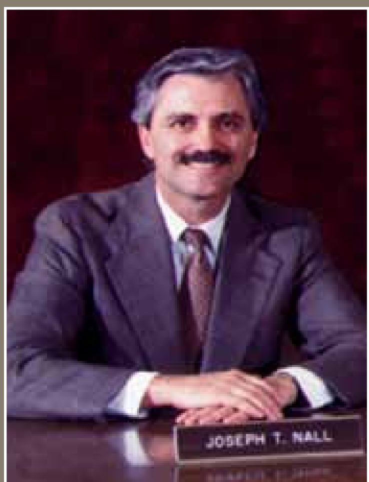
2009 NALL REPORT

Accident Trends and Factors for 2008

An AOPA Air Safety Foundation Publication



Dedication

The *Joseph T. Nall Report* is the AOPA Air Safety Foundation'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

For this twentieth edition of the *Nall Report*, the Air Safety Foundation (ASF) has broadened its coverage beyond its traditional focus on small fixed-wing aircraft by summarizing the numbers and rates of helicopter accidents. This report also includes statistics on accidents that occurred on revenue flights made by commercial operators, chiefly under Part 135 of the Federal Aviation Regulations (FARs), which had been excluded from previous editions. Commercial accidents are analyzed separately from non-commercial due to the broad differences in equipment, regulatory requirements, and operating procedures between these types of operations.

This report 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, ASF gathered NTSB data on 2008's accidents throughout 2009.

Probable cause had been determined for 1,449 of 1,531 accidents (94.6 percent) when the data were frozen for this year. The remaining 5.4 percent were based on preliminary data. 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.

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

ASF gratefully acknowledges the technical support and assistance of:

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

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Bruce Landsberg
President
AOPA Air Safety Foundation

The AOPA Air Safety Foundation has been telling the story of what went wrong for two decades. This is the twentieth edition of the *Joseph T. Nall Report*, a summary of accident trends and factors for general aviation (GA). Having grown from a small black-and-white pamphlet to a full-color document, "the Nall" is widely distributed to pilots, colleges and universities, government agencies, the media, and industry outlets.

The challenge is to take a complex subject and distill it into a comprehensible outline of the prior year's mishaps. Previous issues covered 90% of all GA flight activity. This one adds 90% of what was left but with not as much detail. In addition to non-commercial fixed-wing aircraft weighing 12,500 lbs. or less, we've added commercial flight accidents using GA airplanes and now helicopters.

So what went wrong in 2008?

- Non-commercial fixed-wing accidents decreased in proportion to flight time. The blend in accident types was similar to previous years. The decrease in fuel-management accidents continues.

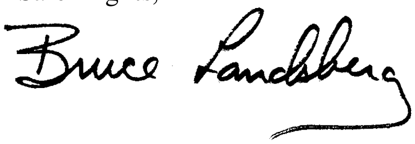
- Disproportionate numbers of personal flight accidents occurred in poor weather, and maneuvering misfortunes resulted in too many fatalities. Way too many pilots are still having trouble landing.

- Amateur-built aircraft continued to suffer dramatically higher accident rates than type-certificated aircraft due, in part, to greater numbers of mechanical failures and unexplained losses of engine power.

ASF is working with EAA on this last item with the understanding that experimental aircraft will entail higher risk. Builders, pilots, and designers should have reasonable freedom to experiment while the public is entitled to their expectation of safety. This *Nall Report* includes a direct comparison in which certificated aircraft losses and accident rates are separated from amateur-built.

As always, we thank our colleagues at FAA and NTSB who assist ASF with this effort each year and especially to the pilot-donors who make the *Nall Report* and all of the ASF education programs and products possible.

Safe Flights,



Trends in General Aviation Accidents, 1999 – 2008

In 2008, more than 99% of all general aviation (GA) flight time 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 88% of fixed-wing time and 54% 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 is 57% higher for non-commercial flights (6.19 compared to 3.95), and the rate of fatal accidents is almost double (1.24 vs. 0.63). The average accident rate for non-commercial helicopter flights is 118% higher than for commercial flights (8.91 vs. 4.09), and the fatal accident rate is 78% greater (1.35 vs. 0.76).

The commercial fixed-wing accident rate spiked in 2008, reaching its highest level of the past five years after almost a decade of relatively consistent decline. The fatal accident rate also hit a five-year high. This reflects both an increased number of accidents and the lowest estimated amount of flight time since 2003. The rates of non-commercial fixed-wing accidents, fatal and non-fatal alike, decreased slightly from 2007, but remained higher than their averages over the past ten years.

The accident rate for commercial helicopter flights has decreased by more than 70% since 2003, the peak year of the past decade, and the fatal accident rate has dropped by more than three-quarters. Decreasing numbers of accidents have coincided with a sharp increase in the estimated amount of flight time. For the past five years the commercial helicopter record has been comparable to that of commercial fixed-wing flights, with a nominally lower average rate of all accidents (2.69 vs. 3.12) and an average fatal accident rate that's barely higher (0.54 vs. 0.45).

General Aviation Accident Rates, 1999 - 2008

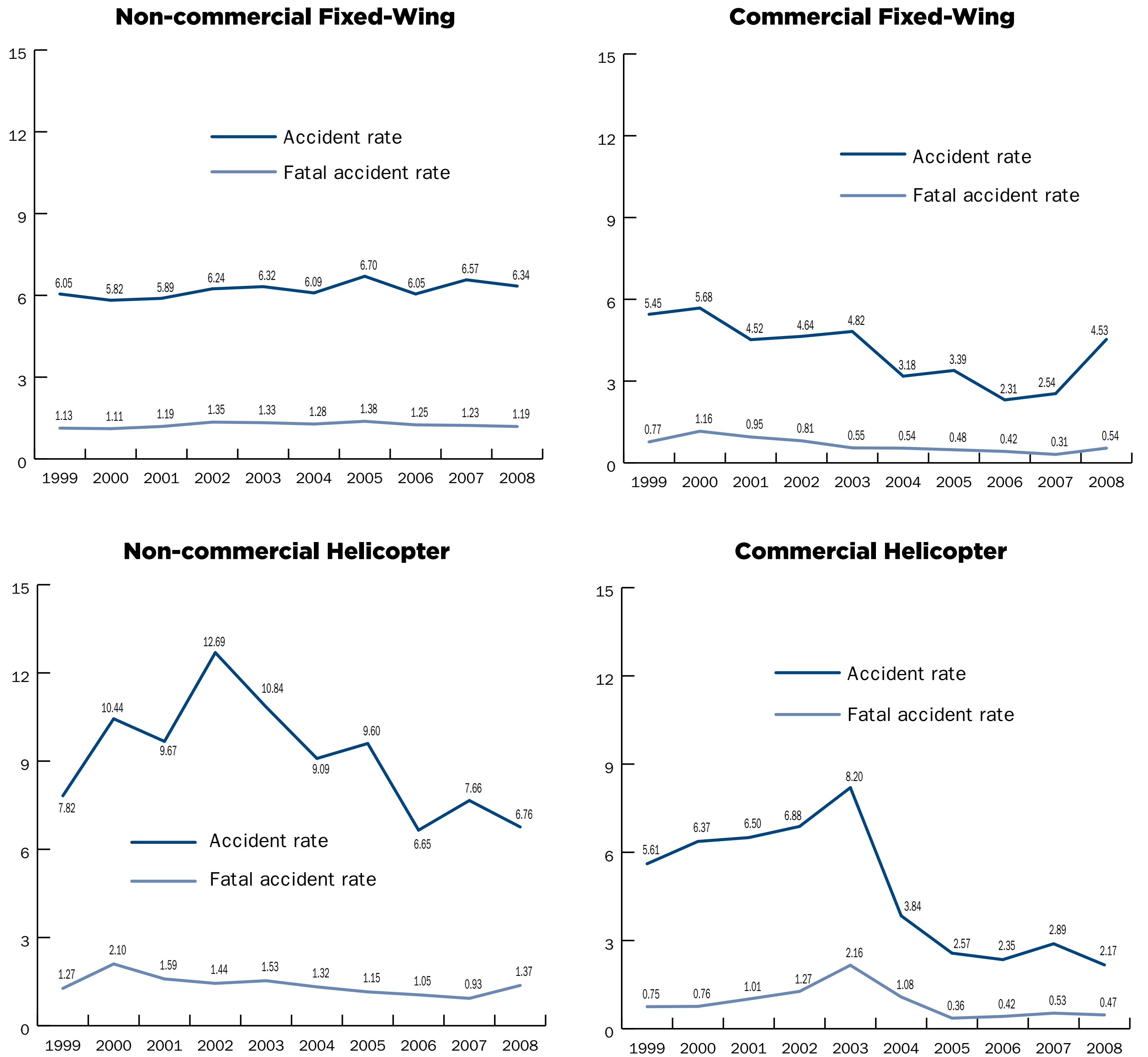


Figure 1

Non-commercial helicopter accidents have generally decreased since 2002. At 6.76 per 100,000 hours, 2008's rate was just over half the 12.69 observed that year, but after seven years of steady declines, the fatal-accident rate jumped to its highest level of the past five years. Accident rates for non-commercial helicopters remain higher than for comparable fixed-wing flights, but the gap is narrowing, and the fatal-accident rates have been similar since 2004.

2008 General Aviation Accidents

The estimated 19.78 million hours flown in non-commercial fixed-wing operations in 2008 (Figure 2) was the lowest in the past decade, but still accounted for more than three-quarters of all GA flight time (77%). It also accounted for 82% of all GA accidents, 84% of fatal accidents, and 80% of individual fatalities. Still, the combination of reduced flight activity and stable or declining accident rates produced the second-lowest number of accidents, lowest number of fatal accidents, and fewest fatalities in the past ten years. The total of 1,254 accidents was just three more than 2006's record low. There were 236 fatal accidents, 11 fewer than in 2007, and the 433 deaths that resulted were four less than occurred that year.

Commercial helicopter flight time, on the other hand, was the highest in the past decade at 1.48 million hours, more than double the estimated levels in 2001 through 2003. This made up 6% of total GA time, but commercial helicopters were only involved in 2% of the accidents, fatal and otherwise. Of 32 accidents, seven were fatal, killing 28. Commercial fixed-wing accidents were the most survivable: Only 12% were fatal, compared to 19-22% for non-commercial fixed-wing and helicopters. However, the number and rate of commercial fixed-wing accidents were the highest since 2000, and the 31 resulting fatalities was the highest number since 2002.

The volume of non-commercial helicopter activity remained close to its ten-year average, but the 2008 total of 118 accidents was easily the lowest in that period, 21% below the 1999-2007 average. However, 20% of these were fatal, a higher lethality rate than any year since 2000, which was also the last year with more individual fatalities. Sharp improvements in accident rates since 2002 have been matched or even outdone by commercial operators, so that the accident and fatal accident rates in non-commercial flights remain about three times higher than in commercial rotorcraft operations.

General Aviation Accidents in 2008

	Non-Commercial		Commercial	
	Fixed-Wing	**Helicopter**	**Fixed-Wing**	**Helicopter**
Number of accidents	1,254	118	127	32
Number of aircraft*	1,272	118	129	33
Flight Hours (millions)	19.78	1.75	2.80	1.48
Accident Rate	6.34	6.76	4.53	2.17
Number of Fatal Accidents	236	24	15	7
Fatal Accident Rate	1.19	1.37	0.54	0.47
Lethality (percent)	18.8	20.3	11.8	21.8
Fatalities	433	49	31	28

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

Figure 2

Helicopter Accidents

Non-Commercial

The 118 accidents recorded in 2008 represents the lowest number and second lowest rate in the past decade. However, the fatal accident rate increased by almost half from 2007's level, and both the 24 fatal accidents and the 49 individual fatalities were the highest counts since the year 2000.

Aircraft Class

Reciprocating engines powered almost two-thirds (64%) 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 42%. However, accidents in piston helicopters also tend to be less serious, with a 15% lethality rate compared to 29% in single-engine turbines and 38% in multiengine turbines. The widespread use of small piston helicopters as primary trainers is probably one factor in this, since instructional accidents are rarely fatal. The pilots of more powerful and sophisticated aircraft are apt to be more highly trained and better able to avoid common mistakes, but this advantage is at least partly offset by the reliance on turbine-powered helicopters to complete more difficult and potentially dangerous missions.

