26TH JOSEPH T. NALL REPORT
General Aviation Accidents in 2014

AOPA AIR SAFETY
INSTITUTE

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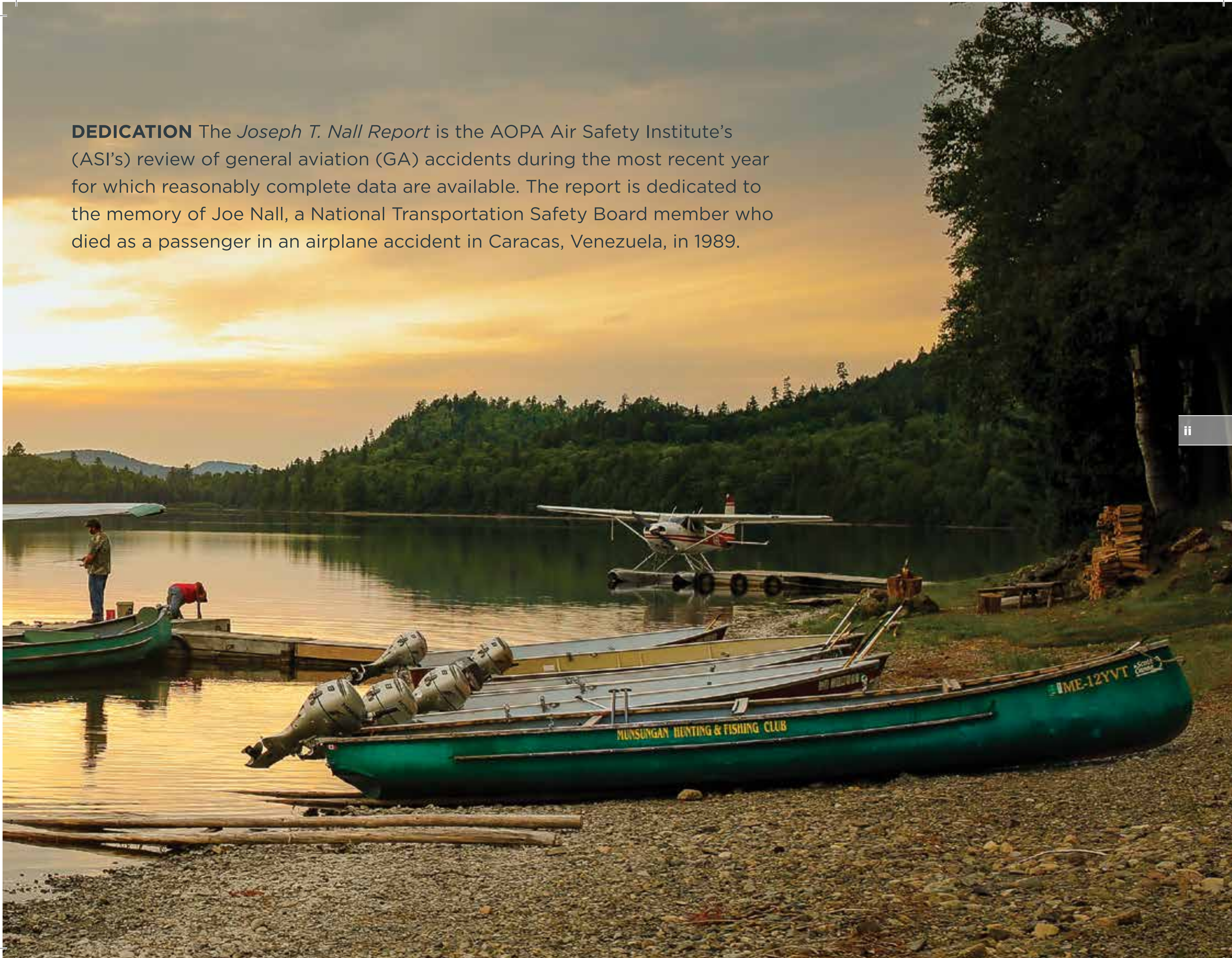
DEDICATION The *Joseph T. Nall Report* is the AOPA Air Safety Institute's (ASI's) review of general aviation (GA) accidents during the most recent year for which reasonably complete data are available. The report is dedicated to the memory of Joe Nall, a National Transportation Safety Board member who 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 2014, more than 200,000 individual aircraft logged over 23 *million* hours flying GA.

Like its recent predecessors, this twenty-sixth 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.

Investigations of fatal accidents typically require more time and resources than those of less severe events. To avoid misclassifying or undercounting important causes, ASI does not initiate analysis for the *Nall Report* until probable cause has been determined for at least 80% of a year's fatal accidents. At the time of publication, 2014 is the most recent year to meet this threshold. ASI's *2015-2016 General Aviation Accident Scorecard* summarizes the number of circumstances of accidents in those two years.

INTERPRETING AVIATION ACCIDENT STATISTICS: **ACCIDENTS VS. ACCIDENT RATES**

The total amount of flight activity nationwide can vary substantially from year to year. 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.

Note: Because the 2011 activity survey was not completed, the Nall Report and GA Accident Scorecard do not estimate rates for that year.

FINAL VS. **PRELIMINARY STATISTICS**

When the data were frozen for the current report, the National Transportation Safety Board (NTSB) had released its findings of probable cause for 1,109 of the 1,163 qualifying accidents (95.4%) that occurred in 2014, including 219 of 229 fatal accidents (95.6%). All remaining accidents were categorized on the basis of preliminary information. As in the past, ASI will review the results after the NTSB has completed substantially all of its investigations to assess how the use of provisional classifications has affected this analysis.

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

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HARTZELL

PUBLISHER'S **VIEW**

The *26th Nall Report* confirms continued improvement in general aviation safety. The significant improvements and historically low accident rates revealed in last year's report proved not to be a one-time statistical anomaly. Across the general aviation community, we can take pride that our collaborative efforts appear to be having a positive, sustained impact. We can also acknowledge that there is more work to do and further improvements are well within our capability. Troubling and stubborn accident categories remain. The wide discrepancy between pilot-related and other types of accident causes and the notable differences in accident rates between commercial, personal, and experimental flying illustrate that further improvements in general aviation safety are needed and achievable.

Once again, the overwhelming cause of accidents is pilot error, which has persistently caused 75% of accidents for decades. That stubborn statistic should motivate our efforts. It means that if we influence pilots to modify their behavior we can drive further reductions in the number of accidents, the overall accident rate, and the number of fatalities. We in aviation should see the intransience of the pilot-related mishap percentage as a "call to arms." Let's commit to driving this percentage down by dropping the pilot-related mishap rate below 4.0 per 100,000 flight hours. To do this, we'll need to rally our collective resources to reduce pilot distraction, enhance situational awareness, improve stick and rudder skills, and influence good decision making. Together, we can influence pilots and policy makers, change behavior, and save lives.

Part of the solution must involve reaching more pilots with safety related content and having more impact when we do reach them. For decades we've been decrying the "unreachables," those pilots who, for whatever reason, don't seek out safety information. Intuitively, we have a hunch that pilots who want safety information are safer pilots, so we struggle to reach the ones who really need us. ASI is setting out to put data behind this hunch, identify the "unreachables," and drive initiatives that reach more and influence more.

Training is only part of the solution to reduce pilot-related mishaps. Bringing modern equipment into airplanes faster and more affordably has proven safety advantages. This will require innovative thinking and process re-engineering from government and industry. Recent acceleration in non-TSO'd equipment approvals and Part 23 reform are positive signs. We must continue to move more aggressively and more rapidly to make modern, affordable, life-saving equipment available to more of the general aviation fleet.

We are pleased that this year's report confirms last year's substantial drop in the GA accident rates which have improved dramatically over the last several decades. All of us – trainers, manufacturers, advocacy groups and government agencies — can take pride that collaborating on difficult and complex initiatives, we produced better procedures and more reliable equipment at more affordable prices improved training and made general aviation even more safe.

This year's report compels us to accept that all we've done is not yet enough. We still haven't reached our potential. Better results are well within our grasp. We have the ability to continue driving positive advances in GA safety if we commit to working together for a wider reach and greater influence.

Safe flying,

Richard G. McSpadden, Jr.
Executive Director, AOPA Air Safety Institute

GENERAL AVIATION **ACCIDENTS IN 2014**

In 2014, there were 1,163 general aviation accidents involving a total of 1,171 individual aircraft (FIGURE 1). These included a midair collision between a Cirrus SR22 and a Robinson R44 helicopter as well as six midairs between airplanes.

The 229 fatal accidents caused 354 individual fatalities, marking a 3% decline from the year before despite an 11% rise in the number of fatal accidents. The number of deaths on non-commercial fixed-wing flights rose by 15, or 5%, nearly offset by a decrease of 11 (39%) on fixed-wing commercial flights. Helicopters saw the opposite relationship: Non-commercial fatalities declined by 18 (43%), while the number on commercial flights climbed from eight to 13.

Non-commercial fixed-wing flights made up 75% of estimated GA activity in 2014, up 2% from the year before. They were responsible for 82% of all accidents and 86% of fatal accidents, up from 81% of each in 2013.

TRENDS IN GENERAL **AVIATION ACCIDENTS, 2005 – 2014**

According to FAA estimates, the nearly decade-long decline in GA flight activity paused and even began to reverse in 2014. Commercial fixed-wing and non-commercial helicopter activity rose by 5% and 21%, respectively, while commercial helicopter and non-commercial fixed-wing time each decreased less than one-half of one percent from the previous year. The aggregate volume across these four sectors increased by 1.7%, from 22.7 million hours in 2013 to 23.1 million in 2014.

There were 952 non-commercial fixed-wing accidents in 2014, nine fewer than the year before (FIGURE 2A). The resulting accident rate of 5.78 per 100,000 hours was essentially unchanged from the previous year's record low (FIGURE 2B). However, 21% caused fatalities, up from 17% the year before, with the result that the fatal accident rate ticked up some 18% to 1.19 per 100,000 hours.

The number of non-commercial helicopter accidents edged up from 105 to 108 but six fewer were fatal. Coupled with the increase in flight activity, these represent declines of 15% in the overall accident rate and 42% in the fatal rate to 6.28 and 0.81 per 100,000 hours, respectively. Eight of 36 commercial helicopter accidents were fatal, the highest proportion since 2007; while the overall rate of 2.36 per 100,000 hours was near the middle of the past decade's range, the rate of 0.53 fatal accidents per 100,000 hours matched the decade's previous high.

Commercial fixed-wing accidents fell 16% to 68; that and the accompanying rate of 2.00 per 100,000 hours both mark new lows. As with commercial helicopter accidents, an unusually high proportion were fatal, but thanks to the increase in activity, the resulting fatal accident rate of 0.32 per 100,000 hours was close to the prior decade's average.

FIGURE 1.
GENERAL AVIATION ACCIDENTS IN 2014

	Non-Commercial		Commercial	
	Fixed-Wing	Helicopter	Fixed-Wing	Helicopter
Number of accidents	952	108	68	36
Number of aircraft*	959	108	68	36
Number of fatal accidents	196	14	11	8
Lethality (percent)	20.6	13.0	16.2	22.2
Fatalities	300	24	17	13

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

FIGURE 2A. GENERAL AVIATION ACCIDENT TRENDS, 2005-2014

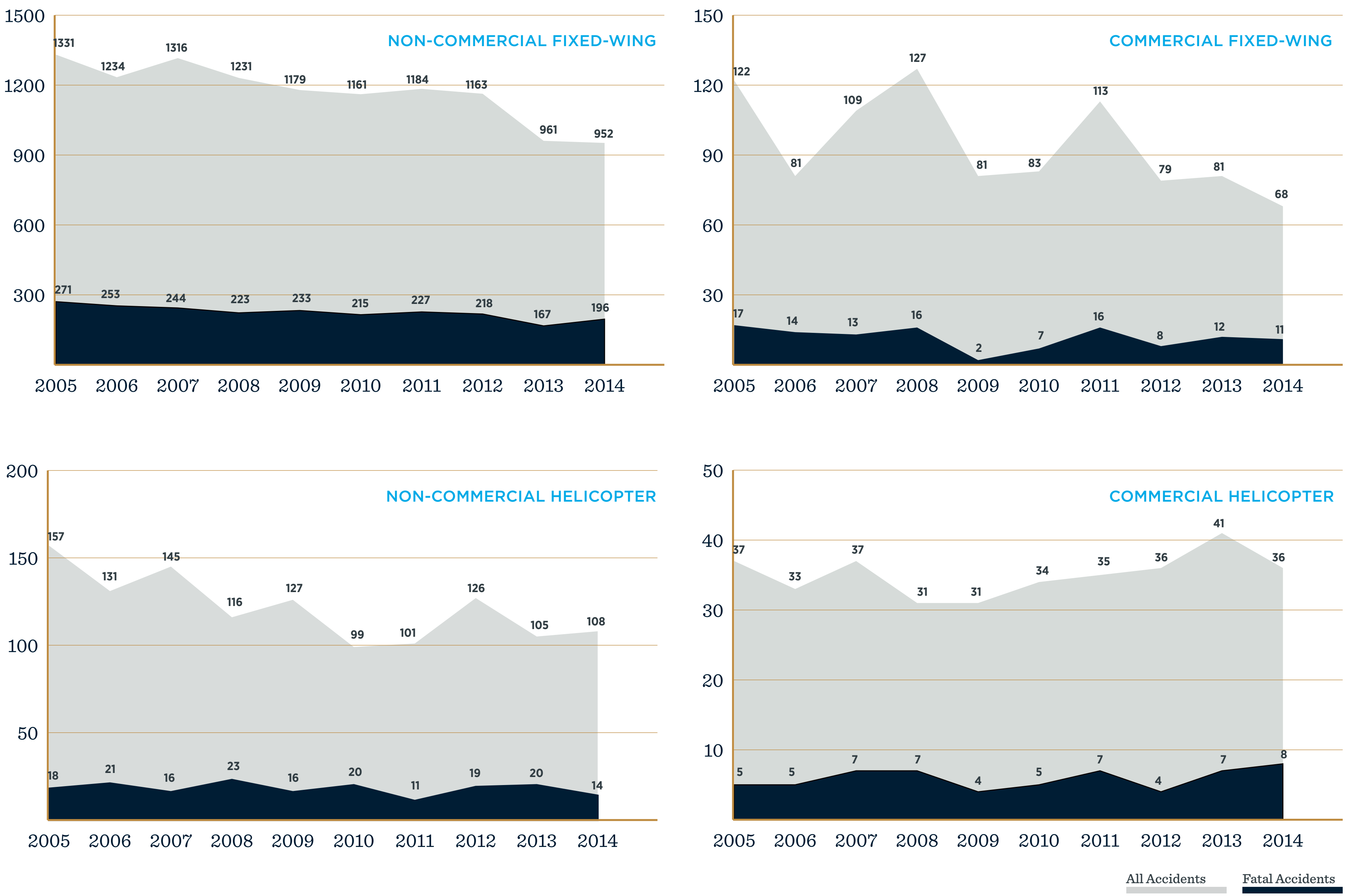
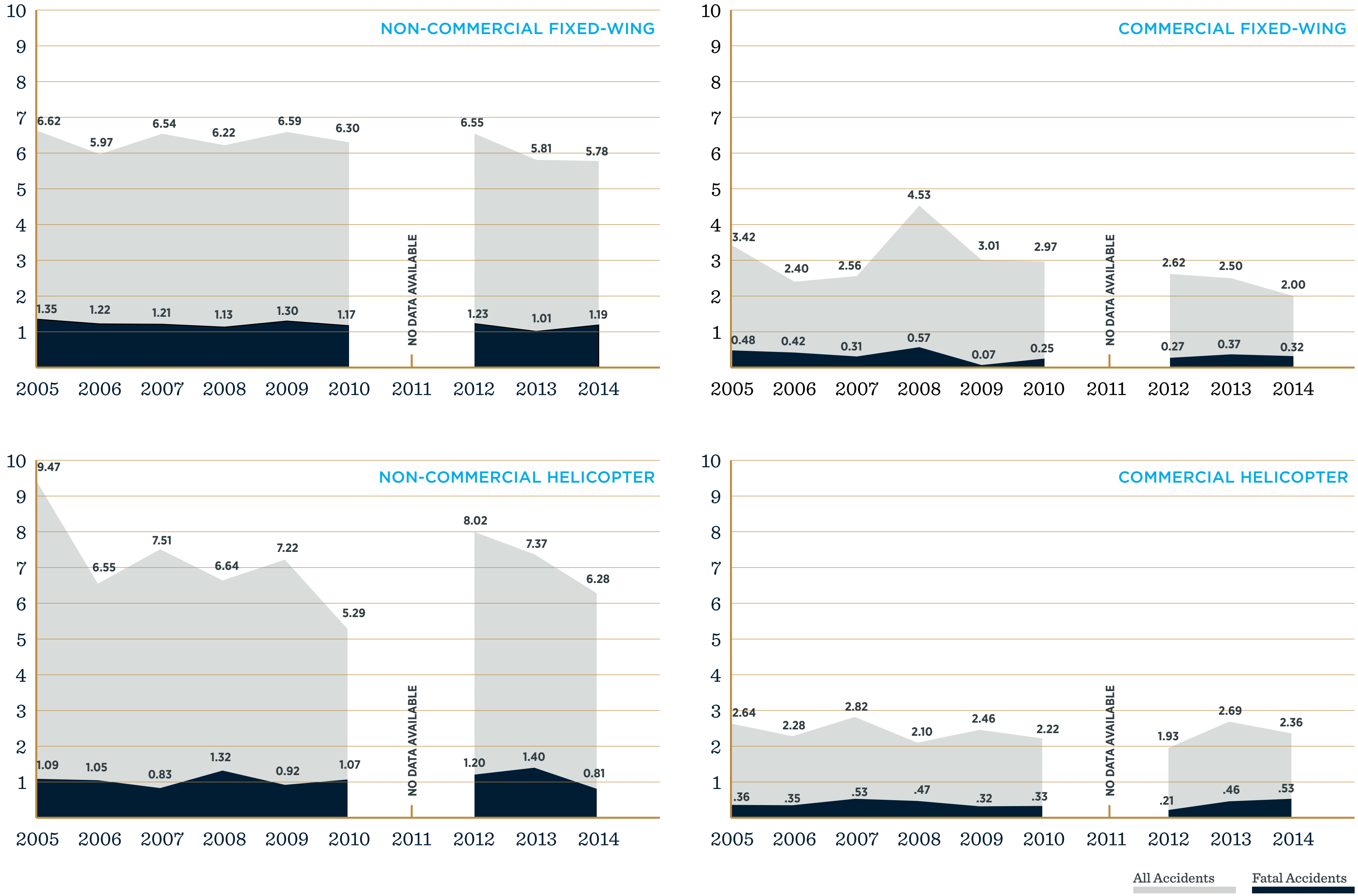


