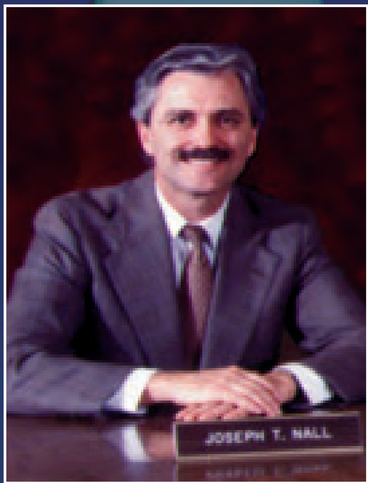
2008
NALL REPORT

Accident Trends and Factors for 2007

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

This report is based on NTSB reports of accidents involving fixed-wing general aviation aircraft weighing 12,500 pounds or less. To provide the most current safety information, AOPA Air Safety Foundation (ASF) gathered NTSB data on 2007's accidents throughout 2008. Probable cause had been determined for 1,230 of 1,385 accidents (88.8 percent) when the data were frozen for this year. The remaining 11.2 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.

A series of refinements to the methods used to conduct the FAA's annual *General Aviation and Part 135 Activity Survey* have improved the ASF's ability to estimate the flight-time exposure of the general aviation fleet. Estimates of accident rates in this year's report are based on these improved measures of exposure, and the rate estimates for 1998 – 2006 have been revised accordingly to allow more accurate comparison. Furthermore, prior editions reported the number of aircraft involved in accidents rather than the number of accidents *per se* (leading midair collisions, for example, to be counted twice). This year's report distinguishes between the two, where appropriate.

As a supplement to the information contained in this report, ASF offers its accident database online. You may search the database by selecting specific criteria. To view the database, visit www.asf.org/database.

The AOPA Air Safety Foundation gratefully acknowledges the technical support and assistance of:

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

Dr. Stephen Veronneau of the FAA's Civil Aerospace Medical Institute provided data on flight experience in the active pilot population as reported on applications for medical certificates.

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

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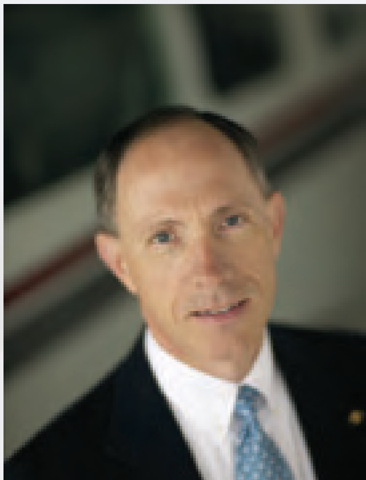


Bruce Landsberg
President
AOPA Air Safety Foundation

In this nineteenth edition of the *Nall Report* we have continued to expand or streamline the data to provide more useful information for the general aviation pilot. ASF is also having increased media contact, unfortunately, often brought on by high profile accidents. We invariably will cite the *Nall Report* and direct reporters to it for more background information.

That puts a premium on our getting the information correct and providing an interpretation that will withstand scrutiny. Perspective is critical as we address tragedy. Bad accidents that occur rarely deserve a different response than bad accidents that occur frequently.

Technology can help, as we've seen with greatly reduced fuel exhaustion accidents. On new technology aircraft where a microprocessor serves the role of a technically competent and persistent nagging passenger, pilots are recognizing that lack of fuel on board is non-negotiable and landing while it is still optional. In 2007 there were 90 fuel mismanagement accidents compared to 120 in 2002.

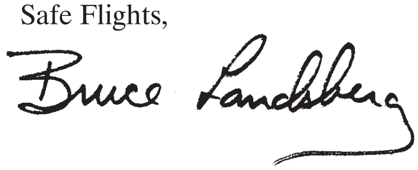
Other areas yield less easily, such as landing. New aircraft designs or inexpensive simulation have not yet yielded a scenario where just anyone is able to land in routinely expected conditions. So for now, the prescription remains as it always has – periodic practice under the eye of a competent instructor.

The total number of accidents is up this year – not so good but fatal accidents are down and as best we can determine, by a greater amount than any decline in flight hours. That brings the fatal accident rate to a six-year low with only 1999 being lower. The elusive denominator, flight exposure, is being addressed far better than it has in the past under FAA's greatly improved *General Aviation Activity Survey.*

ASF continues to expand pilot education outreach through live seminars and our increasingly popular free online course offerings at www.asf.org. The *Nall Report* remains our primary source to determine what topics should be developed.

A major gift from the Estate of Manny Maciel has helped to ensure the availability of funding for this critical resource. FAA and NTSB staff deserve much appreciation in providing the massive amounts of data that are the report's raw material. Finally, my thanks to all the ASF pilot donors who make our general aviation safety effort possible.

Safe Flights,



Overview of 2007 Accident Trends and Factors

The annual AOPA Air Safety Foundation's *Joseph T. Nall Report* is the nation's foremost review and analysis of general aviation (GA) safety for the preceding year. It is designed to help the aviation community, members of the media, and the public to better understand the factors involved in GA accidents.

GA is defined as all flying except for scheduled airline and military flights, and comprises the majority of aviation activity in the United States.

Statistics used in this report are based on National Transportation Safety Board (NTSB) investigations of GA accidents that occurred in 2007 involving fixed-wing aircraft with a gross weight of 12,500 pounds or less. Such airplanes account for about 90 percent of all GA aircraft.

The *Joseph T. Nall Report* analyzes accident data by cause and category, type of operation, class of aircraft, and other factors. This year's edition explores the characteristics of the different types of GA accidents, with closest attention to those that account for the largest numbers of accidents and fatalities.

The total number of GA accidents is relatively low, but remains significantly higher than the airlines. (See the Appendix on page 31 for an overview of GA vs. airline safety.) This is due, in part, to more diverse levels of pilot experience and training, a less restrictive regulatory structure, different aircraft capabilities, and the more challenging operating environment of GA.

Accident Analysis

The general aviation (GA) fixed-wing safety record showed mixed long-term improvement in 2007 (Figure 1), with a total of 1,385 accidents, an increase of 82 compared with 2006. However, an historic low of 252 fatal accidents (down 5.6 percent from the previous year) was also recorded. The 449 total fatalities also represent a new low, decreasing by 9.7 percent.

The reductions in fatal accidents were realized with only a slight drop in the FAA estimated flight hours for 2007, which decreased by only 100,000 hours, less than 0.5 percent compared to 2006.

Accident Trends

Matching accident statistics with flight hours provides a meaningful way to analyze aviation safety. Accident rate statistics take fleet utilization into account, and are expressed as accidents per 100,000 flight hours. This allows accurate year-to-year comparisons. (Figure 2)

With 6.47 accidents per 100,000 flight hours for 2007, the overall accident rate was the third-highest of the last decade. The fatal accident rate of 1.18 per 100,000 flight hours shows marked improvement over the previous six years, but still misses the low mark of 1.11 set in 1999.

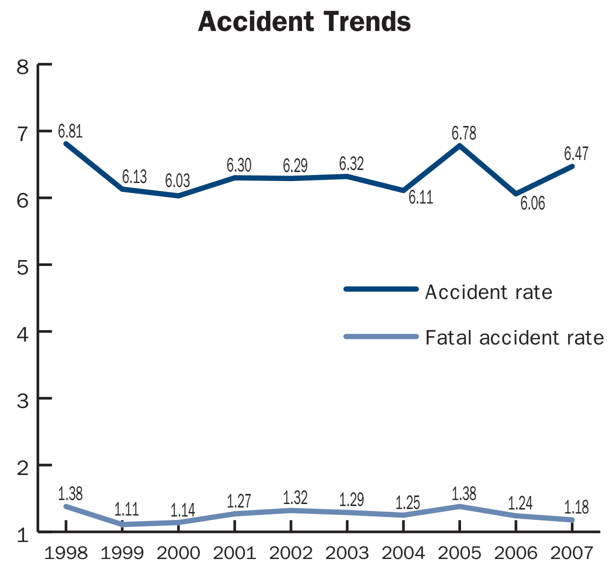


Figure 2

Accident Causes

For analytical purposes, it's helpful to divide the causes of GA accidents into three groups:

- **Mechanical/maintenance –** accidents arising from mechanical failure of a component or an error in maintenance.

Fixed-Wing GA Accidents, 1998 – 2007

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Number of Accidents	1654	1655	1574	1486	1465	1498	1399	1423	1303	1385
Number of Aircraft	1675	1673	1597	1503	1475	1513	1414	1438	1311	1397
Flight Hours (millions)	24.3	27.0	26.1	23.6	23.3	23.7	22.9	21.0	21.5	21.4
Accident Rate	6.81	6.13	6.03	6.30	6.29	6.32	6.11	6.78	6.06	6.47
Number of Fatal Accidents	335	301	297	299	307	306	286	290	267	252
Fatal Accident Rate	1.38	1.11	1.14	1.27	1.32	1.29	1.25	1.38	1.24	1.18
Fatalities	626	560	527	573	527	576	528	506	497	449

Figure 1

Notes: *Collisions are counted as one accident involving multiple aircraft.*

Estimates of total GA activity for 1998 – 2006 have been revised to exclude commercial operations conducted under FAR Part 135. Accidents occurring in Part 135 flights have traditionally been excluded from the Nall Report.

• **Other/unknown –** accidents such as pilot incapacitation and those for which a specific cause could not be determined.

• **Pilot-related –** accidents arising from improper actions or inactions of the pilot.

Figure 3 depicts the numbers of GA accidents by major cause. Percentages represent the relationship of each group to the total for 2007.

General Aviation Accidents 2007

Major Cause	All Accidents	Fatal Accidents
Mechanical	219 (15.8%)	19 (7.5%)
Other or unknown	170 (12.3%)	42 (16.7%)
Pilot-related	996 (71.9%)	191 (75.8%)

Figure 3

Types of Mechanical/Maintenance Accidents

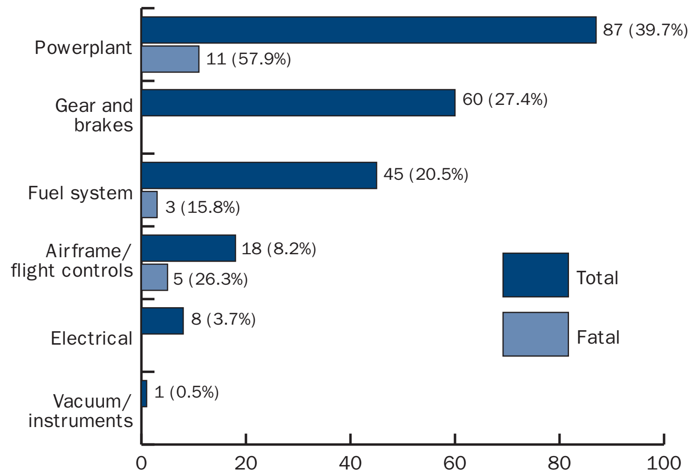


Figure 4

Mechanical/Maintenance

219 total/19 fatal

When properly maintained, general aviation aircraft are very reliable. It is unusual for a part to fail without warning, especially if the aircraft is being properly cared for. Pilots, owners, and maintenance technicians share responsibility for airworthiness.

Malfunctions causing accidents in 2007 (Figure 4) were very similar to those the previous year. Engine and propeller malfunctions accounted for 39.7 percent (87) of the total, with landing gear/brake and fuel system defects representing 27.4 percent (60) and 20.5 percent (45), respectively.

Over the past ten years, the proportion of accidents due to mechanical/maintenance causes has remained fairly constant even as the fleet continues to age, with the average age of a GA aircraft passing 30 years (Figure 5).