Aircraft Class: Non-Commercial Helicopter

Configuration	Accidents	Fatal Accidents	Fatalities
Single-engine piston	75 (64%)	11 (46%)	16 (33%)
Single-engine turbine	35 (30%)	10 (42%)	17 (34%)
Multiengine turbine	8 (7%)	3 (13%)	16 (33%)

Figure 3

Type of Operation: Non-Commercial Helicopter

Type of Operation	Accidents	Fatal Accidents	Fatalities
Personal	40 (34%)	10 (42%)	14 (29%)
Instructional	27 (23%)	3 (13%)	5 (10%)
Public use	12 (10%)	4 (17%)	15 (31%)
Positioning	10 (8%)	2 (8%)	4 (8%)
Aerial observation	8 (7%)	1 (4%)	2 (4%)
Business	7 (6%)	2 (8%)	5 (10%)
Other working use	7 (6%)	1 (4%)	1 (2%)
Other*	7 (6%)	1 (4%)	3 (6%)

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

Figure 4

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 less than 7% of non-commercial helicopter time was spent on personal flights, yet they accounted for 34% of non-commercial helicopter accidents, 42% of fatal accidents, and 29% of individual fatalities. Flight instruction made up almost twice the proportion of total non-commercial helicopter activity (33%) as it did of fixed-wing (19%), but just as on the fixed-wing side, instructional flights led to fewer than their share of accidents, most of which were survivable. Just 27 (23% of the 118 total) took place during instructional flights and only three of these were fatal; this 11% lethality rate is half that incurred in other types of helicopter accidents. Only three instructional accidents took place on student solos. One was fatal.

Taken together, accidents suffered in all remaining types of operations were proportional to their combined amount of flight time. They represented an estimated 49% of total activity and were involved in 43% of all accidents and 45% of fatal accidents. The 30 individual fatalities in these flights represent 61% of the total, largely the result of one accident in a Sikorsky S-61N that killed nine and seriously injured four more. The helicopter lost power to the main rotor during its initial climb, crashed into trees, and subsequently caught fire while transporting firefighters in a wilderness area.

Flight Conditions

As shown in Figure 5 (page 8), 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 15% of accidents in day VMC were fatal compared to 56% of those that occurred in limited visibility. The latter represents half of the 12 accidents in VMC at night and three of four accidents that occurred in instrument meteorological conditions (IMC).

Accident Case Study

DEN08FA092

McDonnell Douglas MD 500E/369E

Sunrise Beach, Missouri

One fatality and one seriously injured

History of Flight

The pilot departed from his private lakefront helipad to take four passengers for a short flight over the lake, which the front-seat passenger estimated lasted no more than five minutes. The pilot and his son, in the back seat, fastened the safety harnesses of all the other passengers, but neither briefed them on how to unbuckle the harnesses or open the doors.

AOPA FILE PHOTO

While approaching the helipad for landing, the helicopter made a left turn and then began spinning rapidly to the right at an altitude estimated at 35 agl. Full opposite pedal did not arrest the spin. After what witnesses described as multiple high-speed rotations, the helicopter hit the water and sank very quickly. The middle passenger in the rear seat, a ten-year-old who had never flown in a helicopter before, was unable to escape in time to avoid drowning.

Pilot Information

The instrument-rated commercial pilot, age 50, held ratings for single- and multiengine airplanes and seaplanes as well as helicopters. Of his 2,360 hours of total flight experience, 560 were in rotorcraft, with 350 in the accident make and model. A little more than three months earlier, he had completed a flight review in the accident helicopter.

Weather

A convective SIGMET was in effect for the route of flight and landing area, advising of severe thunderstorms with cloud tops above FL 450 and the possibility of tornadoes, hail, and wind gusts up to 60 knots. Level II Doppler weather radar indicated an area of moderate to heavy precipitation just south of the accident site, with echo tops at 48,000 feet. The nearest station, located 7 miles to the southeast, reported a few clouds at 2,400 feet, scattered clouds at 5,500, and a ceiling of 9,500 broken. Visibility was six miles in thunderstorms, and winds were from 160 at nine knots gusting to 16. Distant lightning was reported in all quadrants. Witnesses on the scene reported strong, gusty surface winds.

Probable Cause

The loss of tail rotor effectiveness and the pilot's failure to regain aircraft control. Contributing to the accident was the pilot's decision to fly in known adverse weather conditions and the gusty winds generated from convective outflow. Contributing to the severity of the injuries was the pilot's failure to provide a safety briefing to his passengers in accordance with Federal Aviation Regulations.

ASF Comments

Pilots don't always take the required passenger safety briefing seriously, but newcomers to general aviation may not know how to unlatch safety belts or open doors, and in an emergency there may not be time to teach them. Doing it before takeoff doesn't take long. While short flights seem to involve very little risk, any flight can end in a sudden stop – especially if it's made close to violent weather. Maintaining at least 20 miles clearance from thunderstorms is a good rule of thumb for all light aircraft, fixed-wing and rotorcraft alike.

Light and Weather Conditions: Non-Commercial Helicopter			
Conditions	**Accidents**	**Fatal Accidents**	**Fatalities**
Day VMC	102 (86%)	15 (63%)	31 (63%)
Night VMC*	12 (10%)	6 (25%)	11 (22%)
Day IMC	2 (2%)	1 (4%)	1 (2%)
Night IMC*	2 (2%)	2 (8%)	6 (12%)

Figure 5

Pilots Involved in Non-Commercial Helicopter Accidents			
Certificate Level	**Accidents**	**Fatal Accidents**	**Fatalities**
ATP	18 (15%)	3 (13%)	14 (29%)
Commercial	76 (64%)	14 (58%)	25 (51%)
Private	21 (18%)	6 (25%)	9 (18%)
Student	3 (3%)	1 (4%)	1 (2%)
CFI on board*	45 (38%)	3 (13%)	9 (18%)

**Includes single-pilot accidents.*

Figure 6

The preponderance of accidents in VMC during daylight hours likely reflects the underlying patterns of use; the FAA estimates that 83% of all helicopter flight time, including commercial operations, took place in day VMC, while less than 1% was in instrument conditions. If most actual instrument time took place during commercial flights, instrument conditions may pose an increased risk of accidents to non-commercial flights as well as a greater risk that any accidents that do occur will be fatal.

Pilot Qualifications

Figure 6 shows that 80% of the pilots involved in non-commercial helicopter accidents held commercial or airline transport pilot (ATP) certificates, and almost half of those (48%) were also certificated flight instructors (CFIs). This is in sharp contrast with the pattern in non-commercial fixed-wing accidents, where more than half the pilots-in-command hold no certificate above the private pilot level.

Accidents involving commercial pilots or ATPs who were not CFIs were as likely to be fatal as accidents on flights commanded by private or student pilots, with 29% lethality in each. By contrast, only 7% of accidents in which a CFI was on board were fatal. In part, this reflects the relative safety of instructional flights, but 24 of the 45 accident flights involving CFIs were not flight instruction, and only one of these was fatal.

Commercial

Only 32 accidents, seven of them fatal, occurred in commercial helicopter operations in 2008. Almost half (15) were in aerial application flights, though these accounted for barely 10% of commercial flight time. One of those was fatal; the pilot was struck by a rotor blade after exiting the aircraft. Seven accidents, none fatal, occurred during external-load operations. More than 80% of estimated flight time was logged by Part 135 charter and cargo flights, almost one-third of that in medical transports; only ten accidents occurred on Part 135 flights, but they included six of the seven fatal accidents, accounting for 27 of 28 deaths. Half of the fatal accidents took place in air-medical flights. These killed 15 individuals, including all seven aboard two helicopters that collided on approach to the same hospital.

While the rate of fatal accidents has generally decreased since 2003, the total number of fatalities was the third highest in the past decade. There were 33 deaths in 2003 and 32 in 2004.

Twenty-seven of the 32 accidents took place in VMC in the daytime, and four occurred in VMC at night. Two of the latter were fatal, as was the one accident in instrument conditions. Ten of the accident helicopters had reciprocating engines, and nine of these were being used for aerial application (the other was a charter flight). Twenty of the 23 turbine-powered helicopters were single-engine models.

Fixed-Wing Accidents

Causes of Fixed-Wing General Aviation Accidents, 2008				
	Non-Commercial		Commercial	
Major Cause	**All Accidents**	**Fatal Accidents**	**All Accidents**	**Fatal Accidents**
Pilot-related	907 (72%)	167 (71%)	80 (63%)	12 (80%)
Mechanical	178 (14%)	18 (8%)	37 (29%)	3 (20%)
Other or unknown	169 (13%)	51 (22%)	10 (8%)	0 (0%)

Figure 7

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 2008, commercial fixed-wing flights had an accident rate about one-third lower than non-commercial flying, and a smaller proportion of those were attributed to pilot-related causes (Figure 7). At first glance, mechanical causes accounted for twice the share of accidents, and two and a half times the share of fatal accidents, in commercial operations. However, 102 of the 169 "other or unknown" non-commercial accidents involved partial or complete loss of engine power for reasons that were never identified, and 14 of these were fatal.

If all 102 could be proven to result from mechanical failures, these would still make up a smaller proportion of non-commercial than commercial accidents. Since some were likely pilot-induced (e.g., by fuel mismanagement), pilot behavior seems to pose a greater risk in non-commercial flying. This likely reflects both the higher minimum requirements for pilot certification and the more restrictive regulations governing commercial flights. However, pilot-related causes still accounted for 63% of commercial fixed-wing accidents, and 80% of those that were fatal.

Aircraft Class: Non-Commercial Fixed-Wing			
Aircraft Class	**All Accidents**	**Fatal Accidents**	**Lethality**
Single-engine fixed-gear	932 (73%)	142 (59%)	15%
SEF, conventional gear	309	35	11%
Single-engine retractable	225 (18%)	58 (24%)	26%
Multiengine	115 (9%)	41 (17%)	36%
Multiengine turbine	30	11	37%

Figure 8

Non-Commercial

The 1,254 accidents and 236 fatal accidents that occurred in 2008 were the lowest numbers in the past decade, but this reflects a decrease in flight activity more than improvement in accident rates, which remained near the middle of their recent range. Both the overall and fatal accident rates were slightly lower than in 2007, though the difference is 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, almost three-quarters of the accident aircraft were single-engine fixed-gear (SEF), but these were involved in less than 60% of the fatal accidents (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 15% in fixed-gear singles to 26% in retractable singles and 36% in multiengine aircraft. Almost one-third of the fixed-gear singles had conventional landing gear (tailwheels), but less than a quarter of the fatal SEF accidents were in taildraggers, many of which are small, slow, and light.

Type of Operation: Non-Commercial Fixed-Wing

Type of Operation	Accidents	Fatal Accidents	Fatalities
Personal	927 (73%)	186 (77%)	319 (74%)
Instructional	194 (15%)	19 (8%)	31 (7%)
Public use	10 (1%)	1 (< 1%)	1 (< 1%)
Positioning	19 (1%)	3 (1%)	3 (1%)
Aerial observation	11 (1%)	5 (2%)	11 (3%)
Business	33 (3%)	8 (3%)	27 (6%)
Other working use	48 (4%)	11 (5%)	17 (4%)
Other*	30 (2%)	8 (4%)	24 (6%)

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

Figure 9

Light and Weather Conditions: Non-Commercial Fixed-Wing

Light / Weather	All Accidents	Fatal Accidents	Lethality
Day VMC	1072 (85%)	160 (68%)	15%
Night VMC	111 (9%)	25 (11%)	23%
Day IMC	41 (3%)	30 (13%)	73%
Night IMC	19 (2%)	15 (6%)	79%
Not reported	11 (1%)	6 (3%)	

Figure 10

Pilots Involved in Non-Commercial Fixed-Wing Accidents

PIC Certificate Level	Accidents	Fatal Accidents	Lethality
ATP	133 (10%)	28 (12%)	21%
Commercial	339 (27%)	62 (26%)	18%
Private	640 (50%)	126 (52%)	20%
Sport	16 (1%)	1 (<1%)	6%
Student	106 (8%)	7 (3%)	7%
None	23 (2%)	6 (2%)	26%
Unknown	15 (1%)	11 (5%)	73%
Two pilots on board	140 (11%)	32 (13%)	23%
CFI on board*	235 (18%)	48 (20%)	20%
Instrument-rated pilot on board*	644 (51%)	140 (58%)	22%

Includes single-pilot accidents.