FIGURE 2B. GENERAL AVIATION ACCIDENT RATES, 2005-2014



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.

As in 2013, pilot-related causes figured more prominently among non-commercial than commercial accidents **(FIGURE 3)**, while the proportion caused by known mechanical failures was two-thirds higher on commercial flights. The proportion of fatal accidents due to pilot-related causes, however, was slightly higher on commercial flights. In each case about 20% of pilot-related accidents were fatal. Mechanical accidents and accidents that did not fit neatly into either category were more likely to be fatal on non-commercial flights, a pattern that's been consistent for years.

FIXED-WING ACCIDENTS
NON-COMMERCIAL

Both the number and rate of non-commercial fixed-wing accidents in 2014 remained at 2013 levels, maintaining the sharp reduction achieved the preceding year. A 1% decrease in the total number of accidents included a 17% jump in the number that were fatal **(FIGURE 2A)**, returning the fatal accident rate to 2006-2012 levels **(FIGURE 2B)**. However, fatal accidents tended to involve fewer people. The number of individual deaths rose by just 5%, from 285 to 300. The breakdown between pilot-related, mechanical, and other causes **(FIGURE 3)** was also almost identical not just to 2013, but to every year in recent memory.

AIRCRAFT CLASS

More than 70% of the accident aircraft were single-engine fixed-gear (SEF) models **(FIGURE 4)**, including 60% of those involved in fatal accidents. Nearly 45% of SEF airplanes were conventional-gear (tailwheel) models. Consistent with the overall increase in accident lethality compared to 2013, higher proportions of these accidents were fatal, and the lethality of accidents in single-engine retractable-gear airplanes increased by one-third. Unlike most previous years, fatalities were rarer in multiengine aircraft than in retractable-gear singles, and this was true for both piston- and turbine-powered models.

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

	Non-Commercial				Commercial			
	All Accidents		Fatal Accidents		All Accidents		Fatal Accidents	
Pilot-related	717	75.3%	147	75.0%	43	63.2%	9	81.8%
Mechanical	143	15.0%	20	10.2%	17	25.0%	1	9.1%
Other or unknown	92	9.7%	29	14.8%	8	11.8%	1	9.1%

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

Aircraft Class	Accidents		Fatal Accidents		Lethality
Single-engine fixed-gear (SEF)	701	73.1%	119	59.5%	17.0%
SEF tailwheel	309		50		16.2%
Single-engine retractable	192	20.0%	63	31.5%	32.8%
Single-engine turbine	17		8		47.1%
Multiengine	66	6.9%	18	9.0%	27.3%
Multiengine turbine	14		4		28.6%

TYPE OF OPERATION

Personal flights resulted in 76% of 2014's accidents **(FIGURE 5)** and 83% of fatal accidents. The latter represents a five-point rise from 2013, but the excess number of accidents on personal flights has been a consistent pattern for more than 20 years. Instructional flights were once again the second largest category, accounting for more than half the remainder (just under 14% of all and 9% of fatal accidents). Instructional accidents continue to be among the most survivable in both airplanes and helicopters; 13% were fatal compared to 23% on personal flights. Only one accident occurred on corporate and executive transport flights, reinforcing that sector's reputation for a safety record similar to those of the commercial air carriers.

FLIGHT CONDITIONS

Less than 5% of all accidents occurred in instrument meteorological conditions (IMC), but these included nearly 15% of all fatal accidents and 16% of individual deaths **(FIGURE 6)**. The latter two figures both represent decreases from the year before, when 20% of fatal accidents and almost 25% of fatalities took place in IMC. Almost 70% of all accidents in IMC were fatal compared to 17% of those in visual meteorological conditions (VMC) during daylight hours and 26% 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 nearly 75% of all fatal accidents and 73% of individual fatalities. While the proportion of fatal accidents that occurred in IMC decreased from the prior year, the greater lethality of those accidents and the overwhelming preponderance of daytime VMC (which accounts for 90% of all fixed-wing flight activity) among accident conditions are well-established patterns.

PILOT QUALIFICATIONS

Private pilots were in command of 47% of the accident flights, including half of all fatal accidents **(FIGURE 7)**. Commercial pilots flew 28%, 16% were commanded by airline transport pilots (ATPs), and 6% took place on

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

Type of Operation	Accidents		Fatal Accidents		Fatalities	
Personal	730	76.1%	165	82.5%	246	82.0%
Instructional	132	13.8%	17	8.5%	32	10.7%
Public use	8	0.8%	1	0.5%	1	0.3%
Positioning	16	1.7%	4	2.0%	4	1.3%
Aerial observation	5	0.5%	2	1.0%	2	0.7%
Business	22	2.3%	2	1.0%	2	0.7%
Executive/corporate	1	0.1%	0			
Other work use	25	2.6%	4	2.0%	5	1.7%
Other or unknown*	20	2.1%	5	2.5%	8	2.7%

**Includes air shows, flight tests, and unreported.*

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

Light and Weather	Accidents		Fatal Accidents		Fatalities	
Day VMC	835	87.7%	146	74.5%	218	72.7%
Night VMC*	69	7.2%	18	9.2%	31	10.3%
Day IMC	24	2.5%	15	7.7%	23	7.7%
Night IMC*	18	1.9%	14	7.1%	25	8.3%
Unknown	6	0.6%	3	1.5%	3	1.0%

**Includes dusk.*

authorized student solos. Fifty-seven percent of all accident pilots were instrument-rated, well below the 70% of pilots with private pilot or higher certificates who held that rating in 2014. 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. This distribution of certification levels is almost identical to that reported in 2013.

Also similar to 2013 is the fact that lethality was almost identical in flights flown by private pilots and those with advanced certificates. Each was 22% or 23%, but only one of the 54 accidents on student solos was 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 (717 TOTAL / 147 FATAL)

Pilot-related causes consistently account for about 75% of non-commercial fixed-wing accidents. This was true once again in 2014 **(FIGURE 3)**, when 75% of both fatal and non-fatal accidents fell into this category. More than 20% were fatal, about one and one-half times the lethality of accidents attributed to mechanical failures. While the number of pilot-related accidents was essentially unchanged from the year before **(FIGURE 8)**, their lethality ticked up three percentage points.

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

Certificate Level	Accidents		Fatal Accidents		Lethality
ATP	155	16.2%	35	17.5%	22.6%
Commercial	270	28.2%	59	29.5%	21.9%
Private	447	46.6%	100	50.0%	22.4%
Sport	15	1.6%	3	1.5%	20.0%
Recreational	1	0.1%	0		
Student	54	5.6%	1	0.5%	1.9%
Other or unknown	17	1.8%	2	1.0%	11.8%
Second pilot on board	136	14.2%	33	16.5%	24.4%
CFI on board*	219	22.8%	44	22.0%	20.1%
IFR pilot on board*	545	56.8%	126	63.0%	23.1%

**Includes single-pilot flights.*

FIGURE 8. PILOT-RELATED ACCIDENT TREND

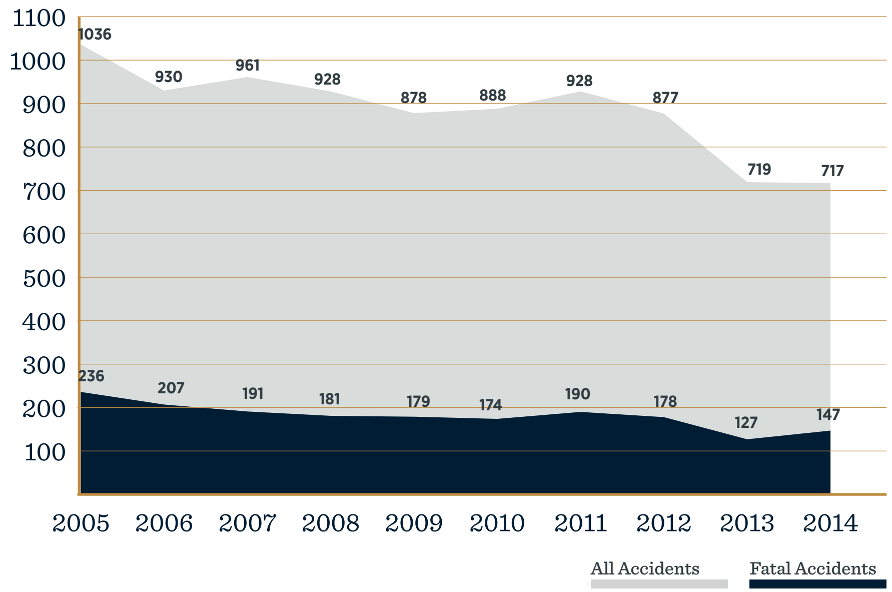


FIGURE 9. PILOT-RELATED ACCIDENT RATES 2005-2014

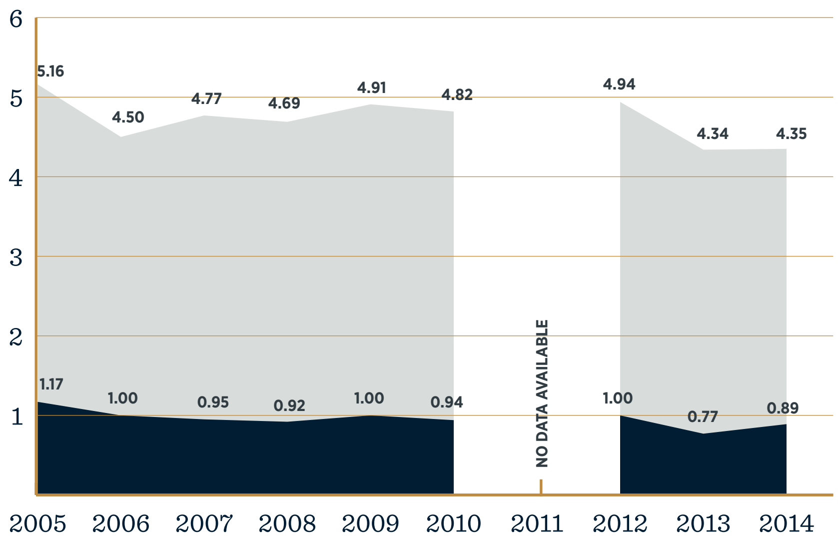
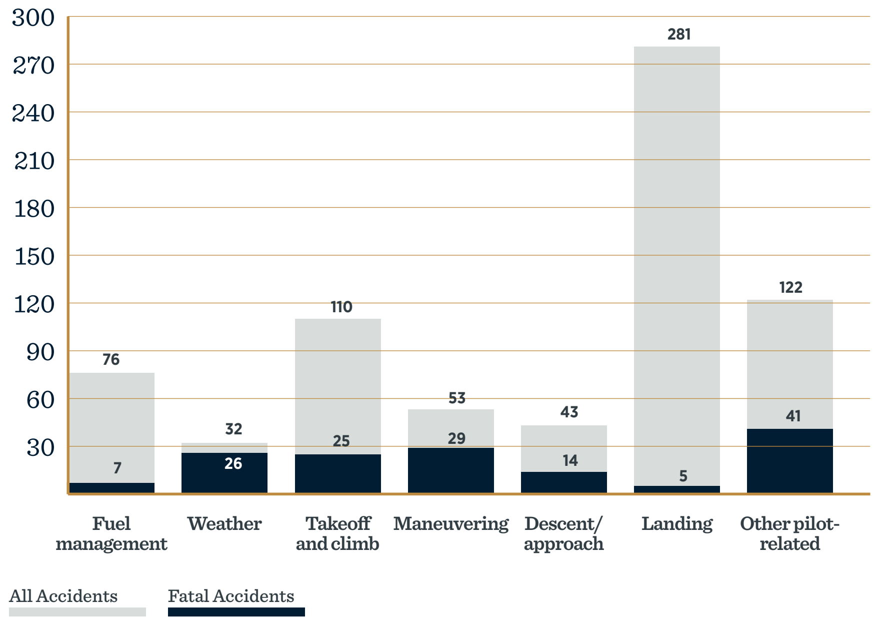


FIGURE 10. TYPES OF PILOT-RELATED ACCIDENTS



The overall rate of pilot-related accidents as scaled by estimated flight time also maintained the dramatic improvement realized in 2013 **(FIGURE 9)**. The rate of fatal pilot-related accidents increased some 16%, but was still the second-lowest on record.

The relative frequencies of the principal types of pilot-related accidents change relatively little from year to year **(FIGURE 10)**. Landing accidents are consistently the most common; in 2014, they outnumbered takeoff accidents by more than two and one-half to one. More unusual was the fact that the greatest number of fatal accidents and second-highest number overall fell into the miscellaneous "other pilot-related" categories. Weather accidents were once again the most consistently lethal, though almost 55% of maneuvering accidents and nearly one-third of those during descent and approach were also fatal.

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

- 28 accidents, seven of them fatal, attributed to inadequate preflight inspections
- 15 non-fatal accidents while taxiing, including two collisions between aircraft on the ground
- 42 accidents during attempted go-arounds, of which five were fatal
- Three accidents, one fatal, in which loss of engine power during cruise was blamed on the pilot's failure to use carburetor heat
- 10 instances, all fatal, of controlled flight into terrain during cruise flight
- One unexplained loss of control in the cruise phase of an IFR flight (also fatal)
- Six cases, five of them fatal, of pilot impairment by alcohol and/or drugs
- Three fatal accidents triggered by physical incapacitation of the pilots involved
- Three episodes of pilot incapacitation for reasons that could not be determined afterwards; two were fatal

- One in-flight suicide
- Seven midair collisions, five of which were fatal; all were between airplanes on non-commercial flights except the collision of a Cirrus SR22 with a Robinson R44 helicopter
- Two collisions between airplanes and ground vehicles, one of which killed an airport worker operating a riding mower
- A collision on the runway between a glider and a tow plane after the tow plane aborted its takeoff roll; no injuries resulted

The number of accidents during go-arounds or precipitated by inadequate preflight inspections fluctuates from year to year, but has generally remained stable. As overall accident counts have declined, the proportion they represent has increased slightly: from three to four percent for go-arounds and from two to three percent for discrepancies missed during preflight. However, 2014 was not the peak year for either category.

