lethality
ATP	20	16.0%	2	16.7%	10.0%
Commercial	27	21.6%	2	16.7%	7.4%
Private	65	52.0%	8	66.7%	12.3%
Sport	4	3.2%	0		
Student	6	4.8%	0		
Other or Unknown	3	2.4%	0		
Second Pilot on Board	23	18.4%	1	8.3%	4.3%
CFI on Board*	29	23.2%	2	16.7%	6.9%
IFR Pilot on Board*	65	52.0%	8	66.7%	12.3%

**Includes single-pilot flights.*

FIGURE 26. MANEUVERING ACCIDENT TREND

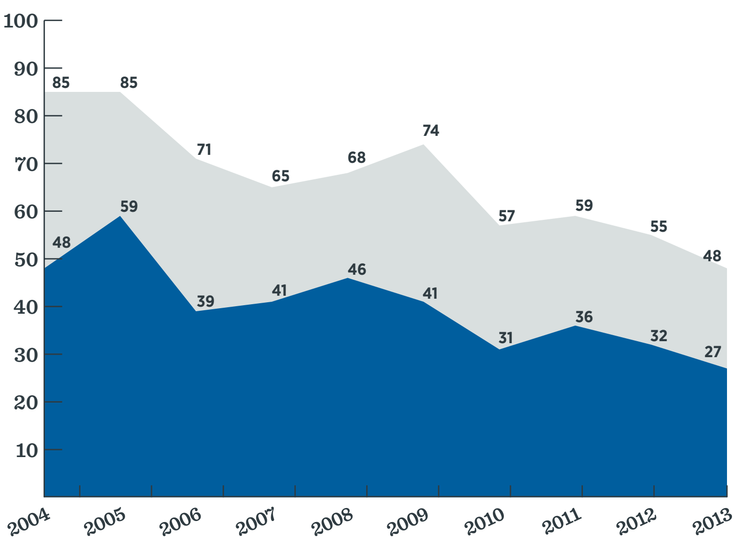


FIGURE 27. TYPES OF MANEUVERING ACCIDENTS

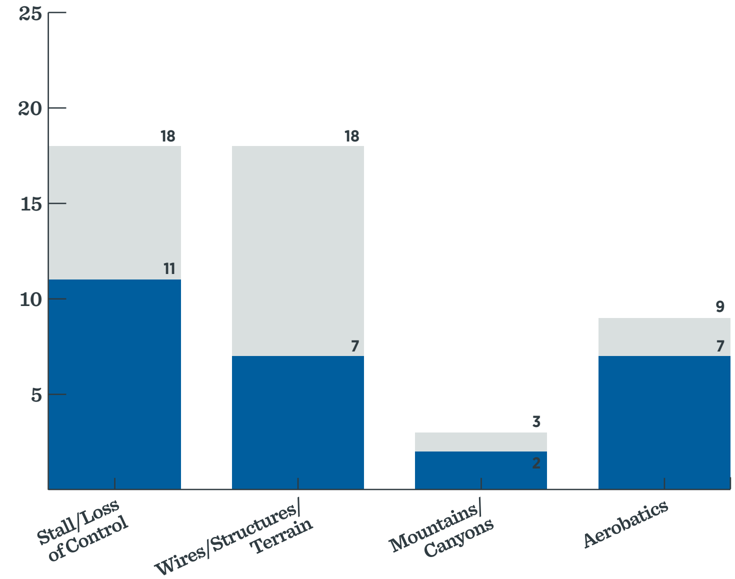


FIGURE 28. AIRCRAFT INVOLVED IN MANEUVERING ACCIDENTS: NON-COMMERCIAL FIXED-WING

Aircraft Class	Accidents		Fatal Accidents		Lethality
Single-Engine Fixed-Gear	36	75.0%	17	63.0%	47.2%
SEF Tailwheel	21		11		52.4%
Single-Engine Retractable	10	20.8%	8	29.6%	80.0%
Single-Engine Turbine	1		1		100.0%
Multiengine	2	4.2%	2	7.4%	100.0%
Multiengine Turbine	1		1		100.0%

All Accidents
Fatal Accidents

NTSB ACCIDENT NO. CEN13FA364

ACCIDENT CASE STUDY: TAKEOFF AND CLIMB

CESSNA 172M, WATERFORD, MICHIGAN | FOUR FATALITIES

HISTORY OF FLIGHT The Skyhawk took off from Runway 09L at 3:40 p.m. with three members of the pilot's family on board. The tower controller saw it climb to an altitude of about 100 feet. The pilot then radioed that the airplane "was a little overweight" and needed to return to land; he was immediately cleared to land on Runway 09R or the nearby grass. Another pilot on final approach to Runway 09L saw the Cessna crossing the departure end of the runway with its wings "shaking," estimating its altitude at 100 to 200 feet. Its left wing dropped and it hit the ground left wing first. Fire erupted within five seconds.

Investigators concluded that the airplane was loaded one and a half pounds below its authorized maximum gross weight. Its flaps were found fully extended to 40 degrees. Normal takeoff procedure in a Cessna 172M is to take off with the flaps fully retracted.

PILOT INFORMATION The 19-year-old pilot had received his private pilot certificate two months before, training almost exclusively in a Cirrus SR20. His application indicated that he'd logged 52.3 hours at the time of his checkride, 10.1 of them on solo flights. Reports that he'd received "a few hours" of checkout instruction in a Cessna 172 could not be verified. The SR20 normally uses 50% flaps for takeoff.

WEATHER A routine weather observation recorded 19 minutes before the accident listed winds from 130 degrees at 6 knots, a scattered layer at 9,000 feet with a broken ceiling at 15,000, a temperature of 28 degrees Celsius with a dew point of 17, and an altimeter setting of 30.17 inches of mercury.

PROBABLE CAUSE The pilot's failure to retract the wing flaps before attempting to take off, due to his lack of familiarity with the airplane make and model, which prevented the airplane from maintaining adequate altitude for takeoff.

ASI COMMENTS Checklist discipline is especially critical in an unfamiliar aircraft. The checklists in the Pilot's Operating Handbook for the Cessna 172M do not call for extending flaps during the preflight inspection—but "Wing Flaps—UP" is the first item in the before-takeoff checklists for both normal and short-field operations.

involved commercial pilots for the second year in a row. More than half of the pilots held instrument ratings, including 17 of the 30 in fatal accidents. Fatalities occurred in six of the eight accident flights that had instructors on board.

ACCIDENT CAUSES: HIGH-RISK PHASES OF FLIGHT

TAKEOFF AND CLIMB (125 TOTAL / 12 FATAL) Takeoffs consistently see the second-highest number of pilot-related accidents. This pattern continued unchanged in 2013 (FIGURE 21), when lapses in airmanship during takeoff or initial climb caused 13% of all accidents, including 7% of those that were fatal. However, the lethality of takeoff accidents dropped noticeably compared to prior years. Less than 10% involved fatalities, down one-third from the year before and less than half the proportion seen between 2004 and 2008.

Losses of aircraft control were the most common type of takeoff accident (FIGURE 22). They accounted for some 42%, down from 50% in 2012. Losses of directional control during the takeoff roll were most common, but the category also includes pitch and roll excursions after lift-off. One-third of all fatal accidents involved departure stalls, but lethality was greatest in the small number of accidents attributed to late decisions to abort the takeoff attempt, overweight aircraft, or excessive density altitude. Errors in setting flaps, fuel mixtures, and other details of aircraft configuration led to 11 accidents, one-third fewer than the year before.

Nine multiengine airplanes suffered takeoff accidents compared to just four in 2012 (FIGURE 23). The number involving retractable-gear single-engine models was almost unchanged at 22; the overall reduction was produced almost entirely by a 23% decrease in fixed-gear singles. This included a 54% decline in fatal accidents (from 13 to six) and a 19% drop in takeoff accidents in SEF tailwheel models.

Some 96% of these accidents (120 of 125) took place in daytime VMC, with only one in IMC and four in visual conditions at night (FIGURE 24). Lethality was five times higher (a combined 40%) in accidents in reduced visibility. Sport pilots and student pilots flying solo were actually underrepresented this year (FIGURE 25); private pilots were in command of more than half of the accident flights, and commercial or airline transport pilots flew nearly 38%. CFIs were present on less than one-quarter, and most of those were not instructional: 82% of takeoff accidents occurred on single-pilot flights.

MANEUVERING (48 TOTAL / 27 FATAL) Whether they involve in-flight losses of control or collisions with obstructions, the vast majority of fixed-wing maneuvering accidents share a common element: the sequence is initiated at low altitude. While some occur in the traffic pattern, many crashes following unintended stalls and nearly all collisions with power lines, broadcast towers, and ridgelines arise directly from the pilot's decision to fly needlessly low in inappropriate locations, making spins unrecoverable and leaving the airplane vulnerable to obstacles that could easily have been overflown. The majority of these sudden impacts are not survivable, so maneuvering accidents consistently rank as one of the two top causes of deaths in general aviation.

In 2013 there were 13% fewer than the year before, and the number of fatal accidents dropped 15% (FIGURE 26). Both these declines were smaller than the corresponding improvements in the overall non-commercial fixed-wing record. In a departure from recent trends, as many involved controlled flight into obstructions as unintended stalls (FIGURE 27), but fatalities were 50% more common in stall accidents. Two of the three mountain-flying accidents were also fatal, as were seven of nine during attempted aerobatics.

