AIR SAFETY INSTITUTE

2010 NALL REPORT

The Joseph T. Nall Report of Accident Trends and Factors

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

Final vs. Preliminary Statistics

Following last year's model, this twenty-first edition of the *Nall Report* continues the Air Safety Institute's expanded coverage of U.S. general aviation, including helicopter accidents and accidents on commercial as well as non-commercial flights by light fixed-wing aircraft. Commercial and non-commercial accidents are once again analyzed separately.

Unlike prior years, the *2010 Nall Report* excludes foreign accidents that appear in NTSB records solely due to the Board's secondary involvement in investigations under the primary jurisdiction of other countries. Foreign accidents are not consistently reported to the NTSB, and those reports that are made generally contain little specific information. This year's *Nall Report* is restricted to accidents that occurred in the airspace of the United States and its territories and possessions, plus accidents in neighboring countries that involved U.S.-registered aircraft on flights that departed from or were intended to arrive in the United States. This rule resulted in the exclusion of 125 accidents over a 10-year period.

This publication is based on NTSB reports of accidents involving powered fixed-wing general aviation aircraft weighing 12,500 pounds or less and rotorcraft of all sizes. To provide the most current safety information, ASI gathered NTSB data on 2009's accidents throughout 2010.

Probable cause had been determined for 1,181 of 1,418 accidents (83.3 percent) when the data were frozen for this year. The remaining 16.7 percent were based on preliminary data. However, probable cause had only been established for 53.3 percent of fatal accidents, which typically require more extensive investigations. This is similar to the proportion of fatal accidents that had received probable-cause determinations in earlier reports.

Prior-year comparisons suggest that this mix of preliminary and final data will not significantly change the conclusions presented here when all final reports are analyzed. In the event that there are significant changes, especially in conclusions related to fatal accidents, ASI will publish an update.

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

ASI gratefully acknowledges the technical support and assistance of the National Transportation Safety Board, the Federal Aviation Administration, and the Aircraft Owners and Pilots Association.

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President's View

2009 was a tough year economically and it was a tough year for certain segments of general aviation concerning safety. Some categories, however, performed exceptionally well.

First the good news:

- The number of accidents on commercial fixed-wing flights decreased by one-third from 2008, and the two fatal accidents represent an 88% decrease from the previous year. No fatal accidents occurred on fixed-wing charter or cargo flights.

- The accident rate for helicopters operated non-commercially increased from 6.56 per 100,000 flight hours in 2008 to 7.40 in 2009. However, this is still a 41% reduction from the recent peak of 12.62 in 2002. The number of fatal accidents was down by five, and the fatal accident rate decreased by 22%.

In the not-so-good news category:

- There were 60 fewer accidents on non-commercial fixed-wing flights than in 2008, but this 5% decrease was barely half the estimated reduction in flight activity. There were 10 more fatal accidents and eight more individual fatalities. Personal flights accounted for less than 47% of non-commercial fixed-wing flight time but led to 78% of all accidents and 84% of fatal accidents.

- Mechanical accidents accounted for a record-high 17% of all accidents. More than half the fatal mechanical accidents occurred in amateur-built airplanes, which represent only about 15% of the fleet. We continue to work with EAA to better understand the causes and effects.

Statistics aside, the Air Safety Institute (formerly the AOPA Air Safety Foundation) continues to reach record numbers of pilots with online courses, webinars, and live seminars. Early data returns show that those who choose to be safe by learning from others' mistakes and avoiding risky flight operations have an above-average safety record. It's perfectly logical. GA flying is as safe as the pilot chooses to make it and there can be a wide continuum.

As always, our thanks to colleagues at FAA and NTSB, industry partners, and especially to the pilot-donors who make these critical safety education programs possible.

Safe Flights,

Bruce Landsberg

President, AOPA Foundation

Trends in General Aviation
2000-2009

More than 99% of all general aviation (GA) flight time in 2009 was logged by either powered fixed-wing aircraft or helicopters. (Gliders, autogyros, and lighter-than-air craft accounted for the rest.) The FAA estimates that non-commercial flying – flights that did not provide direct revenue to the aircraft's owner or operator – made up 87% of fixed-wing time and 58% of helicopter flight time. These flights are usually conducted under the general operating rules of Part 91 of the Federal Aviation Regulations (FARs). Most were made by people who were not employed as pilots, but they also included repositioning flights by charter and cargo operators, public-use flights by government agencies, and corporate transport by professionally crewed flight departments.

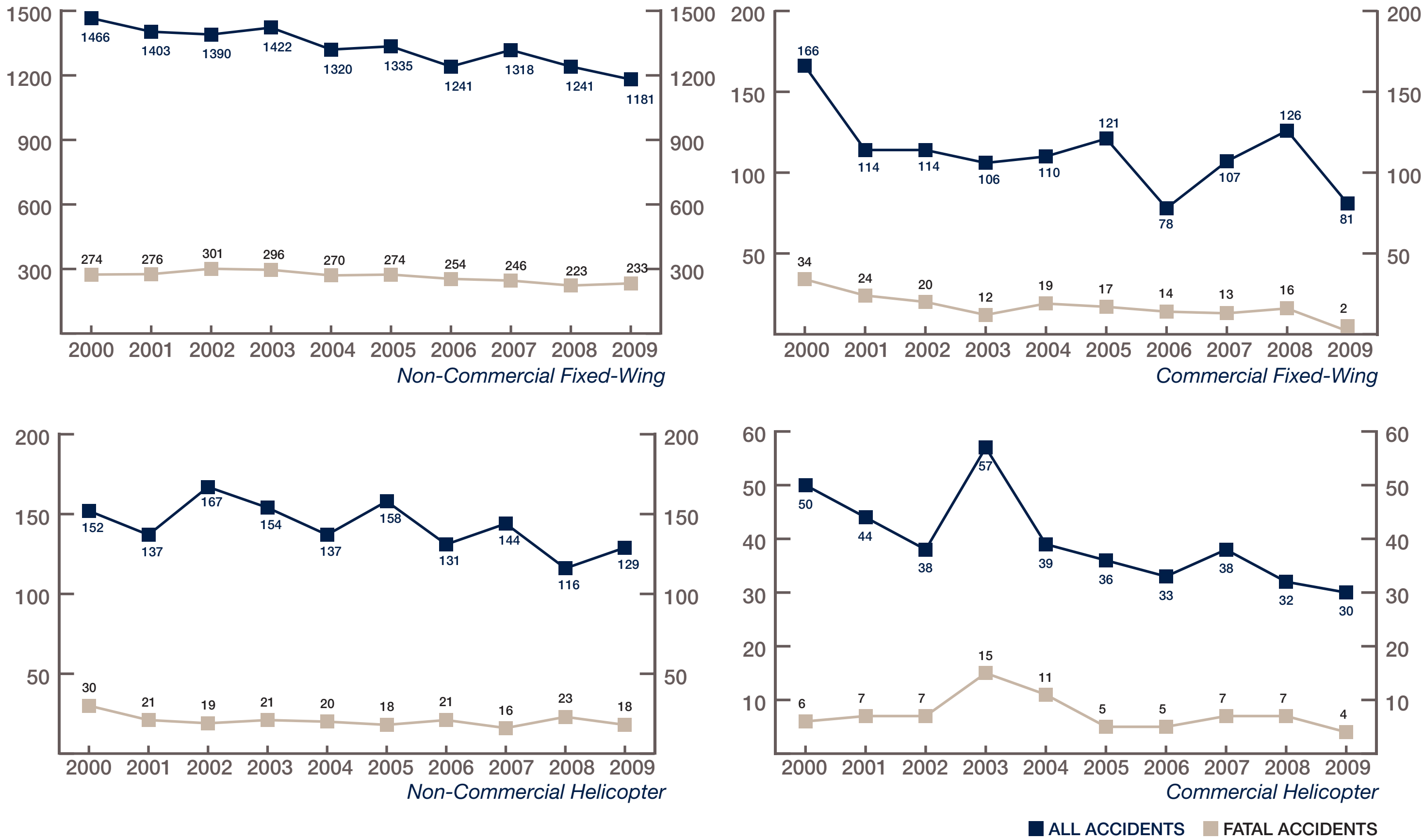
All flights made specifically to produce revenue for the aircraft operators are considered commercial. They include on-demand charter and cargo service conducted under FAR Part 135, aerial application flights made under Part 137, and helicopter external-load transport governed by Part 133. Because the regulations impose more stringent operating and equipment requirements on commercial flights, their risk profiles and safety records differ from those of non-commercial aviation.

Despite year-to-year fluctuations, the number of accidents per 100,000 hours of flight time is consistently and significantly lower in commercial flight (Figure 1). On the fixed-wing side, the average accident rate over the past decade was 67% higher for non-commercial flights (6.19 compared to 3.71), and the rate of fatal accidents was more than twice as high (1.23 vs. 0.56). The average accident rate for non-commercial helicopter flights was 2.3 times as high as for commercial flights (8.73 vs. 3.73), and the fatal accident rate was 81% greater (1.27 vs. 0.70). The disparity in accident rates between commercial and non-commercial activities is not surprising given the significant differences in their regulatory and operational environments.

After spiking in 2008, the commercial fixed-wing accident rate dropped back to the range seen in the previous four years. The fatal accident rate of .07 per 100,000 hours flown was the lowest on record; the only two fatal commercial fixed-wing accidents occurred on aerial application flights, and the only victims were the pilots. The rates of non-commercial fixed-wing accidents, fatal and non-fatal alike, increased to their highest nominal levels since 2005, slightly above their ten-year averages.

The accident rate for commercial helicopter flights in 2009 remained near its 2008 level, and was nominally lower than the commercial fixed-wing rate for the second consecutive year. The fatal accident rate of 0.32 per 100,000 hours was the lowest on record and less than half of the average rate over the past decade. The accident rate on non-commercial helicopter flights reversed its 2008 decline; its increase from 6.65 to 7.40 essentially returned to the 2007 level. However, the fatal-accident rate of 1.03 per 100,000 hours was the second-lowest of the past decade, a 22% decline from the preceding year and 19% below the decade's average.

FIGURE 1A : GENERAL AVIATION ACCIDENTS TRENDS, 2000-2009



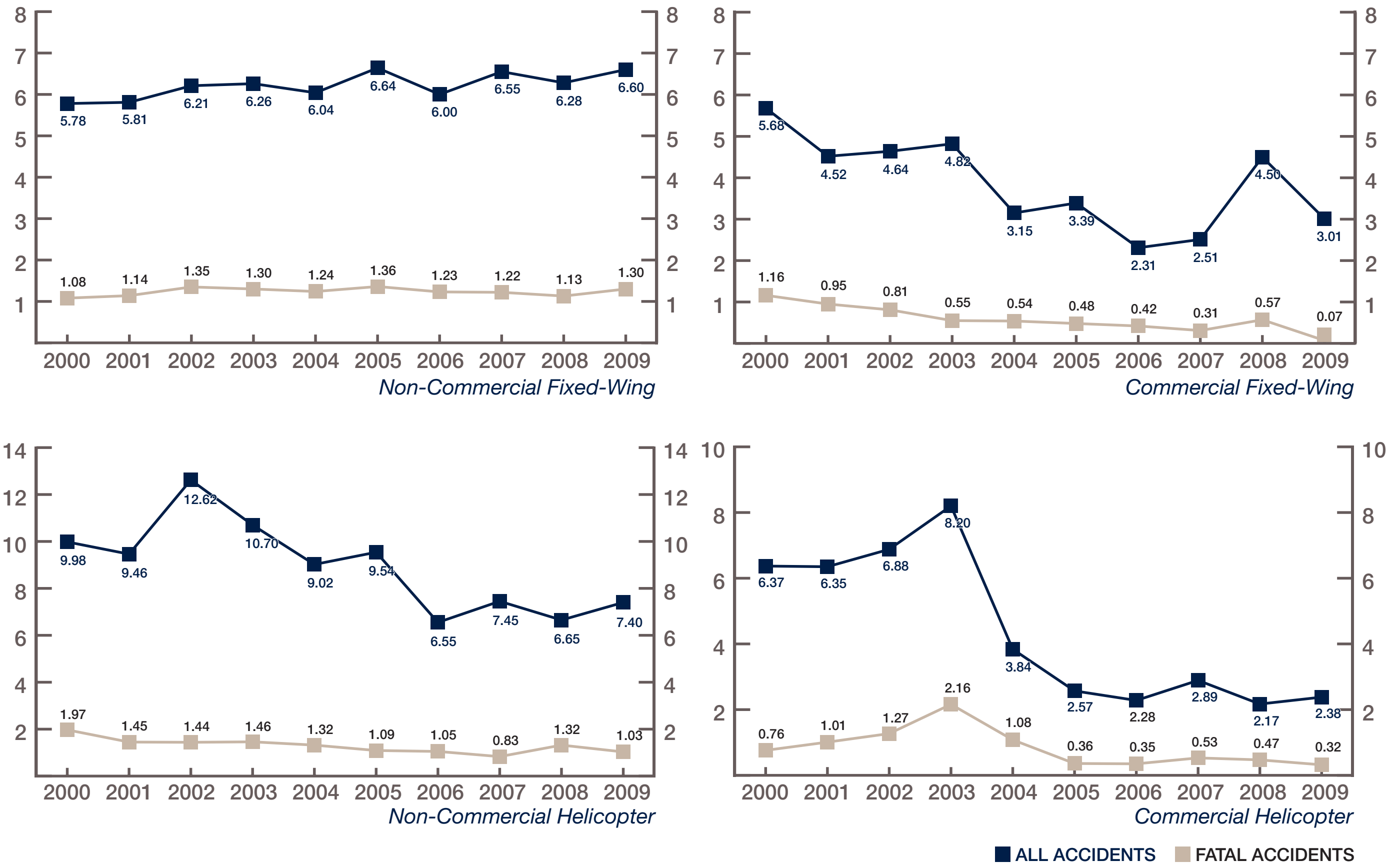
General Aviation Accidents 2009

2009 saw a total of 1,418 general aviation accidents involving 1,431 individual aircraft. (Because three were collisions between commercial and non-commercial aircraft or between helicopters and airplanes, the numbers of accidents within those categories sums to 1,421.) They included 255 fatal accidents that caused 452 deaths. All of these totals were the lowest in the past decade, but those reductions reflect a mixture of diminished activity in some sectors and actual improvements in the accident rates of others.