Details of collisions, accidents involving pilot impairment or incapacitation, and ground injuries are provided in the discussion of "Unusual Accident Categories" later in this report.

Accidents caused by poor fuel management or hazardous weather are usually preceded by some sort of 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.

NTSB ACCIDENT No. CEN14FA288

ACCIDENT CASE STUDY: FUEL MANAGEMENT

P-70 ACEY-DEUCEY, GREAT BEND, KANSAS | TWO FATALITIES

HISTORY OF FLIGHT The pilot had the 18-gallon fuel tank of the two-seat, amateur-built airplane topped off, then took off with a passenger about 9:30 a.m. At 10:04, he sent his wife a text message confirming their arrival at Lucas, Kansas, 46 nautical miles away. He sent a second message announcing their impending departure at 10:13; shortly before noon, a witness near the pilot's home airport of Great Bend saw the airplane descend, pitch up, and stall into the ground. The witness told investigators that the engine sounded "weak as if it had no power," and examination of the wreckage found no usable fuel on board, no blighting or staining of vegetation at the crash site, and no evidence of any mechanical malfunction. Unlike the prototype of this design, which used a 90-horsepower Continental A65 engine, this example had been built with a 125-horsepower Lycoming O-290-G. Its typical fuel burn was 10.5 to 11 gallons per hour, providing a maximum endurance of 1.7 hours with no reserves. The known time of the first flight plus the interval between the pilot's second text message and the accident totalled 1.8 hours.

PILOT INFORMATION The 49-year-old private pilot held ratings for airplane single-engine land and instrument airplane. His logbook showed 1,528 total hours that included 153 in the accident airplane, and he had flown 22 hours in the last 30 days before the accident.

WEATHER Five minutes after the accident, the automated observation facility at the Great Bend Municipal Airport reported winds from 120 degrees at 8 knots, 9 miles visibility below a 1,200-foot overcast, a temperature of 18 degrees Celsius and a dew point of 14 degrees, with an altimeter setting of 30.06 inches of mercury.

PROBABLE CAUSE The pilot's improper preflight planning, which led to a loss of engine power due to fuel exhaustion. Contributing to the accident was the pilot's loss of airplane control during the forced landing.

ASI COMMENTS Perhaps the best fuel management tool is an accurate timepiece, whether the pilot's wristwatch or a panel clock. Knowing the aircraft's fuel endurance and landing before that's reached is among the most basic of all pilot-in-command responsibilities, yet one that is still overlooked or miscalculated dozens of times each year. Planning to land with an ample reserve is a simple and reliable safeguard against the most avoidable of all types of aviation accidents.

ACCIDENT CAUSES: FLIGHT PLANNING AND DECISION-MAKING

FUEL MANAGEMENT 76 TOTAL / 7 FATAL

Though the number of fuel-mismanagement accidents rose from the previous year's all-time low **(FIGURE 11)**, it nearly matched the previous low of 75 set in 2008. However, only seven (9%) were fatal. This marked the lowest number of fatal fuel management accidents, the lowest percentage of all fatal accidents, and the lowest lethality within that category in the more than 30 years covered by the ASI accident database.

Nearly two-thirds (50 of 76) resulted from flight-planning deficiencies such as inaccurate estimation of fuel requirements or failure to monitor fuel consumption in flight, leading to complete fuel exhaustion **(FIGURE 12)**. This is generally the most prevalent type of fuel mismanagement. Errors in operating the aircraft's fuel system (choosing an empty tank or the incorrect use of boost or transfer pumps) caused 32%, while two accidents were blamed on fuel contaminated by water.

Forty-one percent of fuel management accidents involved retractable-gear and multiengine models **(FIGURE 13)**. This was one and a half times their proportion of all non-commercial fixed-wing accidents, in which they accounted for 27%. Only one involved a turboprop (a TBM-700), and none of the eight accidents in multiengine and/or turbine aircraft were fatal.

Eighty-four percent took place in VMC during the daytime **(FIGURE 14)**, similar to its 88% share of all non-commercial fixed-wing accidents **(FIGURE 6)**. Only one, which was fatal, occurred in IMC. There were no fuel-mismanagement accidents on student solos **(FIGURE 15)** for the first time since 2009; more than half (55%) of the accident flights were commanded by commercial or airline transport pilots.

WEATHER 32 TOTAL / 26 FATAL

Because weather accidents are the most consistently fatal, and fatal weather accidents are among the most difficult and time-consuming to investigate, some usually remain unresolved at the time of publication of each edition of the *Nall Report*. 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, dramatic decreases in the numbers of weather accidents the past two years appear to be genuine. Available data sources don't indicate the extent to which this improvement is due to improved weather information in the cockpit, better decision making, or other factors.

A 21% drop in 2013 was followed by a further 22% decrease in 2014; the 2013 figure was confirmed a year later, and the 81% lethality of 2014's weather accidents is in line with the traditional range of 70 to 90%, making it unlikely that the decline is an artifact of the unfinished accident investigations. Compared to the beginning of the decade in 2005, the overall number of weather accidents was down 43% and fatal weather accidents dropped 35%. There were fewer than half as many (and 45% fewer fatal accidents) than in the recent peak year of 2009.

By far the most perilous weather phenomenon is simply condensed moisture. Attempts to fly by visual references in instrument conditions ("VFR into IMC") caused 20 of the 25 fatal weather accidents in 2014 **(FIGURE 17)**. The 91% lethality of these accidents was even higher than the historical average. All four attributed to deficiencies in instrument flying by pilots operating on active IFR flight plans in IMC were also fatal. However, three of four thunderstorm encounters and the only accident ascribed to in-flight icing were survived by all on board. No non-commercial fixed-wing accidents were blamed on non-convective turbulence in 2014.

All four weather accidents involving turboprop airplanes were fatal, as were all eight of those in retractable piston singles **(FIGURE 18)**. The former included two cases of

FIGURE 11. FUEL MANAGEMENT ACCIDENT TREND

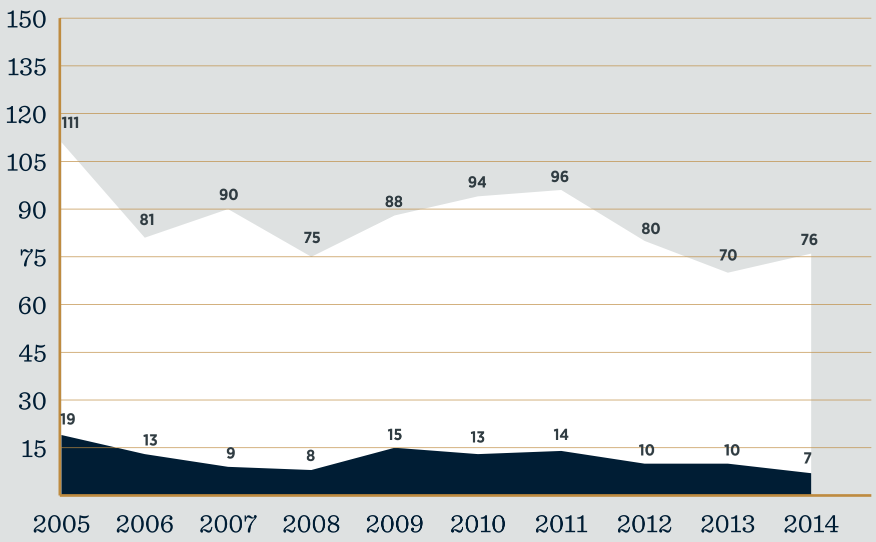


FIGURE 12. TYPES OF FUEL MANAGEMENT ACCIDENTS

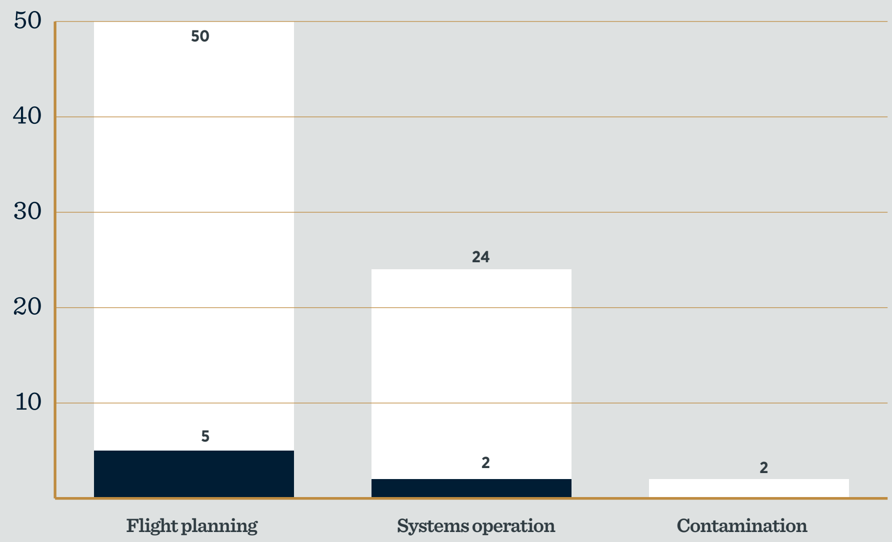


FIGURE 13. AIRCRAFT INVOLVED IN FUEL MANAGEMENT ACCIDENTS: NON-COMMERCIAL FIXED-WING

Aircraft Class	Accidents		Fatal Accidents		Lethality
Single-engine fixed-gear (SEF)	45	59.2%	4	57.1%	8.9%
SEF tailwheel	16		2		12.5%
Single-engine retractable	24	31.6%	3	42.9%	12.5%
Single-engine turbine	1		0		
Multiengine	7	9.2%	0		

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

Light and Weather	Accidents		Fatal Accidents		Lethality
Day VMC	64	84.2%	5	71.4%	7.8%
Night VMC*	10	13.2%	1	14.3%	10.0%
Night IMC*	1	1.3%	1	14.3%	100.0%
Unknown	1	1.3%	0		

Includes dusk.

All Accidents Fatal Accidents

deficient instrument flying and the sole fatal thunderstorm encounter, all in single-engine models; six of the latter were VFR into IMC and two took place under IFR. The 18 accidents in fixed-gear piston singles included 12 fatal instances of VFR into IMC as well as the two that were not fatal, the three non-fatal thunderstorm encounters, and the only fatal icing accident. Piston twins suffered one fatal VFR into IMC and a non-fatal icing accident.

Almost 75% of all weather accidents took place in instrument conditions and/or at night **(FIGURE 19)**, and more than 80% of those were fatal. (In some cases, that classification is based on weather reports from stations considerable distances from the sites of the corresponding accidents.) However, three-quarters of those in visual conditions in daylight resulted in fatalities as well.

Private pilots made up 72% of those involved in identified weather accidents **(FIGURE 20)**, a sharp increase from 56% the year before. Only two held airline transport pilot certificates, and no student, sport, or recreational pilots suffered weather accidents in 2014. Slightly less than half of the accident pilots and only 38% of those in fatal accidents held instrument ratings, a surprising change from prior years: typically more than half of those in fatal accidents were instrument-rated. In a further departure, only six of the flights had instructors on board, with fatalities in just two. In 2013, eight accident flights had instructors on board, and six of those were fatal. As in the past, however, the overwhelming majority of weather accidents (81%) occurred on single-pilot flights.

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

Certificate Level	Accidents		Fatal Accidents		Lethality
ATP	16	21.1%	1	14.3%	6.3%
Commercial	26	34.2%	3	42.9%	11.5%
Private	30	39.5%	3	42.9%	10.0%
Other or unknown	4	5.3%	0		
Second pilot on board	10	13.2%	1	14.3%	10.0%
CFI on board*	20	26.3%	3	42.9%	15.0%
IFR pilot on board*	52	68.4%	5	71.4%	9.6%

**Includes single-pilot flights.*

FIGURE 16. WEATHER ACCIDENT TREND

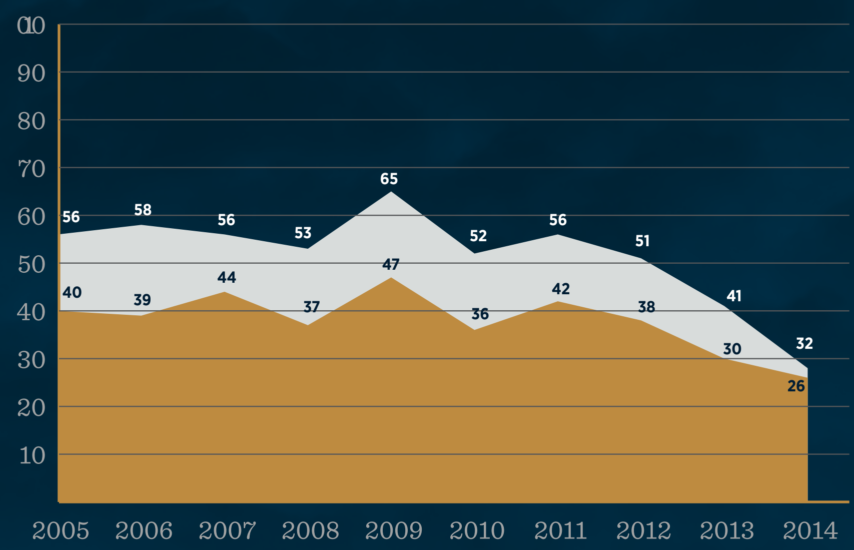


FIGURE 17. TYPES OF WEATHER ACCIDENTS

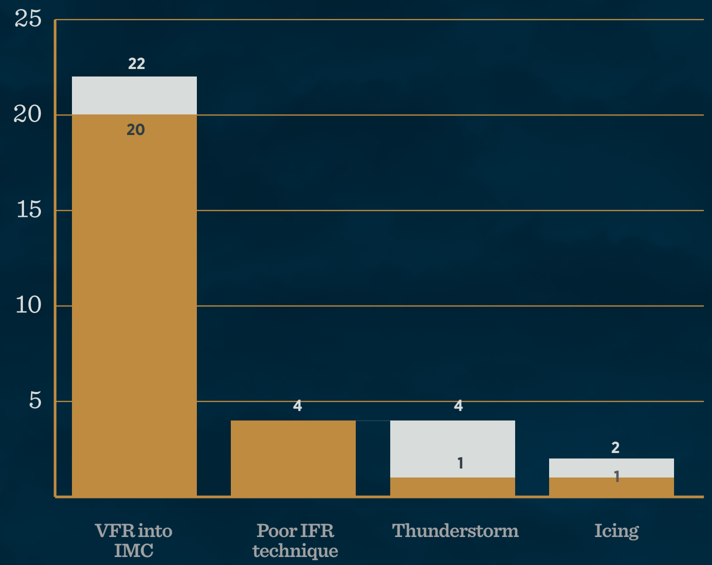


FIGURE 18. AIRCRAFT INVOLVED IN WEATHER ACCIDENTS: NON-COMMERCIAL FIXED-WING

Aircraft Class	Accidents		Fatal Accidents		Lethality
Single-engine fixed-gear (SEF)	18	56.3%	13	50.0%	72.2%
SEF tailwheel	4		2		50.0%
Single-engine retractable	11	34.4%	11	42.3%	100.0%
Single-engine turbine	3		3		100.0%
Multiengine	3	9.4%	2	7.7%	66.7%
Multiengine turbine	1		1		100.0%

All Accidents   Fatal Accidents

NTSB ACCIDENT No. ERA14FA093

ACCIDENT CASE STUDY: WEATHER

AMERICAN CHAMPION 8KCAB, HOLLAND, NEW JERSEY | ONE FATALITY

HISTORY OF FLIGHT The pilot bought the airplane, which was not equipped for instrument flight, directly from its manufacturer. He took delivery at their factory in Rochester, Wisconsin to fly it home to New Jersey, departing the Fox River Airport at 10:04 a.m. The first two legs were uneventful, and he took off from New Castle, Pennsylvania at 1:52 p.m.