Mechanical/Maintenance Accident Trend

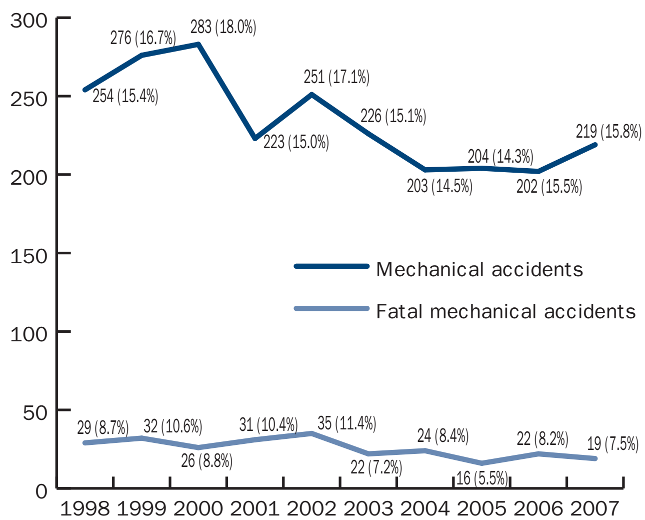


Figure 5

Other, Unknown, or Not Yet Coded

170 total/42 fatal

Loss of power for unknown reasons resulted in 118 (12 fatal) accidents in 2007 (Figure 6). One-third of the remaining accidents in this category (17 of the 52 "other") were classified as "Crashed for unknown reasons." These included half of the category's fatal accidents (15 of 30). Most of these were accidents involving U.S.-registered aircraft that occurred overseas.

Unclassified Accidents

Major Cause	All Accidents	Fatal Accidents
Loss of power	118 (8.5%)	12 (4.8%)
Other	52 (3.8%)	30 (11.9%)
Total	170 (12.3%)	42 (16.7%)

Figure 6

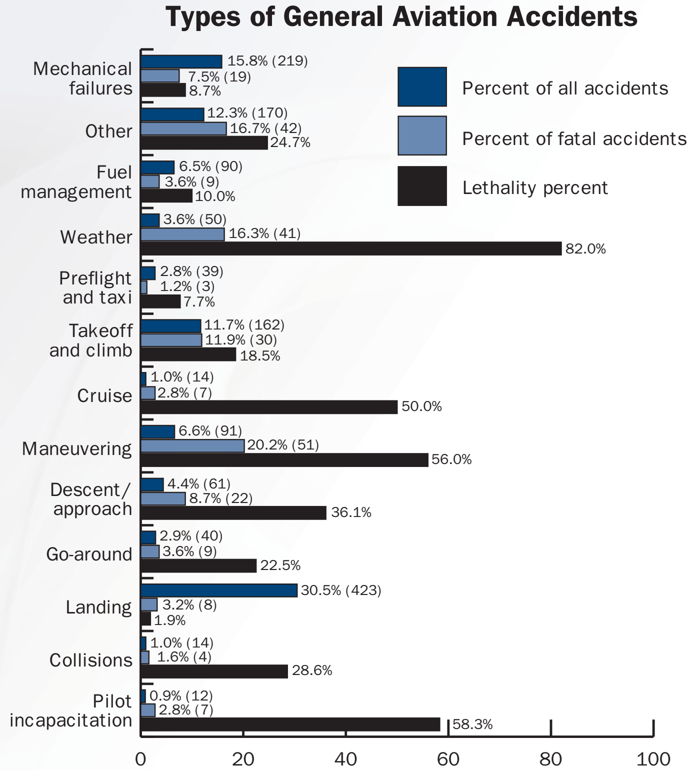


Figure 7

Note: *Percentages are relative to all accidents and all fatal accidents, as appropriate.*

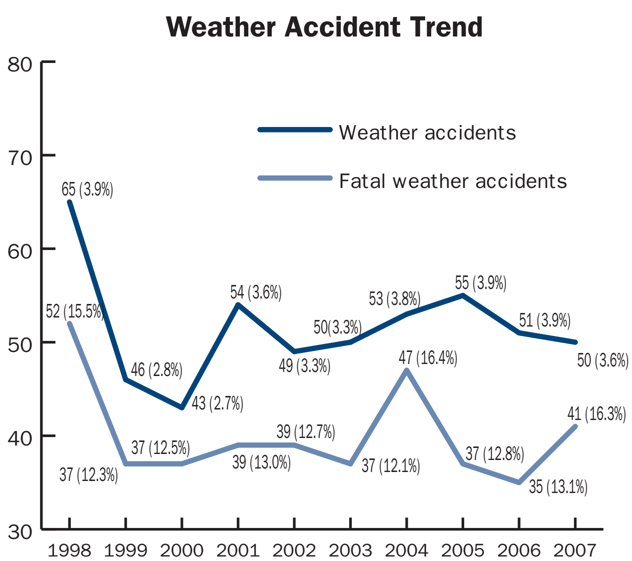


Figure 8

Pilot-Related Accidents

996 total/191 fatal

Figure 7 shows the relative frequencies of all types of GA accidents in 2007. All except "mechanical" and "other" can be grouped together as "pilot-related." Total pilot-related accidents in 2007 showed a slight increase over the previous year, with a gain of 2.4 percent in total (996 vs. 973) and a decrease of 11.6 percent in fatal (191 vs. 216) accidents. Overall, pilot-related accidents accounted for 71.9 percent of total and 75.8 percent of fatal GA accidents. These percentages are similar to prior years and to most human–machine interface numbers. Machines are always much more reliable because they can be redesigned. Human nature is not so easily changed.

The accident factors shown in Figure 7 are defined by the phase of flight in which the accident occurred (for example, landing or maneuvering), or by primary factor (such as mechanical, fuel management, or weather). Accidents in the categories of weather, maneuvering, and descent/approach resulted in disproportionately high numbers of fatal accidents when compared to total accidents in those categories.

Pilot-related weather accidents were comparable to the previous year, registering 50 (5.0 percent) of total and 41 (21.5 percent) of fatal pilot-related accidents [or 3.6 percent of all and 16.3 percent of all fatal accidents, respectively]. Most often, these fatal accidents resulted from pilots deciding to continue VFR flight into instrument meteorological conditions (IMC). In the long term, the proportion of accidents due to weather remains steady. Figure 8 charts the trend of weather-related accidents.

Maneuvering Accident Trend

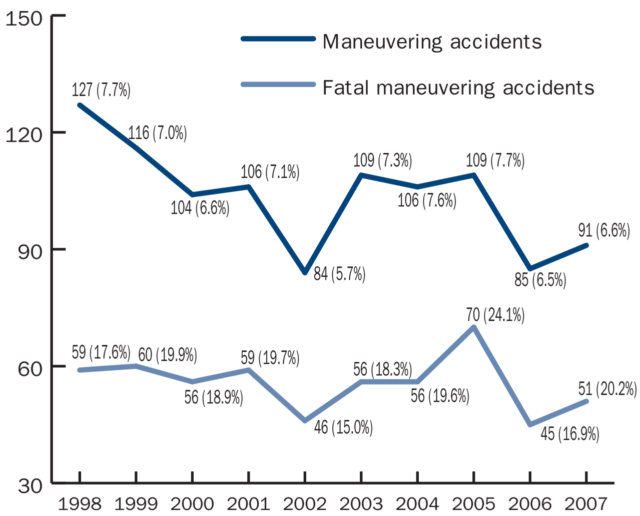


Figure 9

Descent/Approach Accident Trend

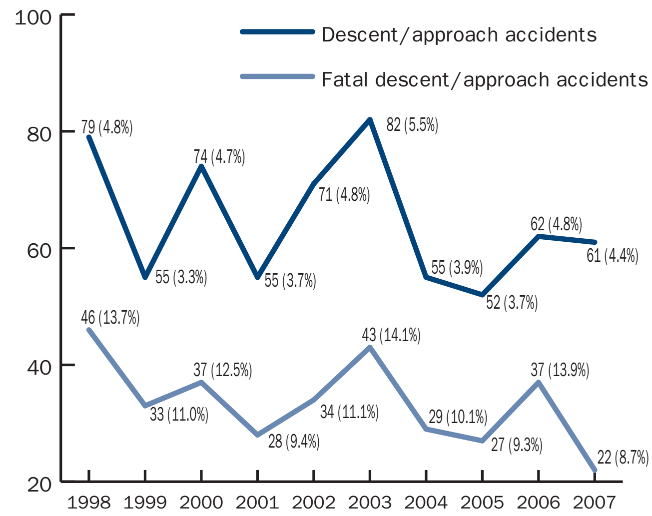


Figure 10

Maneuvering accidents, which accounted for one out of five (20.2 percent) of all fatal GA accidents, showed an increase to 91 from the 85 posted the year before. Some of these accidents involve questionable pilot judgment, such as decisions to engage in buzzing, low passes, or other high-risk activities, while others are attributed to deficiencies in basic airmanship. The trend in maneuvering accidents (Figure 9) shows little change in the percentage of either total or fatal maneuvering accidents since 1998.

Fatal descent and approach accidents, on the other hand, dropped sharply from 13.9 percent of the fatal crashes in 2006 to 8.7 percent in 2007. While the trend (Figure 10) for these accidents has been flat overall, there appears to be improvement in fatal descent and approach crashes. This area will be tracked closely over the next several years to monitor progress.

Takeoff and climb accident statistics continue to show gradual improvement in both total and fatal crashes (Figure 11). Loss of directional control is a frequent causal factor in these accidents.

Takeoff/Climb Accident Trend

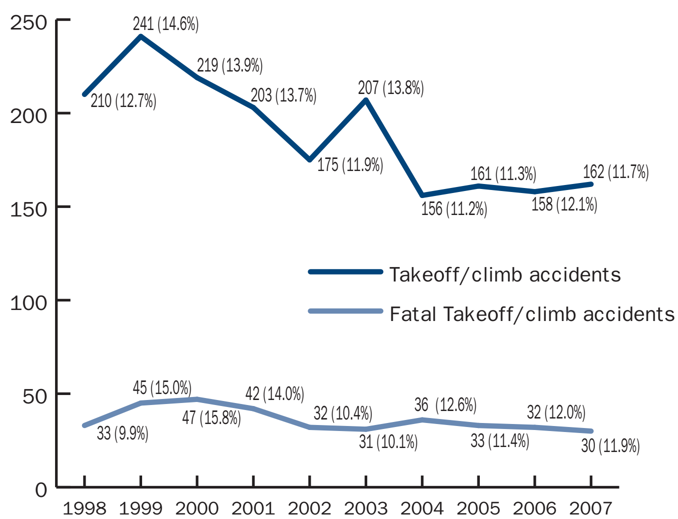
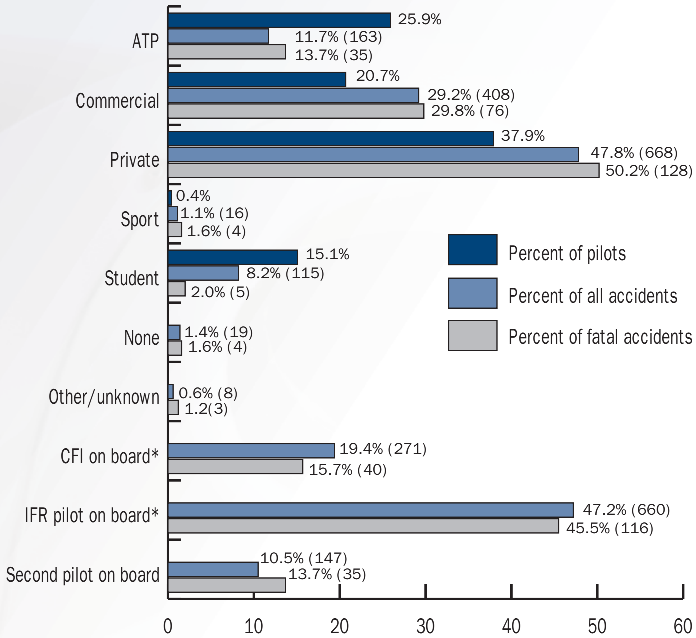


Figure 11

Levels of Pilot Certificates



** Includes single-pilot accidents.*

Figure 12

Distribution of Total Flight Time: ATPs

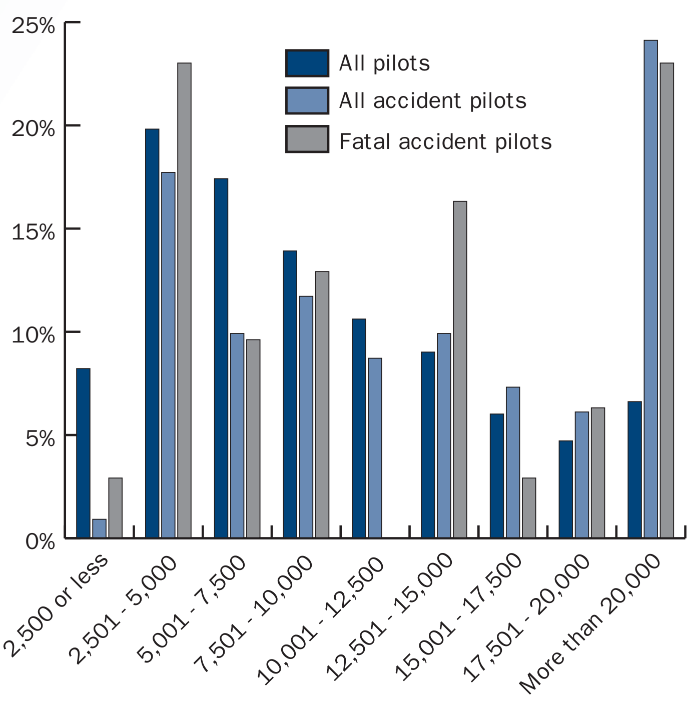


Figure 13

Pilot Experience and Qualifications

Total flight experience varies widely by the type of pilot's certificate held. Fewer than 10 percent of private pilots meet the 1,500 hour requirement to become an ATP. Since accident involvement also differs between certificate levels, each certificate is analyzed separately.