Non-commercial fixed-wing flight activity continued to decline in 2009. A decrease of almost 10% from 2008 more than accounted for the 5% drop in the number of accidents, while the number of fatal accidents actually increased by 10 (4%). Non-commercial fixed-wing flights accounted for 75% of all GA flight time (Figure 2) but 83% of all GA accidents, 91% of fatal accidents, and 89% of individual fatalities. The reductions in the numbers of fatal accidents in other types of operations that occurred during 2008 were maintained in 2009, leaving non-commercial fixed-wing flights to account for a historically disproportionate share. While the total of 1,181 accidents was the lowest in more than 30 years, the accident rate of 6.60 per 100,000 hours was the second highest of the past decade, and not significantly lower than the 2005 estimate of 6.64. The 233 fatal accidents were 10 more than in 2008, and the number of deaths increased by seven to 401.

The volume of commercial flight in helicopters decreased even more sharply, down almost 15% from 2008. The estimated 1.26 million hours flown in 2009 was the smallest amount since 2004, but the numbers of accidents and fatal accidents were the lowest of the decade at 30 and four, respectively. Commercial helicopter flights made up 5% of total GA time (down from 6% in 2008) but accounted for only 2% of GA accidents and less than 1% of all fatal accidents. Four of 30 accidents were fatal, killing 16. Commercial fixed-wing accidents were the most survivable: Less than 3% were fatal, compared to 13-20% for non-commercial fixed-wing and helicopters. It is worth noting, though, that all four lethality rates decreased from 2008. The number of commercial fixed-wing accidents was the second-lowest of the decade, only three more than the 78 registered in 2006, and the two fatal accidents and the two deaths that resulted were the lowest numbers on record. Estimated total flight hours were just 4% less than in 2008.

FIGURE 1B : GENERAL AVIATION ACCIDENT RATES PER 100,000 FLIGHT HOURS, 2000-2009



Non-commercial helicopter flights were the only sector to show no significant decline in activity, decreasing less than 1% from 2008, but the 129 accidents that resulted represent an increase of 11%. However, only 18 were fatal compared to 23 the year before; the 14% lethality and 33 deaths returned to the middle of the previous decade's range. Since commercial operators maintained the recent improvement in their accident rates, this leaves both the accident and fatal accident rates in non-commercial flights at about three times those of commercial rotorcraft.

FIGURE 2 : GENERAL AVIATION ACCIDENTS IN 2009

	NON-COMMERCIAL		COMMERCIAL	
	Fixed-Wing	Helicopter	Fixed-Wing	Helicopter
Number of accidents	1181	129	81	30
Number of aircraft*	1190	129	82	30
Flight hours (millions)	17.89	1.74	2.69	1.26
Accident rate	6.60	7.40	3.01	2.38
Number of fatal accidents	233	18	2	4
Fatal accident rate	1.30	1.03	0.07	0.32
Lethality (percent)	19.7	14.0	2.5	13.3
Fatalities	401	33	2	16

** Counts each aircraft involved in a collision separately.*

FIGURE 3 : AIRCRAFT CLASS: NON-COMMERCIAL HELICOPTER

Aircraft Class	Accidents		Fatal Accidents		Fatalities	
Single-engine piston	79	61%	9	50%	17	52%
Single-engine turbine	43	33%	7	39%	13	39%
Multiengine turbine	7	5%	2	11%	3	9%

FIGURE 4 : TYPE OF OPERATION: NON-COMMERCIAL HELICOPTER

Type of Operation	Accidents		Fatal Accidents		Fatalities	
Personal	42	33%	5	28%	9	27%
Instructional	40	31%	3	17%	4	12%
Public Use	13	10%	2	11%	3	9%
Positioning	15	12%	3	17%	7	21%
Aerial observation	2	2%	0	0%	0	0%
Business	3	2%	1	6%	4	12%
Other working use	10	8%	2	11%	2	6%
Other*	4	3%	2	11%	4	12%

** Includes corporate, flight tests, and unreported*

HELICOPTER ACCIDENTS
Non-Commercial

The 129 non-commercial helicopter accidents in 2009 was an increase of 13 (11%) from 2008 but still the second-lowest count of the past decade, and only 2007 saw a significantly lower fatal accident rate. The 18 fatal accidents matched 2005 for the second-lowest, while the 33 individual fatalities were slightly below the decade's average.

Aircraft Class

Reciprocating engines powered three-fifths (61%) of the helicopters involved in non-commercial accidents (Figure 3). This is one and a half times their share of non-commercial flight activity, which the FAA estimates at about 40%. However, accidents in piston helicopters also tend to be less severe, with an 11% lethality rate compared to 16% in single-engine turbines and 29% in multiengine turbines. In all three classes, though, a smaller share of accidents were fatal in 2009 than in the previous year. The overall lethality of non-commercial helicopter accidents dropped from 20% in 2008 to 14% in 2009.

Type of Operation

Personal flying represents a much smaller share of helicopter activity than it does for fixed-wing aircraft, but results in an even more disproportionate number of accidents and fatalities (Figure 4). The FAA estimated that 7% of non-commercial helicopter flight time took place on personal flights, yet they accounted for 33% of all accidents, 28% of fatal accidents, and 27% of individual fatalities.

The amount of non-commercial helicopter time devoted to flight instruction decreased 16% from the year before, yet the number of instructional accidents increased by almost half: There were 40 in 2009 compared to 27 the year before. The 31% of accidents that occurred on instructional flights was comparable to their 28% share of flight activity, a contrast with earlier years in which flight instruction accounted for a disproportionately small share of helicopter accidents. Only three of 2009's instructional accidents were fatal, however. This 7.5% lethality rate was less than half of that in all other types of helicopter accidents combined. Eight instructional accidents occurred during solo flights by certificated pilots, but none of them were fatal. There were no accidents on student solos.

Taken together, all other types of operations suffered fewer accidents, but those that occurred were more likely to be deadly. The remaining 65% of total flight activity led to 36% of all accidents but 56% of fatal accidents. The 20 individual fatalities in these flights represent 61% of the total. No

FIGURE 5 : LIGHT AND WEATHER CONDITIONS: NON-COMMERCIAL HELICOPTER

Conditions	Accidents		Fatal Accidents		Fatalities	
Day VMC	111	86%	12	67%	16	48%
Night VMC*	14	11%	3	17%	10	30%
Day IMC	1	1%	0	0%	0	0%
Night IMC*	3	2%	3	17%	7	21%

** Includes dusk*

FIGURE 6 : PILOTS INVOLVED IN NON-COMMERCIAL HELICOPTER ACCIDENTS

Certificate Level	Accidents		Fatal Accidents		Fatalities	
ATP	17	13%	3	17%	3	9%
Commercial	81	63%	9	50%	20	61%
Private	28	22%	4	22%	6	18%
None or not reported	3	2%	2	11%	4	12%
CFI on board*	66	51%	9	50%	17	52%

** Includes Single-pilot accidents*

single accident disproportionately increased the casualty count. A business flight in a Robinson R44 that killed all four on board was the only accident that caused more than three fatalities.

Flight Conditions

As shown in Figure 5, the overwhelming majority (86%) of non-commercial helicopter accidents occurred in visual meteorological conditions (VMC) in the daytime, but accidents occurring at night or in instrument conditions were more likely to prove fatal. Just 11% of accidents in day VMC were fatal compared to 21% of those that occurred in visual conditions at night and three of the four accidents that occurred in instrument meteorological conditions (IMC).

The preponderance of accidents in VMC during daylight hours likely reflects the underlying patterns of use; the FAA estimates that 77% of all helicopter flight time, including commercial operations, took place in day VMC, while barely 1% was in instrument conditions. (These estimates were not broken out separately for commercial and non-commercial flights.) If commercial operators did in fact log most of the actual instrument time, IMC may present non-commercial flights with both an increased risk of accidents and a greater likelihood of lethality in any accidents that do occur.

Pilot Qualifications

Figure 6 shows that more than three-quarters (76%) of the pilots involved in non-commercial helicopter accidents held commercial or airline transport pilot (ATP) certificates, and two-thirds of those were also certificated flight instructors (CFIs). This continues the pattern reported the year before, and marks a sharp contrast with non-commercial fixed-wing accidents, in which 63% of pilots-in-command held no certificate above the private pilot level (see Figure 11).

Unlike 2008, fatalities were least common in accidents involving commercial pilots or ATPs who were not CFIs; only three of 32 (9%) were fatal compared to 14% of accidents on flights commanded by either private pilots or CFIs. Barely half the accidents involving CFIs (34 of 66), including only one-third of the fatal accidents, occurred on instructional flights. About two-thirds of the rest (including four fatal accidents) occurred on working flights of various kinds, eight of them on public-use and seven on positioning flights.

HELICOPTER ACCIDENTS
Commercial

Only 30 accidents, four of them fatal, occurred in commercial helicopter operations in 2009. Eleven of these, none fatal, were during aerial application flights, which accounted for only 10% of commercial flight time. Two of seven accidents in external-load operations were fatal, as were two of the 12 that occurred on Part 135 flights. Neither of these were medical transports, though there were two non-fatal accidents on medical flights. The crash of a Sikorsky S-76 transporting workers to an oil platform in the Gulf of Mexico killed eight of the nine on board, while the Hudson River Corridor midair collision killed the pilot and all five passengers on the Eurocopter AS350 that collided with a Piper PA-32R. These two accidents accounted for 14 of the 16 deaths on commercial helicopter flights.

The overall accident rate ticked up slightly to 2.38 per 100,000 flight hours, but remained more than one-third below its ten-year average of 3.73. The rate of fatal accidents continued to decrease, dropping to its lowest level of the decade. The total number killed was 43% below the 28 who died in 2008 but still higher than in five of the preceding nine years.

Twenty-seven of the 30 accidents (90%), including all four fatals, took place in daytime VMC. One accident occurred in instrument conditions during the day and two in VMC at night. Only five of the accident helicopters had reciprocating engines, four of which were being used for aerial application (the other was a charter flight). Twenty-one of the 25 turbine-powered helicopters were single-engine models.

ACCIDENT CASE STUDY

ACCIDENT CASE STUDY #WPR09CA470

AIRCRAFT: Robinson R44

LOCATION: Mt. Charleston, Nevada

SEVERITY: One minor injury and two uninjured

HISTORY OF FLIGHT

The pilot departed the North Las Vegas airport in late afternoon to take two passengers on a sightseeing flight. After flying through Red Rock Canyon at 7,500 msl, they climbed to 11,500 en route to the 11,800-foot summit of Mt. Charleston. The pilot reported that he climbed to about 100 feet above the summit before orbiting it at an airspeed of 50 knots, only to encounter a downdraft on the leeward side that exceeded the helicopter's climb performance. The pilot raised collective and steered toward an open valley 5,000 feet below, but the helicopter hit the mountainside, tumbled, and caught fire. The pilot and passengers were able to evacuate before it exploded; one passenger suffered minor injuries. The emergency locator transmitter was destroyed, but after hiking back to the summit, they were able to call for help on a passenger's telephone.

PILOT INFORMATION

The 39-year-old airline transport pilot held ratings for airplane single-engine land, airplane multiengine land, and helicopter, with instrument ratings for airplanes and helicopters. He reported 2,578 hours of total flight experience including 359 hours in the accident make and model.

WEATHER

Conditions at the accident site included clear skies with unlimited visibility, winds from 260 degrees at 5 knots, a temperature of 8 degrees Celsius, and an altimeter setting of 29.78. Density altitude at the site was calculated at 13,918 feet. The service ceiling of the Robinson R44 is 14,000 feet.

PROBABLE CAUSE

The pilot's failure to maintain aircraft control and terrain clearance while maneuvering at a low altitude above high terrain. Contributing to the accident was a downdraft and high density altitude.

ASI COMMENTS

Density altitude isn't just a fixed-wing problem. Rotary-wing performance likewise degrades with increasing temperature, and strong updrafts and downdrafts can occur in the vicinity of mountain peaks even in generally calm air and light winds. Maneuvering close to the mountainside while at the limit of the helicopter's ability to climb left the pilot with few options when he encountered an unexpectedly powerful downdraft.

FIXED-WING ACCIDENTS
Summary and Comparison

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

Pilot-related: Accidents arising from the improper actions or inactions of the pilot.

Mechanical/maintenance: Accidents arising from mechanical failure of a component or an error in maintenance.

Other/unknown: Accidents for reasons such as pilot incapacitation, and those for which a specific cause has not been determined.

In 2009, the accident rate on commercial fixed-wing flights was less than half that of non-commercial aviation, and a smaller proportion of those accidents was attributed to pilot-related causes (Figure 7). The share attributed to either documented mechanical causes or unexplained losses of engine power was one and a half times as high on commercial flights (35% vs. 23%), but the rate of these failures per hours flown was actually lower (1.04 vs. 1.53 per 100,000 hours). The higher proportion thus represents a sharply lower rate of pilot-related mishaps. However, pilot-related causes still accounted for 60% of all commercial fixed-wing accidents.