Shortly after 4:00 p.m., a dairy farmer was surprised by the sound of an airplane flying so low that she could hear it over the noise of her tractor. Looking up, she saw the silhouette of an airplane but could not make out the details of its shape through the dense fog. Its altitude appeared to be lower than the 150-foot towers supporting high-voltage electric lines nearby. After smelling an unfamiliar odor she later learned was aviation gasoline, she contacted local authorities to report a possible crash. The wreckage was eventually found in a wooded area near the crest of a 417-foot hill less than 10 nautical miles from the pilot's destination.

PILOT INFORMATION The pilot held a commercial certificate with single-engine airplane, gyroplane, glider, and balloon ratings plus private pilot privileges for single-engine seaplane and rotorcraft helicopter, but did not hold an instrument rating. His logbooks were not recovered. His last application for a third-class medical certificate, filed eighteen months before the accident, reported 4,000 hours of career flight experience.

WEATHER The accident took place in the immediate vicinity of a cold front that stretched from eastern New York and Pennsylvania through western New Jersey south into Virginia. An AIRMET issued at 3:45 p.m. warned of ceilings below 1,000 feet and visibility of less than three miles in mixed precipitation and mist that were expected to continue through 6:00 p.m. At 4:51 p.m., the Lehigh Valley International Airport located 15 miles west of the accident site reported winds from 320 degrees at 4 knots, visibility of ¼ mile in fog with a vertical visibility of 300 feet, temperature and dew point of 3 degrees Celsius, and an altimeter setting of 29.91 inches of mercury.

PROBABLE CAUSE The pilot's continued visual flight rules flight into instrument meteorological conditions, resulting in controlled flight into trees and terrain.

ASI COMMENTS Attempts to continue VFR flight into instrument meteorological conditions are consistently the most deadly type of aviation accidents; nearly 90% are fatal. The temptation to press on into deteriorating weather becomes particularly strong when nearing home at the end of a long day. Pilots tempted to succumb to that temptation would do well to remember that the loss of visual references is just as dangerous in the last 10 miles of the flight as the first 10, and that these accidents only end in one of two ways: a collision with terrain, either controlled or uncontrolled. Both are predictably lethal.

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

Light and Weather	Accidents		Fatal Accidents		Lethality
Day VMC	8	25.0%	6	23.1%	75.0%
Night VMC*	2	6.3%	1	3.8%	50.0%
Day IMC	12	37.5%	10	38.5%	83.3%
Night IMC*	8	25.0%	7	26.9%	87.5%
Unknown	2	6.3%	2	7.7%	100.0%

**Includes dusk.*

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

Certificate Level	Accidents		Fatal Accidents		Lethality
ATP	2	6.3%	1	3.8%	50.0%
Commercial	7	21.9%	4	15.4%	57.1%
Private	23	71.9%	21	80.8%	91.3%
Second pilot on board	6	18.8%	2	7.7%	33.3%
CFI on board*	6	18.8%	2	7.7%	33.3%
IFR pilot on board*	15	46.9%	10	38.5%	66.7%

**Includes single-pilot flights.*

All Accidents Fatal Accidents

FIGURE 21. TAKEOFF AND CLIMB ACCIDENT TREND

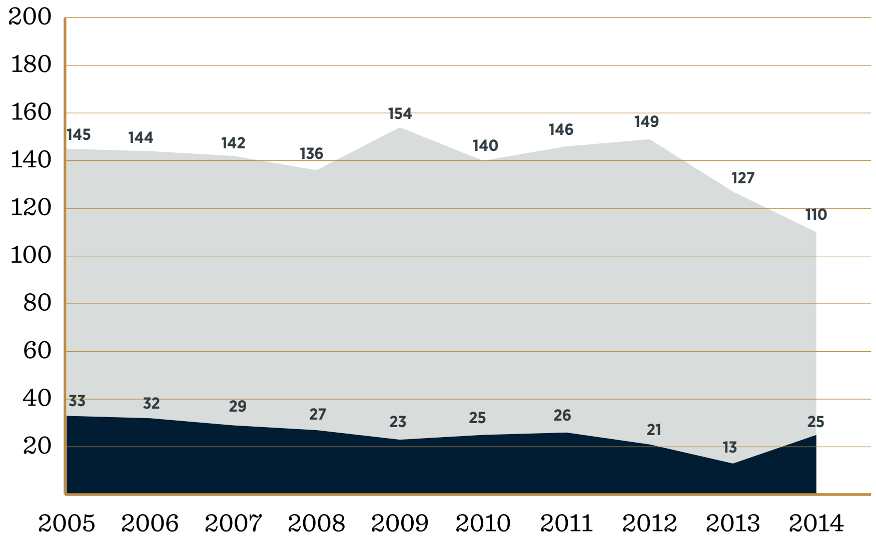
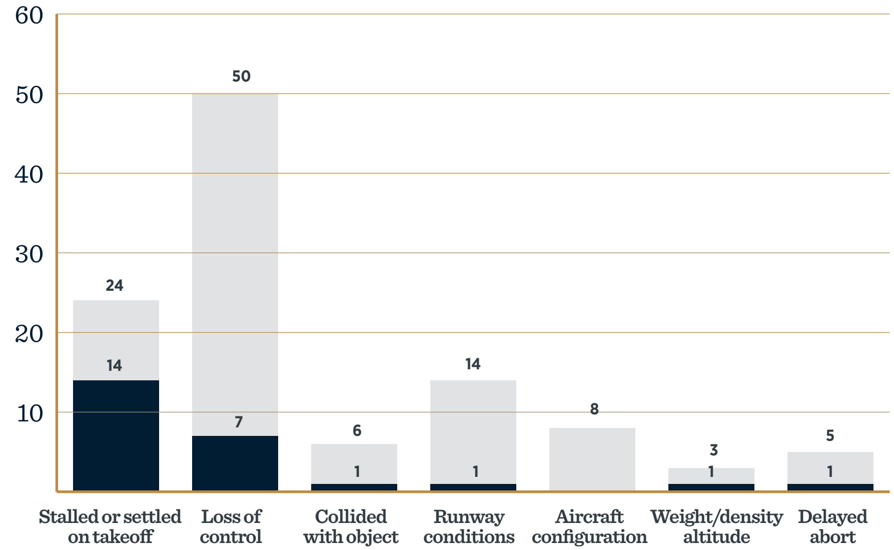


FIGURE 22. TYPES OF TAKEOFF AND CLIMB ACCIDENTS



ACCIDENT CAUSES:
HIGH-RISK PHASES OF FLIGHT

TAKEOFF AND CLIMB 110 TOTAL / 25 FATAL

As in prior years, the second-highest number of pilot-related accidents resulted from lapses of airmanship during takeoff attempts or initial climb (FIGURE 21). While the number of takeoff and climb accidents dropped 13% to 110, a new low, their 23% lethality was the highest since 2005. In retrospect, the unusually low number of fatalities in takeoff accidents during 2013 appears to have been a transient phenomenon, and probably a chance fluctuation.

Losses of aircraft control were the most common type of takeoff accident (FIGURE 22). They accounted for some 45%, similar to the proportion the year before. These were predominantly losses of directional control during the takeoff roll, but the category also includes pitch and roll excursions after liftoff. One in seven were fatal. However, more than half the fatal accidents involved departure stalls, which saw the highest lethality in 2014. The number attributed to late decisions to abort the takeoff attempt, overweight aircraft, or excessive density altitude fell by more than half, while the number attributed to unfavorable runway conditions increased by four. Errors in setting flaps, fuel mixtures, and other details of aircraft configuration led to eight accidents, three fewer than the year before.

Five multiengine airplanes suffered takeoff accidents, down from nine in 2013 (FIGURE 23). The number involving retractable-gear single-engine models decreased 27%, while the number in fixed-gear singles declined only 5%. The number of fatal accidents in both types of single-engine airplanes more than doubled.

Some 96% of all takeoff accidents occurred in daytime VMC, with only one in IMC and three in visual conditions at night (FIGURE 24). Lethality was more than three times higher (a combined 75%) in accidents in reduced visibility. Private pilots were in command of nearly half the accident flights (FIGURE 25), and commercial or airline transport pilots flew 45%. There were only six takeoff accidents on student solos and none involving sport or recreational pilots. CFIs were present on less than one-quarter, and less than half of those (12 of 27) were instructional flights. Nearly 80% of takeoff accidents were on single-pilot flights.

MANEUVERING 53 TOTAL / 29 FATAL

The great majority of fixed-wing maneuvering accidents, whether losses of control or collisions with obstructions, are initiated at low altitude. Some occur in the traffic pattern, but many of the 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. Very often these sudden impacts are not survivable, so maneuvering accidents are consistently one of the two top causes of deaths in general aviation.

In 2014 the number of maneuvering accidents rose 13% from the year before, and two more were fatal (FIGURE 26). However, they actually represented a smaller proportion of all fatal accidents: 14.8%, down from 15.6% in 2013. As has most often been the case in the past, unintended stalls caused more than half (FIGURE 27), and nearly two-thirds of those were fatal. Accidents during aerobatic practice or performances are rare but consistently severe; all four of them were fatal in 2014. Half of the mountain-flying accidents and more than 70% of those involving collisions with obstructions were survived by all on board.

Forty-eight of the 53 maneuvering accidents (91%) took place in visual meteorological conditions during daylight hours, including 27 of the 29 fatal accidents (93%). The time and circumstances of one fatal stall into a mountain ridge could not be determined, as the aircraft's time of departure is not known. One fatal accident took place in IMC at night: A Piper Lance flying VFR collided with a wind turbine while attempting to stay below a low overcast layer. None of the three accidents in nighttime VMC were fatal.

NTSB ACCIDENT No. CEN15FA034

ACCIDENT CASE STUDY: TAKEOFF AND CLIMB

RAYTHEON KING AIR B200, WICHITA, KANSAS
FOUR FATALITIES, TWO SERIOUS INJURIES, AND FOUR MINOR INJURIES

HISTORY OF FLIGHT Immediately after takeoff, the pilot declared an emergency, saying that he had "lost the left engine." The airplane began a shallow left turn and descended into the Flight Safety International building with its landing gear still extended. In addition to the pilot, three people inside were killed and six more were injured by the impact and post-crash fire.

Examination of the propeller blades and sound spectrum analysis suggested that the left engine was producing low to moderate power and the right engine was producing moderate to high power at the moment of impact. Neither propeller was feathered. A sideslip thrust and rudder study determined that during the last moments of the flight the King Air had a 29-degree sideslip angle, suggesting that the pilot had inappropriately applied left rudder. That and the fact that the landing gear were down and the left propeller not feathered led investigators to conclude that he had not followed the emergency procedure for an engine failure on takeoff.

PILOT INFORMATION The 53-year-old airline transport pilot held seven second-in-command and one pilot-in-command type ratings. The month before the accident, he had completed King Air 300 series initial training at Flight Safety International. His logbook was not located, but his training records at FSI indicated that he had accumulated 3,139 hours of flight time that included 2,843 in multiengine airplanes. His make and model experience is not known.

WEATHER Five minutes after the accident, Wichita's automated weather observation system recorded winds from 350 degrees at 16 knots with 10 miles visibility, a few clouds at 15,000 feet, temperature of 15 degrees and dew point of 3 degrees Celsius, and an altimeter setting of 30.12 inches of mercury.

PROBABLE CAUSE The pilot's failure to maintain lateral control of the airplane after a reduction in left engine power and his application of inappropriate rudder input. Contributing to the accident was the pilot's failure to follow the emergency procedures for an engine failure during takeoff. Also contributing to the accident was the left engine power reduction for reasons that could not be determined because a post-accident examination did not reveal any anomalies that would have precluded normal operation and thermal damage precluded a complete examination.

ASI COMMENTS An engine failure after takeoff in a propeller-driven twin is among the most dangerous of all mechanical emergencies. Even in an airplane with ample power to climb on one engine (such as a lightly loaded King Air), maintaining aircraft control requires strict adherence to the specified procedures. Typically these will include retracting the landing gear, feathering the propeller on the inoperative engine if it did not autofeather, and using bank and rudder to counter sideslip while climbing straight ahead. Once a safe altitude is attained, the nose can be lowered to build airspeed before initiating any turns. Attempting to shortcut this procedure with an early return to base risks a catastrophic loss of control.

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

Aircraft Class	Accidents		Fatal Accidents		Lethality
Single-engine fixed-gear (SEF)	89	80.9%	14	56.0%	15.7%
SEF tailwheel	42		6		14.3%
Single-engine retractable	16	14.5%	8	32.0%	50.0%
Single-engine turbine	1		0		
Multiengine	5	4.5%	3	12.0%	60.0%
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	106	96.4%	22	88.0%	20.8%
Night VMC*	3	2.7%	2	8.0%	66.7%
Day IMC	1	0.9%	1	4.0%	100.0%

**Includes dusk.*

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

Certificate Level	Accidents		Fatal Accidents		Lethality
ATP	22	20.0%	8	32.0%	36.4%
Commercial	28	25.5%	8	32.0%	28.6%
Private	53	48.2%	9	36.0%	17.0%
Student	6	5.5%	0		
Other or unknown	1	0.9%	0		
Second pilot on board	24	21.8%	8	32.0%	33.3%
CFI on board*	27	24.5%	7	28.0%	25.9%
IFR pilot on board*	62	56.4%	19	76.0%	30.6%

**Includes single-pilot flights.*

FIGURE 26. MANEUVERING ACCIDENT TREND

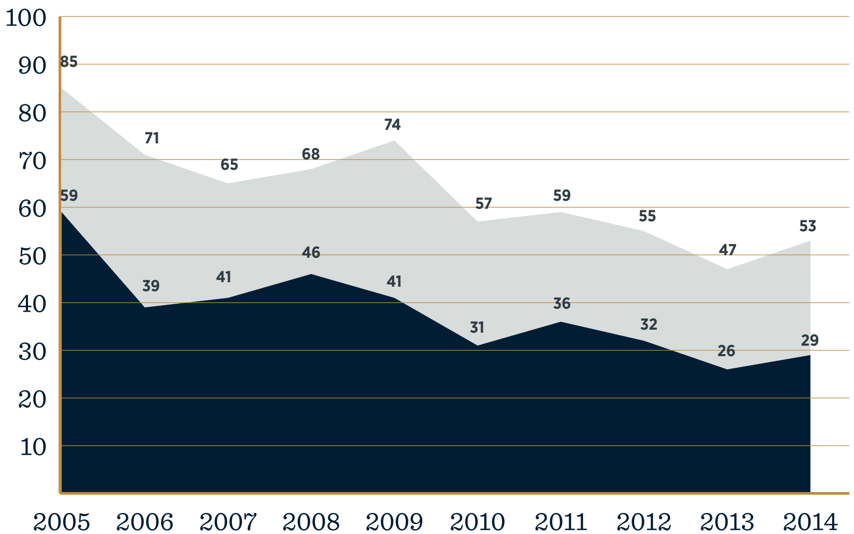


FIGURE 27. TYPES OF MANEUVERING ACCIDENTS

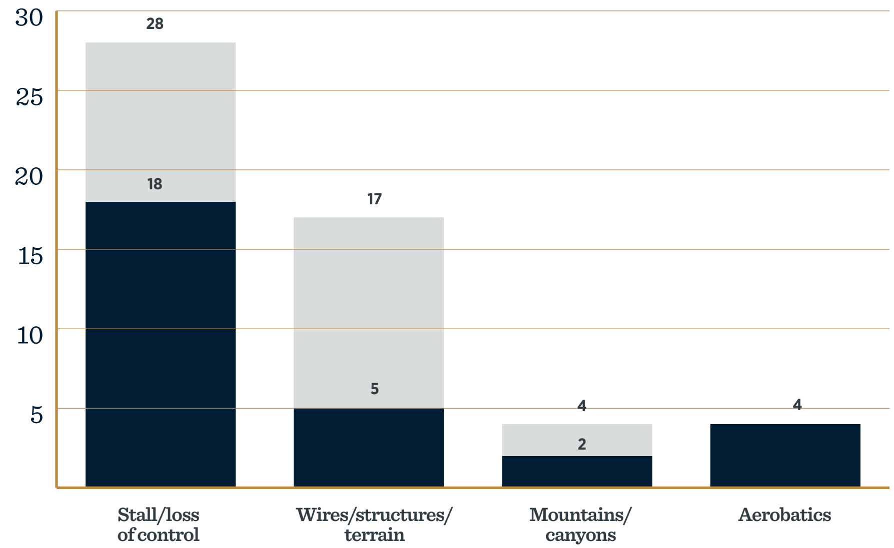


FIGURE 28. AIRCRAFT INVOLVED IN MANEUVERING ACCIDENTS: NON-COMMERCIAL FIXED-WING

Aircraft Class	Accidents		Fatal Accidents		Lethality
Single-engine fixed-gear (SEF)	46	86.8%	25	86.2%	54.3%
SEF tailwheel	24		13		54.2%
Single-engine retractable	7	13.2%	4	13.8%	57.1%
Single-engine turbine	2		2		100.0%