Figure 11

Type of Operation

Once again, the vast majority (73%) of accidents occurred during personal flights (Figure 9), though personal flying made up less than 40% of all non-commercial flight time. These included 77% of all fatal accidents. Instructional flights, on the other hand, occupied 20% of flight time but were only involved in 15% of accidents, and only 10% of instructional accidents were fatal compared to 20% of accidents on other types of flights. Both the tightly structured environment of flight training and the relatively low weight and speed of most primary training aircraft likely contributed to this result. Corporate transport by professionally operated flight departments continued to have the best safety record in general aviation, with only three accidents, none fatal, in almost three million hours flown. Business travel flown by people not primarily employed as pilots also fared well, accounting for 12% of overall flight time but just 3% of fatal and non-fatal accidents.

These results follow the pattern consistently reported in previous years.

Flight Conditions

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

While most fixed-wing flight time is also logged in daylight hours and in VMC, the FAA's activity estimates by light and weather conditions do not distinguish between commercial and non-commercial uses.

Pilot Qualifications

Private pilots were involved in 50% of all accidents and 52% 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 27% of accident flights commanded by commercial pilots and 10% 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, almost two-thirds of all non-commercial accidents involving ATPs (87 of 133) and more than half of those befalling commercial pilots (176 of 339) occurred on personal flights.

Accident lethality showed no clear relationship to certificate level except that accidents on student solos were least likely to be fatal. Again, 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 3% 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 during dual instruction.

Only 140 (11%) of the accident flights were confirmed to have two certificated pilots on board; these included 32 (13%) of the fatal accidents, but there is little data available on the amount of non-commercial flying done with two-pilot crews. About half of all accident flights had at least one instrument-rated pilot on board, similar to the proportion of all pilots 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.

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 can in turn be classified into categories reflecting 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.

Types of Pilot-Related Accidents

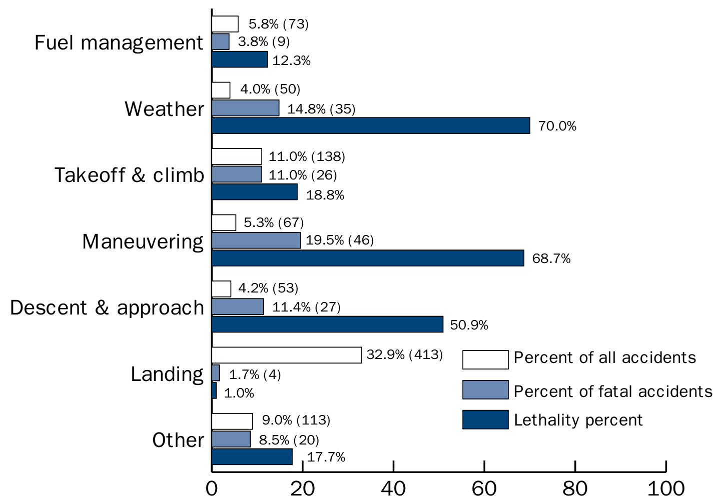


Figure 12

Pilot-Related Accidents

907 total / 167 fatal

Pilot-related categories made up 72% of non-commercial fixed-wing accidents in 2008 and 71% of fatal accidents, typical of the proportions seen over the twenty years of the *Nall Report*. The number of accidents in each major category is shown in Figure 12. As always, bad landings damaged more airplanes but were almost never fatal; weather and maneuvering accidents were much less common, but more than two-thirds proved 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 during attempted go-arounds, four of which were fatal

- 25 accidents, none fatal, attributed to inadequate preflight inspections

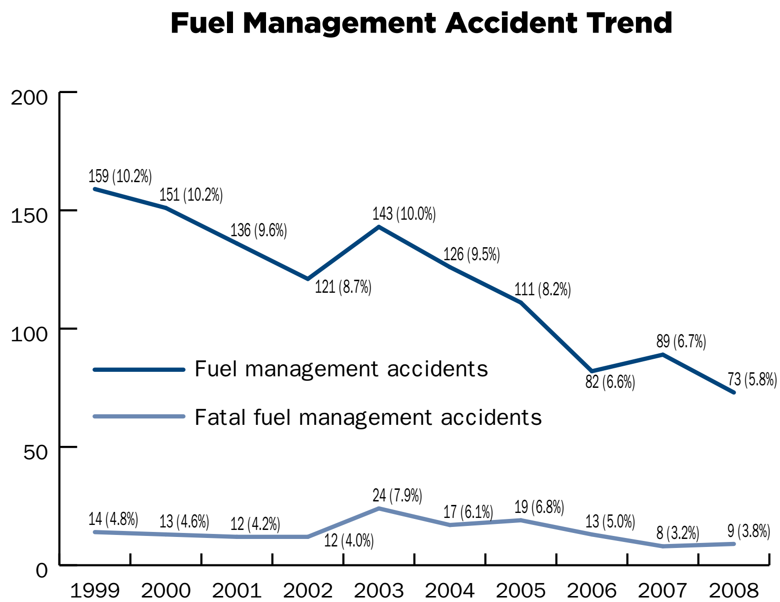


Figure 13

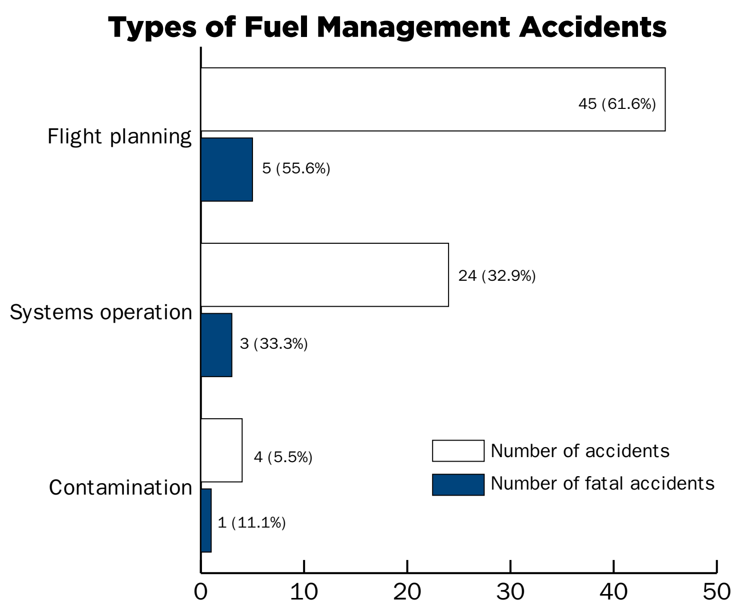


Figure 14

Flight Conditions of Fuel-Management Accidents: Non-Commercial Fixed-Wing

Light / Weather	All Accidents	Fatal Accidents	Lethality
Day VMC	57 (78%)	7 (78%)	13%
Night VMC	14 (19%)	2 (22%)	14%
Day IMC	1 (1%)	0	
Night IMC	1 (1%)	0	

Figure 15

- Nine on-the-ground collisions with other aircraft, none fatal: five during takeoff or landing and four while taxiing

- 30 non-fatal taxi accidents not involving collisions with other aircraft

- Seven accidents in cruise flight that did not involve collisions with birds or other aircraft; three were fatal

- Three fatal accidents attributed to medical incapacitation of pilots flying solo, and five accidents, four of them fatal, in which the pilots were impaired by drugs and/or alcohol.

- Three prop strikes, two of which were fatal

- Three airplanes wrecked in attempted flights by non-pilots, one of whom survived

- Three in-flight losses of aircraft control for reasons that have not been explained; two of these were fatal.

While the aeronautical 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 also tend to reflect deficiencies in airmanship, though it may have been faulty decision-making that placed the pilots in situations where their skills were put to the test.

Accident Causes: Flight Planning and Decision-Making

Fuel Management

73 total / 9 fatal

The steady reduction in accidents due to poor fuel management is one of the bright points in the general aviation record (Figure 13). Since 1999, the number of fuel-management accidents has dropped by more than half, and the share of all accidents attributed to fuel mismanagement has decreased from more than 10% to less than 6%. The 73 that took place in 2008 was the lowest number in that period, and the nine fatal were second only to the record low of eight the year before. Eight of those 10 years saw fewer fuel-management accidents than the year before. Technological improvements such as range rings on moving-map displays and automated reminders to switch tanks probably

Accident Case Study

ANC08FA104

Beech 95-B55, Sitka, Alaska

Two fatalities

History of Flight

The pilot ended a cross-country flight of more than 740 nm with a GPS approach into his planned fuel stop, cancelling his instrument flight plan after landing. Thirty minutes later he contacted ATC from the air to report that he'd been unable to refuel, as "there [was] no one there, all the things are locked." He said, "We thought we would make a quick run to Sitka," 83 nm back the way he'd come, and added, "I hope we have enough fuel." He estimated the quantity on board as "about an hour."

AOPA FILE PHOTO

After an unsuccessful attempt to join the localizer for an LDA approach into Juneau, 36 nm east, the pilot requested clearance to Sitka. Twenty-two minutes after the first radio contact, he estimated fuel on board as "about an hour and ten minutes." Twenty-five minutes later he reported, "Looks like we're having trouble with our left engine," after which contact was lost. An ELT signal helped the Coast Guard locate the wreckage in mountainous, densely forested terrain. The tanks were empty, and there was no smell of fuel at the site.

Pilot Information

The instrument-rated private pilot, age 82, held ratings for single- and multiengine airplanes, single-engine seaplanes, and gliders. His most recent medical application, submitted nine months earlier, listed 7,500 hours of total flight time. That medical application and a request for special issuance were both denied due to his history of coronary heart disease.

Weather

The nearest station reported sky conditions as 2,500 overcast with 10 miles visibility underneath. Surface winds were from 090 at 4 knots. Winds aloft were headwinds of 8 to 13 knots.

Probable Cause

A loss of engine power in flight due to fuel exhaustion resulting from the pilot's inadequate fuel planning and navigation.

ASF Comments

Aircraft stop for fuel because they need it. Neither urgency nor frustration will put any more in the tanks. The manufacturer estimated that this airplane had at most an hour and eleven minutes of fuel remaining when it landed – barely the "golden hour" of reserves that ASF recommends never dropping below. After choosing a fuel stop without confirming the availability of fuel and bypassing larger and closer airports to get there, the pilot took off into instrument conditions over rugged terrain with negligible reserves – choices hardly calculated to produce a good outcome.

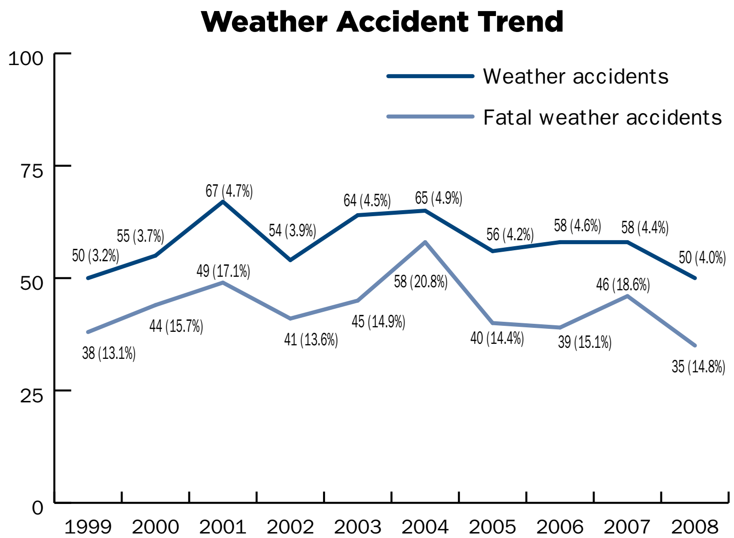


Figure 16

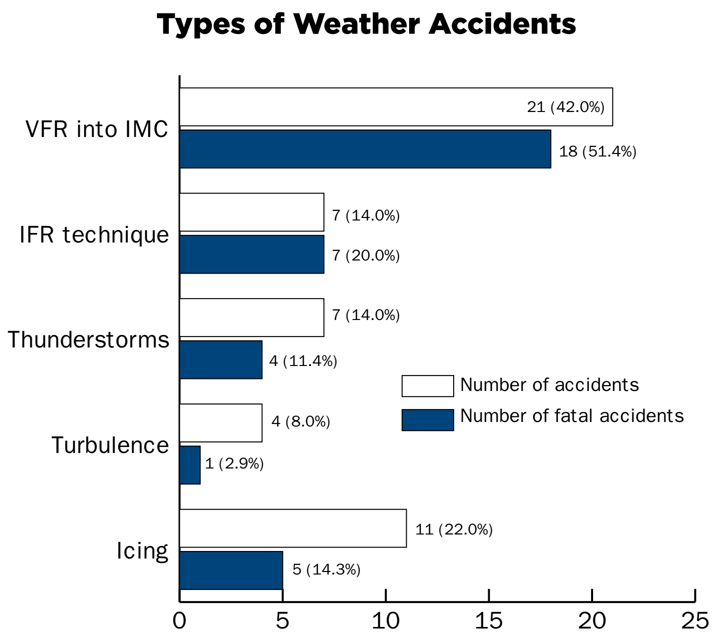


Figure 17

play a role in this improvement, as may continued public-education efforts by both the FAA and the AOPA Air Safety Foundation.