Forty-seven of the 48 maneuvering accidents took place in visual meteorological conditions, 44 of them during daylight hours. Reversing the usual pattern, however, lethality was actually highest in daytime

FIGURE 29. PILOTS INVOLVED IN MANEUVERING ACCIDENTS: NON-COMMERCIAL FIXED-WING

Certificate Level	Accidents		Fatal Accidents		Lethality
ATP	7	14.6%	4	14.8%	57.1%
Commercial	14	29.2%	7	25.9%	50.0%
Private	25	52.1%	15	55.6%	60.0%
Student	1	2.1%	0		
Other or Unknown	1	2.1%	1	3.7%	100.0%
Second Pilot on Board	9	18.8%	5	18.5%	55.6%
CFI on Board*	9	18.8%	7	25.9%	77.8%
IFR Pilot on Board*	24	50.0%	13	48.1%	54.2%

**Includes single-pilot flights.*

FIGURE 30. DESCENT AND APPROACH ACCIDENT TREND

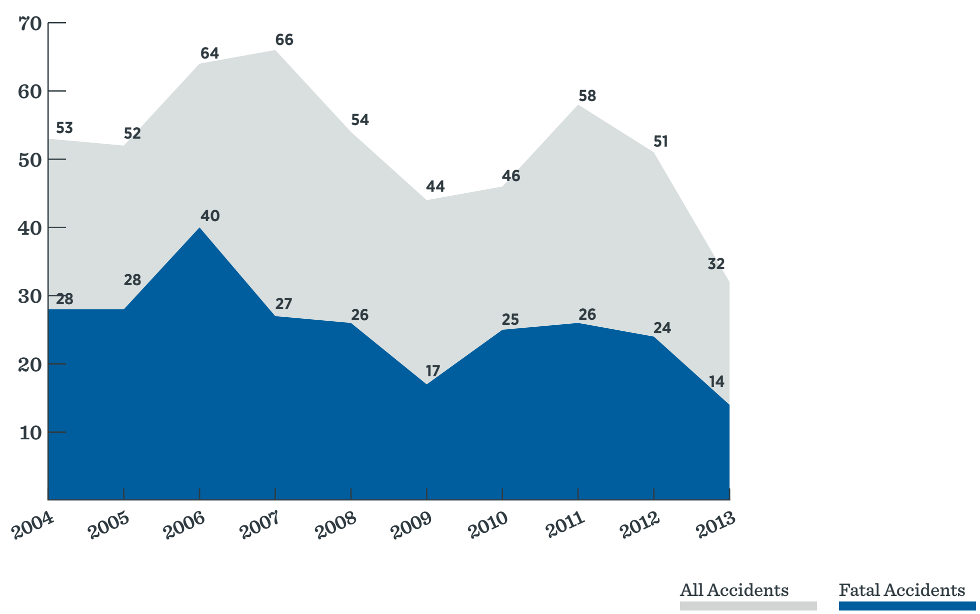


FIGURE 31. TYPES OF DESCENT AND APPROACH ACCIDENTS

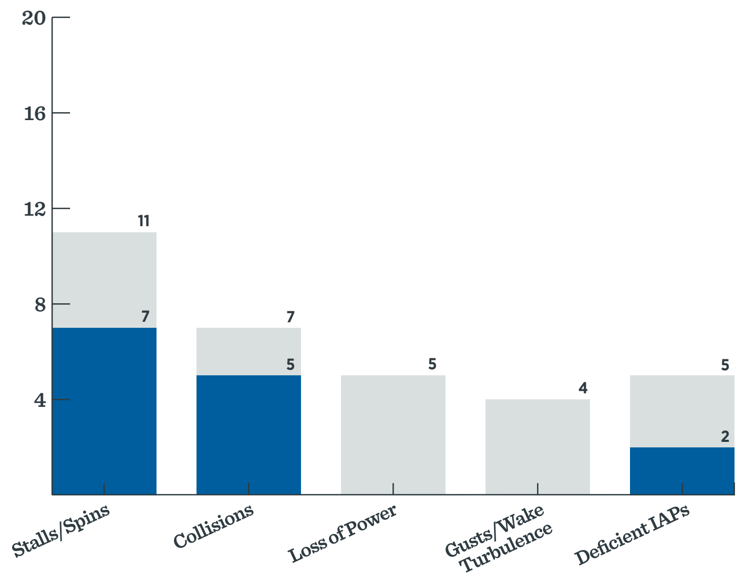


FIGURE 32. AIRCRAFT INVOLVED IN DESCENT AND APPROACH ACCIDENTS: NON-COMMERCIAL FIXED-WING

Aircraft Class	Accidents		Fatal Accidents		Lethality
Single-Engine Fixed-Gear	20	62.5%	8	57.1%	40.0%
SEF Tailwheel	5		3		60.0%
Single-Engine Retractable	8	25.0%	3	21.4%	37.5%
Multiengine	4	12.5%	3	21.4%	75.0%
Multiengine Turbine	1		1		100.0%

FIGURE 33. FLIGHT CONDITIONS OF DESCENT AND APPROACH ACCIDENTS: NON-COMMERCIAL FIXED-WING

Light and Weather	Accidents		Fatal Accidents		Lethality
Day VMC	20	62.5%	7	50.0%	35.0%
Night VMC*	4	12.5%	2	14.3%	50.0%
Day IMC	5	15.6%	4	28.6%	80.0%
Night IMC*	3	9.4%	1	7.1%	33.3%

**Includes dusk.*

FIGURE 34. PILOTS INVOLVED IN DESCENT AND APPROACH ACCIDENTS: NON-COMMERCIAL FIXED-WING

Certificate Level	Accidents		Fatal Accidents		Lethality
ATP	2	6.3%	1	7.1%	50.0%
Commercial	12	37.5%	6	42.9%	50.0%
Private	15	46.9%	7	50.0%	46.7%
Sport	1	3.1%	0		
Student	2	6.3%	0		
Second Pilot on Board	3	9.4%	2	14.3%	66.7%
CFI on Board*	5	15.6%	4	28.6%	80.0%
IFR Pilot on Board*	18	56.3%	10	71.4%	55.6%

**Includes single-pilot flights.*

FIGURE 35. LANDING ACCIDENT TREND

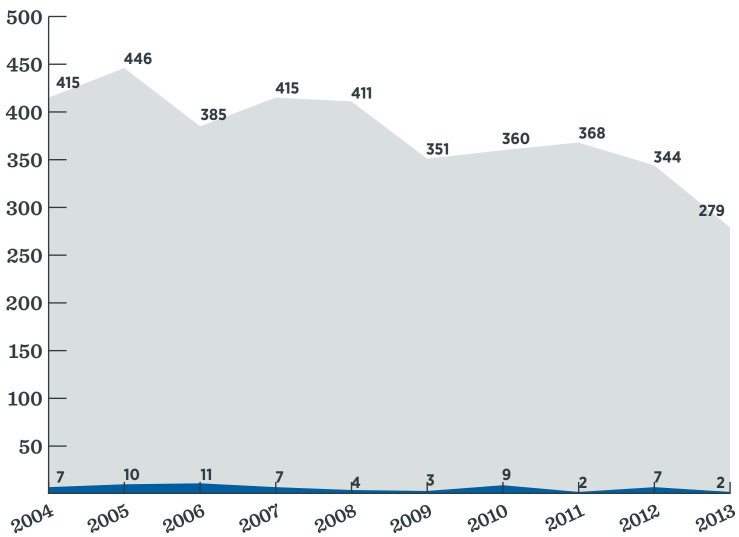


FIGURE 36. TYPES OF LANDING ACCIDENTS

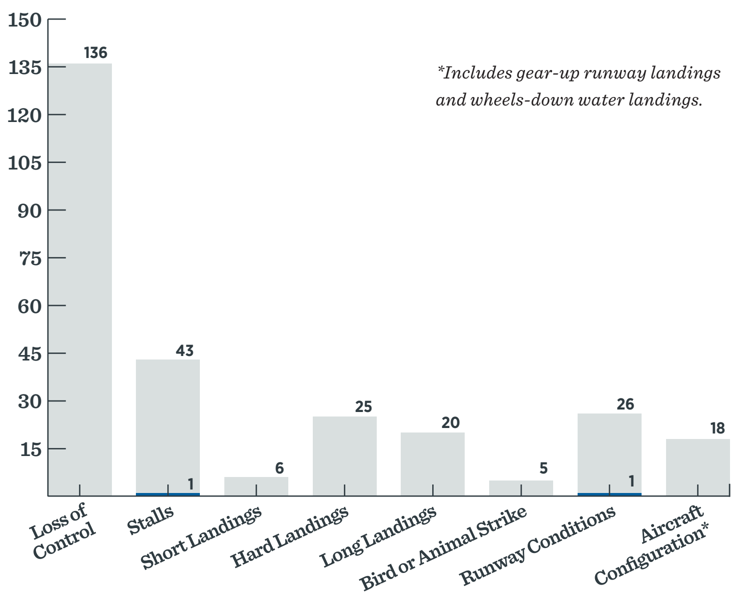


FIGURE 37. AIRCRAFT INVOLVED IN LANDING ACCIDENTS: NON-COMMERCIAL FIXED-WING

Aircraft Class	Accidents		Fatal Accidents		Lethality
Single-Engine Fixed-Gear	230	82.4%	1	50.0%	0.4%
SEF Tailwheel	114		0		
Single-Engine Retractable	35	12.5%	0		
Single-Engine Turbine	4		0		
Multiengine	14	5.0%	1	50.0%	7.1%
Multiengine Turbine	1		0		