All Accidents
Fatal Accidents

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

Certificate Level	Accidents		Fatal Accidents		Lethality
ATP	8	15.1%	4	13.8%	50.0%
Commercial	13	24.5%	9	31.0%	69.2%
Private	24	45.3%	12	41.4%	50.0%
Sport	2	3.8%	2	6.9%	100.0%
Student	1	1.9%	0		
Other or unknown	5	9.4%	2	6.9%	40.0%
Second pilot on board	7	13.2%	4	13.8%	57.1%
CFI on board*	9	17.0%	5	17.2%	55.6%
IFR pilot on board*	28	52.8%	15	51.7%	53.6%

**Includes single-pilot flights.*

FIGURE 31. TYPES OF DESCENT AND APPROACH ACCIDENTS

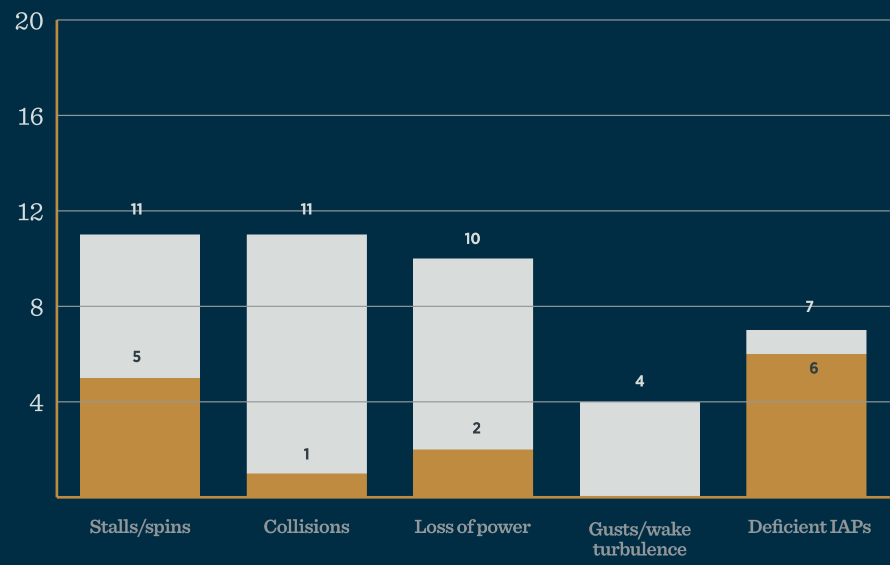


FIGURE 30. DESCENT AND APPROACH ACCIDENT TREND

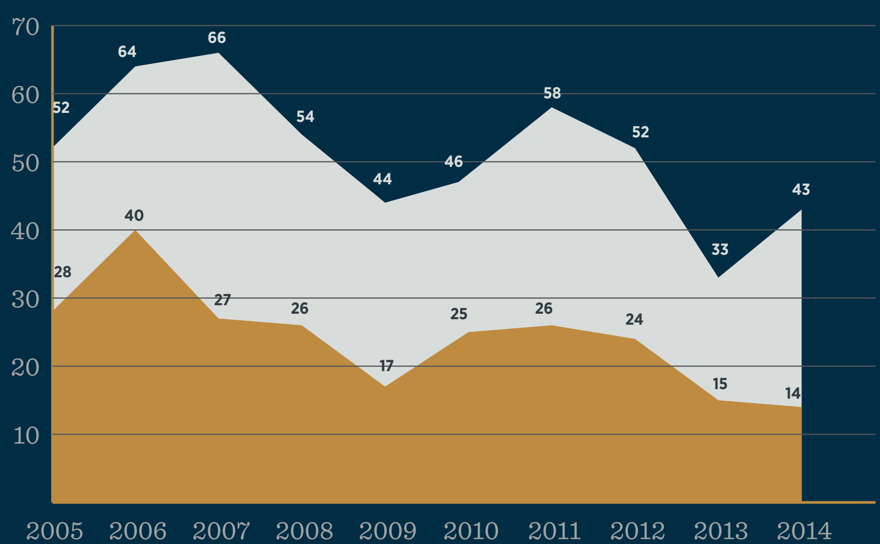


FIGURE 32. AIRCRAFT INVOLVED IN DESCENT AND APPROACH ACCIDENTS: NON-COMMERCIAL FIXED-WING

Aircraft Class	Accidents		Fatal Accidents		Lethality
Single-engine fixed-gear (SEF)	29	67.4%	4	28.6%	13.8%
SEF tailwheel	9		1		11.1%
Single-engine retractable	8	18.6%	6	42.9%	75.0%
Single-engine turbine	1		1		100.0%
Multiengine	6	14.0%	4	28.6%	66.7%
Multiengine turbine	2		1		50.0%

All Accidents   Fatal Accidents

Fifty-one of the accident aircraft (96%) were piston singles, 46 of them fixed-gear **(FIGURE 28)**. Twenty-four (all fixed-gear) were tailwheel models. Lethality was about the same in all three categories, but both accidents in single-engine turboprops were fatal. So were both accidents on flights flown by sport pilots **(FIGURE 29)**; lethality approached 70% on flights commanded by commercial pilots but was only 50% for private pilots and ATPs. Fewer than one in six occurred on two-pilot flights and flight instructors were on board in fewer than one in five, but there were fatalities in more than half of each.

DESCENT AND APPROACH 43 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. After a one-time drop in 2013 their numbers rebounded by nearly one-third **(FIGURE 30)**, but one fewer was fatal. In fact, 2014 saw the fewest fatal descent and approach accidents, the second fewest overall, and the smallest proportion of fatal accidents from these causes in the more than 30 years covered by the ASI Accident Database.

Inadvertent stalls; collisions with wires, terrain, or other solid objects; and unexpected losses of engine power each caused about one-fourth. Collisions with obstructions were actually the most survivable classification in the descent-and-approach category, with fatalities in only one out of 11. At the opposite extreme, six of the seven ascribed to deficient execution of instrument approach procedures were fatal. No fatalities resulted from the four blamed on turbulence or gusts.

NTSB ACCIDENT No. WPR14FA923

ACCIDENT CASE STUDY: MANEUVERING

AMERICAN AVIATION AA-1A, EL MIRAGE, CALIFORNIA | TWO FATALITIES

HISTORY OF FLIGHT The accident occurred during an off-duty recreation day for members of the Los Angeles Fire Department (LAFD) held on a dry lakebed. The pilot was providing rides to friends and family members. Before his third flight, he was asked to do a low pass over the gathering. After flying over them at an altitude of about 50 feet, the airplane began a climbing right turn. Its bank angle increased to almost 80 degrees at 200 feet agl before the nose yawed 20 degrees downward and the airplane began descending rapidly. It struck the ground in a near-vertical attitude about 18 seconds after initiating the climb.

PILOT INFORMATION The 47-year-old pilot was employed as a helicopter pilot for the LAFD's Air Operations Section. He was type-rated in the AgustaWestland AW-139 and preparing for his final checkride for certification as an AW-139 mission commander, and flew 20 to 30 hours per month in that aircraft and the Bell 206. He held a commercial certificate for rotorcraft helicopter with private pilot privileges for airplane single-engine land. About 1,400 of his nearly 1,900 hours of career flight time were in helicopters. Most of the rest were in the accident airplane, of which he was co-owner. He had, however, recently bought another airplane, and three takeoffs and landings the previous week were his first flight in the accident airplane in roughly a year.

WEATHER At the time of the accident, the Southern California Logistics Airport in Victorville, about 13 miles east-southeast of the accident site, reported winds from 130 degrees at 7 knots with 10 miles visibility and scattered clouds at 9,500 and 11,000 feet. The temperature was 37 degrees Celsius, the dew point was -2 degrees, and the altimeter setting was 29.88 inches of mercury.

PROBABLE CAUSE The pilot's loss of airplane control while intentionally maneuvering close to the ground, which resulted in the airplane exceeding its critical angle of attack in a steep bank and entering an accelerated stall.

ASI COMMENTS The accident record demonstrates that even many career pilots don't understand the aerodynamics of accelerated stalls. Both the sudden increase in angle of attack with a rapid pitch upwards and the increased AOA needed to counter the additional G-loading of a steep bank bring the airplane much closer to the critical AOA than the pilot realizes. The stall that results may break suddenly and violently, without any of the indications pilots learn to recognize in training; close to the ground, this can be unrecoverable. Aggressive low-altitude maneuvering is best left to airshow performers. The risks far outweigh the rewards for the rest of us.

NTSB ACCIDENT No. CEN15FA008

ACCIDENT CASE STUDY: DESCENT AND APPROACH

PIPER PA-46-310P, DUBUQUE, IOWA | ONE FATALITY

HISTORY OF FLIGHT The airplane departed Ankeny, Iowa shortly after 10:00 p.m. on an instrument flight plan to Dubuque. The flight progressed uneventfully, and one minute before 11:00 it was cleared for the ILS approach to Runway 36 at Dubuque. A minute later, the pilot was cleared to change to the airport's advisory frequency. Radar data showed the airplane tracking the localizer and descending at 480 to 600 feet per minute until contact was lost in the immediate vicinity of the airport.

Witnesses on the field saw it break out of the clouds above Runway 36 and overfly the runway at an altitude of no more than 100 feet. Its engine appeared to be operating at full power. Three-quarters of the way down the runway, it reentered the clouds. Less than a minute later, the airplane hit a stand of 80-foot-high trees about 3,600 feet north of the airport. The missed-approach procedure called for a straight-ahead climb to 2,000 feet msl (924 feet agl) followed by a climbing left turn to 3,300 feet.

PILOT INFORMATION The instrument-rated private pilot was 59 years old. His logbook showed 1,003 hours of total flight experience that included 76.7 hours in the preceding 90 days. His night, simulated instrument, and actual instrument time were not reported, but he was current for IFR flight, having logged 11 approaches in actual IMC plus navigation and holding procedures in the past 90 days.

WEATHER A METAR recorded at the Dubuque airport seven minutes before the accident reported winds from 360 degrees at 10 knots and 5 miles visibility in light rain and mist beneath a 200-foot overcast. Temperature and dew point were both 13 degrees Celsius and the altimeter setting was 29.46 inches of mercury.

PROBABLE CAUSE The pilot's loss of airplane control while attempting to fly a missed approach procedure in instrument meteorological conditions.

ASI COMMENTS Initiation of a missed approach in actual IMC is one of the highest-workload phases in aviation. It is not easier at night. Three key elements should be committed to memory or posted in large letters on the instrument panel while briefing the approach: initial altitude, heading, and the next fix. The NTSB did not speculate on the possible role of fatigue in the accident chain and was unable to conclude whether the pilot might have experienced spatial disorientation, but it is clear that he did not begin the required climb at the moment it became apparent he'd missed the approach.

The aircraft involved included one single-engine turbine aircraft, two multiengine turboprops, and four piston twins **(FIGURE 32)**. All of the accidents during instrument approach procedures occurred in these or in retractable-gear piston singles, as did two of the five fatal accidents involving stalls, the only fatal CFIT, and one of the two stemming from a loss of engine power. All of the accidents in IMC and four of the seven in VMC at night **(FIGURE 33)** involved complex and/or multiengine airplanes, while fixed-gear singles accounted for 26 of the 30 accidents in visual conditions during daylight. These facts collectively explain the dramatically lower lethality of the accidents in single-engine fixed-gear models.

Sixty percent of the pilots involved held instrument ratings, including 11 of the 14 in fatal accidents **(FIGURE 34)**. Lethality did not vary a great deal by certificate level, ranging from 31% for commercial pilots to 40% among ATPs. All marked reductions from 2013, when lethality was about 50% for all certificate levels. Less than 10% of descent and approach accidents occurred on two-pilot flights, and only one of those were fatal. There were no fatalities on the two flights conducted by sport pilots or the only student solo.

LANDING 281 TOTAL / 5 FATAL

The number of accidents due to inadequate airmanship during landing attempts was unchanged at 281 **(FIGURE 35)**. This represented 30% of all non-commercial fixed-wing accidents in 2014, a proportion that has been extraordinarily stable over time. Five were fatal, up from three the year before, and all five occurred in VMC, one of them at night. Only six landing accidents took place in IMC, four of them during daylight hours; 92% of the total were in visual meteorological conditions in the daytime and another 6% in VMC at night.

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

Light and Weather	Accidents		Fatal Accidents		Lethality
Day VMC	30	69.8%	7	50.0%	23.3%
Night VMC*	7	16.3%	2	14.3%	28.6%
Day IMC	2	4.7%	2	14.3%	100.0%
Night IMC*	4	9.3%	3	21.4%	75.0%

**Includes dusk.*

FIGURE 35. LANDING ACCIDENT TREND

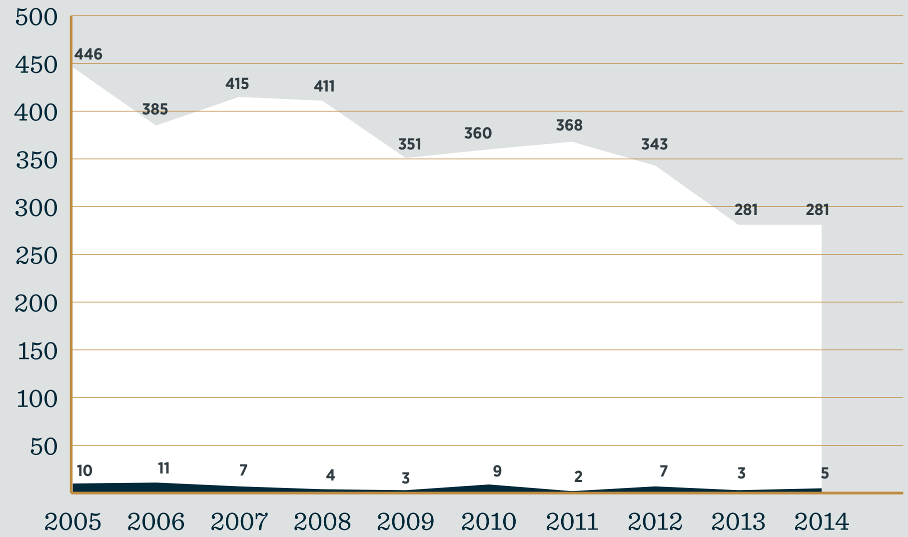
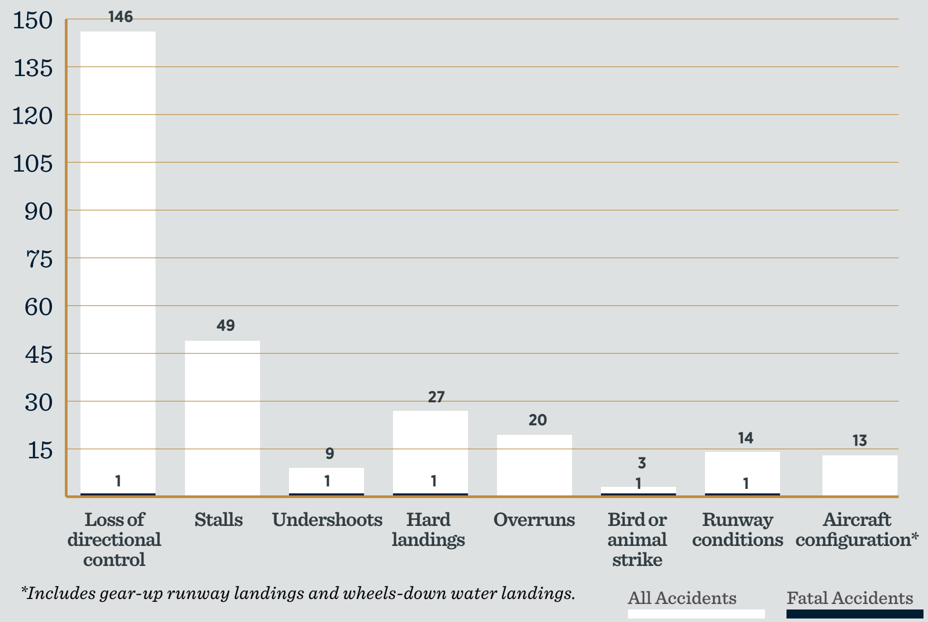


FIGURE 34. PILOTS INVOLVED IN DESCENT AND APPROACH ACCIDENTS: NON-COMMERCIAL FIXED-WING

Certificate Level	Accidents		Fatal Accidents		Lethality
ATP	5	11.6%	2	14.3%	40.0%
Commercial	13	30.2%	4	28.6%	30.8%
Private	22	51.2%	8	57.1%	36.4%
Sport	2	4.7%	0		
Student	1	2.3%	0		
Second pilot on board	4	9.3%	1	7.1%	25.0%
CFI on board*	8	18.6%	3	21.4%	37.5%
IFR pilot on board*	26	60.5%	11	78.6%	42.3%

**Includes single-pilot flights.*

FIGURE 36. TYPES OF LANDING ACCIDENTS



**Includes gear-up runway landings and wheels-down water landings.*

Losses of directional control, always the most common problem, accounted for more than half (**FIGURE 36**). Stalls onto the runway made up 17%, and nearly 10% were hard landings of other descriptions. The number of accidents attributed to wet, soft, or contaminated runways fell by almost half, from 26 to 14, and there were five fewer due to errors in aircraft configuration. (This category included four wheels-down water landings in amphibians and two blamed on incorrect trim settings as well as six inadvertent gear-ups and one premature gear retraction.) Overruns were again more common than undershoots but by a margin of about two to one compared to four to one the year before, jointly accounting for 10% of the total. Only three aircraft were damaged in collisions with birds or other animals, down from five in each of the two previous years.