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 62 percent of the total and five of nine fatal accidents (Figure 14). Almost one-third (24 of 73) 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. Fuel contamination, whether by foreign substances such as water or by use of the wrong grade of fuel, was only blamed for four accidents, one of them fatal.

The different classes of aircraft were involved in fuel-management accidents in almost exactly the same proportions as in non-commercial fixed-wing accidents in general; the more complicated systems on board high-performance and multiengine aircraft don't appear to have been a significant factor. Despite small numbers, a higher proportion seems to have occurred at night (Figure 15), perhaps reflecting the effects of fatigue. No fuel-management accidents happened on student solos; aside from that, there was no obvious relationship to the pilot's certificate level.

Weather

50 total / 35 fatal

While weather only caused 4% of 2008's accidents, it remained the deadliest accident type, with 70% lethality. Of 50 weather accidents, 35 were fatal – almost 15% of all fatal accidents that year. Although this represented a slight decline from 2007 both in absolute numbers and on a percentage basis, the prevalence of weather accidents has shown little change since 1999 (Figure 16). Neither has their lethality, which has only dropped below 70% once during that period (it was 67% in 2006).

The most common type of weather accident continues to be the attempt to fly by visual references in instrument meteorological conditions, often called "VFR into IMC." It also continues to be among the most consistently deadly (Figure 17). There were 21 VFR-into-IMC accidents in 2008, of which 18 (86%) were fatal. Only deficient execution of instrument procedures (by appropriately rated pilots on instrument flight plans) had a

Accident Case Study

LAX08FA246

Cessna 172N, McMurray, Washington

Three fatalities

History of Flight

The pilot and two passengers departed VFR for an airport 85 nm to the southeast. No flight plan was filed. Marginal VFR and IFR conditions prevailed over a wide area including the entire planned route. The pilot received VFR traffic advisories during the first 15 minutes of the flight, maintaining a southeasterly track at altitudes between 2,400 and 2,500 msl for most of that time. Shortly before radar service was terminated, the airplane began a gradual descent to 900 msl, followed by a series of turning climbs and descents between 1,500 and 2,900 msl. The last three radar returns indicated a descending right turn to 2,200 msl, where the airplane crashed into a heavily wooded hillside.

AOPA FILE PHOTO

Pilot Information

The pilot, age 47, held an airline transport pilot certificate with airplane multi-engine rating, a commercial pilot certificate with airplane single-engine land and airplane single-engine sea ratings, a turbojet powered rating, and type ratings in various transport-category aircraft. She reported 14,200 total flight hours on her most recent medical certificate application.

Weather

The nearest airport, 11 miles from the accident scene, reported sky conditions of 500 scattered, 2,000 broken, and 2,700 overcast, with 10 miles visibility. Temperature was 15 degrees C with a dew point of 13, and winds were from 320 at 7 knots.

Probable Cause

The pilot's improper decision to continue VFR flight into IMC. Contributing to the accident were low ceilings, reduced visibility, and mountainous terrain.

ASF Comments

Even the most expert pilots can't count on avoiding obstacles they can't see. The only safe way to fly in poor visibility is at altitudes where there's nothing to hit. This pilot's catastrophic decision to try to slip between descending weather and rising terrain is all the more surprising in light of her evident qualifications to make an instrument flight instead.

Aircraft Involved in Weather Accidents: Non-Commercial Fixed-Wing

Aircraft Class	All Accidents	Fatal Accidents	Lethality
Single-engine fixed-gear	30 (60%)	18 (51%)	60%
SEF, conventional gear	9	4	44%
Single-engine retractable	12 (24%)	11 (31%)	92%
Multiengine	8 (16%)	6 (17%)	75%

Figure 18

Flight Conditions of Weather Accidents: Non-Commercial Fixed-Wing

Light / Weather	All Accidents	Fatal Accidents	Lethality
Day VMC	19 (38%)	7 (20%)	37%
Night VMC	1 (2%)	1 (3%)	100%
Day IMC	24 (48%)	21 (60%)	88%
Night IMC	4 (8%)	4 (11%)	100%
Not reported	2 (4%)	2 (6%)	

Figure 19

Pilots Involved in Weather Accidents: Non-Commercial Fixed-Wing

Certificate Level	All Accidents	Fatal Accidents	Lethality
ATP	9 (18%)	5 (14%)	56%
Commercial	6 (12%)	5 (14%)	83%
Private	32 (64%)	22 (63%)	69%
None	3 (6%)	3 (9%)	100%
CFI on board	8 (16%)	5 (14%)	63%
IFR pilot on board	26 (52%)	20 (57%)	77%

Figure 20

Takeoff and Climb Accident Trend

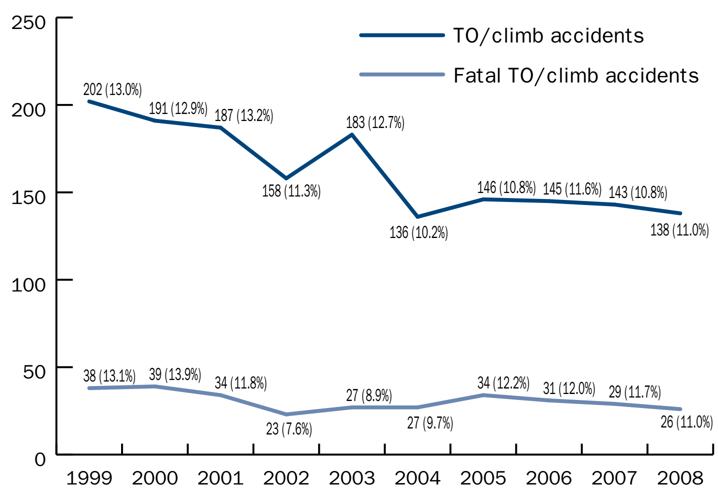


Figure 21

higher lethality rate; all seven of these were fatal. The number of VFR-into-IMC accidents was still the lowest of the past decade, three fewer than the 24 (21 fatal) in 2007.

The number of accidents ascribed to icing, either airframe or induction, was sharply higher at 11, but 2007 had unusually few; 2008's record was more in line with recent history. (Four of the preceding nine years had at least 11 icing accidents apiece.) Five were fatal, as were four of seven thunderstorm encounters and one of the four caused by non-convective turbulence.

Weather accidents were more likely to involve higher-end aircraft, with multiengine and retractable-gear airplanes accounting for 40%, including almost half the fatal accidents (Figure 18). This likely reflects greater exposure to weather hazards, since more capable aircraft are more apt to be used for long-distance transportation rather than training or pleasure flights. Only one, however, was a so-called technologically advanced aircraft (TAA), a factory-built Lancair that crashed attempting a below-minimums instrument approach; but 11 of the accident aircraft (22%) were amateur-built. While not dramatically higher than the overall proportion of accidents involving amateur-built airplanes (17%), it may be higher than expected if in fact they have less exposure to adverse weather. The FAA estimates that less than 3% of amateur-built flight time took place in IMC compared to 15% of that for type-certificated piston airplanes, but those figures include commercial operations, making any differences in exposure on the non-commercial side more difficult to assess.

Forty percent occurred (or at least ended) in VMC (Figure 19), but these were the more survivable, including only 23% of the fatal accidents. Twenty-five of 28 in IMC were fatal, or 89%. Almost two-thirds of the pilots involved (64%) held private certificates (Figure 20), a somewhat higher proportion than of accident pilots in general, but more than half of all the pilots in weather accidents were instrument-rated. No student pilots suffered weather accidents in 2008.

Accident Causes: High-Risk Phases of Flight

Takeoff and Climb

138 total / 26 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 about one-eighth of those that prove fatal. There are suggestions of modest improvement over the past few years (Figure 21); since 2004, there have typically been about 25% fewer takeoff accidents than there were between 1999 and 2003, and their proportion of all accidents has dropped from about 13% to the 10-11% range. (Accidents in the climb above pattern altitude have been rare throughout.) Their percentage of fatal accidents, however, has remained fairly constant.

Losses of aircraft control remain the most common cause of takeoff accidents with 56 (Figure 22), followed by departure stalls (33). Nine of each were fatal, together comprising 69% of the fatal accidents in this category. Twelve were caused by attempts to take off from runways that were slick, contaminated, or unsuitable for reasons of length, slope, or prevailing winds. The 28 "other" accidents included collisions with vehicles, animals, and other unexpected obstructions as well as overruns following 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 23) 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. Almost all (97%) took place in VMC, with 90% in visual conditions in daylight. The certificate levels of the pilots involved mirrored those of all accident pilots almost exactly.

Maneuvering
67 total / 46 fatal

While a higher proportion of weather accidents are fatal, more fatal accidents occur in maneuvering flight than any other pilot-related category (Figure 24), and 2008 was no exception. Forty-six of 67 were lethal (69%). Some of the accident maneuvers were necessary, such as turns in the airport traffic pattern, but poorly executed. Others were needlessly risky activities like buzzing attempts, low-altitude night flights, or attempted aerobatics by untrained 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.

Types of Takeoff and Climb Accidents

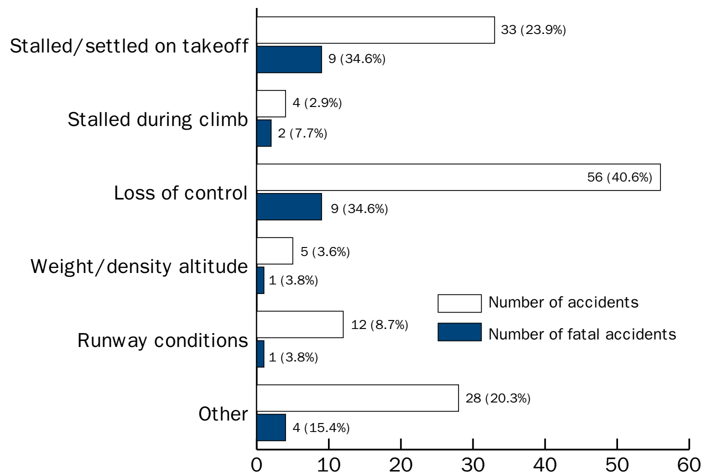


Figure 22

Aircraft Involved in Takeoff and Climb Accidents: Non-Commercial Fixed-Wing

Aircraft Class	All Accidents	Fatal Accidents	Lethality
Single-engine fixed-gear	112 (81%)	16 (62%)	14%
SEF, conventional gear	42	4	10%
Single-engine retractable	21 (15%)	8 (31%)	38%
Multiengine	5 (4%)	2 (8%)	40%

Figure 23

Maneuvering Accident Trend

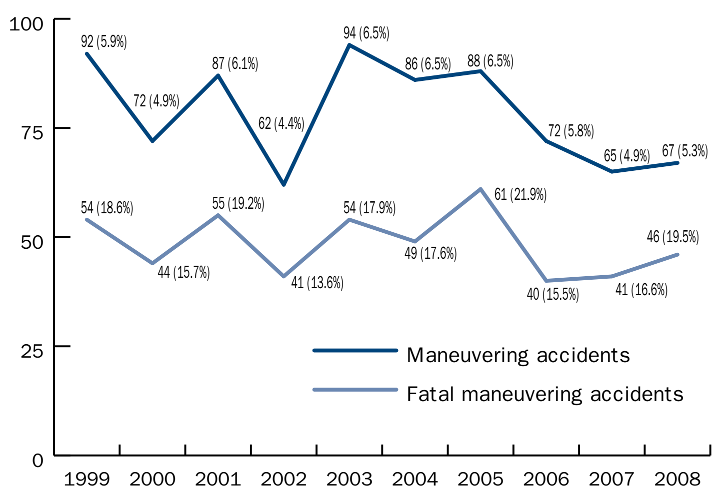


Figure 24

Accident Case Study

CHI08FA150
Socata TBM-700, Iowa City, Iowa
One fatality

History of Flight

The airplane landed on the 3,900-foot Runway 30 with a quartering tailwind of about 6 knots. In less than half an hour the pilot loaded two passengers, a small child and her mother, and requested IFR clearance for the return flight. The pilot allowed the child to ride in her mother's lap without restraints even though she was more than two years old and therefore required by regulation to use a safety belt and harness, and he elected to take off from Runway 30 even though the wind had come around to 100 degrees – almost a direct tailwind – and increased to 21 knots with gusts up to 36. The airplane required 3,000 feet to reach rotation speed, reaching an altitude of about 100 feet as it crossed the threshold. The left wing dropped in an apparent stall and the airplane crashed into a parking lot. The two adults suffered only minor injuries, but the child was killed.