FIGURE 38. PILOTS INVOLVED IN LANDING ACCIDENTS: NON-COMMERCIAL FIXED-WING

Certificate Level	Accidents		Fatal Accidents		Lethality
ATP	35	12.5%	1	50.0%	2.9%
Commercial	63	22.6%	1	50.0%	1.6%
Private	132	47.3%	0		
Sport	8	2.9%	0		
Student	37	13.3%	0		
Other or Unknown	4	1.4%	0		
Second Pilot on Board	35	12.5%	0		
CFI on Board*	56	20.1%	0		
IFR Pilot on Board*	131	47.0%	2	100.0%	1.5%

**Includes single-pilot flights.*

All Accidents Fatal Accidents

NTSB ACCIDENT NO. WPR14LA005

ACCIDENT CASE STUDY: MANEUVERING

CESSNA 340A, PAULDEN, ARIZONA | FOUR FATALITIES

HISTORY OF FLIGHT About 100 clients and staff members were on the grounds of a private firearms training facility when the airplane flew over the site from north to south at low altitude and high speed, then turned left to make another pass from east to west. On the second pass, it flew straight and level into a 50-foot-high radio tower, severing the top 10 feet of the structure and folding up the airplane's right wing. After the impact, the airplane rolled "nearly inverted," crashed into trees some 700 feet away, and was consumed by fire. The lack of any apparent evasive action suggests that the pilot never saw the tower. He was also a client of the facility, and its president recalled that he'd buzzed the field several years earlier and been warned never to do it again.

PILOT INFORMATION The 57-year-old pilot held a private pilot certificate with ratings for single-engine land, multiengine land, and rotorcraft helicopter, with instrument ratings for both airplane and helicopter. His most recent third-class medical application, filed 14 months earlier, listed 4,006 hours of total flight experience.

WEATHER The nearest observation facility was the airport at Prescott, Arizona, located 14 miles south of the accident site. Seven minutes before the accident, it recorded clear skies with 10 statute miles visibility. Winds were from 300 degrees at 8 knots, temperature and dew point were 9 degrees and -3 degrees Celsius, respectively, and the altimeter setting was 30.01 inches of mercury.

PROBABLE CAUSE The pilot's failure to maintain sufficient altitude to clear a radio tower while maneuvering at low altitude and his decision to make a high-speed, low pass over the gun club.

ASI COMMENTS Aggressive maneuvering at recklessly low altitudes precipitates many of the most catastrophic accidents in aviation. This behavior serves no legitimate purpose for either transportation or entertainment. The president of the facility noted that only the momentum imparted by the airplane's high speed, which carried the wreckage past the crowd, averted a much wider tragedy. Nothing can excuse such wanton disregard for the safety of the passengers in the aircraft or bystanders on the ground.

VMC. Twenty-six of those accidents (59%) were fatal compared to just one of three in VMC at night. The only accident in IMC occurred at dusk, and both the pilot and passenger escaped without injury.

Ninety-six percent of the accident aircraft (46 of 48) were piston singles, 36 of them fixed-gear (FIGURE 28). Twenty-one (all fixed-gear) were tailwheel models. Eight of ten accidents in retractable-gear singles were fatal, as were both of those in multiengine airplanes and both in turbine aircraft. Just over half of the accident flights were commanded by private pilots (FIGURE 29), and these also suffered the greatest lethality at 60%. Flight instructors were on board fewer than one in five, but fatalities resulted from more than three-quarters of those in which they were.

DESCENT AND APPROACH (32 TOTAL / 14 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 pattern (if VFR) or the missed approach point or decision height of an instrument approach procedure on an IFR flight. Both their numbers and lethality dropped sharply in 2013 (FIGURE 30); an overall decrease of 37% year over year included a 42% reduction in fatal accidents. Only 8% of all fatal accidents fell into this category, the smallest share since 2009.

Inadvertent stalls were implicated in one-third, including half the fatal accidents (FIGURE 31). Five of seven collisions with wires, structures, terrain, or other solid objects were also fatal. Five accidents, two of them fatal, were attributed to deficient execution of instrument approaches by rated pilots. No fatalities resulted from the five accidents precipitated by unexpected losses of engine power or the four blamed on turbulence or gusts.

One turbine aircraft and four piston twins were involved in descent / approach accidents in 2013 (FIGURE 32). Both represented increases from the previous year, while the number involving single-engine retractables dropped by one-third and the number in fixed-gear singles fell 44%. Unlike 2012, there were fatalities in all categories and classes. Also unlike the previous year, lethality was higher in fixed-gear than retractable-gear models and higher in tailwheel than tricycle-gear designs. The majority, including half the fatal accidents, took place in day VMC (FIGURE 33).

Two of the three accidents on dual-pilot flights were fatal (FIGURE 34), as were four of the five with instructors on board the airplanes. There were no fatalities on the two student solos or the flight conducted by a sport pilot. Lethality hovered around 50% in all accidents involving private, instrument-rated, commercial, and airline transport pilots.

LANDING (279 TOTAL / 2 FATAL) Landing attempts led to 29% of all non-commercial fixed-wing accidents in 2013, a proportion that has shown remarkable stability over time (FIGURE 35). The 19% decrease from 2012 mirrored the overall decline in accidents on non-commercial fixed-wing flights. Only two were fatal, equalling the all-time low recorded in 2011. Both of them occurred in VMC during daylight, the setting for 94% of all landing accidents; another 5% took place in visual conditions at night. The only two in IMC also took place at night.

Losses of directional control, always the most common problem, accounted for almost half (FIGURE 36). Stalls and hard landings made up 24% combined, the same as the year before. The number attributed to wet, soft, or contaminated runways actually increased by three, but there was a 40% decrease in accidents caused by errors in aircraft configuration. Sixteen of 18 were gear-up landings or premature gear retractions; the other two were wheels-down water landings in amphibians. Overruns were four times as frequent as undershoots but both were rare, making up just 9% of the total combined. Five aircraft suffered substantial damage in collisions with birds or other animals, also the same number as in 2012.

Fixed-gear singles made up 82% of the accident aircraft (FIGURE 37), just under half of them taildraggers. Both numbers represent slight increases from the year before. There were no fatal landing accidents in either complex singles or turboprops but one in a piston twin.

FIGURE 39. MECHANICAL ACCIDENT TREND

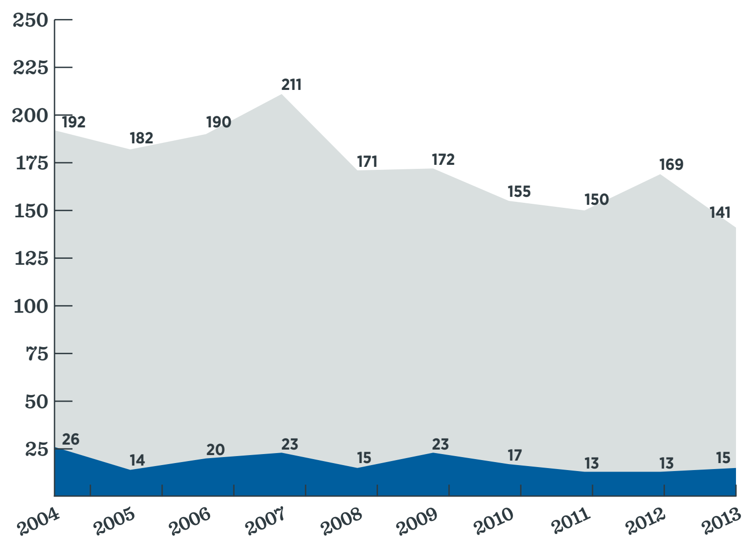
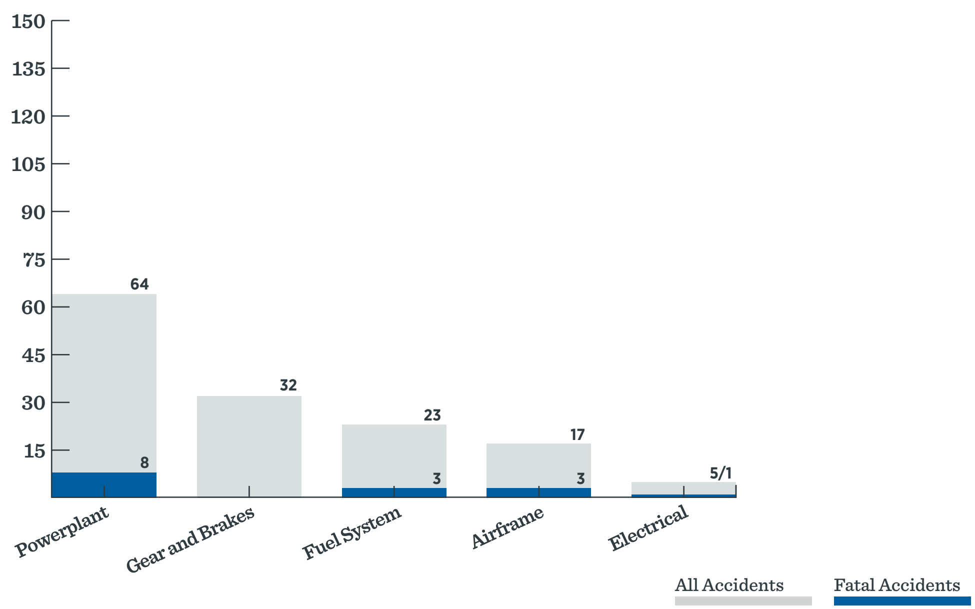


FIGURE 40. TYPES OF MECHANICAL ACCIDENTS



NTSB ACCIDENT NO. ERA13FA358

ACCIDENT CASE STUDY: DESCENT AND APPROACH

ROCKWELL INTERNATIONAL 690B, EAST HAVEN, CONNECTICUT | FOUR FATALITIES

HISTORY OF FLIGHT Fifteen minutes after departure from Teterboro, the pilot was advised to expect the ILS approach to Runway 02 with a circle to land on Runway 20 (which has no straight-in instrument approaches). At 11:15 he was cleared for the approach and handed off to the tower controller, who told him to report a left downwind for Runway 20. The pilot made that report at 11:19 and was cleared to land. Seeing the airplane "skimming the bases" of the clouds and occasionally disappearing from sight, the controller asked whether he was able to maintain visual contact with the runway. A few seconds after the pilot responded "In visual contact now," seven witnesses including the controller saw it pass behind a cloud, then reappear in a nearly vertical nose-down attitude "rotating slowly counterclockwise" into a house. Two children inside the building were killed along with the pilot and his passenger.