Fixed-gear singles made up 81% of the accident aircraft (**FIGURE 37**), and almost exactly half were taildraggers. Both numbers were essentially unchanged from the year before. There was one fatal accident in a retractable single-engine piston airplane; the remainder were all in fixed-gear singles. Five of the six turbine airplanes were twins.

Commercial and airline transport pilots suffered 41% of all landing accidents in 2014 (**FIGURE 38**), up six percentage points from the year before. These included three of the five fatal accidents (all commercial pilots). Private pilots commanded 45% of the accident flights (126), including the other two with fatalities. The 35 landing accidents on student solos represented nearly two-thirds of the 54 student solo accidents of all types. While this proportion is higher than usual, student pilots' susceptibility to landing accidents is a familiar facet of the fixed-wing safety record.

MECHANICAL / **MAINTENANCE**

143 TOTAL / 20 FATAL

The number of non-commercial fixed-wing accidents caused by documented mechanical failures or errors in aircraft maintenance increased by seven (5%) from the previous year's low, and the number of fatal accidents from these causes jumped eight (**FIGURE 39**). The overall rate of these accidents was 0.82 per 100,000 flight hours, almost unchanged

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

Aircraft Class	Accidents		Fatal Accidents		Lethality
Single-engine fixed-gear (SEF)	227	80.8%	4	80.0%	1.8%
SEF tailwheel	113		1		0.9%
Single-engine retractable	39	13.9%	1	20.0%	2.6%
Single-engine turbine	1		0		
Multiengine	15	5.3%	0		
Multiengine turbine	5		0		

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

Certificate Level	Accidents		Fatal Accidents		Lethality
ATP	36	12.8%	0		3.9%
Commercial	77	27.4%	3	60.0%	1.6%
Private	126	44.8%	2	40.0%	
Sport	6	2.1%	0		
Recreational	1	0.4%	0		
Student	35	12.5%	0		
Second pilot on board	32	11.4%	0		
CFI on board*	60	21.4%	2	40.0%	3.3%
IFR pilot on board*	140	49.8%	4	80.0%	2.9%

**Includes single-pilot flights.*

FIGURE 39. MECHANICAL ACCIDENT TREND

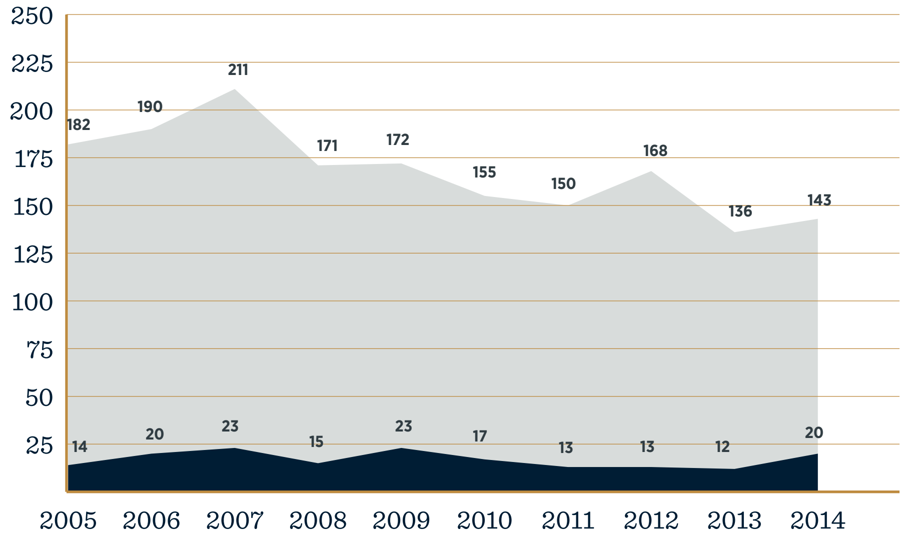


FIGURE 40. TYPES OF MECHANICAL ACCIDENTS

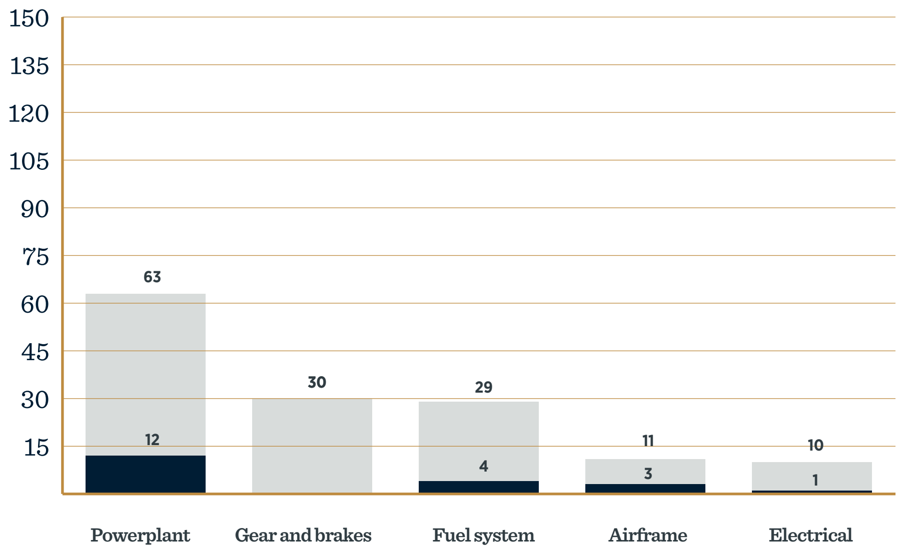


FIGURE 41. AIRCRAFT INVOLVED IN MECHANICAL ACCIDENTS: NON-COMMERCIAL FIXED-WING

Aircraft Class	Accidents		Fatal Accidents		Lethality
Single-engine fixed-gear (SEF)	89	62.2%	14	70.0%	15.7%
SEF tailwheel	38		8		21.1%
Single-engine retractable	39	27.3%	6	30.0%	15.4%
Single-engine turbine	5		0		
Multiengine	15	10.5%	0		
Multiengine turbine	2		0		

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

Certificate Level	Accidents		Fatal Accidents		Lethality
ATP	28	19.6%	5	25.0%	17.9%
Commercial	49	34.3%	7	35.0%	14.3%
Private	62	43.4%	8	40.0%	12.9%
Student	1	0.7%	0		
Other or unknown	3	2.1%	0		
Second pilot on board	20	14.0%	5	25.0%	25.0%
CFI on board*	37	25.9%	5	25.0%	13.5%
IFR pilot on board*	88	61.5%	12	60.0%	13.6%

**Includes single-pilot flights.*

All Accidents Fatal Accidents

from the year before. The increase in the number of fatalities was primarily due to greater lethality in accidents triggered by powerplant failures, where 19% (12 of 63) were fatal **(FIGURE 40)** compared to 10% in 2013.

Powerplant failures remained the most common accident cause, but unlike past years nearly as many arose from problems with aircraft fuel systems (29) as from gear and brake malfunctions (30), typically the second most common variety. In all, 80% of fatal accidents (16 of 20) involved in-flight losses of thrust. 2014 also saw a doubling in the number of accidents precipitated by electrical problems, from five to 10.

Only seven of the 143 accidents (5%) occurred in turbine aircraft **(FIGURE 41)**, five of them single-engine models. All 20 fatal accidents were in piston singles, 14 of them fixed-gear models. Uncharacteristically, lethality was highest among tailwheel airplanes, which have generally enjoyed the greatest survivability in the past. Also unusual were the lack of fatalities in multiengine airplanes and the identical proportion of fatal accidents in fixed-gear and retractable piston singles. In the past, accident lethality has generally increased with the size, speed, and weight of the aircraft involved.

OTHER, UNKNOWN, OR NOT YET DETERMINED 92 TOTAL / 29 FATAL

For the second consecutive year, 6% of all non-commercial fixed-wing accidents 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 the engines that escaped serious impact damage were successfully test-run during the investigations.

Sixteen of the remaining 35 were fatal. In six, the NTSB concluded that the causes could not be identified. Others included a tow plane that became entangled with its banner, a prop strike that killed an FBO worker, a TBM 900 that sank in the open ocean after its pilot became unresponsive, and seven abrupt in-flight upsets for reasons that could not be determined. Non-fatal miscellaneous accidents included three bird strikes and three on-airport collisions with deer at night, two instances in which passengers interfered with aircraft controls, and two cases in which unreported damage from an earlier accident was discovered during preflight. Two parachutists were injured in separate skydiving accidents, one airplane was damaged during an attempted flight by a non-pilot and another during a precautionary off-field landing, a tow plane was upset by an unexpected maneuver by the glider it was towing, and one airplane was damaged by a collision with a snowbank. The causes of three in-flight upsets were never identified.

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

Major Cause	Accidents		Fatal Accidents		Lethality
Other	35	38.0%	16	55.2%	45.7%
Other (Power Loss)	57	62.0%	13	44.8%	22.8%

FIGURE 44. COMMERCIAL FIXED-WING ACCIDENTS

Type of Operation	Accidents		Fatal Accidents		Fatalities	
Aerial Application (Part 137)	44	64.7%	7	63.6%	7	41.2%
Charter or Cargo (Part 135)	24	35.3%	4	36.4%	10	58.8%

FIXED-WING ACCIDENTS **COMMERCIAL**

The number of commercial fixed-wing accidents fell below 70 for the first time **(FIGURE 2A)**. However, 11 (16%) were fatal, the highest proportion since 2004. There were three fewer aerial application accidents and 10 fewer on Part 135 charter or cargo flights, a 29% reduction. In 2014, nearly two-thirds of the fatal accidents were on aerial application flights **(FIGURE 44)**, just the opposite of the previous year. However, nearly 60% of the individual fatalities (10 of 17) occurred during charter operations. As usual, the accident pilots were the only victims in fatal crop-dusting accidents.

FIGURE 45. AIRCRAFT CLASS: COMMERCIAL FIXED-WING

Aircraft Class	Accidents		Fatal Accidents		Lethality
Part 137: aerial application					
Single-engine fixed-gear (SEF)	44	100.0%	7	100.0%	15.9%
SEF tailwheel	44		7		15.9%
Single-engine turbine	28		6		21.4%
Part 135: charter and cargo					
Single-engine fixed-gear (SEF)	15	62.5%	0		
SEF tailwheel	6		0		
Single-engine retractable	2	8.3%	1	25.0%	50.0%
Single-engine turbine	1		0		
Multiengine	7	29.2%	3	75.0%	42.9%
Multiengine turbine	4		0		

FIGURE 46. FLIGHT CONDITIONS: COMMERCIAL FIXED-WING

Light and Weather	Accidents		Fatal Accidents		Lethality
Part 137: Aerial Application					
Day VMC	43	97.7%	6	85.7%	14.0%
Night VMC*	1	2.3%	1	14.3%	100.0%
Part 135: Charter and Cargo					
Day VMC	18	75.0%	1	25.0%	5.6%
Night VMC*	4	16.7%	2	50.0%	50.0%
Day IMC	1	4.2%	0		
Night IMC*	1	4.2%	1	25.0%	100.0%

**Includes dusk.*

NTSB ACCIDENT No. ERA14FA327

ACCIDENT CASE STUDY: LANDING

CESSNA 140, PARMA, NEW YORK | ONE FATALITY

HISTORY OF FLIGHT The pilot of the tailwheel airplane was performing a series of touch-and-goes on Runway 18 of his private airport with a right quartering tailwind. Trees growing on the right side of the runway created additional mechanical turbulence. No one witnessed the accident sequence, but at some point the pilot lost control of the airplane, which veered off the left side of the runway and travelled 390 feet before nosing over in a wheat field. The aluminum center safety belt bracket of the pilot's four-point harness, believed to be original to the 1946-model airplane, failed in overstress, allowing his head to hit the cabin ceiling and causing his death from a cervical spinal fracture and subsequent positional asphyxiation. Following the accident, Cessna issued a service bulletin calling for inspection of the bracket and replacement of any remaining aluminum units with the current steel bracket.

PILOT INFORMATION The 88-year-old pilot held a commercial certificate with ratings for single-engine airplane, single-engine seaplane, instrument airplane, and glider. He also held a flight instructor certificate for single-engine airplane and had logged 2,583 hours, including 438 in tailwheel airplanes. According to friends and family members, he always landed the Cessna 140 in a slip, regardless of wind, and enjoyed the challenge of making downwind landings. He preferred to land on Runway 18 so he could taxi directly to his hangar without back-taxiing. He had previously been involved in two landing accidents, only one of which was reported, and had recently damaged three wingtips and the left aileron in separate incidents.

WEATHER Greater Rochester International Airport, eight nautical miles southeast of the accident scene, reported winds from 300 degrees at 12 knots with gusts to 16. Visibility was 10 miles with a few clouds at 25,000 feet. The temperature was 25 degrees Celsius with a dew point of 12 degrees, and the altimeter setting was 30.21 inches of mercury.

PROBABLE CAUSE The pilot's decision to land with a quartering tailwind and his failure to maintain directional control during the landing roll. Contributing to the severity of the pilot's injuries was the failure of the aluminum center safety belt bracket.

ASI COMMENTS Regular practice in challenging conditions is key to maintaining proficiency, but the degree of challenge needs to be calibrated to a realistic assessment of the pilot's current level of skill. This pilot's recent series of incidents suggests that his self-evaluation may have been optimistic. Owners of older aircraft also have an additional responsibility for assuring that key components – including restraint systems – are inspected and maintained on an appropriate schedule even when the manufacturer provides no specific guidance on inspection intervals.

AIRCRAFT CLASS

All the aerial application accidents occurred in single-engine tailwheel models **(FIGURE 45)**, 28 of which (64%) were turbine-powered. These included six of the seven fatal accidents. Seven (29%) of the Part 135 accidents involved twin-engine airplanes, a sharp increase from just two in 2013. Three of the four fatal accidents were in piston twins; the fourth was in a retractable-gear piston single.

FLIGHT CONDITIONS

For the fifth year out of the past six, all but one of the crop-dusting accidents took place in daytime VMC **(FIGURE 46)**. (In 2012, all of them did.) Three-quarters of the Part 135 accidents also occurred in visual conditions in daylight, but three of the four fatal accidents were among the six that took place in IMC and/or at night.

PILOT QUALIFICATIONS

Airline transport pilots flew less than 5% of the aerial application flights but 46% of the Part 135 accident flights **(FIGURE 47)**. They suffered just one fatal accident in each type of operation. A much higher proportion of charter pilots also held flight instructor certificates, and all were instrument-rated compared to less than one-third of those in Part 137 accidents. Similar patterns have regularly been reported in the past.