FIGURE 7 : CAUSES OF FIXED-WING GENERAL AVIATION ACCIDENTS, 2009

	NON-COMMERCIAL		COMMERCIAL	
Major Cause	Accidents	Fatal Accidents	Accidents	Fatal Accidents
Pilot-related	829 70%	147 63%	50 62%	1 50%
Mechanical	203 17%	24 10%	23 28%	0 0%
Other or unknown	149 13%	62 27%	8 10%	1 50%

FIGURE 8 : AIRCRAFT CLASS: NON-COMMERCIAL FIXED-WING

Aircraft Class	Accidents	Fatal Accidents	Lethality
Single-engine fixed-gear	888 75%	152 64%	17%
SEF conventional gear	403	63	16%
Single-engine retractable	230 19%	62 26%	27%
Single-engine turbine	19	7	37%
Multiengine	72 6%	22 9%	31%
Multiengine turbine	17	4	24%

FIXED-WING ACCIDENTS

Non-Commercial

2009 saw the lowest overall number of accidents and second-smallest number of fatal accidents in the past decade, *but once again this was primarily due to decreased flight activity; the accident and fatal accident rates were near the upper ends of their recent ranges.* The fluctuations from the previous year in both the overall and fatal accident rates were again within the margin of error of the estimates of flight time. The proportions attributed to mechanical and pilot-related causes, respectively, are typical of patterns that have been observed for many years.

Aircraft Class

As in prior years, about three-quarters of the accident aircraft were single-engine fixed-gear (SEF). These were underrepresented among fatal accidents, accounting for 64% (Figure 8). Increasing aircraft speed and complexity were associated with fewer mishaps relative to the amount of time flown but more severe outcomes, with lethality increasing from 17% in fixed-gear singles to 27% in retractable singles and 31% in multiengine aircraft; these figures are similar to those reported in earlier years. Almost half (45%) of the fixed-gear singles had conventional landing gear (tailwheels), consistent with the greater proficiency demanded by conventional-gear aircraft that motivates the specific requirement for a tailwheel endorsement. Unlike in 2008, however, there was essentially no difference in SEF accident lethality between taildraggers and airplanes with tricycle gear.

Type of Operation

Once again, the vast majority (78%) of accidents occurred during personal flights (Figure 9), although personal flying made up less than 47% of all non-commercial flight time. These included 84% of all fatal accidents and caused 86% of individual fatalities. Instructional flights, on the other hand, occupied 16% of flight time and were involved in 13% of accidents, but only 9% of instructional accidents were fatal compared to 20% of accidents on other types of flights. This likely reflects both the tightly structured environment of flight training and the relatively low weight and speed of most primary training aircraft. Instructional flights also spend a high percentage of time in the traffic pattern, the site of a large number of minor accidents during takeoffs and landings. Corporate transport by professionally operated flight departments continued to have the best safety record in general aviation, with just two accidents, neither of them fatal, in more than 2.3 million hours flown. Business travel flown by people not primarily employed as pilots also fared well, accounting for 13% of overall flight time but just 4% of both fatal and non-fatal accidents.

FIGURE 9 : TYPE OF OPERATION: NON-COMMERCIAL FIXED-WING

Type of Operation	Accidents		Fatal Accidents		Fatalities	
Personal	933	78%	199	84%	344	86%
Instructional	150	13%	13	6%	23	6%
Public use	9	1%	1	<1%	1	<1%
Positioning	15	1%	3	1%	5	1%
Aerial observation	7	1%	2	1%	2	<1%
Business	25	2%	10	4%	16	4%
Other working use	30	3%	6	3%	8	2%
Other*	21	2%	2	1%	2	<1%

** Includes corporate, flight tests, and unreported*

FIGURE 10 : LIGHT AND WEATHER CONDITIONS: NON-COMMERCIAL FIXED-WING

Light/Weather	Accidents		Fatal Accidents		Lethality
Day VMC	1029	87%	155	67%	15%
Night VMC	88	7%	27	12%	31%
Day IMC	48	4%	39	17%	81%
Night IMC	16	1%	12	5%	75%

These results follow the pattern consistently reported in previous years, though the proportion of accidents that occurred on personal flights was the highest of the past decade.

Flight Conditions

Almost 95% of non-commercial fixed-wing accidents took place in VMC, and more than nine-tenths of those were during daylight hours (Figure 10). Not surprisingly, however, accidents at night were more often fatal, and lethality was two and a half times higher in accidents that occurred in IMC, when the pilot is less able to avoid obstacles or mitigate the severity of impact.

By FAA estimates, 76% of 2009's fixed-wing flight time was logged in daytime VMC, but this does not distinguish between commercial and non-commercial uses.

Pilot Qualifications

Private pilots were involved in 51% of all accidents and 56% of those that were fatal (Figure 11). They make up 36% of all active U.S. pilots but a larger share of those flying non-commercially, since they are ineligible to command commercial flights. For this reason, and because of the lack of reliable data on their risk exposure in terms of either number of flights or total flight hours, it is not clear whether private pilots are at excess risk compared to pilots at higher certification levels.

Private pilots are less likely to have sought advanced training and almost certainly spend a larger share of their flight time in personal flying, already noted as carrying a disproportionate accident risk. The 20% of active pilots who hold commercial certificates include full-time professional aviators, flight instructors with no other paid flying duties, and pilots who have never flown for pay, among other combinations. About 90% hold instrument ratings compared to 27% of private pilots. Airline transport pilots make up 24% of the population, but that number includes air-carrier and charter pilots whose non-commercial flying is largely limited to positioning legs in company aircraft. The 24% of accident flights commanded by commercial pilots and 13% flown by ATPs include all of the accidents in dual instruction and on positioning flights as well as most of those made for public benefit, aerial observation, and other types of aerial work. However, *two-thirds of all non-commercial accidents involving ATPs (104 of 156) and more than 60% of those befalling commercial pilots (174 of 280) occurred on personal flights.* These included 77% and 62% of fatal accidents, respectively, demonstrating once again the fundamental differences between the natures of personal and professional flight operations.

Accident lethality was essentially constant across certificate levels with one exception: accidents on student solos were only one-quarter as likely

FIGURE 11 : PILOTS INVOLVED IN NON-COMMERCIAL FIXED-WING ACCIDENTS

Certificate Level	Accidents	Fatal Accidents	Lethality
ATP	156 13%	31 13%	20%
Commercial	280 24%	58 25%	21%
Private	610 51%	132 56%	22%
Sport	27 2%	4 2%	15%
Student	94 8%	5 2%	5%
None	17 1%	3 1%	18%
Unknown or recreational	6 1%	3 1%	50%
Two pilots on board	153 13%	35 15%	23%
CFI on board*	248 21%	44 19%	18%
Instrument-rated pilot on board*	587 49%	130 55%	22%

** Includes single-pilot accidents*

FIGURE 12 : PILOT-RELATED ACCIDENT TREND

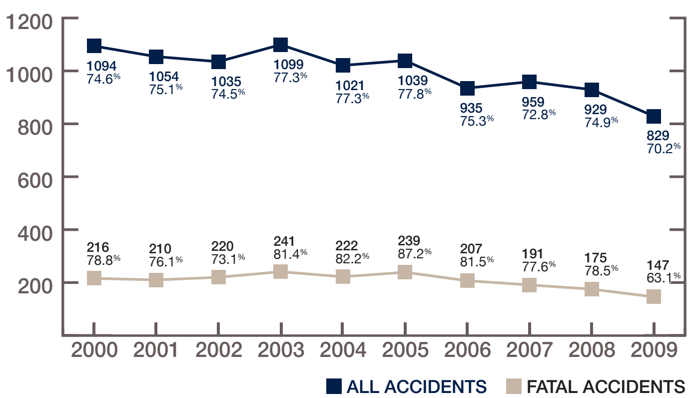
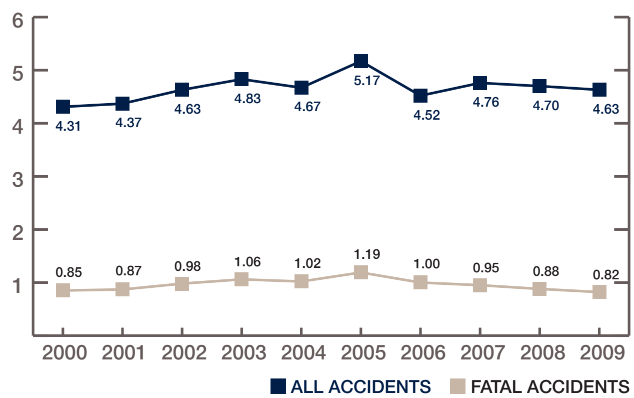


FIGURE 13 : PILOT-RELATED ACCIDENT RATES



to be fatal as accidents involving certificated pilots. This is consistent with both the conditions of flight, with almost all student solos taking place in daytime VMC, and the types of aircraft most typically flown. Student pilots make up 13% of the active population and commanded 8% of all accident flights but just 2% of fatal accidents. Of course, solos make up a relatively small share of a student pilot's flight time, and the CFI is pilot-in-command when providing dual instruction to a student pilot.

Only 153 (13%) of the accident flights were confirmed to have two certificated pilots on board; these included 35 (15%) of the fatal accidents, but there is little data available on the amount of non-commercial flying done with two-pilot crews. Instrument-rated pilots were on board 56% of the accident flights commanded by private, commercial, or airline transport pilots, slightly below the 61% of all pilots at those certificate levels who hold instrument ratings. The low number of accidents involving sport pilots is consistent with the relatively small number of sport pilot certificates issued, presently less than half of one percent of the population. Early returns for 2010 show an increase consistent with an increasing sport pilot population.

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, those that remain are considered pilot-related. Most pilot-related accidents reflect specific failures of flight planning or decision-making or the characteristic hazards of the high-risk phases of flight. Six major categories of pilot-related accidents consistently account for a large number of accidents overall, a high proportion of those that are fatal, or both. Mechanical failures and unexplained mishaps make up most of the rest.

Pilot-Related Accidents

829 total / 147 fatal

Pilot-related categories made up 70% of non-commercial fixed-wing accidents in 2009 and 63% of fatal accidents. These are slightly lower than the aggregate figures for the previous nine years: 75% of all non-commercial fixed-wing accidents and 80% of fatal accidents between 2000 and 2008 were classified as pilot-related.

While the number of pilot-related accidents has tended to decline in recent years (see Figure 12), this mirrors the overall decline in the number of non-commercial fixed-wing accidents, which is largely attributable to decreasing flight activity. The rate of pilot-related accidents has remained essentially constant over the same period, fluctuating between 4.3 and 5.2 per 100,000 flight hours (Figure 13). The rate of 4.63 in 2009 is typical of the past decade, though the rate of fatal pilot-related accidents has declined for

ACCIDENT CASE STUDY

ACCIDENT CASE STUDY #CEN09FA230
AIRCRAFT: Cessna 337C
LOCATION: Stillwater, Oklahoma
SEVERITY: One fatality

HISTORY OF FLIGHT

The aircraft departed from a private strip about 45 minutes after sunset. Five witnesses saw it turn east, then return to the airstrip westbound before turning south and then east before suddenly pitching down and crashing into a small pond at the bottom of a ravine. Three of the witnesses, including a retired CFII / MEI, described the engines as “running rough” or “misfiring,” and four of them reported that the engine noise stopped altogether just before the crash.

Investigators found no evidence of pre-impact malfunctions in the engines or flight controls. The left main and auxiliary tanks contained about three gallons of fuel apiece, while the two right tanks contained less than one gallon combined. Impact damage made it impossible to determine the position of the fuel selectors. The rear engine’s gascolator was empty; the front engine was submerged, and its gascolator contained only water.

The airfield from which the airplane departed was seven nm south of Stillwater Regional Airport. The purpose of the flight was reportedly to buy fuel.

PILOT INFORMATION

The 58-year-old airline transport pilot reported 23,260 hours of total flight experience on his last application for a third-class medical certificate, issued 21 months before the accident. He held ratings for airplane single-engine land, airplane multiengine land, and instrument airplane. His experience in the accident make and model was not reported.

WEATHER

Stillwater Regional Airport, 10 miles from the accident site, reported winds from 050 degrees at 10 knots, clear skies, and 10 miles visibility in dark night conditions.

PROBABLE CAUSE

The total loss of power in both engines due to fuel exhaustion as a result of the pilot’s inadequate fuel planning.

ASI COMMENTS

There was no usable fuel in the two right tanks and less than five gallons of usable fuel in the two left tanks combined. This means that the previous flight ended not only with far less than the one hour’s fuel the Air Safety Institute recommends as an absolute minimum reserve, but an amount well below any legal requirement. There is no rational explanation for this mishap.

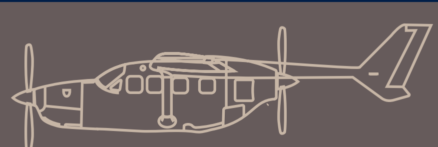


FIGURE 14 : TYPES OF PILOT-RELATED ACCIDENTS

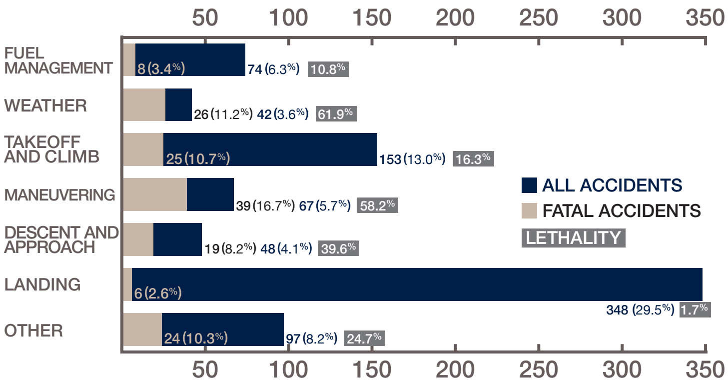


FIGURE 15 : FUEL MANAGEMENT ACCIDENT TREND

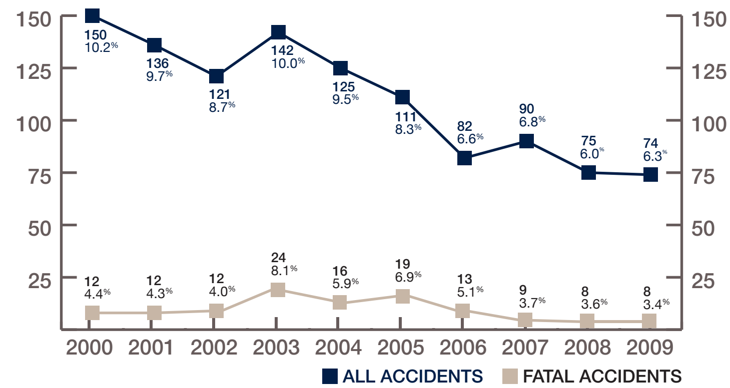


FIGURE 16 : TYPES OF FUEL MANAGEMENT ACCIDENTS

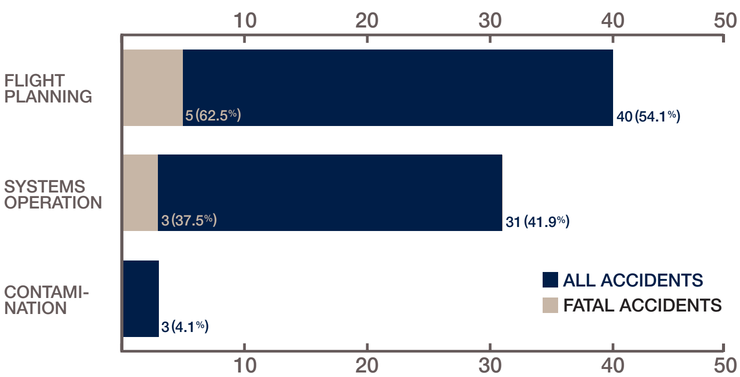


FIGURE 17 : AIRCRAFT INVOLVED IN FUEL-MANAGEMENT ACCIDENTS: NON-COMMERCIAL FIXED-WING

Aircraft Class	Accidents	Fatal Accidents	Lethality
Single-engine fixed-gear	45 61%	3 38%	7%
SEF conventional gear	17	2	12%
Single-engine retractable	25 34%	3 38%	12%
Multiengine	4 5%	2 25%	50%

four consecutive years. The stability of the pilot-related accident rate suggests that an increasing number of mechanical accidents (see page 28) rather than any improvement in this area is the principal reason a smaller percentage of 2009's accidents were found to be pilot-related.