Certificate Level

Student and airline transport pilot (ATP) certificate holders were involved in disproportionately few accidents in 2007 (Figure 12). Possible explanations include the high level of supervision of student pilots and the greater proficiency and experience of ATP pilots, who also typically fly more capable equipment. The great majority of accidents occurred in single-pilot flights, but without exposure data it is not clear whether this is disproportionate. The generally accepted wisdom is that two pilots lower accident involvement. The pilot-in-command, a second pilot, or both were instrument-rated on almost half the accident flights, which generally corresponds to the number of instrument-rated pilots in the population.

Flight Hours

Figure 13 presents the total flight time reported by all active U.S. pilots holding ATP certificates, all ATPs involved in GA accidents in 2007, and those involved in fatal accidents. Figures 14 and 15 display similar information for commercial pilots and private pilots, respectively. The sources of these data and limitations on their interpretation are described in the Appendix.

The high proportion of accidents involving relatively inexperienced pilots is largely explained by the high numbers of pilots at those experience levels. Most private pilots have less than 500 hours total time (71 percent claimed 500 hours or less on their last medical application) but this group had only 49 percent of all accidents and only 38 percent of fatal accidents. Thirty-five percent of all commercial pilots reported 500 hours or less, yet these had only 8 percent of total accidents and 14 percent of fatal accidents. However, it must be noted that data comparing total flight time to recent GA experience aren't consistently available, so it's not clear whether lower-time pilots were less exposed to the risk of accidents because they did less flying.

At the other end, commercial pilots with more than 2,000 hours made up twice as large a share of the accident group (63 percent) as of the pilot population (31 percent), and they had more than half of the fatal accidents. Only 15 percent of all private pilots reported more than 1,000 hours, but 32 percent of all accidents and 35 percent of fatal accidents among private pilots occurred in this group. At the extreme, ATPs with more than 20,000 hours of flight time made up three and a half times as large a share of accident ATPs as of ATPs in general, though this may also reflect factors such as age or lack of recent light-aircraft experience.

Time in Type

Experience in the same make and model of aircraft is widely assumed to reduce risk. However, two factors complicate this analysis: There is no source of comparable data for the entire pilot population, and time in type is missing for most of the pilots involved in fatal accidents. The information that is available can be used to compare accidents within certificate level; however, it is not representative of pilots in general. Time in type for accident pilots in 2007 appears in Figure 16. Little difference is apparent between certificate levels, though the proportion of commercial pilots with less than 200 hours time in type is somewhat smaller than that of private pilots or ATPs. The high proportion of accidents that occur in the first 100 hours is partly due to greater exposure – it's the only category that includes time logged by every pilot in every aircraft – but is so much higher than for the next 100 that it seems likely to reflect genuinely greater risk as well.

Aircraft Class

Another way to study GA accidents is to analyze the classes of aircraft involved. This report studies three classes of fixed-wing GA airplanes: single-engine fixed-gear (SEF), single-engine retractable-gear (SER), and multiengine (ME). These classes are useful because they allow pilots to study safety issues for the type of aircraft they operate.

Distribution of Total Flight Time: Commercial Pilots

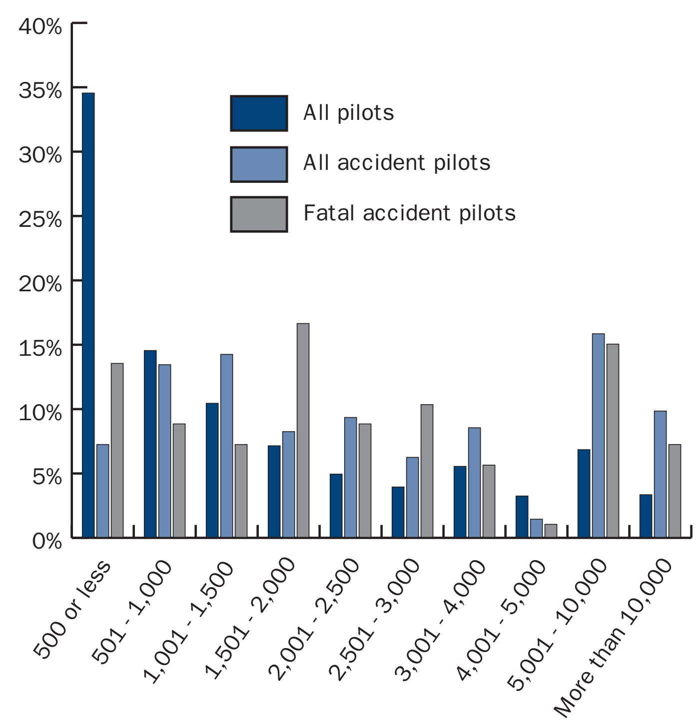


Figure 14

Distribution of Total Flight Time: Private Pilots

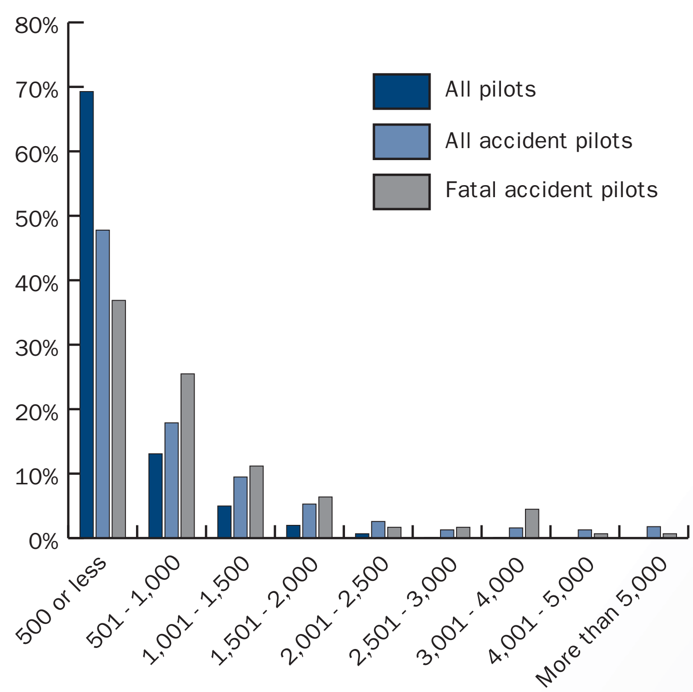


Figure 15

Distribution of Time in Type: All Accident Pilots

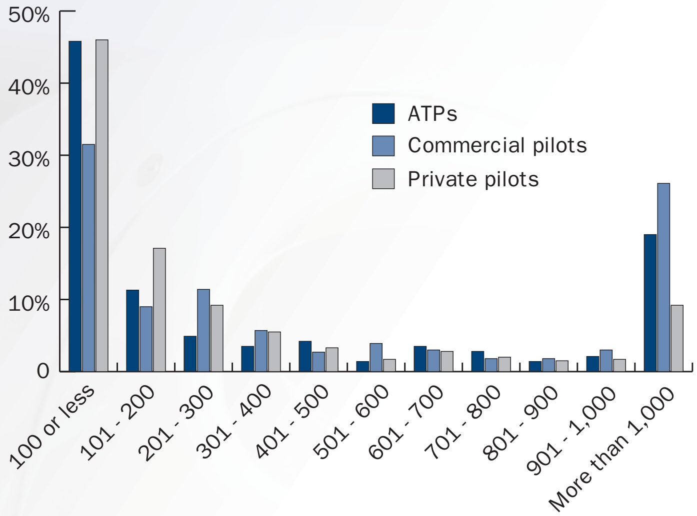


Figure 16

Accidents and Fatalities by Aircraft Class

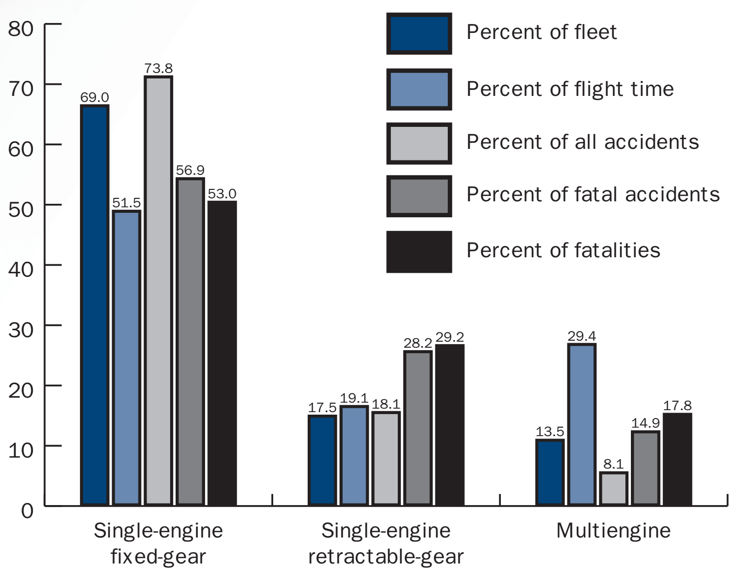


Figure 17

Accidents by class of airplane, along with the percentage of the GA fleet represented by each class, are shown in Figure 17. In 2007, 14 percent of SEF accidents were fatal, SER accidents were double that at 28 percent, and ME was 33 percent. This indicates that as complexity and performance increase, so does lethality, presumably the result of higher speeds and the need for more advanced piloting skills in the larger aircraft. ME aircraft are typically operated in a wider range of weather conditions than the other two classes, accounting for their relatively high fatality rate. Also, with their higher performance and stall speeds, they are less forgiving of pilot mistakes.

Type of Operation

General aviation's versatility is reflected in the wide variety of operations in which GA aircraft are used, from recreational and personal flying to commercial operations. Most 2007 GA flying (Figure 18) was for personal (39.4 percent), instructional (15.2 percent), other working (19.3 percent), and business (14.1 percent) purposes. Detailed definitions for each type of operation are found in the Appendix. Accidents in each of the four primary categories of aircraft use are examined in detail below.

Personal Flying

965 total/186 fatal

In 2007, personal flights accounted for 39.4 percent of general aviation flying, but a disproportionate 69.1 percent of total accidents and a whopping 72.9 percent of fatal accidents. In 2007, 965 accidents, 186 of them fatal, occurred on personal flights. Consistent with the overall trends in GA accidents, these figures represented a slight increase over the 938 accidents—but a slight decrease from the 194 fatal accidents—on personal flights in 2006.

Within these totals, there were 710 pilot-related accidents in personal flying, up from 682 in 2006. Fatal pilot-related accidents dropped from 151 to 142 during the same period.

Instructional Flying

189 total/15 fatal

Instructional flying provides the training and practice that allows pilots to develop and maintain skills, knowledge, and attitudes that directly contribute to safety. Instructional accidents are proportionately lower than personal operations due to the closer supervision provided during flight training. Training, with one exception, takes place in a relatively benign environment. There is little exposure to weather. When strong winds, icing, thunderstorms, or low ceilings are prevalent, most training ceases. That helps to keep instructional flying accidents low but shows up later as new pilots attempt to gain experience in areas where they have little exposure. Individual risk tolerance plays a large part in how safely a new pilot learns to deal with weather. One solution is for new pilots to continue with advanced training or fly with a seasoned mentor to learn weather and cross-country lessons that could not be easily done early on.