Investigators concluded that the low altitude—the circling minimum was 720 feet above the ground—led the pilot to space the downwind leg unusually close to the runway. A bank angle of at least 45 degrees would have been needed to complete the turn to final without overshooting the centerline. Radar data showed the airplane slowing rapidly as it turned from downwind to final; it neared its wings-level stall speed as the turn progressed. The wreckage was found almost exactly on the runway's extended centerline.

PILOT INFORMATION The 54-year-old commercial pilot held ratings for single-engine airplane, multiengine airplane, and instrument airplane. About 1,407 of his 2,067 hours total time had been logged in multiengine models, including 574 hours in turbine aircraft. He had flown 394 hours in actual instrument conditions, but the number of circling approaches he'd performed in actual IMC could not be determined.

WEATHER A METAR recorded five minutes after the accident reported winds from 170 degrees at 12 knots with gusts to 19. Visibility was 9 miles in light rain under a 900-foot overcast. The temperature was 24 degrees Celsius, the dew point 23, and the altimeter setting was 29.88 inches of mercury. A remark noted that ceilings were variable between 600 and 1,100 feet.

PROBABLE CAUSE The pilot's failure to maintain airspeed while banking aggressively in and out of clouds for landing in gusty tailwind conditions, which resulted in an aerodynamic stall and uncontrolled descent.

ASI COMMENTS Circling approaches at the MDA carry intrinsic risks beyond those of either straight-in approaches or normal traffic patterns. That's one reason they're now required on instrument proficiency checks—and why most major U.S. airlines prohibit circling approaches at night and impose higher-than-standard minimums to fly them in daylight. Tighter spacing and higher groundspeed add up to steeper banks at lower altitudes, a sufficiently uncomfortable combination to make diversion to an alternate airport reasonable or even preferable.

Commercial and airline transport pilots suffered 35% of 2013's landing accidents (FIGURE 38), a decrease of seven percentage points from the year before. These included both fatal accidents. Private pilots flew 132 (47%) of the accident flights. The 37 involving student pilots represented exactly half of the 74 accidents of all types on student solos. Student pilots' susceptibility to landing accidents is a familiar facet of the fixed-wing safety record.

MECHANICAL / MAINTENANCE

(163 TOTAL / 9 FATAL) Following a one-year spike, the number of non-commercial fixed-wing accidents caused by documented mechanical failures or errors in aircraft maintenance fell to 141, 6% below 2011 levels (FIGURE 39). The rate of these accidents in 2013 was 0.84 per 100,000 flight hours, almost identical to that in 2010 (the last year prior to the spike for which activity data are available). However, the number of fatal accidents edged up by two.

The decrease from 2012 was chiefly attributable to drops of 32% in both the number triggered by landing gear or brake anomalies and those originating from fuel-system malfunctions. The number caused by powerplant failures actually increased by three, and there were two more accidents involving airframe or flight-control structures. The proportion attributed to powerplant failures jumped eight percentage points to 45%; they were also the cause of more than half the fatal accidents. In 2012, they caused less than one quarter.

Despite the sharp decreases, landing gear and brake malfunctions were the next most common, accounting for some 23%, and 16% arose from problems with fuel-system components. The 17 airframe and flight control failures represented 12%, while less than 4% were caused by electrical problems. This ranking has remained stable for years.

There were five fatal mechanical failures in multiengine airplanes (FIGURE 41). No other year of the past decade had more than three. All five involved losses of engine power: Three were attributed to powerplant failures and two to fuel-system abnormalities. The high lethality in this class of airplane during 2013 was also unusual; rates of 5-10% have been more typical in the past. Nearly one-quarter involved retractable-gear singles, up from 15% the year before, while the proportion involving fixed-gear singles declined to 65% from 77% in 2012.

Almost half were flown by commercial or airline transport pilots, a proportion similar to prior years. The greater prevalence of mechanical problems among complex and multiengine airplanes (which accounted for only 27% of non-mechanical accidents) explains at least part of this difference. Just one occurred in IMC; that was during daylight hours, and was fatal. Two of seven in VMC at night were fatal as well.

OTHER, UNKNOWN, OR NOT YET DETERMINED

(108 TOTAL / 30 FATAL) Six percent of all non-commercial fixed-wing accidents (53) were triggered by losses of engine power for reasons that could not be determined after the fact (FIGURE 43): Adequate amounts of fuel were present, and post-accident examination found no evidence of engine or fuel-system malfunctions prior to impact. Many of those that escaped serious impact damage were successfully test-run during the investigations.

Twenty-three of the remaining 53 were fatal. In 16 of these (plus two non-fatal accidents), the NTSB has acknowledged that the causes could not be determined. Another airplane disappeared in flight and has never been recovered. One of 10 bird strikes was fatal, but the single collision with a deer during the landing roll was not. Nor was the single in-flight collision with an unidentified inanimate object. Two airplanes were struck by skydivers, with fatalities in one, and another was killed after falling off the wing at an altitude too low for the parachute to deploy.

Four airplanes were crashed when untrained individuals attempted to fly them. Surprisingly, three of the four survived. So did the photographer who walked into a spinning propeller on the ground and the banner-tow pilot whose banner got entangled in the 172's nose gear. Five non-fatal accidents involved damage from ruts or holes on poorly maintained runways. Three airplanes were damaged after their owners attempted maintenance work using incorrect techniques, but no fatalities resulted. Losses of control due to wake turbulence and design changes to a homebuilt each caused a single fatal accident. The remainder included damage suffered during a precautionary off-field landing due to a rough-running engine, a case in which the passenger interfered with the flight controls, and one instance in which unreported damage from an earlier flight was discovered during a preflight inspection.

FIGURE 41. AIRCRAFT INVOLVED IN MECHANICAL ACCIDENTS: NON-COMMERCIAL FIXED-WING

Aircraft Class	Accidents		Fatal Accidents		Lethality
Single-Engine Fixed-Gear	91	64.5%	7	46.7%	7.7%
SEF Tailwheel	40		3		7.5%
Single-Engine Retractable	34	24.1%	3	20.0%	8.8%
Single-Engine Turbine	2		0		
Multiengine	16	11.3%	5	33.3%	31.3%
Multiengine Turbine	1		1		100.0%

NTSB ACCIDENT NO. ERA13FA225

ACCIDENT CASE STUDY: LANDING

GRUMMAN G44, CATSKILL, NEW YORK | ONE FATALITY

HISTORY OF FLIGHT The seaplane flew over the Hudson River shortly before 4:30 p.m. Witness accounts varied, but the preponderance of testimony from the 25 individuals interviewed was that it flew southbound at a low altitude with the engines running, reversed course, and descended in a northerly direction. It levelled off above the surface of the river for a few seconds before suddenly banking left. After the left pontoon and nose hit the surface it flipped over, caught fire, and sank.

PILOT INFORMATION The 72-year-old pilot held an airline transport pilot certificate with airplane multiengine land and multiengine sea ratings and commercial privileges for airplane single-engine land and single-engine sea. He was type-rated in the Grumman G73. He had 5,735 hours total flight experience that included 411 in the G44.

WEATHER Twenty-two minutes after the accident, Albany International Airport (29 miles north of the accident scene) reported winds from 190 degrees at 3 knots, a few clouds at 9,000 feet with visibility of 10 miles, a temperature of 27 degrees Celsius with a dew point of 3, and an altimeter setting of 30.29 inches of mercury.

PROBABLE CAUSE The pilot's misjudgment of the airplane's altitude above...water with a glassy condition, which led to the airplane exceeding its critical angle-of-attack and experiencing and aerodynamic stall.

ASI COMMENTS The challenge of making glassy water landings lies in the difficulty of determining the seaplane's altitude above the surface. While seaplanes account for a fairly small proportion of all landing accidents, inaccurate timing of the flare is the central problem in the stalls and hard landings that account for about a quarter of all landing accidents—accidents that typically carry a greater risk of fatality and damage the aircraft more severely than the more common losses of directional control.