The number of accidents in each major category is shown in Figure 14. As always, bad landings damaged the most airplanes but were almost never fatal; weather and maneuvering accidents were much less common, but almost 60% were deadly.

The "Other" category of pilot-related accidents includes a wide variety of accident types that accounted for relatively few events apiece. Among them were:

- 25 accidents attributed to inadequate preflight inspections; three were fatal
- 25 accidents, five of them fatal, during attempted go-arounds
- Ten midair collisions of which seven were fatal; five were between two airplanes flown non-commercially, two involved an airplane and a helicopter, and one each involved collisions between a non-commercial airplane and a commercial airplane, a glider, and a powered parachute
- Four accidents, two of them fatal, were blamed on impairment of the pilots by alcohol or drugs
- Four non-fatal collisions with other aircraft while taxiing, and another 20 non-fatal taxi accidents that did not involve other aircraft
- Four fatal accidents in cruise flight; one appeared to be controlled flight into terrain while the other three involved in-flight losses of control
- Two fatal accidents in which the pilots appear to have been incapacitated by hypoxia
- Two non-fatal prop strikes, and one collision with Canada geese during the landing roll

While the judgment leading to any pilot-related accident could be called into question, fuel-management and weather accidents can be seen primarily as failures of flight planning and in-flight decision-making. Accidents occurring during takeoff and climb, maneuvering, descent and approach, and landing tend to result more directly from deficient airmanship, though it may have been faulty decision-making that placed the pilots in situations beyond their skills.

Accident Causes: Flight Planning and Decision-Making

Fuel Management

74 total / 8 fatal

After declining steadily over the previous ten years, the number of fuel-management accidents leveled off in 2009 (Figure 15); the 74 total

ACCIDENT CASE STUDY

ACCIDENT CASE STUDY #ERA09FA185
AIRCRAFT: Cessna 182P
LOCATION: Carrollton, Georgia
SEVERITY: Three fatalities

HISTORY OF FLIGHT

The pilot and two passengers departed shortly after 8:00 a.m. to attend a stock-car race. No flight plan was filed, and there is no record of the pilot having obtained a weather briefing. Conditions at the point of departure included broken ceilings at 1,500 feet, seven statute miles visibility, and a two-degree temperature-dewpoint spread. The destination airport was only 40 nm away, but a direct route would have passed directly through the core of Atlanta's Class B airspace. Instead, the pilot followed an arc around the west side of the city. Forty minutes after departure, a witness heard a "whining high-speed sound" followed by an impact, and saw water spouting up from the surface of a private lake. The fragments of the airplane were eventually recovered from 16 feet of water. Examination of the wreckage revealed no evidence of damage or malfunction prior to impact.

PILOT INFORMATION

The pilot, age 51, received a private pilot certificate for airplane single-engine land just over one year before the accident. He did not hold an instrument rating. His logbook showed 168 hours of total flight time, 130 of them in the accident make and model, which included 70 hours as pilot-in-command, 3.2 hours in simulated instrument conditions, and no time in actual instrument conditions.

WEATHER

Witnesses at the scene described the weather as "very foggy," with "low cloud cover" and fog over the surface of the lake. The nearest airport, 26 miles to the southeast, reported 5 statute miles visibility under a 500-foot overcast five minutes before the accident, decreasing to 300 feet overcast, a quarter mile visibility, and no difference between temperature and dewpoint 20 minutes later.

PROBABLE CAUSE

The pilot's decision to continue visual flight rules flight into an area of reduced visibility weather conditions, which resulted in disorientation and subsequent loss of aircraft control.

ASI COMMENTS

Attempts to fly by visual references in instrument conditions continue to claim pilots at all levels of experience and, worse, their passengers. Those without the training to fly by instrument references are highly susceptible to spatial disorientation culminating in the loss of aircraft control, while instrument-rated pilots have a better chance of maintaining controlled flight until they hit structures or terrain. The results are equally deadly either way: Over the past ten years, 86% of VFR-into-IMC accidents have been fatal, causing 518 individual deaths.

FIGURE 18 : WEATHER ACCIDENT TREND

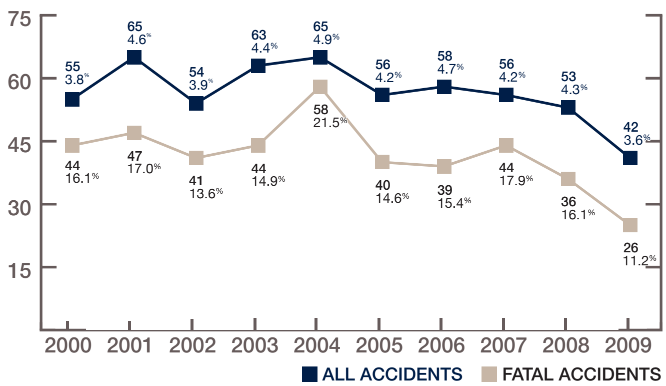


FIGURE 19 : TYPES OF WEATHER ACCIDENTS

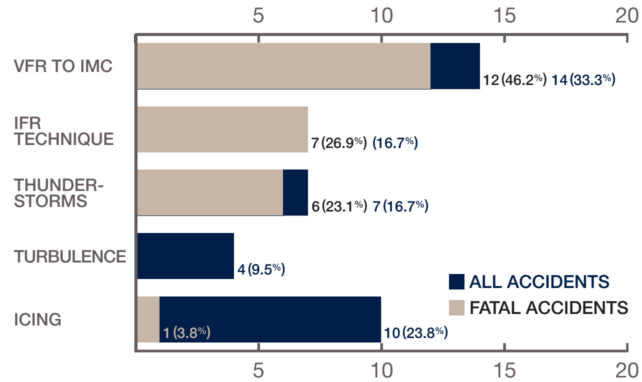


FIGURE 20 : AIRCRAFT INVOLVED IN WEATHER ACCIDENTS: NON-COMMERCIAL FIXED-WING

Aircraft Class	Accidents	Fatal Accidents	Lethality
Single-engine fixed-gear	33 79%	19 73%	58%
SEF conventional gear	11	5	45%
Single-engine retractable	7 17%	5 19%	71%
Multiengine	2 5%	2 8%	100%

and eight fatal accidents were just about the same as in 2008. However, fuel management remains one of the brighter points in the GA record. The number of fuel-management accidents has dropped by more than half since 1999, and they now represent about 6% of all non-commercial fixed-wing accidents compared to 10% a decade earlier. Technological improvements involving fuel-flow computers and glass cockpits as well as increased pilot awareness have both contributed to this encouraging trend.

Deficient flight planning – failures to determine the fuel requirements for the intended flights, to verify the quantity of fuel on board, or to make timely decisions to divert for fuel in the face of changing circumstances – remained the most common cause of fuel-management accidents, causing 54% of the total and five of eight fatal accidents (Figure 16). Forty-two percent, including the three remaining fatal accidents, were traced to errors in fuel system management, typically the failure to select a tank with usable fuel or the inappropriate use of boost or transfer pumps. Only three non-fatal accidents were blamed on fuel contamination, all by water.

Single-engine airplanes with retractable gear were involved in 34% of 2009's fuel-management accidents (Figure 17) but made up only 19% of the accident fleet overall. This is not surprising, since these aircraft fly cross-country to a much higher degree than light fixed-gear singles. Only one occurred in IMC, while 85% took place in visual meteorological conditions in daylight. Private pilots commanded 65% of the accident flights, including five of the eight that were fatal. For the second straight year, there were no fuel-management accidents on student solos.

Weather

42 total / 26 fatal

Bad weather caused fewer accidents in 2009, both in absolute numbers and as a percentage of the overall accident record, and a smaller proportion were fatal (Figure 18). The 42 weather accidents represent a 21% decrease from 2008, when there were 53 – itself the lowest count of the preceding decade. The 26 fatal weather accidents constituted 11% of 2009's fatal accidents, one-third less than the average of 16% seen between 2000 and 2008. The 62% lethality of weather accidents was still the highest of any major category, but less than two-thirds for the first time, and well below the overall 75% during the preceding nine years. *This is the first meaningful improvement in the weather accident record of the past decade; compared to the peak year of 2004, the number of accidents was more than one-third*

FIGURE 21 : FLIGHT CONDITIONS OF WEATHER ACCIDENTS: NON-COMMERCIAL FIXED-WING

Light/Weather	Accidents		Fatal Accidents		Lethality
Day VMC	14	33%	3	12%	21%
Night VMC	4	10%	2	8%	50%
Day IMC	18	43%	16	62%	89%
Night IMC	6	14%	5	19%	83%

FIGURE 22 : PILOTS INVOLVED IN WEATHER ACCIDENTS: NON-COMMERCIAL FIXED-WING

Certificate Level	Accidents		Fatal Accidents		Lethality
ATP	4	10%	0		
Commercial	9	21%	6	23%	67%
Private	29	69%	20	77%	69%
CFI on board	3	7%	1	4%	33%
IFR pilot on board	22	52%	12	46%	55%

lower, and the number of fatal accidents decreased by more than half.

The most common type of weather accident, and one of the most consistently fatal, continues to be the attempt to fly by visual references in instrument meteorological conditions, often called "VFR into IMC" (Figure 19). There were 14 VFR-into-IMC accidents in 2009, of which 12 (86%) were fatal. The same lethality was seen in thunderstorm encounters, where six out of seven were fatal, as were all seven attributed to deficient execution of instrument procedures by appropriately rated pilots on instrument flight plans. However, the number of VFR-into-IMC accidents was still one-third lower than a year earlier, when there were 21 (with 18 fatal).

There were 10 icing accidents, about the same as the year before, but nine of these aircraft escaped without fatalities. Only four accidents were attributed to turbulence outside thunderstorm encounters, and everyone on board survived.

The proportion of weather accidents involving multiengine and retractable-gear airplanes was only 22%, barely half the 40% seen in 2008 (Figure 20). It is not clear whether this reflects improvement in the record of higher-end aircraft or a shift of use to simpler and less expensive airplanes, perhaps in reaction to economic conditions. Five of the 42 accident aircraft were amateur-built, including four of the 26 involved in fatal accidents.

Weather was above VFR minimums at 43% (18) of the accident sites, including five where the accident chain began in instrument conditions (Figure 21). These included only 19% of the fatal accidents. Twenty-one of 24 accidents in IMC were fatal (88%).

Two-thirds of the pilots involved (69%) held private certificates (Figure 22), a somewhat higher proportion than of accident pilots in general, but more than half of all the pilots in weather accidents were instrument-rated. For the third consecutive year, no student pilots suffered weather accidents.

Accident Causes: High-Risk Phases of Flight

Takeoff and Climb

153 total / 25 fatal

It is possible that many pilots underestimate the risks inherent in the takeoff phase, when aircraft are operating at high power settings and angles of attack while accelerating close to the ground. Takeoffs consistently see the second highest number of accidents and cause more than 10% of those that are fatal. After five years of modest decline, the number of takeoff and climb accidents

ACCIDENT CASE STUDY

ACCIDENT CASE STUDY #CEN09FA393
AIRCRAFT: Piper PA32R-300
LOCATION: Lakeview, Arkansas
SEVERITY: Three fatalities, one seriously injured, one minor injury

HISTORY OF FLIGHT

The pilot attempted to take off with four passengers from a 3,200-foot grass airstrip on a calm summer morning. A videotape showed the airplane's nose lifting off the turf about one-third of the way down the runway; the airplane maintained a nose-high attitude until the end of the strip, where it lifted off before disappearing into a depression in the terrain. It briefly climbed back into sight, still nose-high with the wings "wig-wagging," before the propeller hit a barbed-wire fence and then a tree, which sheared off the airplane's left wing. The pilot and the two left-side passengers were killed; the passenger in the right middle seat was seriously injured, while his father, in the right front seat, escaped with minor injuries.

Examination of the wreckage showed that the flaps had been up during the take-off attempt, though the pilot's operating handbook estimated that using 25 degrees of flaps would shorten the takeoff roll by almost one-third. Investigators found that the airplane was at least 188 pounds over its certified maximum gross weight at takeoff, with a center of gravity close to but within the aft limit. The airplane's operator suggested that the aft CG might have contributed to a tendency to pitch up, preventing it from gaining flying airspeed.