The safety exceptions in instructional flying occur in high-density traffic around airports and practice areas. Instructional flights are involved in more potential midair collision environments. CFIs and students involved in training are often distracted from scanning for traffic, and remembering to do so requires a significant effort. Additionally, there is a higher involvement in takeoff and landing accidents because training flights make so many takeoffs and landings.

The 189 instructional accidents in 2007 were a 10 percent increase from the 172 that occurred the previous year, but fewer were fatal: 15, down from 21 in 2006.

Pilot-related instructional accidents in 2007 totaled 147, with 9 being fatal. This represents a significant decline from the 18 fatal instructional accidents in 2006.

Other Working Flights

75 total/25 fatal

Almost three-quarters of all flight time in this category was logged by the professional crews of corporate flight departments. (This is distinct from business flights made by pilots who are not paid specifically to fly.) Aerial observation, including photography, surveys, pipeline and power line inspection, and traffic reporting accounted for most of the rest, but this category also includes uses as diverse as skydiving operations, banner tows, and professional air shows.

Accidents on corporate flights continued to be extremely rare in 2007, with only five in more than three million flight hours. Three of these were fatal. No other type of activity dominated the accident record. Not surprisingly, mishaps in air shows and air races were the most lethal, with fatalities

Accidents by Type of Operation

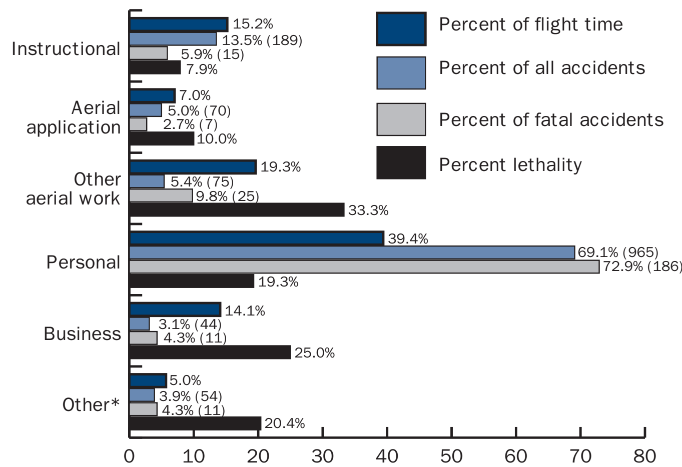


Figure 18

** Includes test flights, positioning, and unknown.*

in eight out of 12. Fifteen accidents occurred in public-use flights by governmental agencies, but only three were fatal, as were five of 12 accidents on ferry flights. Banner-tow and skydive operators each had one fatal accident out of seven. All told, 46 of the accidents on working flights were considered pilot-related, and 19 of these were fatal.

Business Flying

44 total/11 fatal

General aviation is a key component of the national transportation system, providing service to many cities without adequate airline service. While the airlines serve about 600 airports nationwide, GA has direct access to about 5,300 public-use airports. Many GA pilots rely on their airplanes for business transportation, accounting for 14.1 percent of all GA flying in 2007. Business flying is proportionately much safer than other types of GA flying. Aircraft used for business flights tend to be properly equipped to handle challenging conditions, and the pilots more experienced and instrument rated.

Business flying accounted for 44 accidents in 2007, up six from the year before. Eleven of those accidents were fatal, a decrease of four. Twenty-nine of the accidents on business flights in 2007 were considered pilot-related and nine of these were fatal; both represent decreases from the previous report.

Light and Weather Conditions

Conditions	All Accidents	Fatal Accidents
Day VMC	1202 (86.8%)	168 (66.7%)
Night VMC*	112 (8.1%)	31 (12.3%)
Day IMC	44 (3.2%)	36 (14.3%)
Night IMC*	24 (1.7%)	17 (6.7%)
Not reported	3 (0.2%)	0

**Includes dusk.*

Figure 19

Flight Conditions

Flights conducted at night and/or in adverse weather are more challenging than daytime and/or VMC operations. In spite of this, far more accidents occurred during the day than at night (1,246 vs. 136), and far more occurred in VMC than IMC (1,314 vs. 68). Some of this seems likely to reflect underlying patterns of aircraft use. However, changes in the FAA's methods for measuring overall exposure to each of these conditions led to estimates for 2007 that differ dramatically from those for previous years. The ASF's estimation of accident rates within light and weather categories has been postponed pending resolution of this discrepancy. Figure 19 depicts 2007 accident data sorted by day vs. night and VMC vs. IMC.

Though the total numbers are lower, accidents at night are more than twice as likely to be deadly as those during daylight. Those occurring in IMC increase the chances of fatality by a factor of five. Only 16.4 percent of daytime accidents resulted in fatalities, but over one-third (35.3 percent) of all night accidents were fatal. Though only 15.1 percent of accidents in VMC were fatal, more than three-quarters of those in IMC (77.9 percent) claimed a life.

Looking at the combined factors, day VMC accidents had the lowest fatal accident rate of any light/weather condition, with 14.0 percent resulting in death. Fatal accidents made up 81.8 percent of those that occurred in day IMC. At night, just over one-fourth of the accidents in VMC conditions were fatal (27.7 percent) compared to nearly three-quarters of those in IMC (70.8 percent).


None of the hours
in the logbook matter
as much as this minute
in the cockpit.

Accident Factors: Flight Planning and Decision Making

This and the following two sections of the *Nall Report* examine the pilot-related causal factors of GA accidents in more detail. The discussion of each factor presents detailed information on pilot qualifications and experience, aircraft class, type of operation, and typical types of accidents experienced for each factor. Representative accident case studies are presented throughout.

This first section focuses on factors that are related to pilot planning and decision making, and includes accidents related to fuel management and weather.

Fuel Management

90 total/9 fatal

Most fuel-management accidents are the result of one of the following reasons:

- **Flight Planning –** Improper preflight planning resulting in insufficient fuel being on board for the planned flight, or inadequate in-flight monitoring of ground speed.

- **Systems Operation –** Improper operation of the fuel system leading to loss of fuel to the engine, even though fuel is available in at least one tank.

- **Contamination –** Use of fuel containing water, sediments, or other foreign substances that prevent proper operation of the engine.

- **Improper Fueling –** Servicing of the aircraft with the wrong type of fuel, or adding the wrong amount of fuel even though preflight planning was accomplished correctly.

Nearly three-quarters of the fuel management accidents (66) resulted from improper preflight planning (Figure 20). The systems operation category includes seven accidents, two of them fatal, caused by fuel line unporting due to aggressive maneuvering.

Types of Fuel-Management Accidents

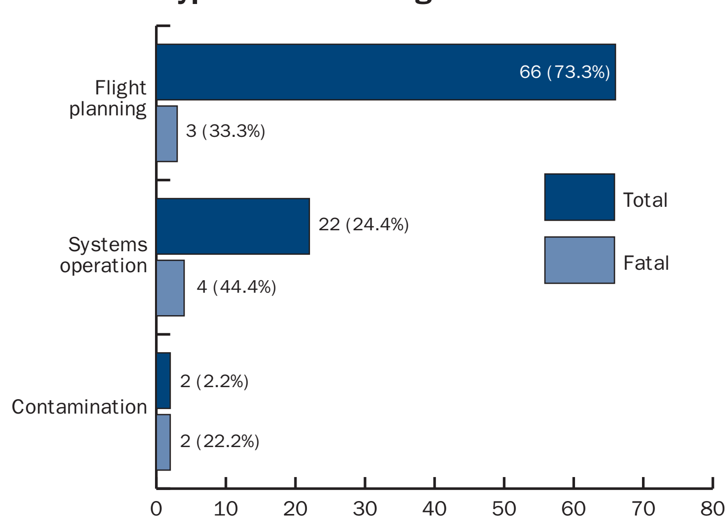


Figure 20

Characteristics of Fuel-Management Accidents

More than half (48 of 90, or 53.3 percent) occurred within five miles of an airport. They were not concentrated among inexperienced pilots: Half of the private pilots involved had more than 500 hours total time; three-quarters of the commercial pilots had more than 800 hours. At least three-quarters of the accident pilots at every certificate level had more than 20 hours of time in type, with median values of 166 hours among private pilots and 264 for commercial pilots (but only 75 hours for ATPs).

Fuel exhaustion (insufficient fuel on board) and starvation (improper operation of the fuel system) accidents were not more common in the more complicated aircraft, but they were more likely to be fatal (Figure 21).

Aircraft Involved in Fuel-Management Accidents

	All Accidents	Fatal Accidents
Single-engine fixed	65 (72.2%)	4 (44.4%)
Single-engine retractable	15 (16.7%)	2 (22.2%)
Multiengine	10 (11.1%)	3 (33.3%)

Figure 21

Note: *The SEF figures include three accidents, two of them fatal, in seaplanes.*

In other ways, fuel-management accidents are fairly typical of GA accidents in general, involving about the same proportions of private, commercial, and airline transport pilots. Student pilots were only involved in two. Eighty percent (72 of 90), including seven of the nine fatal accidents, occurred on personal flights. Instructional flights only accounted for three, none fatal. Ten (including one fatal) were on other types of working flights, with the rest involving three positioning and two business flights. One of the latter was also fatal.

Nearly nine-tenths (88 percent), including seven of the nine that were fatal, occurred in daytime. Fuel-exhaustion accidents in IMC were rare, but those that occurred in IMC or at night were more apt to prove fatal (3 of 13 compared to 6 of 77 in daytime VMC).

Weather

50 total/41 fatal

Typical weather accidents occur for one or more of the following reasons:

• **Continued VFR into IMC –** These accidents often result in loss of aircraft control, or collision with the ground (CFIT) as the flight is continued into deteriorating ceilings and visibilities.

• **Deficient IFR Technique –** Failure to follow appropriate instrument flight procedures, including descending below the minimum altitudes during an instrument approach.

• **Thunderstorm –** Flying too close to, or penetrating, a thunderstorm. High winds, turbulence, and icing can result in structural failure and loss of control.

• **Turbulence –** Turbulence associated with high winds, mountainous terrain, and other factors can result in loss of aircraft control.

• **Icing –** Accumulation of ice on the airframe can lead to loss of lift and performance, as well as possible instrument malfunction due to iced-over sensors.

Accident Case Study

CHI08LA006
Piper PA-28, Festus, Missouri
One fatality

History of Flight

The airplane impacted trees while reportedly en route to the destination airport located approximately 1.5 miles from the accident site. The wooded area was adjacent to a clearing and pasture. Examination of the wreckage revealed the left wing fuel tank was empty and the right wing fuel tank contained approximately one cup of water and one quart of aviation fuel. The right wing fuel line contained approximately one teaspoon of water and one teaspoon of aviation fuel. The electric fuel pump and gascolator contained water. There was no liquid in the carburetor bowl. The engine operated with no anomalies that would have precluded normal operation during a post accident engine run. The airplane flaps were in the fully retracted position and not in the extended position as would have been appropriate for a forced landing.

Pilot Information

The VFR-only private pilot, age 46, had 327 hours of total flight experience, with 54 hours in the accident make and model during the preceding 90 days.

Weather

Conditions were reported as night VFR (just before dawn) with clear skies, visibility 7 statute miles, and winds from 170 degrees at 3 knots.

Probable Cause

The pilot's inadequate aircraft preflight, fuel system water contamination, and fuel starvation, which resulted in a loss of engine power during landing approach. An additional cause was the pilot's failure to follow the emergency landing procedure after the loss of engine power. Contributing to the accident were the trees, and night light conditions.

ASF Comments

This pilot failed to perform the basic planning and preflight functions that every student pilot is taught. Determining fuel requirements that include an adequate reserve and making sure the fuel is free of contamination are critical.