FIGURE 42. PILOTS INVOLVED IN MECHANICAL ACCIDENTS: NON-COMMERCIAL FIXED-WING

Certificate Level	Accidents		Fatal Accidents		Lethality
ATP	32	22.7%	2	13.3%	6.3%
Commercial	38	27.0%	3	20.0%	7.9%
Private	65	46.1%	8	53.3%	12.3%
Sport	3	2.1%	1	6.7%	33.3%
Student	3	2.1%	1	6.7%	33.3%
Second Pilot on Board	27	19.1%	3	20.0%	11.1%
CFI on Board*	43	30.5%	5	33.3%	11.6%
IFR Pilot on Board*	94	66.7%	9	60.0%	9.6%

**Includes single-pilot flights.*

FIGURE 43. 'OTHER' AND UNCLASSIFIED ACCIDENTS: NON-COMMERCIAL FIXED-WING

Major Cause	Accidents		Fatal Accidents		Lethality
Not Yet Assigned	2	1.9%	1	3.3%	50.0%
Other	53	49.1%	23	76.7%	43.4%
Other (Power Loss)	53	49.1%	6	20.0%	11.3%

COMMERCIAL FIXED-WING ACCIDENTS

With the exception of a spike in 2011, the number of commercial fixed-wing accidents has been stable for the past five years, ranging from 79 in 2012 to 83 in 2010 (FIGURE 2A). In 2013 there were 81. Five fewer accidents on aerial application flights than the year before were offset by seven more during on-demand charter and cargo flights conducted under Part 135 (FIGURE 44). However, there were no accidents on fixed-wing medical charters in 2013.

Twelve of the 81 accidents were fatal. The resulting 15% lethality is the highest seen in this sector since 2006, when it reached 17%. Two-thirds of them and 86% of all individual fatalities came in the 34 accidents on Part 135 flights, also an unusually high proportion. This excess doesn't appear to be driven by any single cause (SEE FIGURE 49). The 24 fatalities that resulted are the most since 2008, when 28 people died in 16 fatal accidents. Only four of the 47 crop-dusting accidents were fatal, and the pilots were the only victims.

AIRCRAFT CLASS All but one of the crop-dusting accidents were in single-engine tailwheel models (FIGURE 45), which carry out the vast majority of these operations. Twenty-three were turbine-powered, while 24 had reciprocating engines. Nearly 95 percent of Part 135 accidents involved single-engine airplanes, including seven of the eight with fatalities; four of the six accidents in single-engine turboprops were fatal. No deaths resulted from any of the five accidents in retractable-gear single-engine airplanes.

FLIGHT CONDITIONS All but one of the aerial application accidents took place in daytime VMC (FIGURE 46). One Air Tractor descended into the ground while trying to locate the correct field for a nighttime spray run. About 65% of the Part 135 accidents also occurred in visual conditions in daylight, but four of the eight fatal accidents were among the 11 that took place in IMC and/or at night.

PILOT QUALIFICATIONS Three of the pilots in aerial application accidents and 14 of those who crashed during charter flights held airline transport pilot certificates (FIGURE 47). These included three of the fatal Part 135 accidents. Commercial pilots dominated the crop-dusting record but accounted for just 59% of Part 135 accidents, and all Part 135 pilots were instrument-rated compared to just over half under Part 137. Charter pilots were also nearly three times as likely to hold flight instructor certificates.

ACCIDENT CAUSES Aerial application flights consist almost entirely of low-altitude maneuvering that leaves little room to recover from aircraft malfunctions. The airplanes typically depart heavily loaded from short, rough airstrips. It's therefore not surprising that their accident record continues to be dominated by aborted takeoffs, maneuvering accidents, and emergencies arising from mechanical failures; these made up 19%, 32%, and 28% of their accident record, respectively (FIGURE 48). A sudden cardiac arrhythmia led to the only fatal accident from other causes. Four accidents resulted from losses of engine power that could not be satisfactorily explained afterwards and two were due to fuel mismanagement. There were also three landing accidents.

Landing accidents and mechanical malfunctions caused a combined 50% of all Part 135 accidents in 2013 (FIGURE 49). Fuel mismanagement, which continues to pose significant problems for non-commercial pilots, was no more common than errors while taxiing, and neither led to any fatalities. Both accidents during low-altitude maneuvering and two out of three caused by poor weather were fatal; there was no more than one fatal accident from any other cause.

FIGURE 44. COMMERCIAL FIXED-WING ACCIDENTS

Type of Operation	Accidents		Fatal Accidents		Fatalities	
Aerial Application (Part 137)	47	58.0%	4	33.3%	4	14.3%
Charter or Cargo (Part 135)	34	42.0%	8	66.7%	24	85.7%

FIGURE 45. AIRCRAFT CLASS: COMMERCIAL FIXED-WING

Aircraft Class	Accidents		Fatal Accidents		Lethality
Part 137: Aerial Application					
Single-Engine Fixed-Gear	47	100.0%	4	100.0%	8.5%
SEF Tailwheel	46		4		8.7%
Single-Engine Turbine	23		2		8.7%
Part 135: Charter and Cargo					
Single-Engine Fixed-Gear	27	79.4%	7	87.5%	25.9%
SEF Tailwheel	8		2		25.0%
Single-Engine Retractable	5	14.7%	0		
Single-Engine Turbine	6		4		66.7%
Multiengine	2	5.9%	1	12.5%	50.0%

FIGURE 46. FLIGHT CONDITIONS: COMMERCIAL FIXED-WING

Light and Weather	Accidents		Fatal Accidents		Lethality
Part 137: Aerial Application					
Day VMC	46	97.9%	4	100.0%	8.7%
Night VMC*	1	2.1%	0		
Part 135: Charter and Cargo					
Day VMC	22	64.7%	4	50.0%	18.2%
Night VMC*	9	26.5%	3	37.5%	33.3%
Day IMC	2	5.9%	0		
Night IMC*	1	2.9%	1	12.5%	100.0%

**Includes single-pilot flights.*

FIGURE 47. PILOTS INVOLVED IN COMMERCIAL FIXED-WING ACCIDENTS

Certificate Level	Accidents		Fatal Accidents		Lethality
Part 137: Aerial Application					
ATP	3	6.4%	0		
Commercial	44	93.6%	4	100.0%	9.1%
CFI on Board*	7	14.9%	1	25.0%	14.3%
IFR Pilot on Board*	24	51.1%	1	25.0%	4.2%
Part 135: Charter and Cargo					
ATP	14	41.2%	3	37.5%	21.4%
Commercial	20	58.8%	5	62.5%	25.0%
Second Pilot on Board	2	5.9%	0		
CFI on Board*	15	44.1%	3	37.5%	20.0%
IFR Pilot on Board*	34	100.0%	8	100.0%	23.5%

**Includes single-pilot flights.*

FIGURE 48. TYPES OF COMMERCIAL FIXED-WING ACCIDENTS: PART 137 (AERIAL APPLICATION)

Accident Type	Accidents		Fatal Accidents		Lethality
Mechanical	13	27.7%	0		
Unexplained Power Loss	4	8.5%	0		
Fuel Management	2	4.3%	0		
Takeoff	9	19.1%	0		
Maneuvering	15	31.9%	3	75.0%	20.0%
Landing	3	6.4%	0		
Incapacitation	1	2.1%	1	25.0%	100.0%

FIGURE 49. TYPES OF COMMERCIAL FIXED-WING ACCIDENTS: PART 135 (CHARTER AND CARGO)

Accident Type	Accidents		Fatal Accidents		Lethality
Mechanical	10	29.4%	1	12.5%	10.0%
Fuel Management	1	2.9%	0		
Weather	3	8.8%	2	25.0%	66.7%
Preflight	2	5.9%	1	12.5%	50.0%
Taxi	1	2.9%	0		
Takeoff and Climb	6	17.6%	1	12.5%	16.7%
Maneuvering	2	5.9%	2	25.0%	100.0%
Landing	7	20.6%	0		
Other	2	5.9%	1	12.5%	50.0%

FIGURE 50. MAJOR CAUSES: HELICOPTER GENERAL AVIATION ACCIDENTS

	Non-Commercial				Commercial			
	All Accidents		Fatal Accidents		All Accidents		Fatal Accidents	
Pilot-Related	80	76.2%	17	85.0%	31	75.6%	4	57.1%
Mechanical	24	22.9%	3	15.0%	10	24.4%	3	42.9%
Other or Unknown	1	1.0%	0		0			

**Each aircraft involved in a collision is counted separately.*

FIGURE 51. AIRCRAFT CLASS: NON-COMMERCIAL HELICOPTER

Aircraft Class	Accidents		Fatal Accidents		Fatalities	
Single-Engine Piston	54	51.4%	6	30.0%	10	23.8%
Single-Engine Turbine	50	47.6%	13	65.0%	29	69.0%
Multiengine Turbine	1	1.0%	1	5.0%	3	7.1%

HELICOPTER ACCIDENTS: SUMMARY AND COMPARISON

In 2013, pilot-related causes were implicated in 76% of both commercial and non-commercial helicopter accidents (FIGURE 50), similar to their 74% involvement in the non-commercial fixed-wing record (FIGURE 3). Twenty-one of the 27 fatal accidents were attributed to pilot-related causes. The remaining six were all attributed to mechanical malfunctions.

NON-COMMERCIAL HELICOPTER ACCIDENTS

The number of non-commercial helicopter accidents decreased from 126 in 2012 to 105 in 2013, but the number of fatal accidents edged up from 19 to 20. The overall accident rate fell 7% to 7.45 per 100,000 hours, but the fatal accident rate jumped 23% to 1.48, the highest recorded since 2003.