ACCIDENT CAUSES

Aerial application flights consist almost entirely of heavily loaded departures from short, rough airstrips followed by hard maneuvering at altitudes that leave little room to recover from aircraft malfunctions, pilot miscalculations, or imprecise airmanship. In that light, it's not surprising that four of the seven fatal accidents involved wire strikes **(FIGURE 48)**, and two more followed low-altitude stalls. (The seventh was an unexplained crash during a water calibration flight at night.) The combination of known mechanical failures, fuel mismanagement, and unexplained engine stoppages caused some 43% of Part 137 accidents (19 of 44) but no fatalities; 10 were due to mishandled takeoffs. There was only one landing accident on a Part 137 flight in 2014.

Mechanical problems, fuel mismanagement, and unexplained power losses caused nine of 24 accidents (38%) on Part 135 flights **(FIGURE 49)**, including two of the four that were fatal. Landing accidents were the next leading cause with four. In addition to an engine failure in a Twin Commander 500B and the misfuelling of a Cessna 421 air ambulance with Jet A, the fatal accidents included a loss of control on an IFR flight plan in IMC in a Cessna 210L and spatial disorientation during a dark night takeoff in a Piper PA-31-350. No other causes resulted in more than one accident each, none of them fatal.

HELICOPTER ACCIDENTS **SUMMARY AND COMPARISON**

In 2014, pilot-related causes were implicated in 72% of non-commercial helicopter accidents and 81% of commercial accidents **(FIGURE 50)**. The latter was significantly higher than the 63% of commercial fixed-wing accidents ascribed to pilot-related causes **(FIGURE 3)**, and included all eight fatal accidents on commercial flights. Eleven of 14 fatal non-commercial accidents were also attributed to pilot-related causes, while the other three were ascribed to mechanical malfunctions.

NON-COMMERCIAL **HELICOPTER ACCIDENTS**

There were 108 non-commercial helicopter accidents in 2014 (Figure 2A), three more than the year before, but the proportion that were fatal decreased by one-third, from 19% to 13%. The overall accident rate fell an additional 15% to 6.28 per 100,000 flight hours after a 7% decrease the year before, and the fatal accident rate dropped to 0.81, the lowest in more than 10 years.

AIRCRAFT CLASS

The number of accidents involving single-engine turbine models dropped 10% to 45, and fatal accidents in these models fell by nearly half, from 13 to seven **(FIGURE 51)**. Unlike the year before, the lethality of single-engine piston and turbine helicopters was very similar, but accidents in both were six to seven times more likely to end in death than those in multiengine helicopters, where only one of six was fatal.

FIGURE 47. PILOTS INVOLVED IN COMMERCIAL FIXED-WING ACCIDENTS

Certificate Level	Accidents		Fatal Accidents		Lethality
Part 137: aerial application					
ATP	2	4.5%	1	14.3%	50.0%
Commercial	41	93.2%	6	85.7%	14.6%
Other or unknown	1	2.3%	0		
CFI on board*	4	9.1%	0		
IFR pilot on board*	14	31.8%	4	57.1%	28.6%
Part 135: charter and cargo					
ATP	11	45.8%	1	25.0%	9.1%
Commercial	13	54.2%	3	75.0%	23.1%
Second pilot on board	1	4.2%	0		
CFI on board*	15	62.5%	3	75.0%	20.0%
IFR pilot on board*	24	100.0%	4	100.0%	16.7%

**Includes single-pilot flights.*

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

Accident Type	Accidents		Fatal Accidents		Lethality
Mechanical	12	27.3%	0		
Unexplained power loss	4	9.1%	0		
Fuel management	3	6.8%	0		
Takeoff and climb	10	22.7%	0		
Maneuvering	13	29.5%	6	85.7%	46.2%
Landing	1	2.3%	0		
Other	1	2.3%	1	14.3%	100.0%

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

Accident Type	Accidents		Fatal Accidents		Lethality
Mechanical	5	20.8%	1	25.0%	20.0%
Unexplained power loss	2	8.3%	0		
Fuel management	2	8.3%	1	25.0%	50.0%
Weather	2	8.3%	1	25.0%	50.0%
Taxi	2	8.3%	0		
Takeoff and climb	2	8.3%	1	25.0%	50.0%
Maneuvering	1	4.2%	0		
Decent/approach	1	4.2%	0		
Landing	4	16.7%	0		
Go-around	1	4.2%	0		
Incapacitation	1	4.2%	0		
Other	1	4.2%	0		

FIGURE 50. MAJOR CAUSES: HELICOPTER GENERAL AVIATION ACCIDENTS

	Non-Commercial				Commercial			
	All Accidents		Fatal Accidents		All Accidents		Fatal Accidents	
Pilot-related	78	72.2%	11	78.6%	29	80.6%	8	100.0%
Mechanical	30	27.8%	3	21.4%	7	19.4%	0	

FIGURE 51.
AIRCRAFT CLASS: NON-COMMERCIAL HELICOPTER

Aircraft Class	Accidents		Fatal Accidents		Fatalities	
Single-engine piston	57	52.8%	6	42.9%	11	45.8%
Single-engine turbine	45	41.7%	7	50.0%	10	41.7%
Multiengine turbine	6	5.6%	1	7.1%	3	12.5%

FIGURE 52.
TYPE OF OPERATION: NON-COMMERCIAL HELICOPTER

Type of Operation	Accidents		Fatal Accidents		Fatalities	
Personal	37	34.3%	6	42.9%	9	37.5%
Instructional	27	25.0%	2	14.3%	4	16.7%
Public use	10	9.3%	0			
Positioning	11	10.2%	4	28.6%	8	33.3%
Aerial observation	8	7.4%	1	7.1%	2	8.3%
Business	6	5.6%	0			
Executive/corporate	1	0.9%	0			
Other work use	5	4.6%	0			
Other or unknown	3	2.8%	1	7.1%	1	4.2%

FIGURE 53.
FLIGHT CONDITIONS: NON-COMMERCIAL HELICOPTER

Conditions	Accidents		Fatal Accidents		Fatalities	
Day VMC	100	92.6%	11	78.6%	17	70.8%
Night VMC*	5	4.6%	1	7.1%	2	8.3%
Night IMC*	3	2.8%	2	14.3%	5	20.8%

**Includes dusk.*

TYPE OF OPERATION

By FAA estimates, personal flights represented less than 7% of all non-commercial helicopter activity in 2014, but they accounted for 34% of this sector's accidents and 43% of fatal accidents (FIGURE 52). By this measure, the excess risk on personal flights in helicopters was 2.75 times higher than in airplanes, and the risk of fatality was more than three times higher. Flight instruction supplanted aerial observation as the largest category of non-commercial helicopter activity, responsible for 36% of flight time and 25% of all accidents, including two that were fatal. Only eight accidents, one of them fatal, occurred on observational flights, which made up 31% of aggregate activity. For the first time in three years, an accident occurred on a professionally crewed executive transport, but no lives were lost. Accidents on positioning flights showed particularly high lethality for the second year in a row, with deaths on four out of 11 (36%).

FLIGHT CONDITIONS

Only three accidents took place in IMC, all of them at night. Two were fatal; both were determined to be VFR flight into IMC on positioning legs. Five occurred in visual conditions at night. The one that was fatal was a collision with trees shortly after takeoff from a public-use airport; the pilot was not legally current to carry passengers at night. The proportion of accidents in day VMC, always the scene of the majority of non-commercial helicopter flight, increased 10 percentage points to 93%, and its share of fatal accidents climbed from 56% to 79%.

PILOT QUALIFICATIONS

Private pilots were responsible for 15% of the accident flights (FIGURE 54); according to FAA statistics, they made up 19% of all certificated helicopter pilots. For airline transport pilots, those figures were reversed; 15% of the population suffered 19% of the accidents. Of course, population size does not measure flight activity, and the relatively low amount of personal flight in helicopters suggests that considerably more non-revenue flights are made by professional pilots than in the fixed-wing world.

For the first time in four years, a student pilot was killed flying solo. The aircraft was an amateur-built single-engine model; there was no record of the student's having been endorsed to fly it, and the NTSB classified the flight as personal. As in 2013, more than 80% of all accident pilots held the instrument-helicopter rating, and nearly 60% were flight instructors. Of the 34 accidents on two-pilot flights, 22 (65%) occurred during dual instruction, including two of the four with fatalities.

ACCIDENT CAUSES

The single most prevalent cause was physical failures of aircraft systems or components **(FIGURE 55)**, implicated in 30 accidents (28%). Eight involved engine malfunctions (two piston and six turbine), and three more arose from fuel-system abnormalities. There were also four unexplained power losses (grouped under the "Other/miscellaneous" heading). None of these caused any fatalities; nor did any of the five accidents ascribed to main transmission, clutch, or drive belt problems, the six due to skid or landing gear failures, or the three arising from anomalies in tail rotor systems or in-cockpit flight controls. Deaths did result from one of the two hydraulic system failures, one of two involving airframe damage, and the only failure of a main rotor blade.

Three of the 19 accidents during low-altitude maneuvering were also fatal. These included two of the four wire strikes and one of 10 accidents during autorotation practice, the scene of more than half of all accidents in the maneuvering category. Four helicopters hit other obstructions at low altitude, and one was wrecked practicing a simulated hydraulic failure.

Rotorcraft-specific phenomena including dynamic rollover (seven accidents), loss of tail rotor effectiveness (five), and settling with power (four) jointly constituted the second-largest category, grouped together under the label "rotorcraft aerodynamics." They also included four accidents blamed on losses of main rotor rpm, two losses of control while hovering in ground effect, and one during an emergency autorotation. The only fatality in this group was a pilot killed in a rollover after a hard landing.

Three of five accidents due to inadequate preflight inspections were attempts to take off without removing all tiedowns. As noted earlier, both fatal weather accidents were VFR into IMC on positioning flights at night; the others were a third VFR into IMC with no fatalities and two losses of control in gusting winds. The eight landing accidents included three collisions with obstructions and five low-altitude upsets.

The sole fatal fuel mismanagement accident was water contamination in gasoline kept in five-gallon cans on the pilot's property. Two of the other three were complete fuel exhaustion; in the third, a commercial pilot mistakenly pulled the fuel mixture during an instructional flight, shutting down the engine. In addition to the three unexplained engine stoppages mentioned above, the "other/miscellaneous" category included a bird strike, an in-flight collision with unidentified debris, and a midair collision in the traffic pattern between a departing Robinson R44 and an arriving Cirrus SR22. The remaining fatal accidents were the night departure crash described above, the loss of control of the student in the single-seat experimental aircraft, and an air-tour pilot killed trying to regain control of a helicopter he had vacated with the engine running during a positioning flight.

COMMERCIAL HELICOPTER ACCIDENTS

There were 36 accidents on commercial helicopter flights in 2014, eight of which were fatal. These represent a decrease of five and an increase of one, respectively, from 2013. Seventeen took place during aerial application, including half the fatal accidents; 12 on Part 135 charter or cargo flights, three of which were fatal; and seven during external-load operations, with one fatality **(FIGURE 56)**. Three of the four aerial application accidents were wire

FIGURE 54. PILOTS INVOLVED IN NON-COMMERCIAL HELICOPTER ACCIDENTS

Certificate Level	Accidents		Fatal Accidents		Fatalities	
ATP	21	19.4%	1	7.1%	2	8.3%
Commercial	68	63.0%	10	71.4%	18	75.0%
Private	16	14.8%	2	14.3%	3	12.5%
Student	3	2.8%	1	7.1%	1	4.2%
Second pilot on board	34	31.5%	4	28.6%	8	33.3%
CFI on board*	62	57.4%	8	57.1%	16	66.7%
IFR pilot on board*	87	80.6%	10	71.4%	19	79.2%

**Includes single-pilot flights.*

FIGURE 55. TYPES OF NON-COMMERCIAL HELICOPTER ACCIDENTS

Accident Type	Accidents		Fatal Accidents		Lethality
Preflight / static	5	4.6%	0		
Taxi / ground operations	2	1.9%	1	7.1%	50.0%
Takeoff / climb	3	2.8%	1	7.1%	33.3%
Cruise	2	1.9%	1	7.1%	50.0%
Fuel management	4	3.7%	1	7.1%	25.0%
Weather	5	4.6%	2	14.3%	40.0%
Maneuvering	19	17.6%	3	21.4%	15.8%
Rotorcraft aerodynamics	23	21.3%	1	7.1%	4.3%
Landing	8	7.4%	0		
Mechanical	30	27.8%	3	21.4%	10.0%
Other / miscellaneous	7	6.5%	1	7.1%	14.3%

FIGURE 56. SUMMARY OF COMMERCIAL HELICOPTER ACCIDENTS

	Accidents		Fatal Accidents		Fatalities	
Aerial Application (Part 137)	17	47.2%	4	50.0%	4	30.8%
Single-engine piston	10	58.8%	4	100.0%	4	100.0%
Single-engine turbine	7	41.2%	0			
Day VMC	17	100.0%	4	100.0%	4	100.0%
ATP	4	23.5%	0			
Commercial	13	76.5%	4	100.0%	4	100.0%
Charter or Cargo (Part 135)	12	33.3%	3	37.5%	8	61.5%
Single-engine piston	1	8.3%	0			
Single-engine turbine	10	83.3%	3	100.0%	8	100.0%
Multiengine turbine	1	8.3%	0			
Day VMC	10	83.3%	2	66.7%	5	62.5%
Night VMC*	2	16.7%	1	33.3%	3	37.5%
ATP	2	16.7%	0			
Commercial	10	83.3%	3	100.0%	8	100.0%
External Load (Part 133)	7	19.4%	1	12.5%	1	7.7%
Single-engine piston	1	14.3%	1	100.0%	1	100.0%
Single-engine turbine	5	71.4%	0			
Multiengine turbine	1	14.3%	0			
Day VMC	6	85.7%	1	100.0%	1	100.0%
Night VMC*	1	14.3%	0			
ATP	1	14.3%	0			
Commercial	5	71.4%	1	100.0%	1	100.0%
Other or unknown	1	14.3%	0			

**Includes dusk.*

strikes and the fourth hit a tree. The three fatal charter accidents were caused by a loss of tail rotor effectiveness during an attempted go-around at night on a medical transport, a wire strike on a powerline patrol, and an unexplained loss of control on approach to an oil platform in the Gulf of Mexico. As of this writing, the cause of the accident that caused the death of the pilot on an external-load flight in Alaska has yet to be determined.

None of 2014's commercial helicopter accidents took place in IMC, and only three – two under Part 135 and one under Part 133 – happened at night. 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. One of the charter accidents was fatal, the medical flight that suffered a loss of tail rotor effectiveness described above. Ten of the 12 involving piston helicopters occurred on aerial application flights, while the only accident involving a multiengine turbine helicopter was operating under Part 135. In all, 22 of the 36 accident aircraft (61%) were single-engine turbine models. Seven of the accident pilots held airline transport pilot certificates, nearly twice as many as the year before.

AMATEUR-BUILT AND EXPERIMENTAL **LIGHT SPORT AIRCRAFT**

FIXED-WING: 194 TOTAL / 60 FATAL (INCLUDES 25 E-LSA / 8 FATAL)
HELICOPTER: 7 TOTAL / 2 FATAL

The greatest share of the improvement in GA accident rates in 2013 came from amateur-built and experimental light sport aircraft (E-LSAs), whose accident rate decreased nearly 25%. Unfortunately, that does not appear to have marked the beginning of a trend. While overall accident numbers remained steady, the number of accidents in amateur-built aircraft and E-LSAs rebounded some 20% from 161 to 194 **(FIGURE 57)**, and the number of fatal accidents almost doubled from 31 (an extraordinarily low count by historical standards) to a more typical 60. More alarmingly, the percentage of fatal accidents that occurred in experimental aircraft hit its highest level since at least 2009. The accident rate in these aircraft increased from 17.72 per 100,000 hours in 2013 to 20.59 per 100,000 in 2014, still below the 2012 level of 23.23. The renewed lethality of homebuilt accidents meant that the fatal accident rate rose to 6.35 per 100,000 hours, higher

NTSB ACCIDENT No. WPR14FA203

ACCIDENT CASE STUDY: NON-COMMERCIAL HELICOPTER

ROBINSON R22, SANTA PAULA, CALIFORNIA | ONE FATALITY

HISTORY OF FLIGHT The helicopter departed from Oxnard, California around 9:30 a.m. About an hour later, a witness near Santa Paula saw it flying below the tree line along a dry riverbed. Shortly after the helicopter disappeared from sight, she heard two loud "popping" noises. The helicopter was subsequently found to have hit three-phase transmission lines strung between H-frames about 80 feet above the riverbed.