Types of Weather Accidents

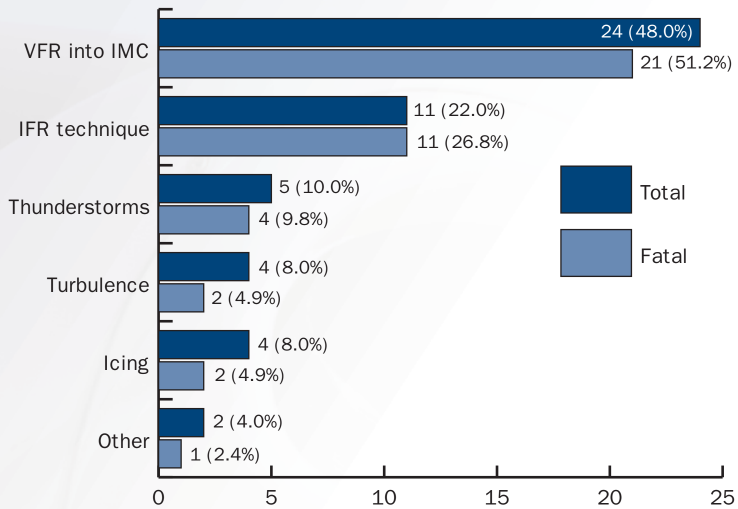


Figure 22

Nearly half of all weather-related accidents resulted from pilots attempting to continue VFR flight into instrument meteorological conditions (IMC). Twenty-one out of the 24 were fatal (Figure 22). VFR into IMC accidents were distributed fairly evenly throughout the year, with six in the first quarter, eight in the second, and five each in the third and fourth quarters.

Deficient instrument flying technique accounted for almost half of the rest, all of which were fatal. This included at least five approaches on which the pilot descended below the minimum descent altitude or decision height without the required visual references.

Of the 36 pilots for whom this information was available, just over half (19) were instrument-rated. Sixteen of the 17 VFR-only pilots held private pilot certificates; 13 of 19 accidents involving instrument-rated pilots were fatal, as were 14 of 17 among VFR pilots. Almost two-thirds of 2007's weather accidents (33) involved private pilots, while ATPs accounted for only two. The other 15 all involved commercial pilots.

Aircraft Class

Faster, more complex aircraft accounted for a higher proportion of weather accidents than of all GA accidents combined, and were more consistently fatal (Figure 23). This is likely the result of such aircraft being used more frequently for transportation missions as well as the greater destructiveness of higher-speed impacts.

Aircraft Involved in Weather Accidents

	All Accidents	Fatal Accidents
Single-engine fixed	29 (58.0%)	22 (53.7%)
Single-engine retractable	12 (24.0%)	11 (26.8%)
Multiengine	9 (18.0%)	8 (19.5%)

Figure 23

Note: *The counts for single-engine fixed include one fatal accident in a seaplane, and at least eleven high-performance or technically advanced aircraft: four Caravans, four C182s, and three Cirrus.*

Type of Operation

A large number (84 percent) of weather accidents occurred on personal flights (Figure 24). Three of the remaining eight (all fatal) were on business flights, three (two fatal) on positioning flights, and one (fatal) on a federal public-use flight. The purpose of the remaining flight was not reported.

Purpose of Weather Accident Flights

	All Accidents	Fatal Accidents
Personal	42 (84.0%)	34 (82.9%)
Business	3 (6.0%)	3 (7.3%)
Public use, positioning, or unknown	5 (10.0%)	4 (9.8%)

Figure 24

Flight Conditions

Twenty (40 percent) of the weather-related accidents occurred in VMC, although several involved marginal or deteriorating conditions (Figure 25).

Flight Conditions During Weather Accidents

	All Accidents	Fatal Accidents
Day VMC	16 (32.0%)	10 (24.4%)
Night VMC	4 (8.0%)	4 (9.8%)
Day IMC	20 (40.0%)	19 (46.3%)
Night IMC	10 (20.0%)	8 (19.5%)

Figure 25

Accident Case Study

DFW07FA049
Cessna 172, Armstrong, Texas
Three fatalities

History of Flight

The noninstrument-rated private pilot inadvertently entered clouds while attempting a night cross-country in marginal night visual meteorological conditions. While maneuvering to maintain visual flight rules, the pilot entered the clouds and consequently lost control of the airplane. The airplane impacted the ground in a right turn in a pronounced nose-low attitude. The area of the accident is sparsely populated and there were no reported eyewitnesses to the accident. A pilot flying in the vicinity of the accident pilot reported several cloud layers between 1,500 and 6,000 feet mean sea level. Examination of the wreckage did not reveal any anomalies or pre-impact defects. The pilot had no actual instrument time and was not prepared to enter instrument meteorological conditions.

Pilot Information

The VFR-only private pilot, age 26, had a total of 85 hours of flight time, all in the same make and model as the accident airplane.

Weather

Conditions were reported as dark night IMC at the accident site; the nearest reporting point indicated sky conditions of 1,600 scattered, 6,000 broken, and visibility 10 statute miles. Winds were from 050 degrees at 8 knots.

Probable Cause

The pilot's continued flight into adverse weather conditions resulting in a loss of control. Contributing factors were the dark night conditions, the clouds, low ceilings, and the pilot's limited night and instrument experience.

ASF Comments

This is a classic example of the VFR into IMC accident. Combining marginal weather with night flight and low instrument experience is a potentially lethal mix.

Accident Factors: High-Risk Phases of Flight

Each flight progresses through a series of phases, some of which present more risk than others. Understandably, the parts of each flight that are close to the ground have higher risk. This section analyzes accidents that occurred during those phases of flight.

Takeoff and Climb

162 total/30 fatal

Typical takeoff and climb accidents occur for one or more of the following reasons:

• **Takeoff Stall/Settling –** These involve loss of airspeed, with the airplane either entering a stall or developing a sink rate from which the pilot does not recover in time.

• **Loss of Control –** Crosswinds and other conditions can lead to an inability of the pilot to maintain directional control. In such cases, the airplane can depart the runway and collide with runway lights, vehicles, and other surface obstructions.

• **Weight/Density Altitude –** The combination of high temperatures and high altitude results in significantly reduced airplane performance. Such conditions can prevent the airplane from being able to climb sufficiently to clear obstructions.

• **Runway Conditions –** The type of runway surface (paved, grass, gravel, etc.) and any contamination such as water or ice can be a factor in takeoff accidents.

During and immediately following takeoff, the aircraft is operating close to the ground and at low speeds. As shown in Figure 26, accidents during takeoff were primarily due to losses of aircraft control (69 of 151 takeoff accidents, or 45.7 percent). More than one-third of those (24) were ascribed to gusts or crosswinds, with inadequate airspeed control causing stalls or settling (22, 14.6 percent of takeoff accidents), high density altitude or over-gross takeoff attempts (19, 12.6 percent), and unsuitable runway conditions (17, 11.3 percent) accounting for the remainder. Such accidents included collisions with objects or vehicles during the takeoff roll, inappropriate aircraft configuration, attempts to take off with known aircraft deficiencies, and fuel contamination.

Eight of the 11 accidents (72.7 percent) that occurred during climb above the traffic pattern were fatal, compared to only 14.6 percent of takeoff accidents (22 of 151). These were typically stalls caused by failure to maintain airspeed during the climb. Loss of positive aircraft control was the common factor in fatal accidents, accounting for all eight in climb and 14 of 22 on takeoff (63.6 percent).

Types of Takeoff and Climb Accidents

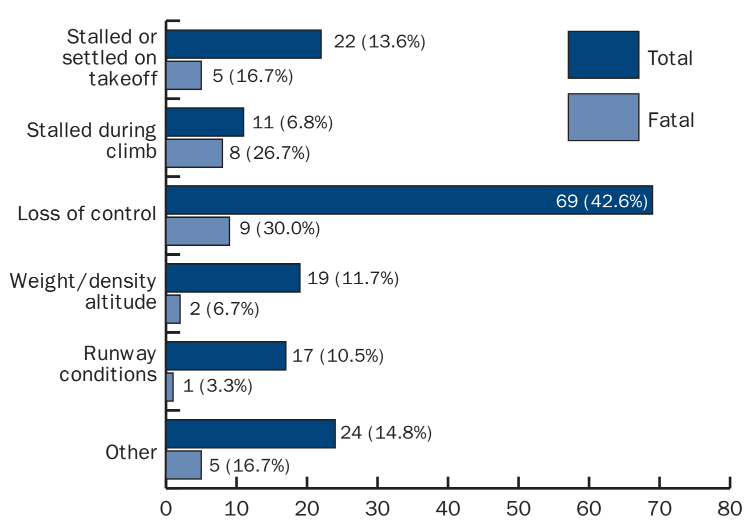


Figure 26

Characteristics of Takeoff and Climb Accidents

The qualifications and experience levels of these pilots were similar to those of the overall population of GA accident pilots. Neither low overall experience nor lack of familiarity with make and model emerge as conspicuous risk factors. Three-quarters of those with at least a private pilot certificate had more than 500 hours total flight experience, and half had at least 200 hours time in type (data not shown).

Single-engine fixed-gear aircraft accounted for 122 of the 151 takeoff accidents (80.8 percent) and almost half of these (60) were conventional-gear (tailwheel) airplanes. Another two involved retractable single-engine tailwheel aircraft, involving conventional landing gear in a total of 41.1 percent of all takeoff accidents. While complete statistics on the proportion of the hours flown in conventional gear airplanes are not available, available data suggests that it's considerably less than half the fleet total; the increased skill level required to take off and land in these airplanes is a likely reason for their high involvement in takeoff accidents. Only seven takeoff accidents (4.6 percent) involved multiengine aircraft. Takeoff and climb accidents in multiengine aircraft were relatively scarce (9 of 162, or 5.6 percent) but lethal; five of nine (55.6 percent) were fatal, compared to 25 of 153 (16.3 percent) in single-engine aircraft.

The number of takeoff and climb accidents was roughly proportionate to the percentage of overall flying for each type of operation. Including three accidents at dawn, almost all (148, 91.4 percent) takeoff and climb accidents took place in daytime VMC. All the fatal accidents occurred during daylight hours, 27 of them (90 percent) in VMC. Six accidents, three of which were fatal, took place in daytime IMC; and five nonfatal accidents were at dusk and three were at night. One of those occurred in instrument conditions.

Maneuvering

91 total/51 fatal

Typical maneuvering accidents occur for one or more of the following reasons:

- **Stall or Loss of Control –** Loss of airspeed during the maneuvering can result in a stall/spin or other loss of control.

- **Wire Strikes and Structure Impacts –** If maneuvering is conducted at extremely low altitudes, collisions with wires or other structures is likely.

- **Mountain or Canyon Impacts –** Terrain impact is another possible result when maneuvering at very low altitudes.

- **Aerobatics –** Conducting aerobatics with improper training or equipment, or at unsafe altitudes, is a high-risk operation.

Accident Case Study

DFW07LA124

Amateur-Built RV-6A, Boerne, Texas

One fatality

History of Flight

The commercial pilot lost control of the single-engine amateur-built airplane during takeoff from a private 2,300-foot long turf runway. Witnesses reported that the airplane appeared to have made a normal takeoff. At about 100 to 150 feet above the ground the airplane was observed to have attained a pronounced nose-high attitude, and subsequently rolled abruptly to the left as the airplane assumed a nose-low attitude. The airplane impacted the ground in the inverted position. A post-impact fire consumed most of the airplane. At the time of the accident, the density altitude was calculated to be 3,126 feet.

Pilot Information

The pilot, age 39, was a former Naval aviator and active helicopter pilot in the Naval Reserve. He held a commercial certificate with instrument rating for single-engine airplanes and helicopters and commuted daily in the accident aircraft. He had 1,798 hours of flight experience, most of it in helicopters, and 250 hours time in type.

Weather

Sky condition was 2,400 broken, visibility 10 statute miles. Winds were from 180 degrees at 10 knots.

Probable Cause

The pilot's failure to maintain the best angle of climb speed resulting in an inadvertent stall. A contributing factor was the high density altitude.

ASF Comments

Use of the proper climb speeds is critical to ensure safety and maximum airplane performance when operating from short runways.