AOPA FILE PHOTO

Pilot Information

The instrument-rated private pilot, age 56, reported 5,688 hours of total flight experience, including 4,388 hours in the make and model of the accident airplane, 145 hours in the last 90 days, and 58.4 hours in the last 30 days.

Weather

During the half hour the airplane was on the ground, an area of convective activity moved past the airport; at the time of the accident, it was six miles to the east of the field. Wind direction varied between 090 and 100 degrees, and velocities increased from 6 knots to 21, gusting to 36. Sky conditions were 2,100 broken with 5 miles visibility.

Probable Cause

The pilot's improper decision to depart with a preexisting tailwind and his failure to abort the takeoff. Contributing to the severity of the injuries was the failure to properly restrain (FAA-required) the child passenger.

ASF Comments

Weather conditions can change rapidly and should be confirmed after any time on the ground. Downwind takeoffs are riskier even in highly capable airplanes, and should be attempted only for good reason and after careful consideration. Seat belts and shoulder harnesses can make the difference between minor scrapes and fatal injuries. By law, they must be used by all passengers who have passed their second birthdays; and even though the Federal Aviation Regulations allow parents to hold children under the age of two, the pilot-in-command is not obliged to permit this. ASF recommends the use of car seats, appropriately strapped in.

More than half (36 of 67) began with stalls or other losses of aircraft control at altitudes too low to allow recovery (Figure 25). Three-quarters of these were fatal. Collisions with wires, structures, or other obstacles caused two-thirds of the rest; 57% of these were fatal, as were six out of seven accidents during attempted aerobatics. Low-altitude canyon flights only caused three accidents in 2008, just one of which was fatal.

Most maneuvering accidents happened in fixed-gear singles (Figure 26); more than 40% of those had conventional landing gear. Only two multiengine airplanes were involved, along with nine single-engine retractables, and this was one of the few accident categories in which lethality did not increase with the weight and speed of the aircraft involved.

All but one took place in VMC, and only three at night; 94% were in VMC during daylight hours. Nine of the accident aircraft were flown by unlicensed pilots (Figure 27), and seven of those accidents were fatal. Aside from these, certificate levels were similar to those of the accident population as a whole, though this year no student pilots were involved.

Descent and Approach

53 total / 27 fatal

The number of descent and approach accidents decreased in 2008, though as a proportion of both fatal and non-fatal accidents they remained in the same range seen in recent years (Figure 28). 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 initial approach fix of an instrument approach procedure on instrument flights. The 51% lethality of these accidents in 2008 is typical of the past ten years and more than double that of fixed-wing GA accidents overall.

Figure 29 shows that the largest number of these were caused by stalls either with or without spins (19), closely followed by collisions with obstacles or terrain (18). The most consistently lethal, however, were improperly executed 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. All 12 of these were fatal, killing 28 people, half of the 56 who died in descent/approach accidents.

Types of Maneuvering Accidents

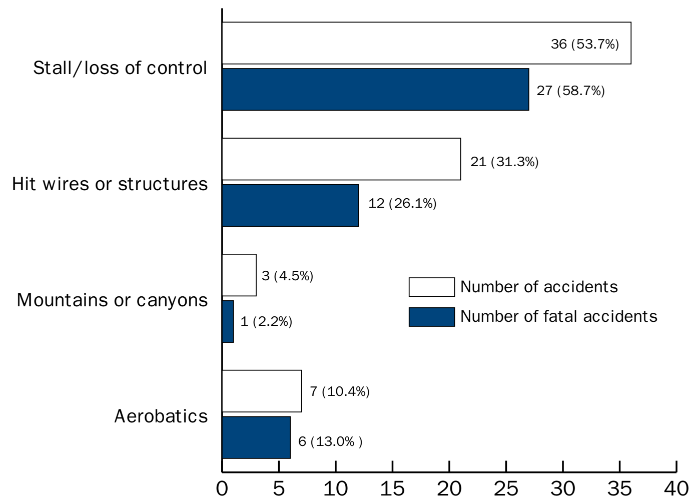


Figure 25

Aircraft Involved in Maneuvering Accidents: Non-Commercial Fixed-Wing

Aircraft Class	All Accidents	Fatal Accidents	Lethality
Single-engine fixed-gear	56 (84%)	39 (85%)	70%
SEF, conventional gear	23	14	61%
Single-engine retractable	9 (13%)	6 (13%)	67%
Multiengine	2 (3%)	1 (2%)	50%

Figure 26

Pilots Involved in Maneuvering Accidents

Certificate Level	All Accidents	Fatal Accidents	Lethality
ATP	10 (15%)	7 (15%)	70%
Commercial	17 (25%)	11 (24%)	65%
Private	31 (46%)	21 (46%)	68%
None	9 (13%)	7 (15%)	78%

Figure 27

Accident Case Study

LAX08LA191
Cessna 172S, Oceanside, California
Two fatalities

History of Flight

A flight of two airplanes flew from their base to another local airport, where the crews had a snack and discussed the flight home. The accident pilot, who had two passengers, said that he wanted to do a spin on the way home, adding that he'd previously done spins with his instructor and a back-seat passenger on board. On the return flight, the accident pilot began an intentional spin at 7,500 msl, recovering after one turn. He then radioed the other airplane to say that he was going to do another, this time letting it spin "a little more before he start[ed] the recovery." The witnesses in the other airplane saw the accident airplane set up and enter the spin, which continued until it crashed into the ocean. The rear-seat passenger survived with serious injuries and was rescued by boaters; neither the airplane nor the bodies of the pilot and front-seat passenger were ever recovered. The Information Manual for the Cessna 172S explicitly prohibits spins when the rear seat is occupied.

AOPA FILE PHOTO

Pilot Information

The 19-year-old pilot had received his private pilot certificate three days before the accident. He had 72 hours of total flight experience, 10 as pilot-in-command.

Weather

Skies were clear, with 9 miles visibility. Winds were from 210 degrees at 8 knots.

Probable Cause

Failure of the pilot to regain airplane control during an intentional stall/spin maneuver.

ASF Comments

The combination of overconfidence, inexperience, and lack of attention to detail frequently contributes to maneuvering accidents. This pilot may also have been poorly served by the irresponsibility of his instructor if the CFI had in fact demonstrated spins while carrying a rear-seat passenger. The aircraft was operated outside of its approved flight envelope.

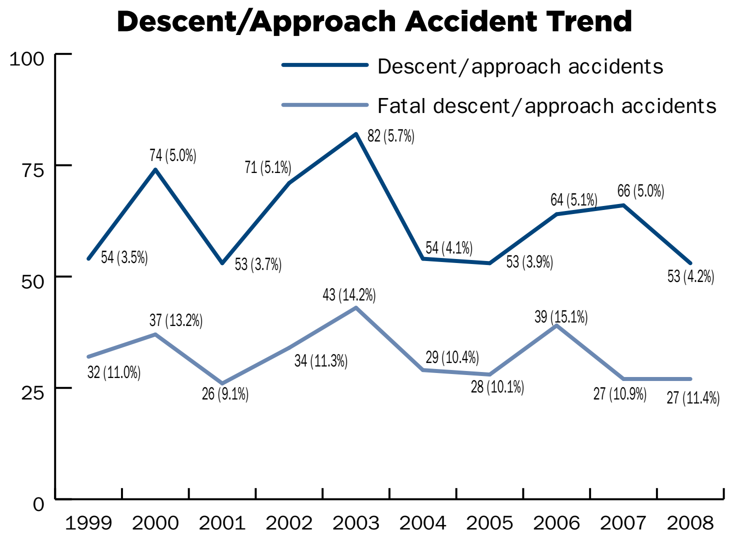


Figure 28

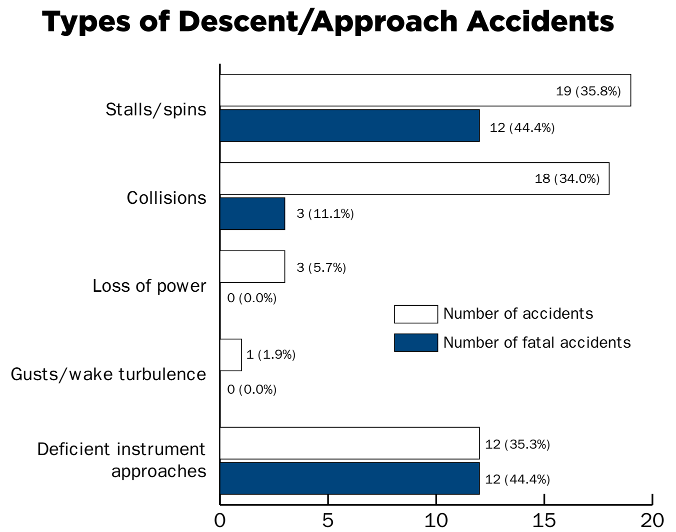


Figure 29

Twenty-five of the other 28 died in the 12 fatal stall/spin accidents, and the other three were killed in three separate collisions.

The classes of aircraft involved resemble the overall accident distribution (Figure 30), but accident lethality was sharply higher in retractable-gear singles and multiengine airplanes. Nine of the 12 that crashed during instrument approaches belonged to one of these classes.

More than 40% of descent/approach accidents happened at night and/or in IMC (Figure 31), and 14 of 23 (61%) were fatal compared to 43% of accidents in daytime VMC. Two were flown by students and six by non-certificated pilots; in each case, half these accidents were fatal (Figure 32). Lethality was uniformly high, regardless of certificate level.

Landing

413 total / 4 fatal

Landings consistently cause the largest number of accidents but almost no fatalities. The number of accidents in 2008 was down by just three from 2007 (Figure 33), so they made up a higher proportion of all accidents for the year; at 33%, it was the second highest in the past decade. Just four were fatal, however, half the number of the year before. 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 low altitude, very close to the point of initial impact. Being on, or at least close to, the runway generally eliminates most obstacles.

Aircraft Involved in Descent/Approach Accidents: Non-Commercial Fixed-Wing

Aircraft Class	All Accidents	Fatal Accidents	Lethality
Single-engine fixed-gear	37 (70%)	13 (48%)	35%
SEF, conventional gear	14	2	14%
Single-engine retractable	12 (23%)	10 (37%)	83%
Multiengine	4 (8%)	4 (15%)	100%

Figure 30

Flight Conditions of Descent/Approach Accidents: Non-Commercial Fixed-Wing

Light / Weather	All Accidents	Fatal Accidents	Lethality
Day VMC	30 (57%)	13 (48%)	43%
Night VMC	11 (21%)	4 (15%)	36%
Day IMC	5 (9%)	5 (19%)	100%
Night IMC	7 (13%)	5 (19%)	71%

Figure 31

Pilots Involved in Descent/Approach Accidents: Non-Commercial Fixed-Wing

Certificate Level	All Accidents	Fatal Accidents	Lethality
ATP	4 (8%)	3 (11%)	75%
Commercial	9 (17%)	5 (19%)	56%
Private	31 (58%)	15 (56%)	50%
Sport	1 (2%)	0	
Student	2 (4%)	1 (4%)	50%
None	6 (11%)	3 (11%)	50%

Figure 32

Accident Case Study

ERA09FA060
Piper PA38-112, Smithfield, Rhode Island
Two fatalities

History of Flight

AOPA FILE PHOTO

The pilot requested VFR advisories for practice instrument approaches to a non-towered field at night. He subsequently received a VFR approach clearance for a VOR/GPS-A approach with a minimum descent altitude (MDA) of 980 msl. Radar data indicated that the airplane crossed the final approach fix at the specified altitude of 1,900 agl; over the next three minutes, it descended steadily to 500 msl, just 80 feet above ground level, before radar contact was lost. About thirty seconds after the last radar return, 9-1-1 operators began receiving calls reporting "a loud explosion" and "a ball of fire." The airplane hit 80-foot trees about two-thirds of a mile short of the runway threshold, leaving a 250-foot debris path.