PILOT INFORMATION The 42-year-old pilot held a commercial certificate with instrument rating for single-engine airplane, multiengine airplane, and single-engine seaplane, as well as private pilot privileges for rotorcraft helicopter. He had passed his helicopter checkride three weeks earlier, and the accident flight was his second since his practical test. His most recent medical application, submitted two months earlier, listed 4,628 hours of flight experience that included 56 hours in helicopters.

WEATHER At 9:55 a.m., the automated weather station at Camarillo, California recorded winds from 200 degrees at 7 knots with clear skies and 10 miles visibility. The temperature was 18 degrees Celsius with a dew point of 12 degrees. The altimeter setting was 30.03 inches of mercury.

PROBABLE CAUSE The pilot's failure to maintain clearance from power lines while flying at a low altitude.

ASI COMMENTS Helicopters' ability to fly extremely slowly and maneuver in closely confined spaces gives them the capability to operate in areas inaccessible to airplanes. Pilots, particularly airplane pilots who've added helicopter ratings, may feel an irresistible urge to exploit this ability for their own entertainment, but low-altitude operations carry attendant risks. Robinson Helicopters' training materials stress that wire strikes are the single most common cause of fatal accidents in their aircraft, and recommend maintaining altitudes of at least 500 feet when there's no functional need to fly lower in order to avoid unmarked obstructions. Adherence to that rule would have prevented this accident and numerous others.

than the overall accident rate on non-commercial fixed-wing flights and 11% above the fatal accident rate of experimental aircraft in 2012.

In addition to 25 E-LSAs and seven helicopters, the accident fleet included 145 single-engine fixed-gear airplanes, 90 of them with tailwheels and 55 built in tricycle-gear configuration **(FIGURE 58)**. There were also 23 retractable-gear singles and one multiengine airplane. Five of the fixed-wing aircraft were fitted with turbine engines, but the rest were all piston-powered. Lethality was essentially constant in all aircraft categories, though four of the five accidents in single-engine turboprops were fatal.

The increased accident rate is almost entirely attributable to jumps in the number of mechanical failures (50, up more than 50% from the year before) and cases of fuel mismanagement, which nearly tripled from five to 14. There were five more maneuvering accidents, and four more were fatal. The aggregate number during takeoffs, landings, and go-arounds barely changed, rising from 64 to 67, and most other accident categories saw minimal differences from 2013.

The "other pilot-related" category included three midair collisions with certified aircraft, two of which were fatal; three accidents, two of them fatal, caused by pilot incapacitation in flight for reasons that could not be determined, as well as one fatal accident blamed on the pilot's impairment by drugs and alcohol; three losses of control in cruise flight, of which the two that were fatal included one in an amateur-built helicopter; and a hard landing in an emergency autorotation that the pilot survived. The 10 remaining accidents collected as "other or unknown" included a collision with a deer during a night landing that the pilot escaped without injury; a loss of control during an unintended flight by an individual without a pilot certificate; one aircraft damaged in a precautionary off-field landing due to a rough-running engine; and an unexplained upset on short final that the pilot survived with serious injuries. There were also a non-fatal accident blamed on passenger interference with the flight controls and five fatal crashes for which probable cause has not been definitively established.

UNUSUAL ACCIDENT **CATEGORIES**

Twenty fatal and 10 non-fatal accidents arose from circumstances too rare to support tabulation as separate categories for statistical analysis:

COLLISIONS 9 TOTAL / 5 FATAL

There were seven midair collisions in 2014. Five were fatal, causing nine individual deaths. All three occupants of a Robinson R44 helicopter died in a traffic-pattern collision with a Cirrus SR22; the Cirrus pilot deployed the airplane's ballistic parachute, and he and his passenger survived with minor injuries. This was the only collision between different categories of aircraft, and all involved non-commercial flights.

Three of the remaining six involved two certified airplanes, and three were between a certified and an amateur-built aircraft. The pilot of a Hawker Sea Fury survived the collision that killed the pilot of a Cessna 210 during an attempted air-to-air photo session, and the pilot of an American Champion 7GCBC made a successful dead-stick landing after striking a Cessna 172 in the traffic pattern of the rural Idaho airstrip where they'd planned to meet. The Cessna pilot died in the crash. The pilot of an amateur-built Searey was actually unaware of the collision that killed the pilot and passenger in another 172 while both aircraft were providing introductory flights. Both pilots died when a Cessna 170 collided with an amateur-built Skykits Savannah.

There were no injuries in the collision between a landing Vans RV-12 and a deHavilland DHC-1 Chipmunk. The pilot of a Pitts Special S-1S survived with serious injuries after striking a landing Piper PA-28-140 from behind; the pilot and passenger in the Piper were unhurt. There were no injuries in either of the two collisions on the ground, one involving a Cessna 172 and a Piper PA-24-250 Comanche and the other between a glider and its towplane following an aborted takeoff.

ALCOHOL AND DRUGS 6 TOTAL / 5 FATAL

The pilot of the Piper PA-60 Aerostar that crashed while flying aggressive aerobatics at extremely low altitudes had a postmortem blood alcohol content of 0.252 grams per deciliter. The melted remains of a whiskey bottle were found in the wreckage. He had a history of alcohol dependence, but had reportedly been sober for the past four years. A Cessna 172 pilot who hit trees during a series of low passes also had postmortem alcohol levels well above the legal limit of 0.040.

Alcohol impairment was also blamed for a Piper PA-24-250's descent into trees on short final at night and a Zenair STOL CH 701's low-altitude collision with powerlines. The pilots' postmortem blood alcohol levels were 0.192 and 0.148, respectively. Toxicology results showed that the airshow pilot whose Boeing PT-75 Stearman descended into the runway during an inverted ribbon cut had potentially impairing levels of a sedating over-the-counter antihistamine. In all five cases the pilots were the only fatalities, though a passenger in the Comanche suffered serious injuries.

The pilot and passenger in a Cherokee 140 that stalled during an attempted go-around somehow avoided injury. A witness reported having seen the pilot "consume 12 to 16 alcoholic beverages between 0745 and 1230" before leaving to meet the passenger for the flight. He refused to submit to testing by police.

While up from 2013's all-time low, substance impairment was implicated in just one-half of one percent of all GA accidents in 2014. All six occurred on personal flights.

PHYSICAL INCAPACITATION 9 TOTAL / 6 FATAL

Three fewer accidents were attributed to pilots' physical incapacitation than in 2013, and there were four fewer fatal accidents. All six of those that were fatal occurred in airplanes, and the pilots were the only casualties. Five were classified as personal flights; the sixth was an authorized solo by a student pilot who apparently committed suicide by

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

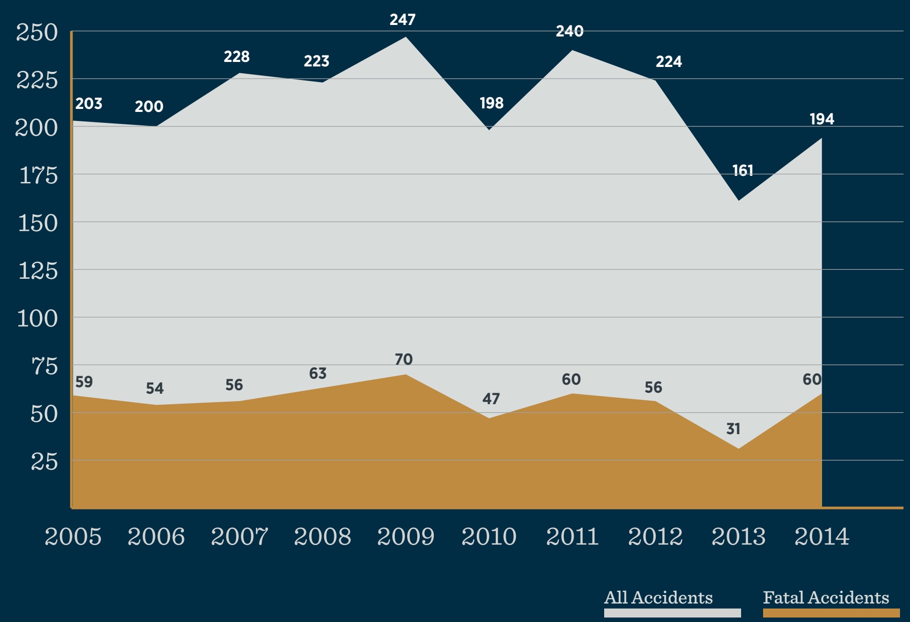


FIGURE 58. TYPES OF AMATEUR-BUILT AIRCRAFT INVOLVED IN ACCIDENTS

Aircraft Class	Accidents		Fatal Accidents		Lethality
E-LSA	25	12.4%	8	12.9%	32.0%
Single-engine fixed-gear (SEF)	145	72.1%	43	69.4%	29.7%
SEF tailwheel	90		29		32.2%
Single-engine retractable	23	11.4%	9	14.5%	39.1%
Single-engine turbine	5		4		80.0%
Multiengine	1	0.5%	0		
Helicopter	7	3.5%	2	3.2%	28.6%

FIGURE 59.
TYPES OF ACCIDENTS IN AMATEUR-BUILT AIRCRAFT

Aircraft Class	Accidents		Fatal Accidents		Lethality
Mechanical	50	24.9%	15	24.2%	30.0%
Unexplained power loss	14	7.0%	5	8.1%	35.7%
Fuel management	14	7.0%	2	3.2%	14.3%
Weather	4	2.0%	3	4.8%	75.0%
Preflight	5	2.5%	1	1.6%	20.0%
Takeoff and climb	18	9.0%	6	9.7%	33.3%
Maneuvering	19	9.5%	12	19.4%	63.2%
Descent / approach	7	3.5%	2	3.2%	28.6%
Landing	46	22.9%	4	6.5%	8.7%
Go-around	3	1.5%	0		
Other pilot-related	11	5.5%	7	11.3%	63.6%
Other or unknown	10	5.0%	5	8.1%	50.0%

diving into the ocean at full power. One accident each was attributed to heart attack and stroke; in the other three, the nature of the incapacitating event could not be specifically identified.

A passenger attempted to take control of an Aerospatiale AS-350-B2 helicopter after its pilot abruptly lost consciousness on a Part 135 photo flight. All three people on board survived with significant injuries; the pilot was subsequently diagnosed with sick sinus syndrome, which can cause sudden loss of consciousness. A Vans RV-7A's pilot apparently lost consciousness on short final but suffered only minor injuries. Doctors concluded the most likely cause was dehydration. The six passengers on board a Britten-Norman Islander BN-2 escaped without injury after its pilot lost consciousness while taxiing. The pilot himself suffered minor injuries, and a subsequent medical examination found no apparent cause for this event.

These nine pilots represent less than two one-thousandths of one percent (.002%) of the nearly 600,000 U.S. pilots the FAA considered active in 2014.

OFF-AIRPORT GROUND INJURIES
3 ACCIDENTS / 2 GROUND FATALITIES
AND 2 SERIOUSLY INJURED

A father and daughter were killed on a Florida beach when they were struck by the wing of a Piper PA-28-181 attempting to make a forced landing after an engine failure. The pilot had tried to steer for an unoccupied area and did not see the victims in the water. He and his passenger were unhurt.

One person in a vehicle was seriously injured in the crash of a Eurocopter AS-350-B2 news-gathering helicopter that lost tail rotor effectiveness just after takeoff from a downtown Seattle helipad. The NTSB concluded that a hydraulic failure was probably to blame for the accident, which killed the helicopter's pilot and only passenger. In Alaska, a boat operator was struck by a de Havilland DHC-2 Beaver that was following the boat at low altitude, suffering serious injuries. The airplane was subsequently damaged when it collided with the boat after the pilot landed on the river to offer assistance.

ON-AIRPORT GROUND INJURIES
3 ACCIDENTS / 5 GROUND FATALITIES, 2 SERIOUSLY INJURED, AND 4 MINOR INJURIES

A King Air 200 that lost one engine just after takeoff crashed into a flight training facility at Wichita International Airport, killing three people inside the building, seriously injuring two more, and causing minor injuries to four. The pilot was also killed. An FBO employee died after walking into the left propeller of an idling deHavilland DHC-6 Twin Otter skydiving airplane; she had gone out to take the pilot's order for lunch and was apparently more accustomed to single-engine airplanes. A Champion 7ECA struck a riding mower during its landing roll, killing the operator.

SUMMARY

- The prior year's sudden and dramatic improvement in non-commercial fixed-wing safety was maintained in 2014. Both overall and fatal accident rates remained at or near historic lows despite an 18% uptick in the proportion of accidents causing fatalities.

- 2013's improvement in the accident record of amateur-built and experimental light sport aircraft did not continue. The number of accidents involving these aircraft rose 20% and the number of fatal accidents nearly doubled from the extraordinarily low number recorded the year before. Their fatal accident rate was more than five times higher than that of non-commercial fixed-wing flights overall.

- The causes of non-commercial fixed-wing accidents remained similar to prior years, with 75% attributed to actions or inactions of the pilots, 15% to verified mechanical failures, and 6% to losses of engine power for unknown reasons. As in the past, personal flights suffered both disproportionate numbers of accidents and a higher rate of fatalities than flights for most other purposes.

- Reductions in the number of accidents during takeoff and initial climb or triggered by adverse weather were partly offset by increases in the numbers caused by fuel mismanagement, during low-altitude maneuvering, and in the descent and approach phase between the en route and airport environments.

- The number of non-commercial helicopter accidents increased much less than the amount of flight activity, and the number of fatal accidents fell 30%. This sector's fatal accident rate dropped below 1.0 per 100,000 hours for only the third time.

- Mechanical failures, low-altitude maneuvering, and rotorcraft-specific aerodynamic phenomena remained the three leading causes of non-commercial helicopter accidents. A one-third decrease in maneuvering accidents was offset by a 25% increase in those caused by mechanical problems and a 28% rise in the "rotorcraft aerodynamics" category. Contributing to the reduction in maneuvering accidents was a one-third drop in accidents during practice autorotations, from 15 to 10; however, this year one was fatal.

- The number of commercial accidents in both airplanes and helicopters showed welcome declines, while the aggregate number of fatal accidents remained the same with one more in helicopters but one fewer in airplanes. The overall accident rates in both sectors decreased modestly, while fatal accident rates remained relatively unchanged.

- The majority of fatal commercial fixed-wing accidents happened on aerial application flights, but the pilots were the only victims. Ten of the 17 individual deaths occurred in the four fatal accidents on Part 135 charters.

- As in prior years, the greatest share of commercial helicopter accidents took place on aerial application flights. Unlike 2013, however, when fatalities were concentrated in external-load operations, more than 60% of individual deaths happened during on-demand charters.

- The numbers of midair collisions and accidents blamed on either pilot impairment or physical incapacitation all increased modestly in 2014, but remained well within the range that has typified the past decade. These represent infinitesimal fractions of both pilots and flight operations.

- A total of six 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 40.

WHAT DOES **GENERAL AVIATION FLY?**

General aviation aircraft are as varied as their pilots and the types of operations flown. The following aircraft categories and classes are included in this year's *Nall Report*:

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

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

- FAR Part 121 airline operations
- Military operations
- Fixed-wing aircraft weighing more than 12,500 pounds
- Weight-shift control aircraft
- Powered parachutes
- Gyroplanes
- Gliders
- Airships
- Balloons
- Unmanned aerial systems (UAS, or "drones")

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.

FIGURE 60 shows the FAA's estimate of the number of powered GA aircraft that were active in 2014, 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.

FIGURE 60: WHAT DOES GENERAL AVIATION FLY?

Aircraft Class	Commercial		Non-Commercial	
Piston single-engine	2,417	18%	123,619	66%
Piston multiengine	1,054	8%	12,092	6%
Turboprop single-engine	2,285	17%	2,305	1%
Turboprop multiengine	1,272	10%	3,916	2%
Jet	2,697	20%	9,665	5%
Helicopter	3,277	25%	6,689	4%
Experimental	219	2%	25,972	14%
Light sport*	0		2,231	1%
Total	13,221		186,489	

**Note: In the 2012 through 2014 surveys, the FAA counted experimental light sport aircraft in the "experimental" rather than the "light sport" category.*

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.

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.

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