Types of Maneuvering Accidents

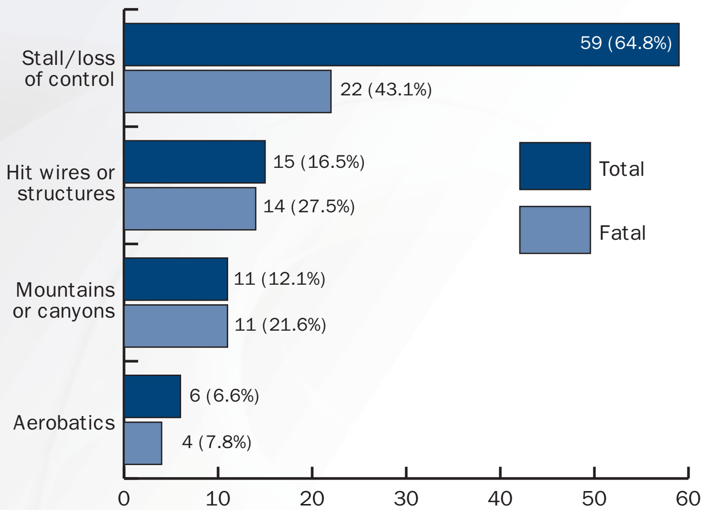


Figure 27

Maneuvering was the leading cause of fatal general aviation accidents in 2007 (Figure 27), accounting for 91 total and 51 fatal accidents. Almost two-thirds (59 of 91, or 64.8 percent) involved stalls and/or loss of aircraft control, often at low altitudes. Fifteen (16.5 percent) involved collisions with structures or power lines, 11 (12.1 percent) were collisions with mountains or canyon walls, and six (6.6 percent) occurred while attempting aerobatic maneuvers.

Fatal maneuvering accidents were almost equally divided between collisions with wires, objects, terrain, etc. (25, or 49.0 percent) and losses of aircraft control, including stalls with or without spins (22, or 43.1 percent).

Pilot Qualifications and Experience

Commercial pilots were disproportionately involved in maneuvering accidents, making up 40 of the 89 whose certificate levels were known (44.9 percent). Twenty-nine (32.6 percent) were private pilots and 13 (14.6 percent) held ATP certificates (Figure 28). Four student pilots, two sport pilots, and one unlicensed pilot also had maneuvering accidents. Eleven of 13 accidents involving ATPs were fatal (85 percent) compared to 40 percent for commercial pilots and 62 percent for private pilots. The distribution of flight experience at each level does not differ greatly from those in other accident categories (data not shown).

Pilots Involved in Maneuvering Accidents

Certificate Level	All Accidents	Fatal Accidents
ATP	13 (14.3%)	11 (21.6%)
Commercial	40 (44.0%)	16 (31.4%)
Private	29 (31.9%)	18 (35.3%)
Sport	2 (2.2%)	1 (2.0%)
Student	4 (4.4%)	2 (3.9%)
None or unknown	3 (3.3%)	3 (5.9%)

Figure 28

Aircraft Class

A disproportionate number of maneuvering accidents (83 of 91, or 91.2 percent) occurred in fixed-gear singles, and 51 of these (56.0 percent of all maneuvering accidents) had conventional gear (Figure 29). However, those in tricycle-gear airplanes had a sharply higher lethality rate: 78 percent vs. 37 percent in tailwheel airplanes. The relatively high rate of survivable crop-dusting accidents is one factor in this difference. The figures for fixed-gear singles also include two accidents in seaplanes, one fatal.

Aircraft Involved in Maneuvering Accidents

	All Accidents	Fatal Accidents
Single-engine fixed	83 (91.2%)	44 (86.3%)
Conventional gear	51	19
Single-engine retractable	7 (7.7%)	6 (11.8%)
Multiengine	1 (1.1%)	1 (2.0%)

Figure 29

Type of Operation

Aerial application flights accounted for about 7 percent of all GA flight time but 24.2 percent of maneuvering accidents. However, less than one-third of those proved fatal (Figure 30). About half of all maneuvering accidents in other types of working flights (including instruction) were fatal (9 of 17), while more than two-thirds of those on personal flights caused at least one death.

Purpose of Maneuvering Accident Flights

	All Accidents	Fatal Accidents
Personal	49 (53.8%)	33 (64.7%)
Aerial application	22 (24.2%)	7 (13.7%)
Instruction	4 (4.4%)	2 (3.9%)
Other aerial work	13 (14.3%)	7 (13.7%)
Business, positioning, and test flights	3 (3.3%)	2 (3.9%)

Figure 30

Flight Conditions

Most maneuvering crashes (84.6 percent) occurred in daytime VMC (Figure 31). Only four took place in IMC and ten at night. However, 11 of 14 (78.6 percent) maneuvering accidents that occurred at night or in IMC were fatal, compared to 51.9 percent of those that occurred in VMC during daylight (40 of 77).

Flight Conditions During Maneuvering Accidents

	All Accidents	Fatal Accidents
Day VMC	77 (84.6%)	40 (78.4%)
Night VMC	10 (11.0%)	7 (13.8%)
Day IMC	4 (4.4%)	4 (7.8%)

Figure 31

Accident Case Study

LAX07FA160
Diamond DA-40, Lake Pleasant, Arizona
Two fatalities

History of Flight

The pilot telephoned an acquaintance who was boating on a lake, and informed him that he planned to overfly the lake. At the end of the evening's civil twilight, witnesses observed the airplane approach the lake. The pilot telephoned the acquaintance and asked him to shine a light toward the airplane to facilitate being located on the lake. Other recreational boaters in the vicinity reported observing the airplane perform low altitude maneuvers, including a steep pull-up and a 70-degree angle bank. Witnesses estimated that some maneuvers were performed within a wingspan or two above the lake. The witnesses said the engine was not sputtering and sounded "real strong." During one of the buzzing maneuvers, the airplane descended into the lake, fragmented, and sank. The accident occurred minutes after the end of civil twilight with a marginally visible horizon. A majority of the wreckage, including the engine, was not recovered.

Pilot Information

The pilot, age 45, held an airline transport pilot certificate for multiengine airplanes and a commercial certificate for single-engine airplanes. He was type-rated in the Cessna 500 Citation and Shorts SD-3. Of at least 9,700 hours of total flight experience, 2,100 were in single-engine airplanes. His time in type was not reported.

Weather

The sky was clear, with 10 statute miles visibility and winds from 290 degrees at 3 knots.

Probable Cause

The pilot's failure to maintain sufficient altitude above the surface of water during an intentional buzzing maneuver. Contributing to the accident was the nighttime lighting environment.

ASF Comments

Buzzing is always a high-risk maneuver and should be avoided. Adding reduced visibility in the dark and lack of visual references while flying over water made this crash almost inevitable.

Descent/Approach

61 total/22 fatal

The descent and approach phase of flight extends from the beginning of the descent from cruise altitude until the aircraft reaches the MAP (IMC) or the runway threshold (VMC).

Typical descent/approach accidents occur for one or more of the following reasons:

- **Stalls and/or Spins –** Loss of airspeed during the descent can result in a stall, spin, or other loss of control.

- **Collisions with Wires, Objects, Terrain, etc. –** If the descent is continued below a safe altitude, collisions with terrain, wires, or other objects are possible.

- **Loss of Engine Power –** Loss of power due to carburetor icing or incorrect fuel mixture.

- **Gusts or Wake Turbulence –** The effects of low altitude turbulence or the wake of heavy aircraft can cause loss of control.

Eight fatal accidents occurred in IMC; seven of them involved collisions with objects or terrain, including two during circling approaches. Eight of the 14 fatal accidents in VMC were the result of terrain and obstacle collisions (Figure 32). The remaining accidents were stalls and/or spins, except for one VMC accident attributed to gusts or wake turbulence.

Types of Descent/Approach Accidents

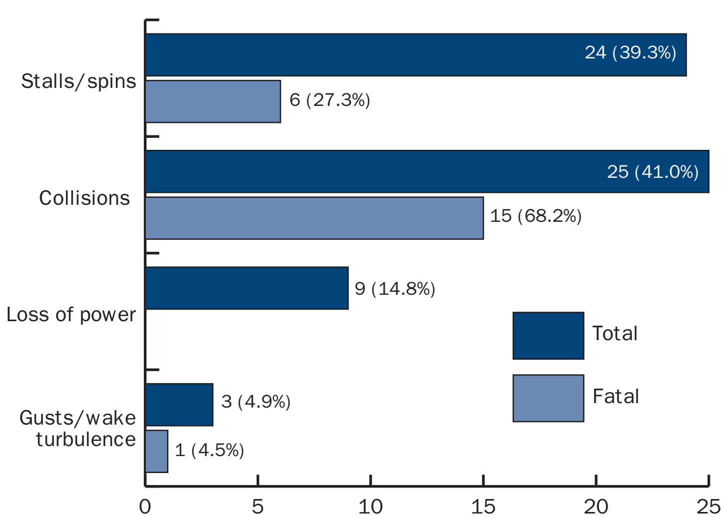


Figure 32

Stalls, on the other hand, accounted for almost half (18 of 39) of nonfatal approach and descent accidents; the remainder included ten collisions with wires, objects, or terrain (half of them at night), nine cases of power loss due to the pilot's failure to use carburetor heat, and two caused by wake turbulence or gusts.

Pilot Qualifications and Experience

Five of seven descent/approach accidents involving ATPs were fatal (71 percent), compared to 38 percent for private pilots and 18 percent for commercial pilots (Figure 33). These included two accidents on business flights, both fatal, and three fatal accidents that occurred in nighttime IMC.

Pilots Involved in Descent/Approach Accidents

Certificate Level	All Accidents	Fatal Accidents
ATP	7 (11.5%)	5 (22.7%)
Commercial	11 (18.0%)	2 (9.1%)
Private	39 (63.9%)	15 (68.2%)
Student	2 (3.3%)	0
None	2 (3.3%)	0

Figure 33

Descent and approach accidents were not concentrated among inexperienced pilots. Half of the private pilots involved had more than 700 hours of flight experience; and three-quarters of the commercial pilots had more than 2,000 hours. Make-and-model experience was missing for about a quarter of the accident pilots, but where available it did not suggest that lack of familiarity with the accident aircraft was a major risk factor; the median level was 200 hours or more at every certificate level (data not shown).

Characteristics of Descent/Approach Accidents

Fixed-gear single-engine aircraft accounted for a smaller proportion of descent/approach mishaps than of other types of accidents (Figure 34).

Aircraft Involved in Descent/Approach Accidents

	All Accidents	Fatal Accidents
Single-engine fixed	38 (62.3%)	10 (45.5%)
SE retractable	16 (26.2%)	8 (36.4%)
Multiengine	7 (11.5%)	4 (18.2%)

Figure 34

The great majority of descent/approach accidents occurred on personal flights (78.7 percent), as did 18 of 22 fatal accidents. Eight of 11 accidents in IMC were fatal (73 percent) compared to 28 percent in VMC (Figure 35). Eight of 13 that occurred at night (62 percent) were fatal compared to 29 percent of daylight accidents. The eight fatal accidents in IMC were equally split between day and night, and seven of them involved attempted approaches into airports where weather was definitely (3) or possibly (4) below minimums.

Flight Conditions During Descent/Approach Accidents

	All Accidents	Fatal Accidents
Day VMC	42 (68.9%)	10 (45.5%)
Day IMC	6 (9.8%)	4 (18.2%)
Night VMC	8 (13.1%)	4 (18.2%)
Night IMC	5 (8.2%)	4 (18.2%)

Figure 35

Accident Case Study

NYC07FA056
Beech BE36, Wayne, New Jersey
One fatality

History of Flight

The airplane approached the destination airport in night instrument meteorological conditions. The pilot received a clearance for the localizer approach, and radar and global positioning system (GPS) data revealed the airplane was established on the localizer course centerline. The airplane crossed the final approach fix 200 feet below the minimum altitude for the fix, and over the next 1.5 miles, descended on an approximate 7-degree approach angle and a 945 feet-per-minute rate of descent. The airplane continued its descent and struck trees on a ridgeline approximately 400 feet below the intermediate altitude for that segment of the approach. Examination of the wreckage revealed no mechanical anomalies.

Pilot Information

The pilot, age 55, held an airline transport pilot's certificate for multiengine airplanes restricted to centerline thrust and a commercial certificate with instrument rating for helicopter and single-engine airplane. He was a certificated flight and instrument instructor for single- and multiengine airplanes and helicopters with 4,455 hours total flight time and 2,000 hours in the accident make and model.

Weather

Sky conditions were 500 scattered with visibility 4 statute miles in mist; temperature and dew point were both 7 degrees C. Witnesses reported visibility as low as 1/8 statute mile at the accident site. Winds were light and variable at 3 knots.

Probable Cause

The pilot's failure to comply with the published instrument approach procedure, which resulted in controlled flight into terrain.

ASF Comments

This pilot may have been trying to "duck under" the clouds in order to get visual contact with the runway. It is critical to comply with minimum altitudes on instrument approaches. A normal ILS is 3 degrees and this aircraft was descending at double that. An unstabilized approach after the final approach fix/waypoint should always result in a go-around.