Pilot Information

The pilot, age 43, held a private pilot certificate with instrument rating for single-engine airplane. His logbooks indicated 1,405 hours of total flight experience with more than 800 hours in the accident airplane. The pilot-rated passenger serving as safety pilot, age 64, held a private pilot certificate for single-engine airplane with 244 hours of flight experience.

Weather

Sky conditions were 8,000 overcast with 10 miles visibility. Winds were from 310 degrees at 7 knots. The accident occurred about 40 minutes after sunset.

Probable Cause

The pilot's improper descent below the published minimum descent altitude during the approach, which resulted in controlled flight into terrain.

ASF Comments

Rigorous adherence to the charted procedure is vital during instrument approaches, whether in actual or simulated instrument conditions. Premature descent below the published minimum altitude is especially perilous at night or in reduced visibility. Thought should also be given to the choice of safety pilots. Familiarity with instrument procedures is essential. In this case, a low-time safety pilot with limited night-flying experience probably never recognized either their descent below the MDA or their proximity to the treetops.

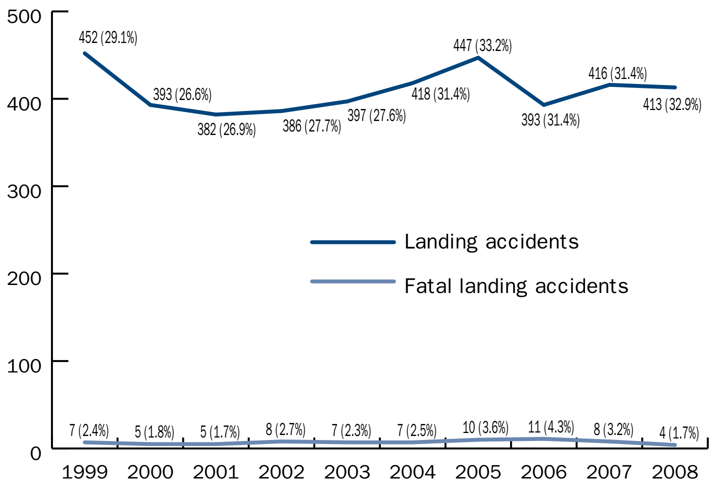


Figure 33

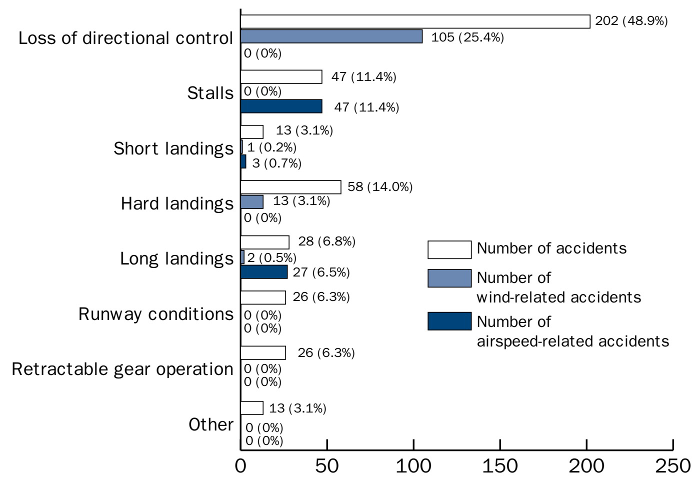


Figure 34

The types of landing accidents remain fairly constant as well (Figure 34). Losses of directional control accounted for almost half (49%), and just over half of these were blamed at least in part on wind conditions, most often gusts and crosswinds (or, perhaps more appropriately, the pilot-in-command's inability to handle prevailing wind conditions). Hard landings (14%) and stalls (11%) made up another quarter, while overruns, runway conditions, and errors in operating retractable gear systems accounted for 6-7% each. Only about 3% of landing accidents involved coming up short, about the same proportion as such miscellaneous mishaps as wildlife strikes, collisions with vehicles, and collisions with other aircraft on the runway.

More than three-quarters of the accident airplanes were fixed-gear singles, and one-third of these were tailwheel models (Figure 35). Two of the four fatal accidents were in multiengine airplanes; there were none in retractable-gear singles. Only four landing accidents took place in IMC, and none of those were at night. Twenty-nine occurred in visual conditions at night, but 92% of all landing accidents were in VMC during the daytime.

Landing accidents are the only category that includes a disproportionate share of student pilots (Figure 36). Students made up more than one-sixth of landing accident pilots (72 of 413), more than double the share of students among accident pilots overall, and landings made up more than two-thirds of all accidents involving student pilots. CFIs, unfortunately, share the responsibility for this. No student landing accidents were fatal in 2008.

Aircraft Involved in Landing Accidents: Non-Commercial Fixed-Wing

Aircraft Class	All Accidents	Fatal Accidents	Lethality
Single-engine fixed-gear	323 (78%)	2 (50%)	< 1%
SEF, conventional gear	108	1	1%
Single-engine retractable	53 (13%)	0	
Multiengine	37 (9%)	2 (50%)	5%

Figure 35

Pilots Involved in Landing Accidents: Non-Commercial Fixed-Wing

Certificate Level	All Accidents	Fatal Accidents
ATP	30 (7%)	0
Commercial	104 (25%)	0
Private	195 (47%)	4
Sport	5 (1%)	0
Student	72 (17%)	0
None	7 (2%)	0

Figure 36

Accident Case Study

SEA08FA161
Cessna 441, Sunriver, Oregon
One fatality

History of Flight

The pilot cancelled his instrument clearance about 20 miles south of his destination airport, then transmitted his intention to land straight in on Runway 36. Witnesses at the airport agreed that the approach path, speed, and initial touchdown appeared normal; nevertheless, the airplane bounced, beginning a series of increasingly high bounces that ended when the nose and right wing dropped and the right propeller hit the runway. Witnesses then heard the engines go to full power and saw the nose lift into the air in an apparent go-around attempt. The right engine stopped operating shortly afterward and the airplane rolled right, striking a tree and then the ground. It was consumed by fire within four minutes.

NASA FILE PHOTO

Pilot Information

The pilot, age 50, held a private pilot certificate with instrument rating for single- and multiengine airplanes. He had about 965 hours of total flight experience, including 845 as pilot-in-command of multiengine airplanes and 277 in the accident make and model.

Weather

Sky conditions were reported as 10,000 scattered. Winds were from 337 degrees at 4 knots.

Probable Cause

The pilot's misjudged landing flare and improper recovery from a bounced landing, and the pilot's failure to maintain directional control during the go-around after one of the airplane's propellers struck the runway.

ASF Comments

Whether in a single or a twin, attempting a go-around after a prop strike is extremely hazardous. The only certainty is that the powerplant has been damaged, making its performance unpredictable and its reliability uncertain. The best response is almost always to cut the throttles, try to maintain directional control while sliding to a stop, and call the insurance company after the dust settles. In this case, the pilot's total flight experience was also unusually low for the model of aircraft.

Mechanical/Maintenance Accident Trend

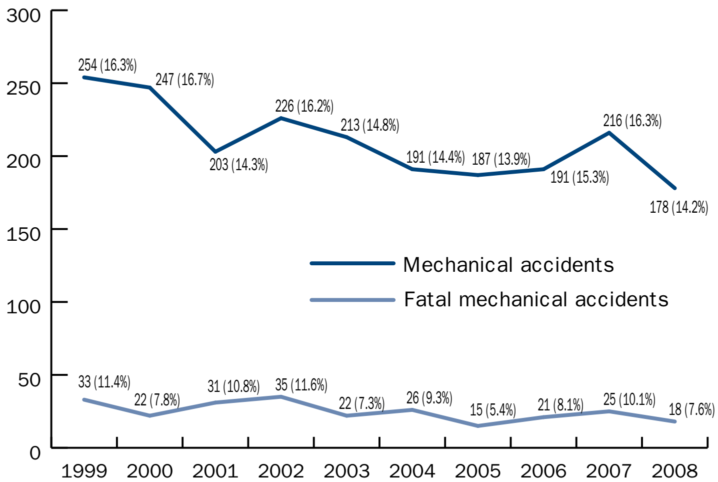


Figure 37

Types of Mechanical/Maintenance Accidents

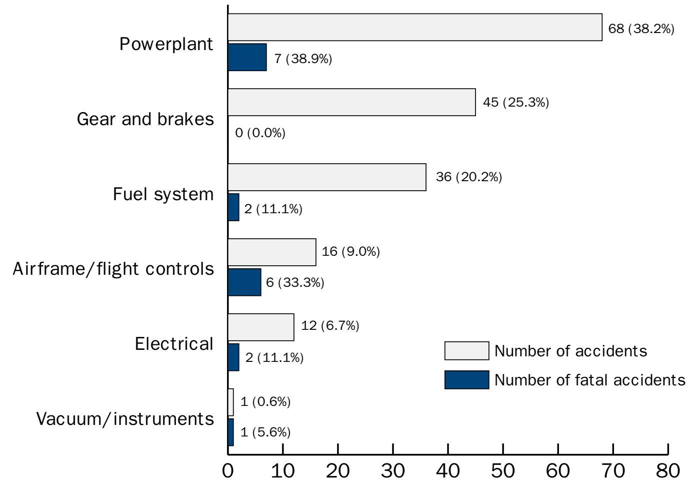


Figure 38

Mechanical / Maintenance
178 total / 18 fatal
Accidents primarily caused by deficient maintenance or the failure of components in normal service remain relatively rare. The 178 recorded in 2008 were the fewest in the past decade (Figure 37) and represented the second smallest percentage of all accidents after 2005, though year-to-year differences have been slight. Over the past ten years, mechanical failures have caused an accident less than once for every 100,000 hours flown, and those have been relatively survivable. Ten percent of mechanical accidents were fatal in 2008, half the lethality rate of all other accident types combined. The 18 fatal accidents in this category is the second lowest since 2005, and third lowest of the decade as a percentage of all fatal accidents.

Powerplant problems remain the most common type of mechanical accidents, causing 68, or 38% of the total (Figure 38). Seven were fatal, 39% of all fatal mechanical accidents. Gear and brake malfunctions were the next most common, causing 45 accidents (25%) but no fatalities. Discrepancies in fuel systems such as pump failures or leaking fuel lines caused 36 accidents (20%), but only two were fatal; on the other hand, airframe and flight control failures caused only 16 of 178 accidents (9%), but six of the 18 fatals. Their 38% lethality was exceeded only by that of vacuum system failure, which caused exactly one (fatal) accident. Aircraft electrical systems were only implicated in 12 accidents, and this distribution is very similar to the patterns reported for 2007 and earlier years.

Aircraft Involved in Mechanical / Maintenance Accidents: Non-Commercial Fixed-Wing

Aircraft Class	All Accidents	Fatal Accidents	Lethality
Single-engine fixed-gear	105 (59%)	8 (44%)	8%
Single-engine retractable	54 (30%)	6 (33%)	11%
Multiengine	19 (11%)	4 (22%)	21%
Multiengine turbine	7	2	28%

Figure 39

Despite their greater complexity, multiengine airplanes were not involved in a disproportionate number of mechanical accidents (Figure 39), but the proportion involving retractable-gear singles was almost twice as high as in all other types of accidents combined (30% compared to 16%). Unlike the overall accident record, however, the difference in lethality between fixed-gear and retractable singles was negligible, and that of multiengine accidents was still lower than multiengine lethality overall.