AIRCRAFT CLASS The number of accidents involving single-engine turbine models actually increased from 42 to 50. Thirteen were fatal compared to eight the year before, accounting for 69% of all individual fatalities (FIGURE 51). Single-engine turbine accidents were fatal two and a half times as often as those in piston helicopters, where a 30 percent overall decrease included a one-third reduction in fatal accidents. Only one multiengine turbine helicopter was involved in a non-commercial accident compared to nine the year before, but three deaths resulted from a tail rotor failure in a Sikorsky S-76A++ on a post-maintenance test flight.

TYPE OF OPERATION Personal flights make up a much smaller share of helicopter than fixed-wing activity, but carry even greater excess risk. In 2013, the FAA estimated that only 6% of all non-commercial helicopter time was devoted to personal flights, but this included 25% of both fatal and non-fatal accidents and caused nearly 30% of all individual fatalities (FIGURE 52). Flight instruction accounted for 28% of flight activity and 27% of all accidents, but there were no fatal accidents on instructional flights during 2013. Aerial observation was the single largest category of non-commercial helicopter activity (more than 35% of the total), but was involved in only eleven accidents nationwide. Just one of those was fatal. As in the past two years, no accidents occurred on professionally crewed executive transports.

The number of helicopters involved in accidents on public-use flights decreased by two, while the number on business flights without professional crews fell from 10 to four. Five of eight accidents on positioning flights were fatal compared to just one of 10 in 2012, as were half the accidents on other types of working flights including air tours test flights, and TV production. Positioning and other working flights accounted for six of the eight fatal accidents ascribed to weather conditions, two of the three caused by mechanical malfunctions, one wire strike, and one death caused by head injuries from a main rotor strike while the helicopter was on the ground.

FLIGHT CONDITIONS Non-commercial helicopter flight is overwhelmingly carried out in visual meteorological conditions (VMC), the vast majority of it during daylight hours. Only six accidents, 6% of the 2013 total, took place in instrument conditions (FIGURE 53). Three were fatal. Another 10% occurred in VMC at night, and half of those were fatal as well. By comparison, less than 13% of accidents in visual conditions during daylight hours caused fatalities.

PILOT QUALIFICATIONS More than 85% of the accident pilots held either commercial or airline transport pilot (ATP) certificates (FIGURE

54), including 85% of those involved in fatal accidents. More than 80% of all accident pilots held the instrument-helicopter rating, and some 60% were flight instructors. Only 31 accidents (30%) took place on two-pilot flights, and 26 of those (81%) occurred during dual instruction. There were only three accidents, none fatal, on student solos.

ACCIDENT CAUSES Twenty-four of the 105 accidents (23%) were attributed to physical failures of aircraft components (FIGURE 55). Only seven involved engine systems, parts, or accessories (three piston and four turbine). The only in-flight failure of tail rotor blades proved fatal, as did two of five malfunctions in main-rotor pitch-change mechanisms. Fuel-system discrepancies brought down five helicopters, transmission or driveshaft problems in the main and tail rotor systems each damaged two, and in-cockpit flight control and instrumentation failures caused one accident apiece, but no fatalities resulted from any of these events.

More than one-quarter of all accidents took place during low-altitude maneuvering, but only three were fatal, half the number of the year before. All three were wire strikes. There were also three wire strikes that did not result in any deaths and three other collisions with other low-elevation obstructions. Once again, the majority of maneuvering accidents occurred during autorotation practice: 15 of 26, or 58%. One pilot lost control making a pedal turn, and another helicopter was wrecked during a simulated hydraulic failure.

Hazards of flight such as fuel exhaustion and adverse weather are common to all powered aircraft, but some risks peculiar to helicopters have no direct fixed-wing equivalents. Phenomena such as mast bumping, dynamic rollover, ground resonance, and loss of tail rotor effectiveness (LTE) have been grouped together in the category called "rotorcraft aerodynamics" and accounted for 18 non-commercial

FIGURE 52. TYPE OF OPERATION: NON-COMMERCIAL HELICOPTER

Type of Operation	Accidents		Fatal Accidents		Fatalities	
Personal	27	25.7%	5	25.0%	12	28.6%
Instructional	28	26.7%	0			
Public Use	11	10.5%	3	15.0%	5	11.9%
Positioning	8	7.6%	5	25.0%	12	28.6%
Aerial Observation	11	10.5%	1	5.0%	1	2.4%
Business	4	3.8%	0			
Executive/Corporate	2	1.9%	1	5.0%	2	4.8%
Other Work Use	8	7.6%	4	20.0%	8	19.0%
Other or Unknown	6	5.7%	1	5.0%	2	4.8%

FIGURE 53. FLIGHT CONDITIONS: NON-COMMERCIAL HELICOPTER

Conditions	Accidents		Fatal Accidents		Fatalities	
Day VMC	87	82.9%	11	55.0%	18	42.9%
Night VMC*	11	10.5%	5	25.0%	10	23.8%
Day IMC	2	1.9%	0			
Night IMC*	4	3.8%	3	15.0%	11	26.2%
Unknown	1	1.0%	1	5.0%	3	7.1%

**Includes dusk.*

NTSB ACCIDENT NO. ERA13FA336

ACCIDENT CASE STUDY: NON-COMMERCIAL HELICOPTER

ROBINSON R66, NOXEN, PENNSYLVANIA | FIVE FATALITIES

HISTORY OF FLIGHT The flight departed from the Tri-Cities Airport southwest of Binghamton, New York at 9:51 p.m., about an hour after the pilot sent a message advising his brother that he was "Waiting out weather to fly back … tonight." He requested VFR traffic advisories to the Jack Arner Memorial Airport south of Wilkes-Barre, Pennsylvania. Four passengers were on board.

At 10:04 he was handed off to Wilkes-Barre Approach Control and reported that the aircraft was level at 3,000 feet. At 10:19, radar showed it turning left from a south-southeasterly heading to the northwest in the vicinity of a wind farm. The radar track continued parallel to a service road inside the installation.

The pilot radioed that "We're inadvertent IMC, reversing ah, can you give us a heading to the nearest airport, please." After receiving a vector, the pilot transmitted that he was "…having trouble maintaining control here." The controller then asked whether he was having difficulty maintaining altitude. The pilot's "Affirmative" was the last transmission received from the helicopter; radar data showed it descending from 2,600 to 2,300 feet with no change in location before contact was lost. The wreckage was found shortly before 2:00 p.m. the next afternoon in a heavily wooded area.

PILOT INFORMATION The 30-year-old pilot held commercial and flight instructor certificates for rotorcraft helicopter. He did not have an instrument rating. Reconstruction of his flight records suggested total flight experience of 1,335 hours, including 92 hours at night. The extent of his training in either simulated or actual instrument conditions is not known, but none was logged during the five months before the accident.

WEATHER An observation recorded at Binghamton nine minutes before the flight departed included visibility of 2.5 miles in moderate rain, broken layers at 600 and 1,400 feet agl, and a 7,000-foot overcast. Winds were from 190 degrees at 8 knots. The accident site was on the boundary of the area covered by an Airmet Sierra that forecast IFR conditions, including ceilings below 1,000 feet and visibility of less than three miles in precipitation and mist, that were expected to continue until 5:00 the next morning. The moon was below the horizon.

PROBABLE CAUSE The pilot's decision to continue VFR flight into night instrument meteorological conditions, which resulted in spatial disorientation and a loss of control.

ASI COMMENTS Helicopter pilots are less likely than airplane pilots to hold instrument ratings, and fewer helicopters are certified for flight in instrument conditions. It's little wonder, then, that attempts to continue VFR flight in IMC are every bit as deadly in rotorcraft. In 2013, VFR in IMC was the leading cause of fatal accidents on non-commercial flights, accounting for as many as mechanical malfunctions and wire strikes combined.

accidents (17% of the total). Loss of main rotor rpm and loss of tail rotor effectiveness were the most common, causing six accidents each; the latter included this year's only fatal accident in this category. Dynamic rollover and a loss of control while hovering in ground effect led to two accidents apiece, while settling with power and a poorly executed emergency autorotation each led to one.

Fuel mismanagement and unfavorable weather combined to cause 15% of all accidents, almost the same share as on non-commercial fixed-wing flights, but the proportions were reversed: Weather led to 10% of helicopter accidents compared to 6% in airplanes, but was highly lethal in both. In helicopters, it was the leading cause of fatal accidents, accounting for 40% of the total. Six of the eight fatal accidents involved either attempted VFR flight in IMC or collisions with obstructions in marginal visibility; one fatal accident apiece was attributed to airframe and induction icing. Four of the five fuel-mismanagement accidents were blamed on water contamination. Takeoff and landing accidents made up less than 10% of the total compared to some 57% of non-commercial fixed-wing accidents, and only one was fatal.

No helicopters were damaged in collisions with other aircraft during 2013, but two accidents occurred during external-load operations on public-use flights conducted under Part 91. Four of the six accidents grouped together as "Other/ Miscellaneous" involved unexplained losses of engine power. The others included one case of pilot incapacitation and the accidental discharge of a net gun into the main rotor blades.

COMMERCIAL HELICOPTER ACCIDENTS

There were 41 accidents on commercial helicopter flights in 2013, seven of which were fatal. These represent increases of five and three, respectively, from 2012. Eighteen took place during aerial application, 13 on Part 135 charter or cargo flights, and 10 during external-load operations (FIGURE 56), including four of the seven that were fatal. Two utility linemen were killed when a shield wire severed the line from which they were suspended. The pilots were the only casualties in the other three fatal external-load accidents, the two that occurred on Part 135 flights, and the only fatal crop-dusting accident.