Landing

423 total/8 fatal

The landing phase extends from either the missed approach point (IMC) or the runway threshold (VMC) through touchdown, until the aircraft completes its ground run. It also includes aborted landings where touchdown has occurred and the landing is rejected.

Typical landing accidents occur for one or more of the following reasons:

- **Loss of Directional Control –** The inability of the pilot to keep the airplane on the runway, sometimes as a result of crosswinds, is a leading factor in landing accidents.

- **Inadequate Airspeed Control –** Pilots' inability to maintain the proper approach and landing airspeed can result in low altitude stalls, hard landings, touching down short of the runway, or landing farther down the runway than desired. Long landings often result in running off the far end and colliding with ground objects.

- **Runway Conditions –** Contaminated runways can decrease the effectiveness of aircraft brakes, leading to loss of control or departing the end of the runway.

Types of Landing Accidents

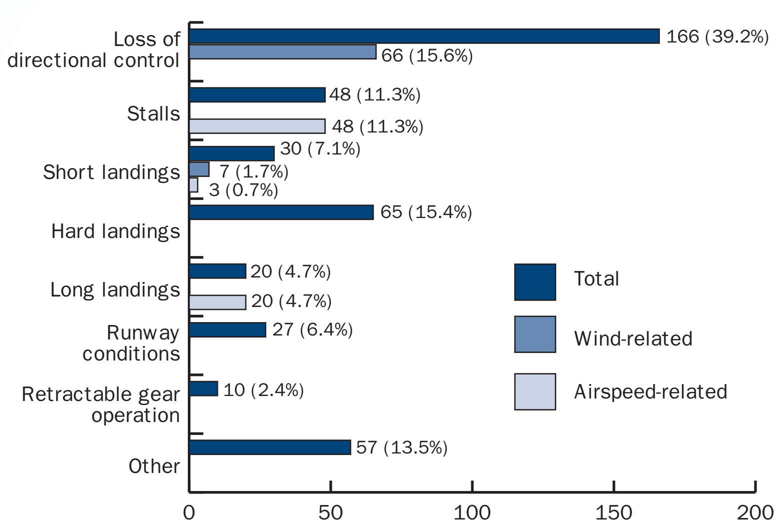


Figure 36

- **Retractable Gear Operation –** Failure to extend, or improper operation of, the landing gear can lead to gear-up landings and inadvertent retraction during the landing and landing roll.

As in previous years, landing accidents were the most common but least likely to be fatal. Loss of directional control was by far the most common reason for landing accidents (166 or 39.2 percent), with inadequate airspeed control (71) and hard landings (65) also responsible for significant numbers (Figure 36). At least 329 of the 423 landing accidents (78 percent) can be attributed to deficiencies in stick-and-rudder airmanship.

Pilot Qualifications and Experience

Landings accounted for more than half of all accidents involving student pilots (66 of 115, or 57.4 percent), and were the only major category in which the proportion of student pilots (15.6 percent) was higher than their proportion of all accident pilots (8.2 percent). ATPs were at reduced risk; they made up 25.9 percent of the pilot population but had only 6.6 percent of landing accidents with no fatalities. Five of the eight fatal landing accidents involved commercial pilots.

Types of landing accidents varied with certificate level. Stalls were not involved in any of the ATP accidents but accounted for 5 percent of those suffered by commercial pilots, 10 percent of those involving private pilots, and 32 percent of those by student pilots. Hard landings made up about twice the proportion of all landing accidents among private and student pilots (18 and 20 percent, respectively) as among commercial and ATPs (about 10 percent for each). On the other hand, loss of directional control accounted for 54 percent of ATP landing accidents, 44 percent among commercial pilots, 38 percent among private pilots, and 36 percent among student pilots. Pilots involved in landing accidents tended to have less time in type than other accident pilots (data not shown), though it's worth noting that three-quarters of those at *every* certificate level, including student, had more than 25 hours.

Aircraft Class

Eighty-two percent (348) of landing accidents were in fixed-gear singles, a disproportionate number of which (132, or 38 percent of all fixed-gear singles) were tailwheel models (Figure 37). Only three of eight fatal accidents took place in SEF aircraft, and none were in tail-draggers. Retractable singles accounted for 46, three of them fatal; multiengine aircraft for 25, with two fatal; and single-engine seaplanes for four.

Aircraft Involved in Landing Accidents

	All Accidents	Fatal Accidents
Single-engine fixed*	352 (83.2%)	3 (37.5%)
Conventional gear	132	0
SE retractable	46 (10.9%)	3 (37.5%)
Multiengine	25 (5.9%)	2 (25.0%)

Figure 37

Includes four seaplanes.

Type of Operation

Personal flights accounted for about the same proportion of landing accidents (294 of 423, or 69.5 percent) as of other types of GA accidents (Figure 38). These included seven of the eight fatal accidents. Instructional flying, however, counted for almost all the rest (92, or 21.7 percent), none of them fatal. The remaining crashes were about evenly split between business travel (15) and an assortment of different types of working flights (13).

Purpose of Landing Accident Flights

	All Accidents	Fatal Accidents
Instructional	92 (21.7%)	0
Aerial work	13 (3.1%)	1 (12.5%)
Personal	294 (69.5%)	7 (87.5%)
Business	15 (3.5%)	0
Positioning or test flights, or unknown	9 (2.1%)	0

Figure 38

Flight Conditions

Only three landing accidents occurred in IMC, and all but 31 (7.3 percent) occurred during daylight hours (Figure 39).

Flight Conditions During Landing Accidents

	All Accidents	Fatal Accidents
Day VMC	391 (92.4%)	6 (75.0%)
Day IMC	1 (0.2%)	0
Night VMC	29 (6.9%)	1 (12.5%)
Night IMC	2 (0.5%)	1 (12.5%)

Figure 39

Accident Case Study

MIA08LA024
Cirrus SR-22, Hendersonville, North Carolina
Two uninjured

History of Flight

The pilot stated that he landed on runway 15 and was on the landing rollout when a gust of wind caused the left wing to come up. He applied left aileron and there was no response. The airplane started turning to the right. He lost directional control of the airplane and it came to a stop on the runway. A witness stated that he heard an increase in engine power and looked up. The airplane was about 2 feet above the runway "flailing," rose to an altitude of less than ten feet, and appeared to be banking and yawing out of control. Runway 15 was 3075 x 40 feet.

Pilot Information

The instrument-rated private pilot, age 52, had 985 hours total flight time with 101 hours in type. He had logged 24 hours in the previous 90 days and 11 in the preceding 30, all in the accident make and model.

Weather

The nearest weather reporting facility, located 11 nautical miles southeast of the crash site, reported clear sky conditions and winds from 150 degrees at 8 knots. No gusting winds were reported at the time of the accident.

Probable Cause

The pilot's improper recovery from a bounced landing resulting in a loss of directional control.

ASF Comments

Proper execution of go-arounds and balked landings should be part of checkouts and a comprehensive recurrent training program. It's not something we practice often and yet is a demanding maneuver.

Accident Factors: Other Phases of Flight

Preflight, taxi, cruise, and go-around phases of flight hold less risk than other phases. Preflight, taxi and go-around are discussed here. With only 14 accidents occurring during cruise, the numbers during that phase were too small for meaningful analysis.

Preflight and Taxi

39 total/3 fatal

The 17 accidents attributable to inadequate preflight included five attempted takeoffs over maximum gross weight, three prop strikes, five undetected discrepancies with fuel systems, flight controls, or seats, and four starting accidents not involving prop strikes.

Twenty-two of the 39 (56.4 percent) were taxi accidents, including eight collisions with objects, structures, or vehicles, and 14 losses of control in winds, jet blast or prop wash, on slippery surfaces, etc. Of 37 pilots whose certificate status was reported, 13 (35.1 percent) held commercial (10) or ATP (3) certificates. Nineteen (51.4 percent) were private pilots, four were students, and one held no pilot certificate.

Go-Around

40 total/9 fatal

This phase includes missed approach (IMC) and go-around (VMC). These involve abandoning the approach prior to touchdown. Typical go-around accidents occur for one or more of the following reasons:

- **Stalls –** Inadequate airspeed control during the go-around can lead to a stall.

- **Loss of Directional Control –** Loss of directional control during the rapid application of power is another factor in go-around accidents.

- **Late Go-Around Attempts –** Waiting until the aircraft is very near touchdown can lead to hard contact with the ground.

- **Aircraft Configuration –** Improper configuration of landing gear and flaps can lead to poor aircraft climb performance followed by collision with ground objects.

Failure to maintain airspeed resulting in a stall accounted for 42.5 percent of go-around accidents (Figure 40). Seventeen of the 40 accidents were stalls, eleven involved loss of directional control, seven were attributed to late decisions to go around, and five were caused by failures to reconfigure the aircraft correctly.

Types of Go-Around Accidents

	All Accidents	Fatal Accidents
Stalls	17 (42.5%)	5 (55.6%)
Loss of directional control	11 (27.5%)	3 (33.3%)
Late go-around attempts	7 (17.5%)	1 (11.1%)
Aircraft configuration	5 (12.5%)	0

Figure 40

Only one-fourth of pilots involved in go-around accidents held commercial or ATP certificates, but half of these were fatal, in contrast with only 13 percent (4 of 30) of those among private, sport, and student pilots. Student pilots were responsible for five accidents, none of them fatal.

A higher proportion of go-around crashes occurred in more complex aircraft, but only two of the single-engine fixed-gear models were high-performance aircraft. Note the much higher lethality of go-around accidents in twins and retractables, likely associated with the higher energy levels of more complex aircraft – 43.8 percent vs. 8.3 percent in fixed-gear singles.

Instructional flights accounted for a relatively high proportion (9 of 40, or 22.5 percent) of go-around accidents, and one-third of the fatal ones. Twenty-nine of the remaining 31, and five of the remaining six fatal accidents, occurred on personal flights.

Aircraft Involved in Go-Around Accidents

	All Accidents	Fatal Accidents
Single-engine fixed	24 (60.0%)	2 (22.2%)
SE retractable	13 (32.5%)	6 (66.7%)
Multiengine	3 (7.5%)	1 (11.1%)

Figure 41

Ninety percent (36) of accidents in this phase occurred in daytime VMC, including six of nine fatal accidents. Both of those that took place in instrument conditions were fatal, as was one of the two accidents in VMC at night. Three out of four go-around accidents in restricted visibility proved fatal compared to one-sixth of those in daylight visual conditions.

Other Accident Factors

Midair Collisions

10 total/4 fatal

In 2007 GA aircraft were involved in ten midair collisions, four of which were fatal. The fatal accidents included a collision between two competitors rounding the first pylon in an air race at Reno and a collision between a vintage P-51 and an amateur-built P-51 replica during a formation landing at Oshkosh. The other two fatal accidents both involved instructional flights: A Cessna 172 practicing maneuvers in dual instruction collided with a departing V35B on a clear day, and a student pilot flying solo hit a light twin on an instrument flight plan. None of the remaining six caused serious injuries. Three of these occurred in the traffic pattern (one at a towered field), two during formation flight, and one in low-altitude cruise flight.

Alcohol and Drugs

6 total/3 fatal

Alcohol and drug misuse continues to rank low as an accident factor. Historically, these have been cited as a cause or factor in about 1.1 percent of all accidents. As a class, these accidents have a high probability of ending in a fatality. In 2007, four accident pilots were impaired by alcohol and two by drugs. All but one of the alcohol-related accidents was fatal. One of the fatals also caused serious injury to a student pilot whose CFI was killed. None of these accidents were attributed to illicit recreational drugs, but two were caused by prescription and/or over-the-counter medications.

Pilot Incapacitation

6 total/4 fatal

Pilot incapacitation is rare. Of the six incapacitation accidents that occurred in 2007, one was the result of a heart attack, and one a probable stroke. Both were fatal. Two, one fatal, were attributed to spatial disorientation. The remaining two were an apparent murder-suicide that killed two, and a loss of consciousness on short final that the pilot speculated might have been caused by dehydration. He suffered only minor injuries after a hard landing.

Ground Injuries: Off-Airport

13 total (6 accidents)/5 minor injuries, 4 serious injuries, 4 fatalities

The thought of airplanes falling out of the sky, causing death or injury on the ground, is a common worry for nonpilots. This concern is often cited as a reason to restrict or close GA airports, even though statistics show it is far more fiction than fact. In 2007 there were a total of six GA accidents that resulted in thirteen off-airport ground injuries.