Other, Unknown, or Not Yet Determined
169 total / 51 fatal

More than 13% of 2008's accidents (169 of 1,254) could not be clearly ascribed to either mechanical or pilot-related causes, and 30% of them were fatal (Figure 40). In almost half (25) of the 51 fatal accidents, too little information was available at the time of publication to reach even preliminary conclusions about their causes. Sixty-nine people were killed in them, 16% of all non-commercial fixed-wing fatalities for the year. More than anything, the large number of unexplained fatal accidents reflects the difficulties of conducting investigations without being able to interview survivors. Eight non-fatal accidents were also unclassified; five were in ultralights or weight-shift control aircraft.

"Other" and Unclassified Accidents: Non-Commercial Fixed-Wing

Major Cause	All Accidents	Fatal Accidents	Lethality
Not yet determined	33 (20%)	25 (49%)	76%
Loss of power	102 (60%)	14 (27%)	14%
Other	34 (20%)	12 (24%)	35%

Figure 40

A full 60% of the accidents in the "other or unknown" category (102 in all) were precipitated by a sudden loss of engine power for reasons that could not be reconstructed afterward: adequate fuel was present and the engines displayed no evidence of pre-accident abnormalities. Those engines that remained reasonably intact were typically test-run successfully during the investigations, and the pilots involved did not acknowledge any operational errors. While some may have resulted from carburetor icing or other avoidable hazards, none could be conclusively identified. Twenty-eight of these (27%) occurred in amateur-built aircraft, including six of 14 (43%) that were fatal. By comparison, amateur-built airplanes were involved in 18% of all non-commercial fixed-wing maintenance-related accidents and 26% of fatal accidents while making up a little less than 10% of the fleet.

The remaining 34 (including 12 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 30.

Fixed-Wing Accidents: Commercial

The number of accidents on commercial flights in fixed-wing airplanes increased 18% from 2007 to 2008 (from 109 to 127), while estimated total flight activity decreased by one-third. This produced the highest accident rate since 2003, reversing the trend of the previous decade. The number of fatal accidents increased by two to 15, causing 31 deaths and resulting in the highest rate of fatal accidents since 2004. However, the overall accident rate remained 28% lower than the non-commercial equivalent, and the fatal accident rate was 55% less.

The diversity of commercial fixed-wing flight operations reflects that of general aviation as a whole. Aerial applicators flew just under 29% of all commercial fixed-wing time, almost all of it maneuvering with heavy payloads at low altitude. 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 41). Almost all crop-dusters are fixed-gear singles, as are many of the airplanes that provide cargo and passenger service to remote locations. Both of these environments also benefit from the shorter takeoff rolls of tailwheel airplanes, which may explain why taildraggers were involved in two and a half times as high a proportion of commercial accidents (61%) as of non-commercial (24%).

Aircraft Class: Commercial Fixed-Wing

Aircraft Class	All Accidents	Fatal Accidents	Lethality
Part 137: Aerial Application			
Single-engine fixed-gear	81 (100%)	6 (100%)	7%
SEF, conventional gear	76	5	7%
Part 135: On-Demand Charter and Cargo			
Single-engine fixed-gear	23 (48%)	4 (44%)	17%
SEF, conventional gear	4	1	25%
Single-engine retractable	2 (4%)	0 (0%)	
Multiengine	23 (48%)	5 (56%)	22%
Multiengine turbine	6	1	17%

Figure 41

Type of Operation: Commercial Fixed-Wing

Type of Operation	Accidents	Fatal Accidents	Fatalities
Agricultural	81 (63%)	6 (40%)	6
Charter – non-medical	46 (36%)	9 (60%)	25
Charter – medical	2 (2%)	0	0

Figure 42

Flight Conditions: Commercial Fixed-Wing

Light / Weather	All Accidents	Fatal Accidents	Lethality
Part 137: Aerial Application			
Day VMC	79 (98%)	6 (100%)	8%
Night VMC	2 (2%)	0	
Part 135: On-Demand Charter and Cargo			
Day VMC	33 (72%)	6 (67%)	18%
Night VMC	5 (11%)	0	
Day IMC	5 (11%)	2 (22%)	40%
Night IMC	3 (7%)	1 (11%)	33%

Figure 43

Multiengine airplanes, on the other hand, flew almost half (46%) of all commercial time and 73% of time flown under FAR Part 135, but were only involved in 48% of the accidents that occurred on charter flights (18% of all commercial accidents). Despite the greater impact forces associated with higher speed, the lethality of multiengine accidents was not dramatically higher than that of single-engine charter accidents (22% vs. 16%). Lethality differed much more conspicuously by type of operation.

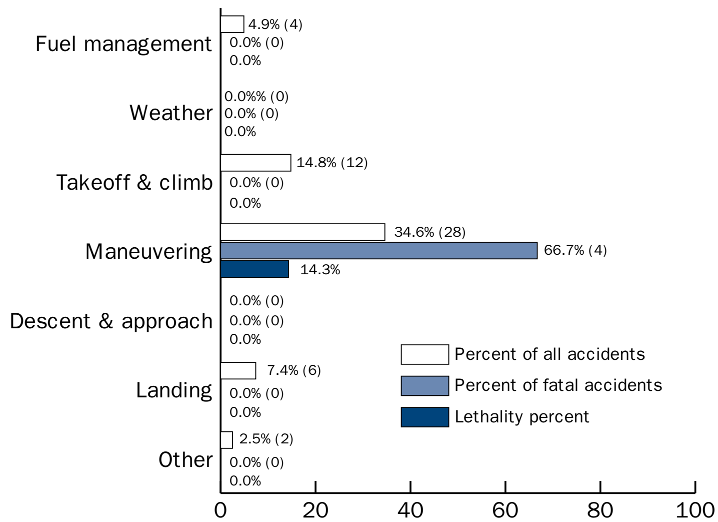
Type of Operation

Sixty-three percent of commercial fixed-wing accidents took place in agricultural application flights (Figure 42), but 60% of fatal accidents occurred in charter and on-demand cargo flights, and these accounted for 81% of the individual fatalities. The fatal accident rate was one-third lower in crop-dusting even though its overall accident rate was four times as high as for Part 135 operations, reflecting the combination of the high-risk environment with impacts that are usually low-speed and begin at low altitudes in aircraft **designed with particular attention to crashworthiness.** (While rate estimates should be interpreted with some caution due to the margins of error around the flight-time estimates, these differences are dramatic enough to be persuasive.)

Pilots Involved in Commercial Fixed-Wing Accidents			
PIC Certificate Level	**Accidents**	**Fatal Accidents**	**Lethality**
Part 137: Aerial Application			
ATP	6 (7%)	1 (17%)	17%
Commercial	75 (93%)	5 (83%)	7%
Flight instructors	16 (20%)	1 (17%)	6%
Part 135: On-Demand Charter and Cargo			
ATP	22 (46%)	5 (56%)	23%
Commercial	26 (54%)	4 (44%)	15%
Two-pilot crews	2 (4%)	0	
Flight instructors	19 (40%)	4 (44%)	21%

Figure 44

Types of Pilot-Related Accidents: Part 137



Types of Pilot-Related Accidents: Part 135

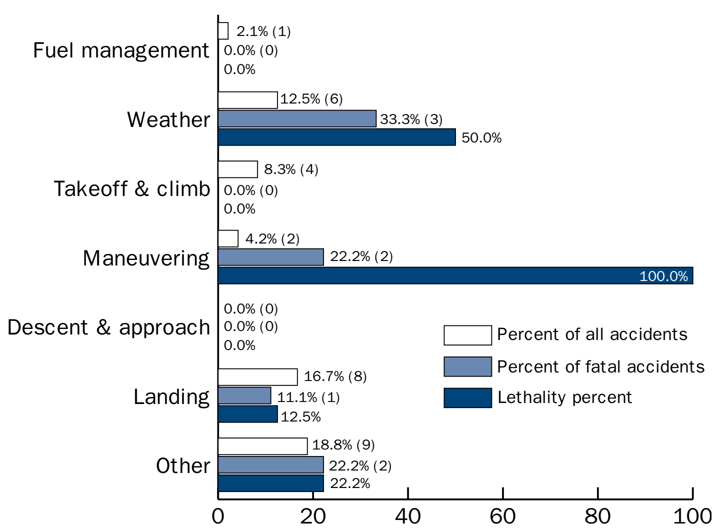


Figure 45

None of the fatal crop-dusting accidents injured anyone besides the pilots. In contrast with the helicopter record, only two accidents occurred on medical transport flights. These represented just 4% of all accidents in on-demand operations, and neither was fatal.

Flight Conditions

Commercial accidents also occurred predominantly in daytime VMC (Figure 43), 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 79 of 81 (including all six fatals) took place during daylight hours. Thirteen of 46 Part 135 accidents (28%) happened at night or in IMC, double the proportion among non-commercial accidents, including three of the nine that were fatal.

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. Almost half of the Part 135 accident flights (46%) were flown by ATPs (Figure 44), including five of the 9 that were fatal (56%). By comparison, only 7% of the crop-dusting accidents involved ATPs, and the proportion holding flight instructor certificates was only half as great (20% vs. 40%). Only two of the accidents involved two-pilot crews and neither was fatal. However, aerial application aircraft are almost always single-seat, and smaller aircraft used for cargo and charter flights are usually flown single-pilot.

Accident Causes

Mechanical failures were blamed for 29% of commercial accidents (37 of 127), about double their proportion of non-commercial accidents (Figure 7, page 9). Twenty-one, including two of the three that were fatal, were on agricultural application flights, which also included eight of nine accidents attributed to unexplained losses of engine power. The remaining "other" accident was a bird strike by an amphibious air taxi in Alaska.

The major types of pilot-related commercial accidents are shown in Figure 45. Sharp differences are apparent between the two types of operations. More than half of those on crop-dusting flights (28 of 52) occurred during maneuvering, which made up only 7% of the pilot-related Part 135 accidents (2 of 30). On-demand operators, on the other hand, suffered 8 of 14 landing accidents, including the only fatal one, and all six accidents ascribed to adverse weather. Aerial applicators had 12 of 16 accidents during takeoff and four of the five attributed to fuel mismanagement.

Vastly fewer landing accidents, a complete absence of accidents during approach and descent, and the higher proportion of maneuvering accidents were the most dramatic differences from the non-commercial accident distribution. Only one commercial flight (operating under Part 135) had an accident during an attempted go-around.

Unusual Accident Factors: All Aircraft

Collisions
23 total / 6 fatal

Non-commercial fixed-wing aircraft were involved in 11 midair collisions in 2008. Four of them were fatal, causing 14 total fatalities. Nine (including all four of the fatal accidents) were between two airplanes operated non-commercially; one involved an aerial application airplane, and one towplane collided with the glider it was pulling.

Three of the eight airplanes involved in fatal midair collisions were on instructional flights, and two of these hit each other: a Cessna 172 and a Piper PA-44-180 collided in a very busy training area in Florida. Another Cessna 172 flown by a solo student pilot collided with a Cirrus SR22 in Wyoming. The other five (including the Cirrus) were all on personal flights.

Four more collisions took place on runways during takeoffs and landings, and five while taxiing. A collision between two amateur-built aircraft at a fly-in killed both pilots and both passengers: a Velocity RG went off the left side of the runway after landing and hit an RV-8, which had taxied clear. None of the other eight on-ground collisions were fatal.

On the commercial side, there were two non-fatal taxi collisions between fixed-wing air taxis (both in Bethel, Alaska). A fatal collision between two medical transport helicopters on approach to the same hospital killed all seven on board both aircraft.

Alcohol and Drugs
5 total / 4 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 2008. Only five were attributed to this cause, all on non-commercial fixed-wing flights. Four of the pilots were killed, but no one else was injured; in all four cases the pilot's impairment was caused at least in part by prescription drugs, though two also tested positive for alcohol and a third for cocaine. The one pilot who survived was uninjured after a series of bounced landings collapsed the nose gear in his Cessna 182, but his blood-alcohol content was measured at 0.24 percent 75 minutes after the accident.

Physical Incapacitation
3 total / 3 fatal

Physical incapacitation of pilots is also extremely rare. Only three such accidents occurred during 2008; all were fatal, but no one besides the pilots was injured. All took place in non-commercial flights in fixed-wing aircraft. The pilots of an amateur-built RV-10 and a Universal Globe both lost consciousness in flight, and pathologists were unable to determine whether they had died prior to impact. The destruction of a Pilatus PC-12 on visual approach to Santa Fe, N.M., on a dark night was blamed on fatigue; the solo pilot had been awake for at least seventeen hours and flown for eight and a half, crossing two time zones.