One aerial application and one Part 135 accident occurred in VMC at night, and there was one accident on a Part 135 flight in IMC during daylight hours. None were fatal. Ten of the 11 involving piston helicopters occurred on aerial application flights, while the only two involving multiengine turbine models were operating under Part 135. In all, 28 of the 41 accident aircraft (68%) were single-engine turbine models. Only four of the accident pilots held airline transport pilot certificates, two each flying under Parts 135 and 137.

FIGURE 54. PILOTS INVOLVED IN NON-COMMERCIAL HELICOPTER ACCIDENTS

Certificate Level	Accidents		Fatal Accidents		Fatalities	
ATP	18	17.1%	5	25.0%	13	31.0%
Commercial	72	68.6%	12	60.0%	25	59.5%
Private	11	10.5%	3	15.0%	4	9.5%
Student	3	2.9%	0			
Other or Unknown	1	1.0%	0			
Second Pilot on Board	31	29.5%	1	5.0%	1	2.4%
CFI on Board*	63	60.0%	11	55.0%	26	61.9%
IFR Pilot on Board*	87	82.9%	18	90.0%	39	92.9%

**Includes single-pilot flights.*

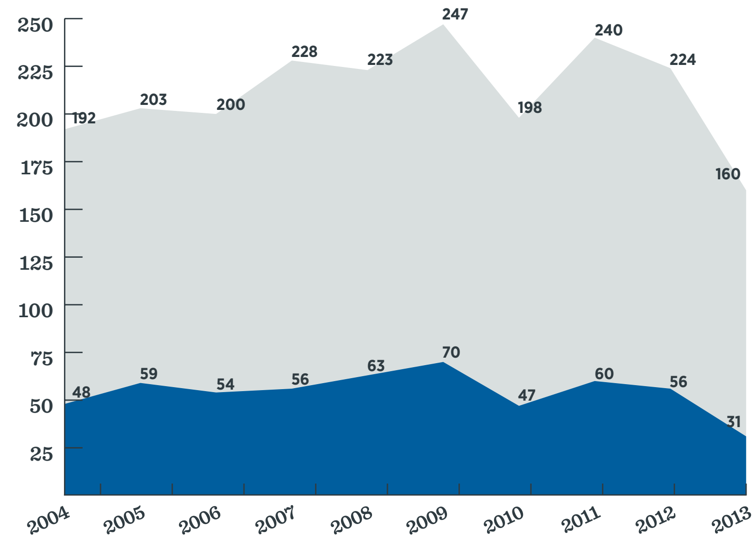
FIGURE 55. TYPES OF NON-COMMERCIAL HELICOPTER ACCIDENTS

Accident Type	Accidents		Fatal Accidents		Lethality
External Load	2	1.9%	1	5.0%	50.0%
Mechanical	24	22.9%	3	15.0%	12.5%
Fuel Management	4	3.8%	1	5.0%	25.0%
Weather	10	9.5%	8	40.0%	80.0%
Preflight/Static	2	1.9%	1	5.0%	50.0%
Takeoff/Climb	1	1.0%	0		
Maneuvering	28	26.7%	3	15.0%	10.7%
Rotorcraft Aerodynamics	18	17.1%	1	5.0%	5.6%
Landing	9	8.6%	1	5.0%	11.1%
Other/Miscellaneous	6	5.7%	1	5.0%	16.7%
Not Yet Assigned	1	1.0%	0		

FIGURE 56. SUMMARY OF COMMERCIAL HELICOPTER ACCIDENTS

	Accidents		Fatal Accidents		Fatalities	
Aerial Application (Part 137)	**18**	43.9%	**1**	14.3%	**1**	12.5%
Single-Engine Piston	10	55.6%	0			
Single-Engine Turbine	8	44.4%	1	100.0%	1	100.0%
Day VMC	17	94.4%	1	100.0%	1	100.0%
Night VMC*	1	5.6%	0			
ATP	2	11.1%	0			
Commercial	16	88.9%	1	100.0%	1	100.0%
Charter or Cargo (Part 135)	**13**	31.7%	**2**	28.6%	**2**	25.0%
Single-Engine Piston	1	7.7%	0			
Single-Engine Turbine	10	76.9%	2	100.0%	2	100.0%
Multiengine Turbine	2	15.4%	0			
Day VMC	11	84.6%	2	100.0%	2	100.0%
Night VMC*	1	7.7%	0			
Day IMC	1	7.7%	0			
ATP	2	15.4%	0			
Commercial	11	84.6%	2	100.0%	2	100.0%
External Load (Part 133)	**10**	24.4%	**4**	57.1%	**5**	62.5%
Single-Engine Turbine	10	100.0%	4	100.0%	5	100.0%
Day VMC	10	100.0%	4	100.0%	5	100.0%
Commercial	10	100.0%	4	100.0%	5	100.0%

FIGURE 57. FIXED-WING AMATEUR-BUILT AND EXPERIMENTAL LIGHT SPORT ACCIDENT TREND



All Accidents Fatal Accidents

FIGURE 58. TYPES OF AMATEUR-BUILT AIRCRAFT INVOLVED IN ACCIDENTS

Aircraft Class	Accidents		Fatal Accidents		Lethality
E-LSA	31	19.0%	3	9.7%	9.7%
Single-Engine Fixed-Gear	106	65.0%	23	74.2%	21.7%
SEF Tailwheel	64		13		20.3%
Single-Engine Retractable	20	12.3%	4	12.9%	20.0%
Multiengine	3	1.8%	1	3.2%	33.3%
Helicopter	3	1.8%	0		
Turbine Helicopter	2		0		

AMATEUR-BUILT AND EXPERIMENTAL LIGHT-SPORT AIRCRAFT

FIXED-WING (160 TOTAL / 31 FATAL; INCLUDES 31 E-LSA / 3 FATAL) **HELICOPTER** (3 TOTAL / NO FATAL) Amateur-built and experimental light-sport aircraft (E-LSAs), which have long been troubled by the highest accident rate in general aviation, showed the greatest improvement in 2013. An 8% decrease in flight activity was accompanied by a 30% reduction in the number of accidents (FIGURE 57), from 232 to 163. Thirty-one of them were in E-LSAs, the same number as in 2012. Accidents in amateur-built airplanes not qualified for operation under sport-pilot rules dropped 33%, from 193 to 129, and the number in amateur-built helicopters fell from eight to three. The combined accident rate for these three categories decreased nearly 25%, from 23.23 per 100,000 flight hours to 17.72.

In addition to being less frequent, these accidents were less severe. Thirty-one were fatal (19% of the total) compared to 57 (25%) the year before. This 46% reduction in the number of fatal accidents translates to a 41% decrease in the fatal accident rate, which fell from 5.71 per 100,000 hours in 2012 to 3.37 per 100,000 hours in 2013. In all, 55% of the total reduction in the number of non-commercial general aviation accidents in 2013 and 52% of the decline in fatal accidents came from the improvement in the homebuilt sector.

Despite these encouraging results, flying amateur-built and experimental light sport aircraft continues to carry elevated risks. Their overall accident rate in 2013 was 3.4 times as high as the combined rate for non-commercial flights in certified airplanes and helicopters. (In 2012 it was four times higher.) Their fatal accident rate was 3.75 times higher, down from nearly six times as high the year before.

Accident risk is known to be particularly high during the initial flight-test period. Of the 117 accident aircraft for which the airframe's total time in service was reported, 18 (15%) had flown fewer than 40 hours. Median time in service was 284 hours with a high of 3,325 hours.

In addition to 31 E-LSAs and three helicopters, the accident fleet included 106 single-engine fixed-gear airplanes, 64 of them with tailwheels and 42 built in a tricycle-gear configuration (FIGURE 58). There were also twenty retractable-gear singles and three multiengine airplanes. All of the fixed-wing aircraft used reciprocating engines, but two of the three helicopters were turbine-powered. In a sharp departure from earlier years, lethality was lowest (below 10%) in the E-LSA category and essentially equal at 20-22% in the other single-engine airplanes.

There were actually four more landing accidents than in 2012, increasing their percentage of the total from 17% to 26% (FIGURE 59). The number due to known mechanical failures fell 35% and the number caused by unexplained losses of engine power dropped 32%. There were 50% fewer accidents due to deficient takeoff technique, and the number of go-around accidents fell from 10 to three. There were also two-thirds fewer descent and approach accidents and 55% fewer due to fuel mismanagement, while the numbers of weather and maneuvering accidents saw little change. Five accidents were triggered by discrepancies that should have been detected by preflight inspections, and three occurred while taxiing.

UNUSUAL ACCIDENT CATEGORIES

Seventeen fatal and eleven non-fatal accidents arose from circumstances too rare to support tabulation as separate categories for statistical analysis:

COLLISIONS (9 TOTAL / 3 FATAL) There were six midair collisions in 2013. Three were fatal, causing seven individual deaths.

All occurred between fixed-wing aircraft on non-commercial flights. Both occupants of a fixed-gear Cessna 172 died after their airplane climbed into a Cessna 172RG that was conducting a familiarization flight in the local practice area. All three on board the 172RG survived the ensuing forced landing.

Both occupants of both airplanes died in the collision between a Piper Archer and a Cessna 172 near Anthem, Arizona where both were conducting instructional flights. The passenger in a Piper Arrow was killed when it collided with a Piper Tri-Pacer on final approach to a grass strip in rural Idaho.