One person was killed when his house was hit by a light business jet attempting a go-around. Three people on the ground were killed and four more seriously injured in the crash of a light twin. Four other accidents caused a total of five minor injuries to off-airport individuals.

Propeller Strike Injuries

3 total/0 fatal

Propeller strike injuries usually result from either an attempt to hand-prop an airplane or inadvertent contact with a moving propeller by an individual in the ramp area. The number of fatalities from propeller strikes is very low, averaging two per year. Three propeller strike accidents occurred in 2007, one during hand-propping. The other two were people (one passenger and one aircraft mechanic) who walked into moving propellers.

Amateur-Built Aircraft

226 total/55 fatal

The amateur-built aircraft fleet includes a wide variety of designs and technologies, and covers the full range from simple, low-performance pleasure craft to high-tech, high-performance models. Most are single-engine. Pilots of amateur-built aircraft represent the full range of experience and certification.

226 amateur-built aircraft were involved in accidents, and 55 (24.3 percent) of these were fatal. All were single-engine and 205 (90.7 percent) had fixed gear (including 10 seaplanes or amphibians). A total of 102 (including three with retractable gear and one amphibian) had conventional landing gear (Figure 42).

Amateur-Built Aircraft Involved in Accidents

	All Accidents	Fatal Accidents
Single-engine fixed	205 (90.7%)	47 (85.5%)
Conventional gear	99	17
SE retractable	21 (9.3%)	8 (14.5%)

Figure 42

Figure 43 tracks the proportion of accidents in amateur-built aircraft to overall GA accidents over the last ten years. Total amateur-built accidents continue to increase.

The accident factor distribution is not markedly different from that in manufactured airplanes, with the exception of a somewhat higher proportion of maneuvering accidents (Figure 44).

Amateur-Built Aircraft Accident Trend

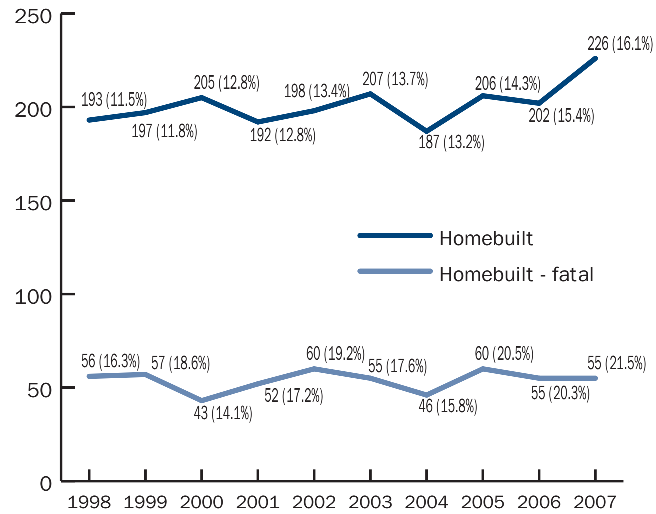


Figure 43

Types of Accidents in Amateur-Built Aircraft

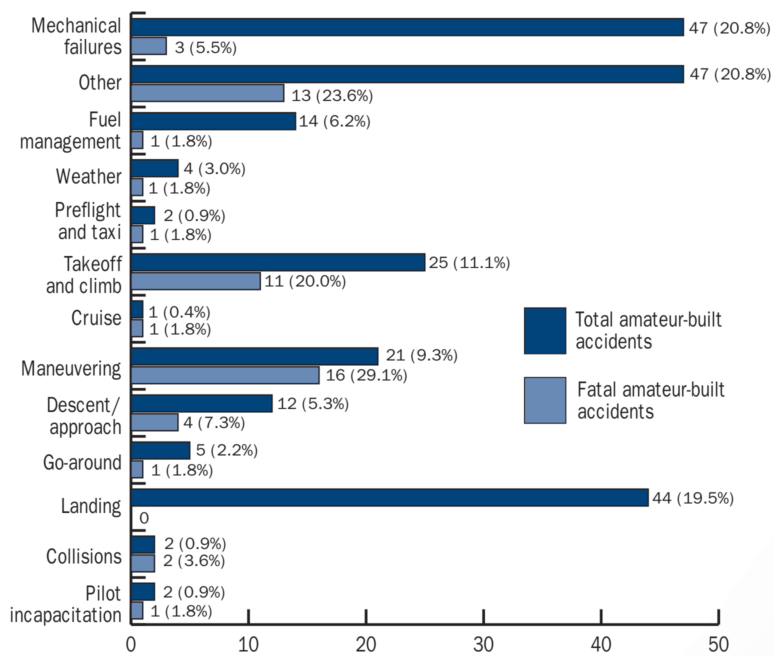


Figure 44

Summary

- A historic low of 252 fatal accidents (down 5.6 percent from the previous year) was recorded. The 449 total fatalities also represent a new low, decreasing by 9.7 percent.

- The rate for fatal accidents of 1.18 per 100,000 flight hours shows marked improvement over the previous six years, but still misses the historic low set in 1999 (1.11).

- Total pilot-related accidents in 2007 showed a slight increase over the previous year, with a gain of 2.4 percent for total (996 vs. 973) and a decrease of 11.6 percent for fatal (191 vs. 216) accidents.

- In 2007, personal flights accounted for 39.4 percent of general aviation flying, but a disproportionate 69.1 percent of total accidents and 72.9 percent of fatal accidents.

- The high proportion of accidents suffered by less experienced pilots was not excessive relative to the overall numbers of pilots with comparable levels of experience.

- Forty-one of the 50 weather-related accidents were fatal. Nearly half of all weather-related accidents resulted from pilots attempting to continue VFR flight into instrument meteorological conditions (IMC).

- Maneuvering remains one of the leading causes of general aviation accidents with 91 total and 51 fatal accidents.

- Fatal descent and approach accidents dropped sharply from 13.9 percent of the fatal crashes in 2006 to 8.7 percent in 2007.

Appendix

General Aviation Safety vs. Airlines

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

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

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

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

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

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

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

What Is General Aviation?

Although GA is typically characterized by recreational flying, it encompasses much more. Besides providing personal, business, and freight transportation, GA supports diverse activities such as law enforcement, forest fire fighting, air ambulance, logging, fish and wildlife spotting, and other vital services. For a breakdown of GA activities and their accident statistics, see "Type of Operation" on page 11.

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 each year's *Nall Report:*

- Piston single-engine
- Piston multiengine
- Turboprop single-engine
- Turboprop multiengine
- Experimental
- Amateur-built
- Turbojet

What Does General Aviation Fly?

	Air Taxi	General Aviation
Piston single-engine	1,751	145,818
Piston multiengine	1,483	17,854
Turboprop single-engine	582	3,477
Turboprop multiengine	882	4,574
Turbojet	2,681	7,704
Helicopter	1,954	7,613
Experimental	107	23,121
Light Sport	0	6,066
TOTAL	9,440	216,227

Figure 45

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

- FAR Part 121 airline operations
- FAR Part 135 charter operations
- Military operations
- Aircraft weighing more than 12,500 pounds
- Helicopters
- Gliders
- Balloons

Figure 45 shows the FAA's estimate of the number of powered GA aircraft that were active in 2007, sorted by category and class, separately for air-taxi operators and other GA users. The estimates of total flight time used in this report are based on 92.6 percent of the GA fleet.

Data on Pilot Experience

Information on the total flight time of accident pilots may come from any of several sources of varying degrees of currency. Interviews with surviving pilots or examination of logbook entries are usually the most up to date; when these are not available, the experience claimed on medical certificate or insurance applications may be cited instead. Medical data are more recent (and thus show more flight time) for pilots who maintain higher levels of certification—within the past six months for a current first-class certificate but (in 2007) up to three years old for a valid third-class – and, like total flight time, medical class is associated with certificate level: Among the 2007 accident pilots, more than three-quarters of first- and second-class medicals were held by commercial pilots or ATPs, while 85 percent of third-class certificates belonged to private or student pilots.

Medical applications provide the only available information on flight experience across the entire U.S. pilot population. The most current data available from the FAA's Civil Aerospace Medical Institute (CAMI) are based on each active pilot's most recent application as of 2005. Pilots were considered "active" unless their most recent medical certificate had been allowed to lapse from third-class status, at which point they were dropped from the data set. No effort was made to link the records of individuals, who were not identified in either the NTSB or the CAMI data; rather, the CAMI data provide a snapshot of the overall distribution of flight experience for each type of pilot certificate.

The accuracy with which the 2005 data estimate the distribution in 2007 is not known, but there is reason to believe that benchmark figures such as the percentage of private pilots with less than 500 hours do not change quickly. The steady increase of experience among active pilots is offset in some part by the entry of new certificate holders and the departure of experienced pilots who stop flying. Comparing the number of pilots in the lower experience categories with the number of new private and commercial certificates issued annually implies that the turnover in these groups is relatively slow.

The complexity of the relationships between certificate level, total flight experience reported, and the currency of those reports makes it clear that the numbers of accidents within flight-time categories must be interpreted with caution. More experienced pilots may be at greater risk of accidents simply because they fly more often. Many commercial pilots without ATP certificates may be building time rapidly while employed as flight instructors or crop dusters, exaggerating the difference between experience reported earlier on the medical application and actual experience on a given date. The role of flight experience as an accident risk factor seems less straightforward than previously supposed.

The availability of time in type for accident pilots depends on the accident's severity: Missing data are concentrated among fatal accidents. In 2007, more than two-thirds of the accidents for which time in type was never determined were fatal, and time in type was unavailable for almost two-thirds of all fatal accidents (63 percent). The pattern was similar within every certificate level except student, and is not surprising: The pilots are often among the fatalities, and their logbooks may be lost or destroyed. Information is not as reliably available from insurance carriers, flight schools, company flight departments, or other external sources. For this reason, this report makes no attempt to analyze time in type among pilots involved in fatal accidents.

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.

- **Executive/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.

Phase of Flight

The phase of the flight or operation is the particular phase of flight in which the first occurrence or circumstance occurred:

- **Standing –** From the time the first person boards the aircraft for the purpose of flight until the aircraft taxies under its own power. Also, from the time the aircraft comes to its final deplaning location until all persons deplane. Includes preflight, starting engine, parked-engine operating, parked-engine not operating, and idling rotors.

- **Taxi –** From the time the aircraft first taxies under its own power until power is applied for takeoff. Also, when the aircraft completes its landing ground run until it parks at the spot of engine shutoff. Includes rotorcraft aerial taxi. Includes taxi to takeoff and taxi from landing.

- **Takeoff –** From the time the power is applied for takeoff up to and including the first airborne power reduction, or until reaching VFR traffic pattern altitude, whichever occurs first. Includes ground run, initial climb, and rejected takeoff.

- **Climb –** From the time of initial power reduction (or reaching VFR traffic pattern altitude) until the aircraft levels off at its cruise altitude. Also includes en route climbs.

- **Cruise –** From the time of level off at cruise altitude to the beginning of the descent.

- **Descent –** From the beginning of the descent from cruise altitude to the IAF, FAF, outer marker, or VFR pattern entry, whichever occurs first. Also includes en route descents, emergency descent, auto-rotation descent, and uncontrolled descent.

- **Approach –** From the time the descent ends (IAF, FAF, outer marker, or VFR pattern entry) until the aircraft reaches the MAP (IMC) or the runway threshold (VMC). Includes missed approach (IMC) and go-around (VMC).

- **Landing –** From either the MAP (IMC) or the runway threshold (VMC) through touchdown or after touchdown off an airport, until the aircraft completes its ground run. Includes rotorcraft run-on, power-on, and auto-rotation landings. Also includes aborted landing where touchdown has occurred and landing is rejected.

- **Maneuvering –** Includes the following: aerobatics, low pass, buzzing, pull-up, aerial application maneuver, turn to reverse direction (box-canyon-type maneuver), or engine failure after takeoff and pilot tries to return to runway.

- **Other –** Any phase that does not meet the criteria of any of the above. Examples are practice single-engine air work, basic air work, external load operations, etc.

- **Unknown –** The phase of flight could not be determined.

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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The four most useless things in aviation are:

- runway behind you,
- altitude above you,
- fuel that's back in the truck,
- and half a second ago.

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