Off-Airport Ground Injuries
6 accidents / 6 fatalities, 7 serious injuries

A total of six accidents (including one midair collision) caused six deaths and seven serious injuries to uninvolved people on the ground. All occurred in non-commercial fixed-wing flights. Four of them involved aircraft crashing into residences, causing a total of five deaths and six serious injuries among the occupants. These included a Cessna 310 that suffered fuel exhaustion on final approach, a Mooney M20 that lost control on a practice flight in actual instrument conditions, a Cessna 172 that crashed into a beach cottage after its pilot took off into instrument conditions without a clearance and became disoriented, and an amateur-built Velocity RG that lost engine power on a test flight.

The remaining fatality was caused by falling debris from the midair collision of two single-engine Cessnas in the traffic pattern at Corona, California. One person was seriously injured and two received minor injuries when a Cirrus SR22 crashed into a residential neighborhood, hitting two cars; and three people in an automobile suffered minor injuries in a head-on collision with an amateur-built Kitfox CL that was flying low over a highway. Investigators were unable to determine whether the pilot, who was killed, was attempting an emergency landing.

Propeller and Rotor Strike Injuries
4 total / 3 fatal

Attempts to hand-prop airplanes did not cause any reported propeller strikes in 2008. However, a lineman and a student pilot were killed and one passenger was seriously injured in three separate accidents when they walked into the arcs of rotating propellers. All three took place after sunset. In addition, a helicopter ground crewman was killed by a fragment of a shattered main rotor blade after a gust of wind caused the rotor to hit a fuel truck.

Amateur-Built Aircraft

Fixed-wing: 226 total / 61 fatal
Helicopter: 12 total / none fatal

In 2008, 228 amateur-built fixed-wing aircraft were involved in 226 distinct accidents, the same numbers as in 2007 (Figure 46). This represents 18% of all non-commercial fixed-wing accident aircraft, the highest proportion in the past ten years, during which time that proportion has steadily increased. Sixty-one of these were fatal, resulting in 82 deaths; these were increases of six fatal accidents and nine fatalities from the previous year, and made up 26% of fatal accidents and 19% of all fatalities. **By comparison, amateur-built aircraft logged less than 5% of the corresponding flight time. 2008 saw the highest numbers of fatal accidents and individual fatalities in the past decade, and more total accidents than any year except 2007. The 27% lethality rate in these accidents was 10 full percentage points higher than that of accidents in type-certificated airplanes.**

During the same period, the number of amateur-built helicopters involved in accidents has ranged from a low of 7 (none fatal) in 2001 to a high of 16, one of which was fatal, in 2002. There were 12 in 2008, one of the four years out of the past ten that saw no fatal accidents in amateur-built helicopter accidents. None of the past ten years had more than two.

The FAA's estimates of the total amount of time flown by amateur-built aircraft have decreased steadily since 2004, and 2008's figure of 872,024 hours was the lowest since 2001. While helicopters probably make up a small proportion of the amateur-built fleet and account for relatively little of this time, the FAA estimates do not distinguish between aircraft categories. The most accurate estimate of accident rates would therefore include both fixed-wing and helicopters.

Figure 47 illustrates the proportions of non-commercial flight time and non-commercial accidents in 2008 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 88% of flight time, 75% of accidents, and 67% of fatal accidents. The

Accident Trend for Amateur-Built Aircraft

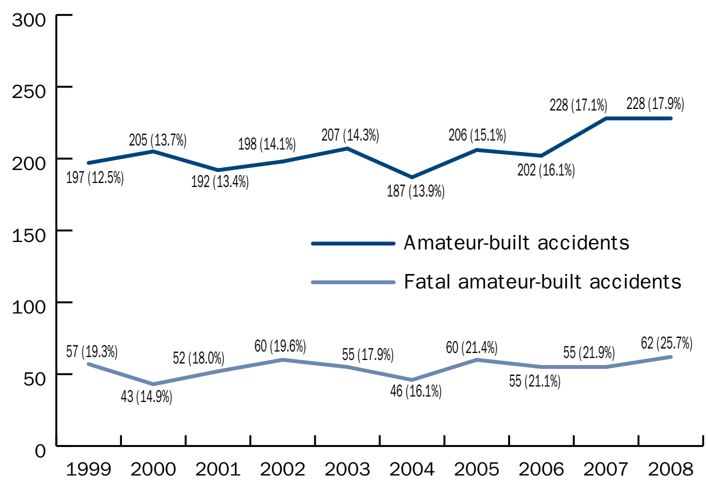


Figure 46

Percentages of Non-Commercial Flight Time vs. Accidents, 2008

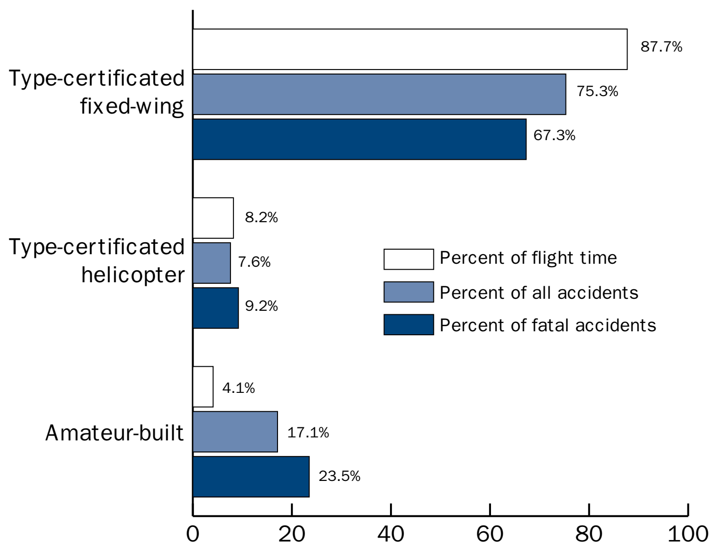


Figure 47

Types of Amateur-Built Aircraft Involved in Accidents

Aircraft Class	All Accidents	Fatal Accidents	Lethality
Single-engine fixed-gear	190 (79%)	45 (73%)	24%
SEF, conventional gear	86	17	20%
Single-engine retractable	37 (15%)	17 (27%)	46%
Multiengine	1 (<1%)	0	
Helicopter	12 (5%)	0	

Figure 48

Types of Accidents in Amateur-Built Aircraft

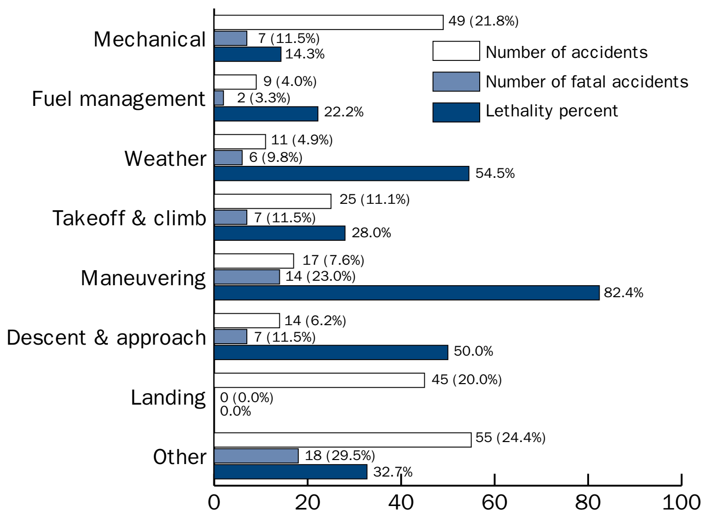


Figure 49

proportion of accidents involving amateur-built aircraft, on the other hand, was more than four times higher than their share of hours flown, and their proportion of fatal accidents was almost six times as large.

Accidents in amateur-built aircraft are a major contributor to the overall non-commercial accident rates. **In 2008, amateur-built aircraft had 27.29 accidents per 100,000 estimated flight hours, almost five times the rate of type-certificated aircraft, and their fatal accident rate of 7.00 was more than seven times higher.** These comparisons would not be materially affected by the exclusion of amateur-built helicopter accidents. 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 4.7 times in 2008, and the excess risk of fatal accidents has never dropped below 2.4. In 2008, it rose to 5.1.

All but one of the 228 airplanes were single-engine (Figure 48), and 190 of these (79%) had fixed gear (including eight seaplanes or amphibians). This is 15 fewer than in 2007, while the number involving retractable gear increased from 21 to 37. A total of 91 of the accident aircraft had conventional landing gear, including four retractables and the only twin. Each year saw 12 non-fatal helicopter accidents; in 2007, there was also a thirteenth that was fatal.

The types of accidents suffered by amateur-built fixed-wing airplanes in 2008 was little changed from the pattern reported last year for 2007, but suggests some differences between the manufactured and homebuilt fleets (Figure 49). Landing accidents accounted for only 20% of the amateur-built total compared to 33% of all non-commercial fixed-wing accidents and 36% of those in type-certificated airplanes. On the other hand, the shares attributed to mechanical failures (22%) and unexplained losses of engine power (12%) were noticeably higher. Together they accounted for more than one-third (34%) of all accidents in amateur-built airplanes, one and a half times the 22% seen in the fleet as a whole and almost double the 19% share in the manufactured sector. The proportion of fatal accidents in these two categories was also sharply higher, 17% among amateur-builts compared to 11% in the entire fleet and 9% in certified aircraft. The underlying difference in accident rates suggests that this reflects an excess of mechanical failures and power losses more than greater success in landing.

Summary

• The accident rate for helicopters operated non-commercially has decreased by 47% since 2002, from 12.69 to 6.76 per 100,000 flight hours. However, the 24 fatal accidents in 2008 was the largest number since 2000, and the fatal accident rate was the highest since 2003. The overall accident rate was only 7% higher than that for non-commercial fixed-wing flights; the fatal accident rate was 15% higher.

• The commercial helicopter accident rate has dropped by 74% from its recent peak in 2003, from 8.20 accidents per 100,000 flight hours to 2.17, and the fatal accident rate decreased by 78% (from 2.14 to 0.47) over the same period. In 2008, both rates were lower than those in fixed-wing commercial operations.

• Seventy fewer accidents occurred in non-commercial fixed-wing flights than in 2007, but much of the decrease was explained by a reduction in flight activity. The overall accident rate of 6.34 per 100,000 hours was three and a half percent lower than 2007's figure, but still the third highest of the past decade. The fatal accident rate of 1.19 was the lowest since 2001. The numbers of fatal accidents and individual fatalities reached new lows of 236 and 433, respectively, though the latter was only four less than in 2007.

• 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 34% of the fatal accidents even though just 9% of all accidents fell into those categories.

• Personal flights accounted for less than 40% of non-commercial fixed-wing flight time but included 73% of all and 77% of fatal accidents. Not only did these make up 92% of all accidents involving private pilots, but a majority (52%) of those involving commercial pilots and 65% of those suffered by ATPs.

• The number of commercial fixed-wing accidents increased by 19 (18%) from 2007, while the number of fatal accidents increased by two. Thanks to a one-third decrease in estimated flight time, the corresponding accident rates increased by 78% and 74%, respectively. The total number of fatalities was 31, up 5 from the year before.

• The fixed-wing commercial accident record represents a blend of two very different patterns. Agricultural application work had a high rate of generally non-fatal accidents, producing 63% of all accidents but just 40% of fatal accidents in only 29% of commercial flight time. On-demand cargo and charter operators flew more than twice as much with only one-quarter the accident rate, but more than double the accident lethality and a fatal accident rate more than 50% higher.

• Amateur-built aircraft continued to have dramatically 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) 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 other vital services. For a breakdown of GA activities and their accident statistics, see “Type of Flying” on page 36.

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
- Gyroplanes
- Gliders
- Airships
- Balloons

Figure 50 shows the FAA's estimate of the number of powered GA aircraft that were active in 2008, 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.

What Does General Aviation Fly?

	Commercial	Non-Commercial
Piston single-engine	3,794	141,703
Piston multiengine	1,421	16,094
Turboprop single-engine	1,712	1,738
Turboprop multiengine	1,081	4,375
Turbojet	1,838	9,204
Helicopter	2,976	6,900
Experimental	167	23,197
Light Sport	4	6,807
TOTAL	**12,993**	**210,018**

Figure 50

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 Foundation's Web site: www.asf.org.

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