PILOT INFORMATION

The instrument-rated private pilot was 52 years old. His logbook showed 673.8 hours of total flight experience, including 567.4 hours as pilot-in-command and 165.3 in the accident make and model. He had completed a flight review in the same airplane three months before the accident.

WEATHER

Eleven minutes before the accident, an airport five miles to the east reported calm winds, with clear skies and 6 miles visibility in haze. Temperature was 27 degrees Celsius with a dew point of 23 and altimeter setting of 29.91. Density altitude at the point of departure was estimated at 2,367 feet; field elevation is 479 msl.

PROBABLE CAUSE

The pilot's poor judgment/decision making in attempting the no-flap takeoff, his failure to comply with weight limitations, and his failure to calculate the airplane's performance under existing conditions.

ASI COMMENTS

When maximum performance must be extracted from the aircraft, correct configuration is essential. The NTSB calculated that with flaps up, the airplane would have needed 3,190 feet to clear a 50-foot obstacle, just 10 feet less than the runway length. With 25 degrees of flaps, that distance would have been cut to 1,870 feet.

FIGURE 23 : TAKEOFF AND CLIMB ACCIDENT TRENDS

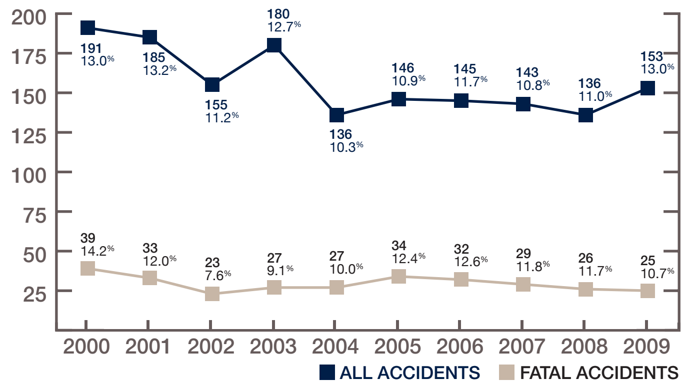


FIGURE 24 : TYPES OF TAKEOFF AND CLIMB ACCIDENTS

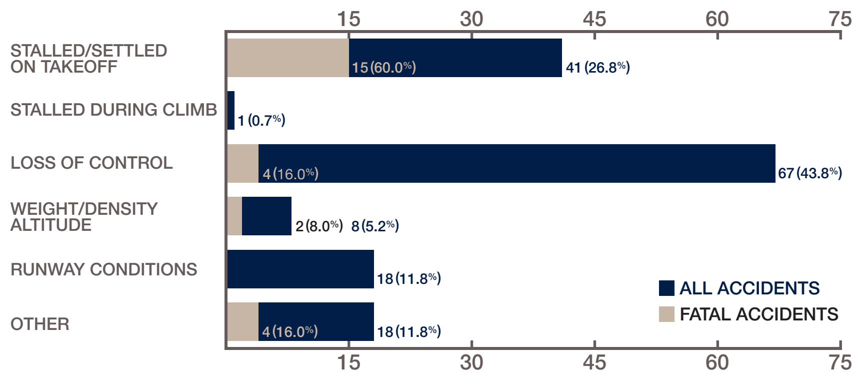


FIGURE 25 : AIRCRAFT INVOLVED IN TAKEOFF AND CLIMB ACCIDENTS: NON-COMMERCIAL FIXED-WING

Aircraft Class	Accidents		Fatal Accidents		Lethality
Single-engine fixed-gear	132	86%	17	68%	13%
SEF conventional gear	59		9		15%
Single-engine retractable	14	9%	5	20%	36%
Multiengine	7	5%	3	12%	43%

jumped to its highest level since 2003 (Figure 23), though the number of fatal takeoff and climb accidents was the second-lowest of the decade. The proportion of accidents occurring during takeoff and initial climb increased from 11% in 2008 to 13% in 2009, but as a proportion of fatal accidents they actually decreased slightly.

Loss of aircraft control remains the most common cause of takeoff accidents, accounting for 67, or 44% of the total (Figure 24). The deadliest type of takeoff accident was the departure stall, involved in 27% overall (41 of 153) but 60% of fatal accidents (15 of 25). Eighteen accidents, none fatal, were caused by attempts to take off from runways that were slick, contaminated, or unsuitable for reasons of length, slope, or prevailing winds. Eight (including two fatal) were attributed to overweight aircraft and/or high density altitudes, while the 18 “other” accidents included collisions with vehicles, animals, and other unexpected obstructions, errors in the use of carburetor heat, and overruns due to delayed decisions to abort the takeoff.

Takeoff accidents followed the overall patterns of non-commercial fixed-wing aircraft in terms of the classes of aircraft involved (Figure 25) except perhaps for a greater increase in lethality among retractable-gear and multiengine aircraft. Again, this is consistent with the greater impact forces created by heavier weights and greater speed. Every one took place in VMC, and 96% took place during daylight hours, including 23 of 25 (92%) of the fatal accidents. The certificate levels of the pilots involved mirrored those of all accident pilots almost exactly.

Maneuvering

67 total / 39 fatal

While a higher proportion of weather accidents are fatal, more fatal accidents occur in maneuvering flight than any other pilot-related category (Figure 26), a pattern that continued to hold in 2009. Thirty-nine of 67 were fatal (58%), a decrease from 66% the year before but toward the middle of the range for the preceding decade. Some of the accident maneuvers (such as turns in the airport traffic pattern) were necessary but poorly executed. Others were risky activities like buzzing attempts, low-altitude night flights, or attempted aerobatics by untrained

ACCIDENT CASE STUDY

ACCIDENT CASE STUDY #WPR09FA235
AIRCRAFT: Beech BE-95-A55
LOCATION: Minden, Nevada
SEVERITY: Five fatalities

HISTORY OF FLIGHT

The pilot invited four friends to go for a local flight at the end of a day's work on a neighboring ranch. Numerous witnesses, including two other pilots, saw the airplane make several passes over the ranch and nearby houses at altitudes as low as 100 feet, and a hiker on a nearby ridge photographed it flying three to four wingspans above the valley floor. At the end of the last pass, the airplane pulled up sharply before banking hard to the left and dropping nose-first into the ground. The witnesses reported that the engines sounded smooth and strong until the moment of impact, and physical evidence suggested that they were producing full power until then.

PILOT INFORMATION

The pilot, age 58, operated an aircraft maintenance and sales business. He held an aircraft and powerplant certificate with inspection authorization, a private pilot certificate with instrument rating for airplane single-engine land, and a multiengine rating limited to VFR flight. Friends confirmed that he was in the habit of making only required logbook entries such as flight reviews, but the previous December his application for a third-class medical certificate had reported 4,700 hours of total flight experience, including 90 hours in the preceding six months.

WEATHER

Conditions at the South Lake Tahoe airport, 13 nm from the accident site, reported clear skies and 10 miles visibility, with winds from 220 degrees at 8 knots gusting to 14.

PROBABLE CAUSE

The pilot's failure to maintain an adequate airspeed while maneuvering during a low altitude maneuver that resulted in a stall.

ASI COMMENTS

Even experienced pilots don't always understand the aerodynamics of accelerated stalls. The high loads produced by abrupt maneuvers cause stalls at speeds well above those listed in the pilot's operating handbook, and the resulting break will be more sudden and violent than those typically encountered while practicing airwork. At low altitude, recovery is probably impossible – another fact that makes buzzing a thoroughly bad idea.

FIGURE 26 : MANEUVERING ACCIDENT TRENDS

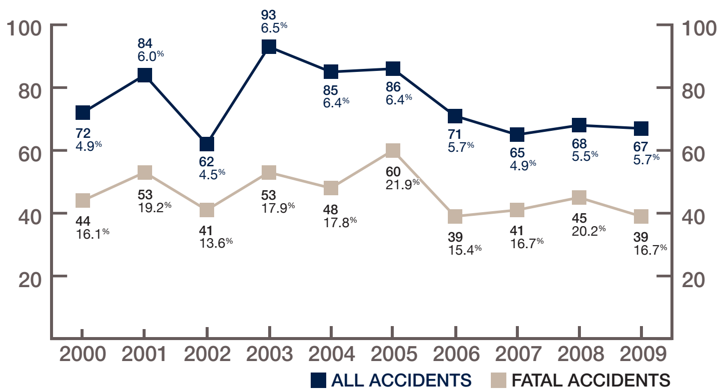


FIGURE 27 : TYPES OF MANEUVERING ACCIDENTS

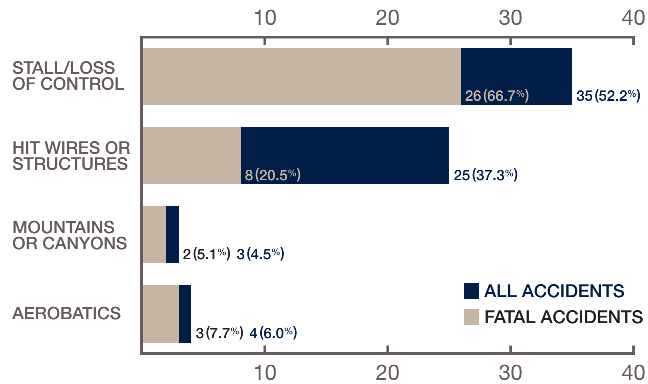


FIGURE 28 : AIRCRAFT INVOLVED IN MANEUVERING ACCIDENTS: NON-COMMERCIAL FIXED-WING

Aircraft Class	Accidents		Fatal Accidents		Lethality
Single-engine fixed-gear	52	78%	28	72%	54%
SEF conventional gear	28		17		61%
Single-engine retractable	9	13%	8	21%	89%
Multiengine	6	9%	3	8%	50%

FIGURE 29 : PILOTS INVOLVED IN MANEUVERING ACCIDENTS

Certificate Level	Accidents		Fatal Accidents		Lethality
ATP	10	15%	6	15%	60%
Commercial	22	33%	12	31%	55%
Private	32	48%	21	54%	66%
Sport	1	1%	0		
Student	1	1%	0		
None	1	1%	0		
CFI on board	19	28%	10	26%	53%

pilots and/or in unapproved aircraft. Most were initiated at low altitudes, giving the pilots little time or room to respond if anything went wrong.

More than half (35 of 67) began with stalls or other losses of aircraft control at altitudes too low to allow recovery (Figure 27). This indicates that these accidents were more tied to poor judgment than lack of knowledge or skill, and three-quarters of them were fatal. Collisions with wires, structures, or other obstacles caused 25 of the remaining 32, but in 17 of them everyone on board survived. On the other hand, three of the four aerobatic accidents and two of the three canyon impacts proved fatal.

Most maneuvering accidents happened in fixed-gear singles (Figure 28), and more than half of those had conventional landing gear. Six multiengine airplanes were involved, and half of those accidents were fatal along with eight out of nine in single-engine retractables.

All but one took place in VMC, and only two were at night; 96% occurred in VMC during daylight hours. Commercial or airline transport pilots flew 48% of the accident aircraft, a proportion one-third higher than among accident pilots overall (Figure 29). Unlike 2008, only one of the accident aircraft was flown by an unlicensed pilot. Nineteen flights, 28% of the total, had at least one CFI on board, but only nine of these accidents occurred on instructional flights.

Descent and Approach

48 total / 19 fatal

The number of descent and approach accidents also decreased in 2009, both in absolute numbers and as proportions of both fatal and non-fatal accidents, reaching the lowest levels of the past decade (Figure 30). These are defined as accidents occurring 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 instrument flights. Their 40% lethality was likewise more than one-fifth lower than in recent years; it averaged 51% between 2000 and 2008. The 49 resulting fatalities represent a 13% decrease from 56 the year before.

Figure 31 shows that the largest number of these were caused by either stalls or collisions with obstacles or terrain (20 each). Stall/spin accidents caused 29 of the 49 individual casualties (59%), and 15 others died in collisions. The most consistently lethal category was improperly executed

ACCIDENT CASE STUDY

ACCIDENT CASE STUDY #CEN10FA069
AIRCRAFT: Beech A36
LOCATION: Eagle Pass, Texas
SEVERITY: One fatality

HISTORY OF FLIGHT

The pilot departed from Kerrville, Texas before dawn and received his IFR clearance from the Houston Air Route Traffic Control Center. After discussion of the weather, the pilot reported visual contact with a local landmark and said he thought he saw the field, but requested the GPS approach to Runway 31 “to make sure.” He also advised that in the event of a missed approach, he’d divert to Uvalde. No further communications were received from the pilot after he was cleared for the approach and a change to the local advisory frequency.

Radar track data indicated that the Bonanza proceeded inbound to the airport but drifted off to the east. Just after the last radar contact at 1,200 feet, it collided with the airport fence on a course aligned with the east perimeter road. A post-impact fire destroyed the airplane.

PILOT INFORMATION

The 73-year-old pilot held an airline transport pilot certificate for airplane multiengine land, a commercial certificate with instrument rating for airplane single and multiengine land and sea, and a commercial certificate for gliders, as well as a flight instructor certificate for single- and multiengine airplane, instrument airplane, and glider. He was issued a first-class medical certificate three months before the accident. At that time, he reported 28,425 hours of flight experience, including 150 hours in the preceding six months.

WEATHER

No reports were available within 30 miles of the accident site. At Laughlin Air Force Base and Del Rio, Texas, 33 and 38 miles northeast, respectively, conditions included indefinite ceilings and visibility less than a quarter mile in fog. Uvalde, 45 miles to the northwest, reported clear skies and 10 miles visibility. Winds were generally light or calm throughout the area, with no differences between temperatures and dewpoints. The accident occurred almost an hour and a half before sunrise.

PROBABLE CAUSE

The pilot’s decision to continue the approach below minimums without visual references, and subsequent collision with the perimeter fence/terrain.