Only minor injuries to the Cirrus pilot resulted from the collision between a Cessna 152 and a Cirrus SR22 near College Station, Texas. Both were able to return to the airport and land safely. The two L-39 jets that collided during a practice run before the Reno Air Races were also able to land without incident and without injury to their pilots. Finally, the pilot of a Cessna 182 that was struck by a Cessna 185 during a formation skydiving flight in Superior, Wisconsin was able to parachute to the ground after the airplane disintegrated, suffering only minor injuries. His four passengers also jumped safely. The five skydivers on the 185 jumped as the airplane rolled inverted; its pilot subsequently recovered control and landed. Images of the accident captured by several of the divers' helmet cameras gained wide circulation.

No serious injuries resulted from any of the three on-ground collisions. The propeller of a Pitts S-2B struck the wing of a Cessna 170 as the Pitts taxied back to the runway. The right wing of a Cessna 182 on a taxiway hit the left wing of a Cessna 172 entering the taxiway from the ramp; both pilots were faulted for failing to notice the other airplane. A second Pitts S-2 taxied into the tail of a Cessna 172 that had landed on the parallel runway while the Cessna waited for a taxi clearance; the NTSB noted that the ground controller didn't advise the Pitts pilot of the stationary airplane ahead of him, and the Pitts pilot didn't make S-turns while taxiing.

ALCOHOL AND DRUGS (2 TOTAL / 1 FATAL) Toxicology results suggested that the solo pilot killed in the crash of a Luscombe 8A near Oceano, California was impaired by recent use of marijuana. The pilot who stalled a Cessna 172 onto the runway during pattern work in Akron, Colorado had a blood alcohol content of .078%, but he and his passenger escaped with minor injuries. Unlike any year in recent memory, no accidents were attributed to impairment by either prescription or over-the-counter drugs, and the totals of two accidents and one fatality are the lowest since the Air Safety Institute began tracking this category.

PHYSICAL INCAPACITATION (12 TOTAL / 10 FATAL) Six fatal accidents, all in airplanes, were caused by sudden cardiovascular events. The pilots were the only casualties. Five were operating under Part 91; the sixth was a crop-duster pilot who died while making water drops during a proficiency demonstration. A Bellanca 14-19-3A crashed after the pilot lost consciousness due to carbon monoxide poisoning, and the pilot of a Cessna 172 succumbed to "a medical event of undetermined nature."

Two out of three suicide attempts were successful. The owner of an RV-4 shot himself in flight, and the renter of a Cessna 172 dove it into the ground at full power. A Cirrus SR22 pilot survived with serious injuries after engaging the autopilot and taking sleeping pills. The autopilot's envelope protection system kept the airplane under control through the power-off descent after the fuel tank ran dry. And an apparently healthy 18-year-old student pilot with no prior medical history escaped injury after suffering a seizure while taxiing.

By FAA estimates, the active U.S. pilot population was just under 600,000 in 2013. These 12 pilots therefore represent a scant two one-thousandths of one percent (.002%) of that total.

OFF-AIRPORT GROUND INJURIES (2 ACCIDENTS / 2 GROUND FATALITIES AND 1 SERIOUSLY INJURED) Two children were killed when a Rockwell Commander 690B crashed into their house while on approach to the airport in East Haven, Connecticut. The pilot and the only passenger, his son, also died. One person on the ground suffered serious injury when a Hawker 390 jet crashed into three homes during an attempted go-around at South Bend, Indiana. The pilot in command and the pilot-rated passenger in the right front seat were killed, while the two passengers in the back seats escaped with serious injuries. The cockpit voice and flight data recorders indicated that the right-seat passenger, who held a multiengine rating but was not type-rated for the jet, inadvertently moved the throttles into the fuel cut-off position; through the approach, the pilot had apparently been showing him how to fly the airplane. He was unable to restart the engines but still attempted to go around after the landing gear wouldn't extend.

ON-AIRPORT GROUND INJURIES (3 ACCIDENTS / 2 GROUND FATALITIES AND 1 SERIOUSLY INJURED) While trying to get a picture of the airplane in the run-up area, the girlfriend of the pilot of a Quicksilver Sport IIs walked into the moving propeller. She survived with serious injuries. A runway maintenance worker was killed by the propeller of a Grumman G164-B crop-duster landing after a positioning flight. In the only helicopter accident in any of this year's "unusual" categories, the just-relieved pilot of an Enstrom F-28C died after being hit in the head by a main rotor blade while walking away from the aircraft following a "hot" crew change.

FIGURE 59. TYPES OF ACCIDENTS IN AMATEUR-BUILT AIRCRAFT

Aircraft Class	Accidents		Fatal Accidents		Lethality
Mechanical	33	20.2%	4	12.9%	12.1%
Unexplained Power Loss	13	8.0%	2	6.5%	15.4%
Fuel Management	5	3.1%	1	3.2%	20.0%
Weather	4	2.5%	1	3.2%	25.0%
Takeoff and Climb	18	11.0%	4	12.9%	22.2%
Maneuvering	14	8.6%	8	25.8%	57.1%
Descent/Approach	5	3.1%	2	6.5%	40.0%
Landing	43	26.4%	0		
Go-around	3	1.8%	1	3.2%	33.3%
Other Pilot-Related	13	8.0%	5	16.1%	38.5%
Other or Unknown	12	7.4%	3	9.7%	25.0%

SUMMARY

- The record of non-commercial fixed-wing flights, which accounted for 73% of all GA activity, showed an unexpected and dramatic improvement in 2013. Its accident rate declined some 12% to 5.77 per 100,000 flight hours, the lowest on record. The rate of fatal accidents fell 19%, dropping below 1.00 per 100,000 hours for the first time.
- More than half the overall reduction in non-commercial fixed-wing accidents came from a 33% decrease in accidents in amateur-built airplanes, including a 42% reduction in the number of fatal accidents. The overall number in experimental light-sport aircraft was unchanged, but the number of fatal E-LSA accidents dropped from eight to three.
- The gap in accident rates between certified and amateur-built aircraft also narrowed: from 4.0 times higher in 2012 to 3.4 times in 2013. The fatal accident rate was 5.9 times greater in 2012; in 2013, it was 3.7 times more.
- Rather than being concentrated in one or a handful of accident types, the improvement was across the board: the relative frequencies of different causes were almost unchanged. New lows were recorded in every major accident category tracked by ASI.
- The number of non-commercial helicopter accidents fell 17%, but the number of fatal accidents increased by one. Taken together with a 10% decrease in estimated flight activity, this produced the highest fatal accident rate in this sector since 2003.
- Practice autorotations remain the maneuver leading to the largest number of helicopter accidents, but no fatalities resulted from any of the 15 that took place in 2013.
- Commercial accidents in both airplanes and helicopters increased modestly but remained in line with recent trends. Commercial flight activity in airplanes increased while that in helicopters fell sharply. The fatal accident rate on commercial helicopter flights was more than double the record low of 2012, but still within the range seen in the prior decade.
- By historical standards, fixed-wing Part 135 accidents suffered unusually high lethality. They accounted for two-thirds of all fatal accidents and 86% of fatalities in commercial fixed-wing GA even though 58% of all accidents occurred on aerial application flights. No specific cause accounted for the excess.
- The greatest share of commercial helicopter accidents took place on aerial application flights, but more than 60% of fatalities occurred during external-load operations.
- There were only three fatal midair collisions in 2013, and just two accidents were blamed on impairment of the pilots involved by drugs or alcohol. None involved either prescription or over-the-counter drugs.
- A total of five accidents caused four deaths and two serious injuries to people on the ground. Three of those took place on airport grounds.

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 (a.k.a. crop-dusting) and banner towing, have inherent operational 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 weather reporting and air traffic 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.

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 42.

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

FIGURE 60: WHAT DOES GENERAL AVIATION FLY?

Aircraft Class	Commercial		Non-Commercial	
Piston Single-Engine	2,748	19.2%	121,650	67.1%
Piston Multiengine	1,005	7.0%	12,252	6.8%
Turboprop Single-Engine	2,502	17.5%	1,976	1.1%
Turboprop Multiengine	1,323	9.2%	3,817	2.1%
Turbojet	2,789	19.4%	8,848	4.9%
Helicopter	3,760	26.3%	6,005	3.3%
Experimental	161	1.1%	24,757	13.7%
Light sport*	15	0.1%	2,041	1.1%
Total	**14,303**		**181,346**	

**Note: In the 2012 and 2013 surveys, the FAA counted experimental light-sport aircraft in the "experimental" rather than the "light sport" category.*

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 60 shows the FAA's estimate of the number of powered GA aircraft that were active in 2013, 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 97.9 percent of the GA fleet.

WHAT IS THE ACCIDENT RATE? The different sectors of GA vary widely in their levels of flight activity, imparting corresponding differences in exposure to the risks of accidents. To make meaningful comparisons, the numbers of accidents are standardized by computing the corresponding rates, conventionally expressed as the average number of accidents per 100,000 hours of flight time. GA activity is estimated in an annual aircraft activity survey conducted by the FAA, which provides breakdowns by category and class of aircraft and purpose of flight, among other characteristics.

NTSB DEFINITIONS

ACCIDENT/INCIDENT (49 CFR 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.

AOPA AIR SAFETY INSTITUTE

421 AVIATION WAY, FREDERICK, MD 21701
AIRSAFETYINSTITUTE.ORG

COPYRIGHT © 2016 AOPA AIR SAFETY INSTITUTE