ASI COMMENTS

No matter how expert the pilot or how familiar the airport, nothing less than unequivocal visual contact with the runway environment allows a safe descent below the MDA. Collisions with obstacles are particularly lethal in low-visibility conditions, as the pilot is usually unable to see the obstruction in time to mitigate the impact.

FIGURE 30 : DESCENT/APPROACH ACCIDENT TREND

FIGURE 31 : TYPES OF DESCENT/APPROACH ACCIDENTS

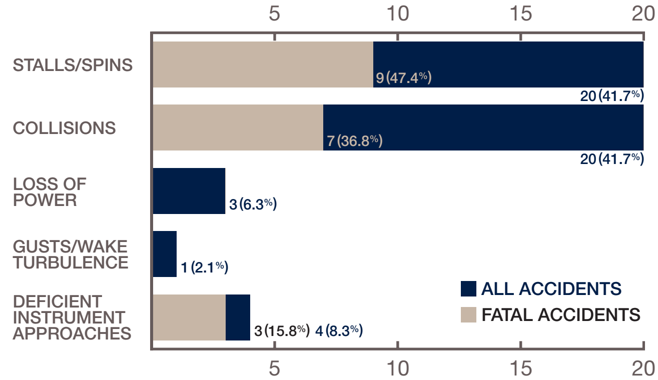


FIGURE 32 : AIRCRAFT INVOLVED IN DESCENT/APPROACH ACCIDENTS: NON-COMMERCIAL FIXED-WING

Aircraft Class	Accidents	Fatal Accidents	Lethality
Single-engine fixed-gear	33 69%	8 42%	24%
SEF conventional gear	15	2	13%
Single-engine retractable	11 23%	7 37%	64%
Multiengine	4 8%	4 21%	100%

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

Light/Weather	Accidents	Fatal Accidents	Lethality
Day VMC	31 65%	8 42%	26%
Night VMC	7 15%	3 16%	43%
Day IMC	7 15%	6 32%	86%
Night IMC	3 6%	2 11%	67%

instrument approaches, usually involving descents below the published minimum altitude for a segment or descents below the minimum descent altitude or decision height without the required visual references. Three out of four were fatal, causing five deaths. However, four accidents of this type marked a two-thirds reduction from the 12 (all fatal) that occurred in 2008.

The classes of aircraft involved resemble the overall accident distribution (Figure 32), but accident lethality was sharply higher in retractable-gear singles and multiengine airplanes. Higher approach speeds and greater mass contribute to more violent impacts.

More than one-third of descent/approach accidents (35%) happened at night and/or in IMC (Figure 33), and 11 of 17 (65%) were fatal compared to 26% of accidents in daytime VMC. Sport pilots were involved in just two non-fatal accidents (Figure 34). At all higher certificate levels, about 40% of descent/approach accidents were fatal.

Landing

348 total / 6 fatal

The largest number of accidents consistently occur during the landing phase, but these produce almost no fatalities. The number of landing accidents in 2009 decreased by 65 from the 2008 total of 413 (Figure 35); this was more than the total decrease of 60 in all non-commercial fixed-wing accidents. Landing accidents made up the smallest proportion of all accidents since 2003, the last time they accounted for less than 30%. The number of fatal accidents increased from four to six, still less than 3% of all fatal accidents, and the lethality of landing accidents remained below 2%. The low lethality of landing accidents is usually attributed to the low and decreasing speed of the aircraft and the fact that positive control is generally maintained until very close to the initial point of impact. Being on, or at least close to, the runway usually eliminates most obstacles.

The types of landing accidents remain fairly constant as well (Figure 36). Losses of directional control accounted for more than half (56%), and more than one-third of those were blamed at least in part on wind conditions, most often gusts and crosswinds (or, perhaps more appropriately, the pilot's

ACCIDENT CASE STUDY

ACCIDENT CASE STUDY #ERA09LA176
AIRCRAFT: Piper PA28-140
LOCATION: Ridgeland, South Carolina
SEVERITY: One fatality, one seriously injured

HISTORY OF FLIGHT

After taking off from Runway 21, the pilot felt that the engine was not producing sufficient power, and completed the traffic pattern to make a normal landing. He reported that the airplane never climbed above 500 agl. A second engine run-up seemed normal, and the pilot made a second takeoff from Runway 21. The engine again seemed underpowered, and the pilot elected to turn 180 degrees and land on Runway 3. Witnesses described the airplane banking back toward the runway from a low altitude before the right wing struck the pavement. The gear collapsed, and the fuselage suffered impact damage from the firewall back to the trailing edges of both wings. Four days after the accident, the passenger succumbed to his injuries.

PILOT INFORMATION

The 48-year-old private pilot reported 160 hours of total flight experience, including 40 in the accident make and model. The 74-year-old passenger was the pilot's father. He held an airline transport pilot certificate for airplane single-engine land, a commercial pilot certificate for airplane multiengine land, airplane single-engine sea, and glider, a flight instructor's certificate for airplane single-engine land and instrument airplane, and an airframe and powerplant mechanic's certificate with inspection authorization. He had previously served as an FAA accident-scene investigator.

WEATHER

Beaufort Marine Corps Air Station (NBC), located 14 nautical miles east of the accident site, reported a broken ceiling at 6,500 feet, 7 statute miles visibility, with winds from 180 degrees at 5 knots.

PROBABLE CAUSE

The pilot's failure to maintain control of the airplane during a precautionary landing. Contributing to the accident was a partial loss of engine power for undetermined reasons.

ASI COMMENTS

Attempting a sharp turn back to the runway from low altitude is a perilous exercise. With the engine still producing some power, a wider, more gradual turn would have offered better alignment with the runway and the hope of a softer touchdown. In this case, the pilot's decision to take off a second time after failing to diagnose and remedy the engine's apparent lack of power was unfortunate.

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

Certificate Level	Accidents		Fatal Accidents		Lethality
ATP	8	17%	3	16%	38%
Commercial	14	29%	6	32%	43%
Private	23	48%	9	47%	39%
Sport	2	4%	0		
None	1	2%	1	5%	100%

FIGURE 35 : LANDING ACCIDENT TRENDS

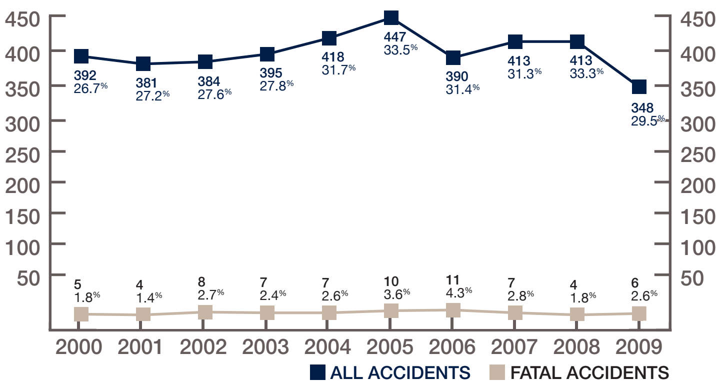
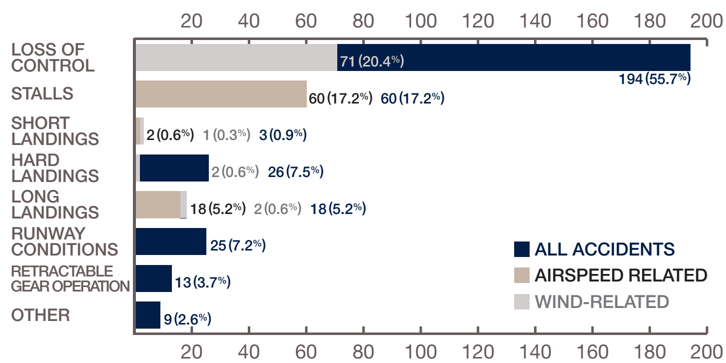


FIGURE 36 : TYPES OF LANDING ACCIDENTS



inability to handle prevailing winds). Stalls (17%), hard landings (7%), and runway conditions (7%) made up almost another third. Eighteen long landings resulted in overruns, and only 13 accidents were caused by errors in operating retractable gear systems. However, the majority of gear-up landings are not considered accidents under the definition set forth in 49 CFR Part 830. Only three aircraft came up short of the runway for reasons unrelated to mechanical problems or powerplant function.

Four-fifths of the accident airplanes were fixed-gear singles, and almost half of those (48%) were tailwheel models (Figure 37). However, half of the six fatal accidents were in multiengine airplanes or retractable-gear singles. Only three landing accidents took place in IMC, and none of those were at night. Just 19 occurred in visual conditions at night, so 94% of all landing accidents were in VMC during the daytime.

Not surprisingly, landing accidents are the only category that includes a disproportionate share of student pilots (Figure 38). Students made up almost one-sixth of the pilots who suffered landing accidents (57 of 348), more than double the share of students among accident pilots overall, and more than 60% of all accidents involving student pilots were landing mishaps. CFIs share some responsibility for this. There has not been a fatal landing accident on a fixed-wing student solo since 2001.

Mechanical / Maintenance

203 total / 24 fatal

While accidents caused by mechanical failures or improper maintenance remained relatively rare, 2009 saw sharp increases in both their number and severity (Figure 39). The number of mechanical accidents jumped 19% to 203, the second-highest count since 2004, and these made up a greater proportion of the overall accident record than at any time in the past 20 years. Twenty-four of them were fatal, a 60% increase from the near-record low of the year before. The 12% lethality of mechanical accidents was the highest since 2004, and they caused a larger share of all fatal accidents than in any year since 2002. Possible explanations could include the deterioration of

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

Aircraft Class	Accidents		Fatal Accidents		Lethality
Single-engine fixed-gear	280	80%	3	50%	1%
SEF conventional gear	133		1		1%
Single-engine retractable	49	14%	2	33%	4%
Multiengine	19	5%	1	17%	5%

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

Certificate Level	Accidents		Fatal Accidents		Lethality
ATP	41	12%	0		
Commercial	66	19%	1	17%	2%
Private	180	52%	5	83%	3%
Sport	3	1%	0		
Student	57	16%	0		
None	1	<1%	0		
CFI on board	77	22%	1	17%	1%

components in aircraft that are flown less frequently and decisions by some owners to defer maintenance or repairs during times of financial difficulty.

The most common cause of mechanical accidents, as in past years, was powerplant failure, implicated in 89 (44% of the total) that included two-thirds of the 24 fatal accidents (Figure 40). Gear and brake malfunctions caused 53 accidents (26%), but none were fatal. As in 2008, the second-highest number of fatal accidents and second-greatest lethality came from failures in airframes and primary flight controls, where five accidents out of 19 were fatal, as was the one accident attributed to vacuum system or instrument failure. Fuel-system discrepancies led to 29 accidents (14%), including two that were fatal, while there were no fatalities among the 12 accidents attributed to electrical problems. The relative frequencies of the different types of mechanical accidents have remained quite stable over the years.

Despite their greater complexity, multiengine airplanes were not involved in a disproportionate number of mechanical accidents (Figure 41), but the proportion involving retractable-gear singles was two-thirds higher than in all other types of accidents combined (29% compared to 17%), and these accidents were almost 60% more likely to be fatal. However, there were no fatal mechanical accidents in multiengine airplanes in 2009.

More than half the fatal mechanical accidents (13 of 24) occurred in amateur-built airplanes, which also accounted for 56 of the 203 mechanical accidents overall (28%). By comparison, the FAA estimates that amateur-built airplanes made up 15% of the non-commercial fixed-wing fleet and logged slightly more than 6% of total flight time.

Other, Unknown, or Not Yet Determined

149 total / 62 fatal

Almost 13% of 2009's non-commercial fixed-wing accidents (149 of 1,181) could not be clearly ascribed to either mechanical or pilot-related causes, and 42% of these were fatal (Figure 42). In 25 of the 62 fatal accidents, too little information was available at the time of publication to make even preliminary attributions of their causes. More time

FIGURE 39 : MECHANICAL ACCIDENT TRENDS

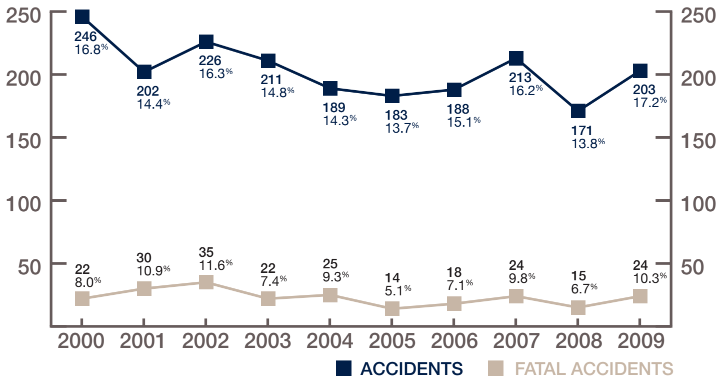


FIGURE 40 : TYPES OF MECHANICAL ACCIDENTS

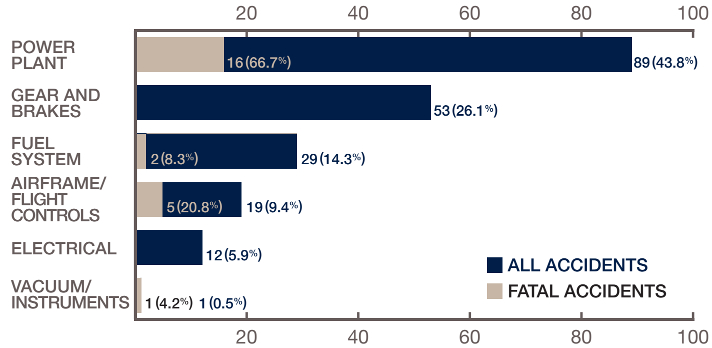


FIGURE 41 : AIRCRAFT INVOLVED IN MECHANICAL/MAINTENANCE ACCIDENTS: NON-COMMERCIAL FIXED-WING

Aircraft Class	Accidents	Fatal Accidents	Lethality
Single-engine fixed-gear	128 63%	13 54%	10%
Single-engine retractable	59 29%	11 46%	19%
Single-engine turbine	5	1	20%
Multiengine	16 8%	0	
Multiengine turbine	5	0	

FIGURE 42 : "OTHER" AND UNCLASSIFIED ACCIDENTS: NON-COMMERCIAL FIXED-WING

Major Cause	Accidents	Fatal Accidents	Lethality
Not yet determined	30 20%	25 40%	83%
Loss of power	70 47%	7 11%	10%
Other	49 33%	30 48%	61%

is typically required to investigate fatal accidents, and 18 out of the 25 occurred in the second half of the year. Five non-fatal accidents also remained unclassified at the time of publication. Just under half of the accidents in the "other or unknown" category (70 of 149) arose from the sudden loss of engine power for reasons that could not be reconstructed afterward: adequate fuel was present and investigators found no evidence of pre-accident discrepancies. Those engines that remained reasonably intact were typically test-run successfully during the investigations, and the pilots involved did not admit making any operational errors. While some may have resulted from carburetor icing or other avoidable hazards, none could be conclusively identified. Twenty-five of these (36%) occurred in amateur-built aircraft, including four of the seven that were fatal, even greater than their share of identified mechanical accidents. As noted earlier, amateur-built airplanes were involved in 28% of all non-commercial fixed-wing accidents attributed to mechanical failures, including 13 of the 24 that were fatal, while making up 15% of the fleet and accounting for a little over 6% of flight time.

The remaining 49, 30 of which were fatal, included such rare events as midair collisions, bird and wildlife strikes, pilot death or incapacitation, and injuries caused to airport ground crews. Several are discussed under "Unusual Accident Factors" on page 34.

FIGURE 43 : AIRCRAFT CLASS: COMMERCIAL FIXED-WING

Aircraft Class	Accidents		Fatal Accidents		Lethality
Part 137: Aerial Application					
Single-engine fixed-gear	52	100%	2	100%	4%
SEF conventional gear	51		2		4%
Part 135: On-Demand Charter and Cargo					
Single-engine fixed-gear	14	47%	0		
SEF conventional gear	7		0		
Single-engine retractable	3	10%	0		
Multiengine	13	43%	0		
Multiengine turbine	4		0		

FIGURE 44 : TYPE OF OPERATION: COMMERCIAL FIXED-WING

Type of Operation	Accidents		Fatal Accidents		Fatalities
Agricultural	52	63%	2	100%	2
Charter: Non-medical	29	35%	0		
Charter: Medical	1	1%	0		

FIXED-WING ACCIDENTS

Commercial

After increasing in 2008, the number of accidents on commercial flights in fixed-wing airplanes dropped by more than one-third to 81, the second-lowest number of the past decade. Only two were fatal, both in crop-dusters, an 88% decrease from 2008 and an 83% improvement over the previous low of 12 recorded in 2003. The estimated fatal accident rate of 0.07 per 100,000 flight hours was barely a quarter of that seen in commercial helicopter flights, and an order of magnitude lower than that of non-commercial operations. **There were no fatalities on fixed-wing charter or cargo flights conducted under Part 135 during 2009.**

The diversity of commercial fixed-wing flight operations reflects that of general aviation as a whole. Aerial applicators flew an estimated 31% of all commercial fixed-wing time, almost all of it low-altitude maneuvering with heavy payloads. On-demand cargo and air-taxi flights not only play a different role in remote rural areas than urban centers, but tend to be carried out in very different aircraft. Unlike helicopters, fixed-wing aircraft transport medical patients between centers of care rather than evacuating them from emergency sites. Accident patterns reflect this variety of uses and underlying risks.

Aircraft Class

The types of fixed-wing aircraft involved in commercial GA accidents reflect the circumstances under which they were flown (Figure 43). Almost all crop-dusters are fixed-gear singles, as are many of the airplanes that provide cargo and passenger service to remote locations. The nearly universal use of taildraggers for agricultural application, which accounted for nearly two-thirds of commercial fixed-wing accidents, was the chief reason they were involved in more than twice as high a proportion of commercial accidents (71%) as of non-commercial (34%).

Multiengine airplanes, on the other hand, flew just under 50% of all commercial time and 70% of time flown under FAR Part 135, but were only involved in 43% of the accidents that occurred on charter flights (16% of all commercial accidents). Lethality reached record lows in all types of commercial fixed-wing flying in 2009: Only two of 52 crop-dusting accidents (4%) were fatal, and there were no fatal accidents under Part 135.

FIGURE 45 : FLIGHT CONDITIONS: COMMERCIAL FIXED-WING

Light/Weather	Accidents		Fatal Accidents		Lethality
Part 137: Aerial Application					
Day VMC	50	98%	2	100%	4%
Night VMC	1	2%	0		
Part 135: On-Demand Charter and Cargo					
Day VMC	23	77%	0		
Night VMC	3	10%	0		
Day IMC	2	7%	0		
Night IMC	2	7%	0		

FIGURE 46 : PILOTS INVOLVED IN COMMERCIAL FIXED-WING ACCIDENTS

Certificate Level	Accidents		Fatal Accidents		Lethality
Part 137: Aerial Application					
ATP	6	12%	0		
Commercial	46	88%	2	100%	4%
Flight instructors	12	23%	0		
Part 135: On-Demand Charter and Cargo					
ATP	16	53%	0		
Commercial	14	47%	0		
Two-pilot crews	3	10%	0		
Flight instructors	20	67%	0		

Type of Operation

Sixty-three percent of commercial fixed-wing accidents took place during agricultural application flights (Figure 44), the same proportion as the year before. These included the only two fatal accidents, and the only fatalities were the two pilots. The improvement in the record of charter and on-demand cargo operators from 2008, when nine fatal accidents killed 25 individuals, was dramatic, and there was only one accident on a medical transport flight.

Flight Conditions

Commercial accidents also occurred predominantly in daytime VMC (Figure 45), and if all commercial accidents are combined, their distribution over light and weather conditions appears very similar to the non-commercial. However, all of the agricultural application accidents were in VMC, and all but one took place during daylight hours. Seven of 30 Part 135 accidents (23%) happened in IMC or at night, nearly double the 13% of non-commercial accidents.

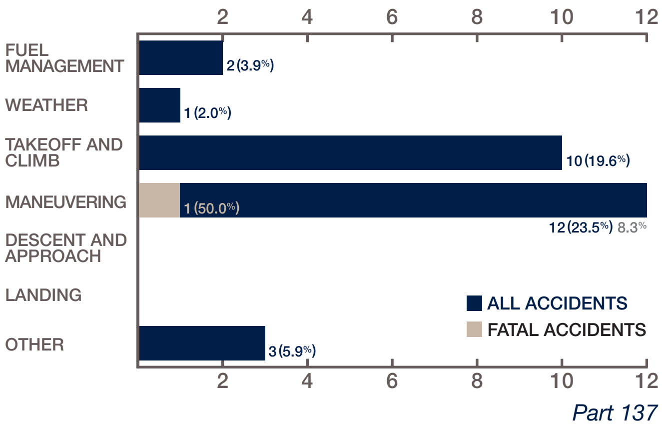
Pilot Qualifications

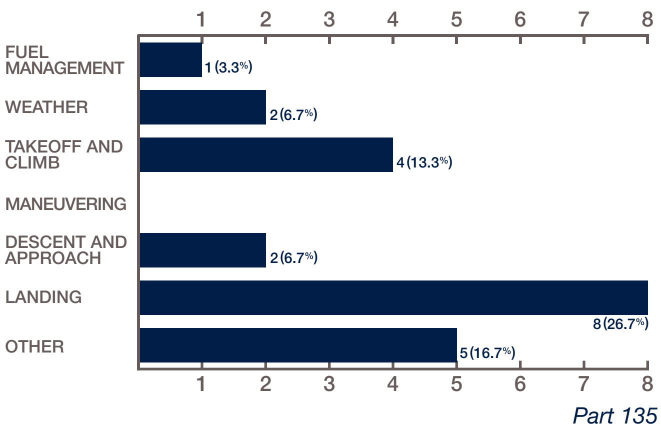
The FAA estimated that in 2008, there were approximately 18% more airline transport pilots than commercial pilots, but it is not known how many were employed in general aviation. More than half of the Part 135 accident flights (53%) were flown by ATPs (Figure 46). By comparison, only 12% of crop-dusting accidents involved ATPs, and barely one-third as many of the accident pilots held flight instructor certificates (23% vs. 67%). Only three Part 135 accidents (10%) involved two-pilot crews, but the proportion of cargo and charter flights flown single-pilot is not known.

Accident Causes

Mechanical failures were blamed for 28% of commercial accidents (23 of 81), about double their proportion of non-commercial accidents (Figure 7, page 13). Two-thirds of them (16) were on agricultural application flights, which also included all five of the accidents attributed to unexplained losses of engine power. The four remaining "other" accidents included the fatal crash of a crop-duster that may have been due to sudden cardiac arrest, one bird strike in flight, a clear-air turbulence encounter on an air ambulance that injured the patient,

FIGURE 47 : TYPES OF COMMERCIAL FIXED-WING ACCIDENTS





and a tail strike on the ramp while loading a Cessna Caravan.

The major types of pilot-related commercial accidents are shown in Figure 47. Sharp differences are apparent between the two types of operations. Three-quarters of those on crop-dusting flights (22 of 28) occurred during takeoff or while maneuvering, which made up less than 20% of pilot-related Part 135 accidents (four of 21). On-demand operators, on the other hand, suffered all eight landing accidents and the only two during descent and approach. Fuel-management and weather accidents were equally rare in both environments.

Vastly fewer accidents during approach, descent, and landing and a higher proportion of maneuvering accidents were the most dramatic differences from the non-commercial accident distribution. Only two commercial flights (both operating under Part 135) had accidents while taxiing, and there were no commercial accidents during go-arounds.

FIXED-WING ACCIDENTS
Unusual Accident Factors

Collisions
15 total / 7 fatal

Non-commercial fixed-wing aircraft were involved in nine midair collisions in 2009. These included all seven fatal collisions, which resulted in a total of 19 deaths. Three fatal midairs were collisions with other categories of aircraft: the Hudson River tour helicopter, a glider hit by a towplane, and a powered parachute struck by an unregistered homebuilt. There were also non-fatal collisions between a North American T-6 and a Robinson R22 helicopter and between a Cessna 182 and a Mooney M20; both occurred in airport traffic patterns.

The only other midair in 2009 involved two crop-dusters attempting to land on the same runway. Neither was equipped with a radio.

For the second straight year, there was a fatal midair between two airplanes on instructional flights. In this case, a Cessna 152 and a Piper PA-28-161 collided while both were conducting simulated instrument approaches in Arizona. The pilot flying the Cessna was ejected from the airplane during an uncontrolled descent. The fatal collision over Long Beach, California also involved an instructional flight, in this case VFR airwork in a Cessna 172 that collided with a Cessna 310 on a cross-country flight. The other airplanes involved in midairs were all on personal flights, though the R22 was being used for dual instruction and the Eurocopter AS350 hit over the Hudson River was conducting a commercial air tour.

No serious injuries resulted from any of the five on-ground collisions. Four were between taxiing airplanes and one was on a runway, where a Pitts landed on top of a Cessna 172.

Alcohol and Drugs
4 total / 2 fatal

Accidents due to the pilot's impairment by alcohol or other drugs have historically been very rare, and this was the case again in 2009. Only four were attributed to this cause, all on non-commercial fixed-wing flights. Two of the pilots and one passenger were killed and a third pilot was seriously injured, but no one on the ground was hurt. The impairment of three of these pilots was attributed to alcohol, while toxicological evidence of recent marijuana use was cited in the otherwise unexplained loss of control that killed the solo pilot of a Cessna 172.

Physical Incapacitation
2 total / 2 fatal

Physical incapacitation of pilots is also extremely rare. Only two accidents

FIGURE 48 : FIXED-WING AMATEUR-BUILT ACCIDENT TRENDS

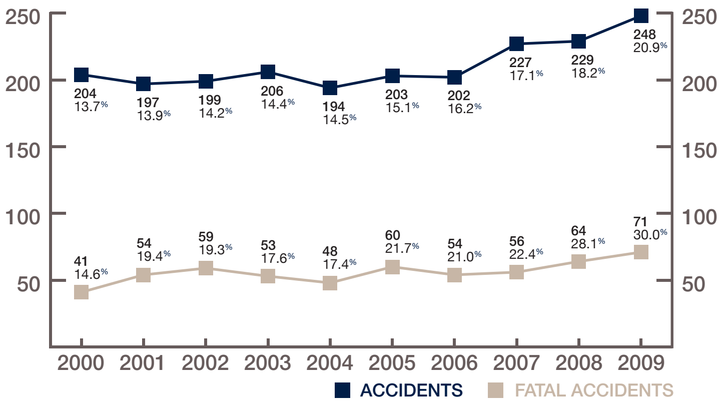
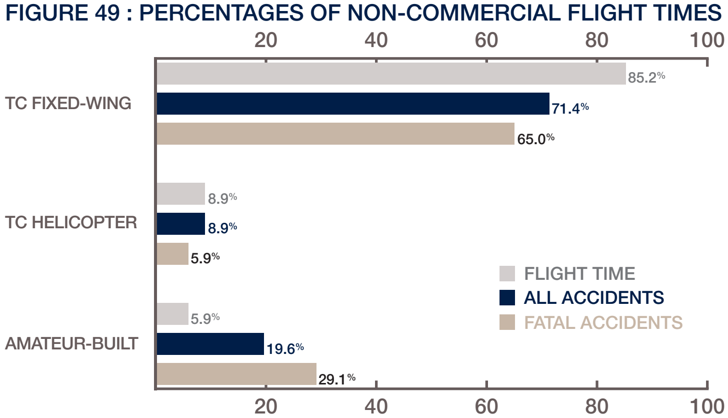


FIGURE 49 : PERCENTAGES OF NON-COMMERCIAL FLIGHT TIMES



in 2009 were attributed to physical incapacitation, and both involved apparent hypoxia in unpressurized piston singles operated at high altitudes. The pilot of a Cirrus SR22 lost consciousness at FL 250 after neglecting to have his oxygen system refilled; the airplane held a steady course on autopilot until its fuel was exhausted. The pilot of a Mooney M20M also became unresponsive at FL 250; the airplane passed directly over its destination airport and continued on the same heading until it entered an uncontrolled descent. At this writing, a finding of probable cause has not yet been released for either accident.

Off-Airport Ground Injuries

1 accident / 1 ground fatality

Only one accident in 2009 caused any serious injury to an uninvolved person on the ground. A Cessna 310 crashed into a house shortly after takeoff, killing both the pilot and one person inside the building.

On-Airport Ground Injuries

4 accidents / 1 fatal

Four accidents caused two deaths and three serious injuries to people on airport grounds. A Piper PA-18 struck a Jeep during an intentional low pass, killing both people in the vehicle. The pilot and the driver had rehearsed this maneuver before. A photographer was struck by the light-sport airplane whose takeoff he was filming, a skydiver's parachute was severed by the Twin Otter jump plane as it returned to land, and a loader suffered a prop strike while cleaning a Piper PA-25 after a crop-dusting run. The engine had been left running as it cooled.

Propeller and Rotor Strike Injuries

3 total / none fatal

In addition to the ground crewman mentioned above, two pilots were hit by airplane propellers in 2009. All three survived. One of the pilots was attempting to hand-prop a seaplane, while the other was trying to help a passenger apply the brakes after the pilot jump-started the engine.

Amateur-Built Aircraft

Amateur-Built Aircraft
Fixed-wing: 248 total / 71 fatal
Helicopter: 11 total / 3 fatal

Update and Correction

The 2009 Nall Report *overestimated the accident rates for amateur-built aircraft in 2008. The report cited an overall rate of 27.29 accidents per 100,000 flight hours and a fatal accident rate of 7.00 per 100,000 hours. These have now been corrected to 22.34 and 5.89 per 100,000 hours, respectively.*

Through 2008, the FAA's General Aviation and Air Taxi Activity Survey *combined all light-sport aircraft in a single category. The* 2009 Nall Report *counted accidents in experimental LSAs in the amateur-built category without counting their flight time, thus inflating the rate estimates. The FAA subsequently added a separate breakout of experimental and special LSA activity to the 2009 Activity Survey. Including e-LSA activity increased the estimate of amateur-built flight time, thereby reducing the rates.*

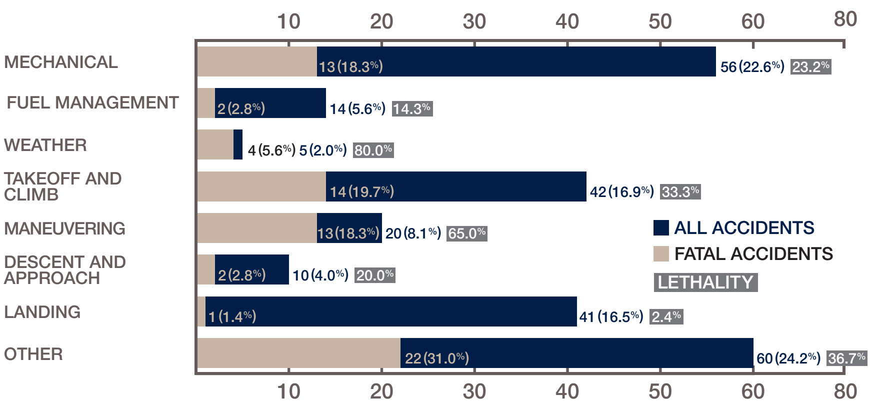
Higher accident rates among amateur-built aircraft should come as no surprise. Both their physical characteristics and the way they're used expose homebuilts to greater risk and make accidents less survivable. Even by GA standards, the amateur-built fleet is exceptionally diverse, ranging from open-framework designs with no cabin structure to pressurized cross-country machines. However, the majority are small, simple craft used primarily for short pleasure flights, meaning more frequent takeoffs and landings – which together account for almost half of all fixed-wing GA accidents. The expertise of the builders varies, as do the make-and-model experience of the pilots and the availability of useful transition training. Homebuilders are not required to meet specific crashworthiness standards but are free to experiment with previously untested systems, including engines not designed for aircraft use, and modifications of airframes, controls, and instrumentation. Unexpected flight characteristics may result, which must be explored cautiously during the required flight-test period.

In 2009, 248 amateur-built fixed-wing aircraft were involved in accidents, 19 more than in 2008 (Figure 48). This represents 21% of all non-commercial fixed-wing accident aircraft, a proportion that has increased steadily for more than ten years. Seventy-one of these accidents were fatal, resulting in 98 deaths; these represent increases of nine and 12, respectively, from the previous year, accounting for 30% of the year's fatal accidents and 24% of all fatalities. By comparison, amateur-built aircraft logged less than 7% of the corresponding flight

FIGURE 50 : TYPES OF AMATEUR-BUILT AIRCRAFT INVOLVED IN ACCIDENTS

Aircraft Class	Accidents		Fatal Accidents		Lethality
Single-engine fixed-gear	217	84%	60	81%	28%
SEF conventional gear	136		35		26%
Single-engine retractable	28	11%	9	12%	32%
Multiengine	3	1%	2	3%	67%
Helicopter	11	4%	3	4%	27%

FIGURE 51 : TYPES OF FIXED-WING AMATEUR-BUILT AIRCRAFT ACCIDENTS



time. 2009 surpassed 2008 for the highest numbers of accidents, fatal accidents, and individual fatalities in the past decade. Their lethality was 29% compared to 17% for all non-commercial accidents in factory-built airplanes.

During the same period, the number of amateur-built helicopters involved in accidents has ranged from a low of seven (none fatal) in 2001 to a high of 16, one of which was fatal, in 2002. There were 11 in 2009, three of them fatal. This was the first year since 1998 to see more than two fatal accidents in homebuilt helicopters.

Experimental LSAs accounted for almost 15% of all time flown by amateur-built aircraft. In addition, the estimated level of activity of traditional amateur-built aircraft increased by almost 13% from its 2008 estimate of 872,024, bringing the total amount of amateur-built flight time to 1.15 million hours in 2009.

The accident rate for amateur-built aircraft has held relatively constant over the past ten years, ranging from a high of 25.42 per 100,000 hours in 2001 to a low of 20.40 in 2004. The estimated 2009 rate of 22.45 is roughly in the middle of that range, though the fatal accident rate of 6.41 was second only to the 6.76 estimated for 2001. These rate estimates combine both fixed-wing and helicopter accidents, since the FAA estimates of homebuilt flight activity do not distinguish between aircraft categories.

Figure 49 illustrates the proportions of non-commercial flight time and non-commercial accidents in 2009 that were attributed to type-certificated airplanes, type-certificated helicopters, and all amateur-built aircraft combined. Helicopters figured into the accident record almost exactly in proportion to the amount of time flown; manufactured fixed-wing aircraft contributed 85% of flight time, 71% of all accidents, and 65% of fatal accidents. The proportion of accidents involving amateur-built aircraft, on the other hand, was more than three times higher than their share of hours flown, and their proportion of fatal accidents was almost five times as high.

Accidents in amateur-built aircraft remain a major contributor to the overall non-commercial accident rates. In 2009, the accident rate among amateur-built aircraft was just under four times the rate for type-certificated aircraft, and their fatal accident rate was more than six and a half times higher.

Since 1999, amateur-built aircraft have consistently had accident rates from 3.6 to 5.1 times higher than those of type-certificated fixed-wing airplanes in non-commercial operation, and fatal accident rates from 4.3 to 7.6 times as high. Compared to non-commercial flights in type-certificated helicopters, the excess accident risk has increased from 1.9 times in 2002 to 3.3 times in 2009, and the excess risk of fatal accidents has never dropped below 2.4. In 2009, it rose to 7.5.

All but three of the 248 airplanes were single-engine (Figure 50), and 217 of these (89%) had fixed gear (including 14 seaplanes or amphibians). The 28 with retractable gear are nine fewer than in 2008. A total of 140 of the accident aircraft had conventional landing gear, including two retractables and two of the three twins. There was one fewer helicopter accident than in 2008, but three were fatal compared to none the year before.

The types of accidents suffered by amateur-built fixed-wing airplanes in 2009 was little changed from the pattern reported in previous years, but once again suggests some differences between the manufactured and homebuilt fleets (Figure 51). Landing accidents accounted for only 17% of the amateur-built total compared to 33% of those in type-certificated airplanes. On the other hand, the shares attributed to mechanical failures (23%) and unexplained losses of engine power (10%) were noticeably higher, though the overall increase in the number of mechanical accidents in 2009 closed the gap somewhat. Together these categories accounted for almost one-third (33%) of all accidents in amateur-built airplanes, more than one and a half times the 20% share in the manufactured sector. The proportion of fatal accidents in these two categories was also sharply higher, 21% among amateur-builts compared to only 7% in certified aircraft.

Summary

• The accuracy and consistency of this year's report are improved by the exclusion of accidents that occurred outside the boundaries of the U.S. National Airspace System. The same correction has been applied to data from the past ten years to assure the validity of historical comparisons.

• The number of accidents on commercial fixed-wing flights decreased by one-third from 2008, and the two fatal accidents represent an 88% decrease from the previous year. No fatal accidents occurred on fixed-wing charter or cargo flights.

• The commercial helicopter accident rate maintained its recent improvement despite a slight increase from 2008. The overall rate of commercial helicopter accidents has decreased 71% since 2003, from 8.20 accidents per 100,000 flight hours to 2.38, and the fatal accident rate has been reduced by 85% (from 2.16 to 0.32) over the same period. Only four fatal accidents occurred on commercial helicopter flights in 2009, but the 16 fatalities that resulted are still in the middle of the range for the preceding decade.

• The accident rate for helicopters operated non-commercially increased from 6.65 per 100,000 flight hours in 2008 to 7.40 in 2009. However, this is still a 41% reduction from the recent peak of 12.62 in 2002. The number of fatal accidents was down by five, and the fatal accident rate decreased by 22%.

• There were 60 fewer accidents on non-commercial fixed-wing flights than in 2008, but as a percentage the decrease was barely half the estimated reduction in flight activity. There were 10 more fatal accidents and eight more individual fatalities. The estimated total and fatal accident rates both increased, but by amounts that remain within the margins of error of the corresponding flight-time estimates.

• Accidents on non-commercial fixed-wing flights continued to follow familiar patterns. More than 70% were judged to have been pilot-related. Almost one-third of all accidents occurred during landing attempts, while weather and maneuvering accidents were the most consistently lethal. Together they accounted for 28% of the fatal accidents even though just 9% of all accidents fell into those categories.

• Mechanical accidents were both more common and more lethal than in recent years, accounting for a record-high 17% of all accidents. More than half the fatal mechanical accidents occurred in amateur-built airplanes.

• Personal flights accounted for less than 47% of non-commercial fixed-wing flight time but led to 78% of all and 84% of fatal accidents. Not only did these make up 94% of all accidents involving private pilots, but three-fifths of those involving commercial pilots and two-thirds of those suffered by ATPs.

• Amateur-built aircraft continued to have significantly higher rates of both fatal and non-fatal accidents than comparable type-certificated aircraft, suffering particularly from greater numbers of mechanical failures and unexplained losses of engine power.

Appendix

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

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

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

Limited Cockpit Resources and Flight Support: Usually, a single pilot conducts GA operations, and the pilot typically handles all aspects of the flight, from flight planning to piloting. Air carrier operations require at least two pilots. Likewise, airlines have dispatchers, mechanics, loadmasters, and others to assist with operations and consult with before and during a flight.

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

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

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

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

FIGURE 52 : WHAT DOES GENERAL AVIATION FLY?

Aircraft Class	Commercial	Non-Commercial
Piston single-engine	2,457	138,192
Piston multiengine	1,223	15,251
Turboprop single-engine	1,666	2,292
Turboprop multiengine	812	4,284
Turbojet	2,649	8,619
Helicopter	2,938	7,046
Experimental	119	24,300
Light sport	2	6,545
Total	11,866	206,529

other vital services. For a breakdown of GA activities and their accident statistics, see "Type of Flying" on page 42.

What Does General Aviation Fly?

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

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

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

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

Figure 52 shows the FAA's estimate of the number of powered GA aircraft that were active in 2009, sorted by category and class, separately for aircraft primarily operated commercially and other GA users. The estimates of total flight time used in this report are based on 99.2 percent of the GA fleet.

Interpreting Aviation Accident Statistics: What is the accident rate?

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

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

NTSB Definitions

Accident/Incident (NTSB Part 830)

The following definitions of terms used in this report have been extracted from NTSB 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.

Additional Resources

If you would like additional information about the topics covered in this report, as well as many other topics not covered, visit the Air Safety Institute's Web site at *www.airsafetyinstitute.org*.

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The Air Safety Institute recertifies more flight instructors than any other course provider. Renew in person or online. Renew any time in your four-month renewal period and keep your original expiration date!

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Each Safety Quiz offers a quick, easy, and interactive way to assess and expand your knowledge. Check back often: New quizzes, underwritten by the AOPA Insurance Agency, Inc., are added frequently.

Accident Database/Analysis
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Search the Air Safety Institute Accident Database. Learn more about general aviation safety issues with ASI's in-depth analysis, including archived versions of the annual *Nall Report* and Special Reports you won't find anywhere else.
- Searchable Accident Database
- Popular database searches
- Special reports
- Interactive accident maps
- Real Pilot Stories

Free Safety Seminars
www.airsafetyinsitute.org/seminars
Every year, the Air Safety Institute offers more than 200 free safety seminars throughout the United States. Attending a seminar is a great way to learn while enjoying the company of your fellow pilots—and if you're lucky, you might even win one of the many great door prizes!

Free Webinars
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Learn about safety from the comfort of your home or office. Real-time webinars allow you to interact with subject matter experts through the live chat feature. Recorded webinars are available online.

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Taking a cue from televised public service announcements, these short videos are meant to raise awareness of common accident causes.

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