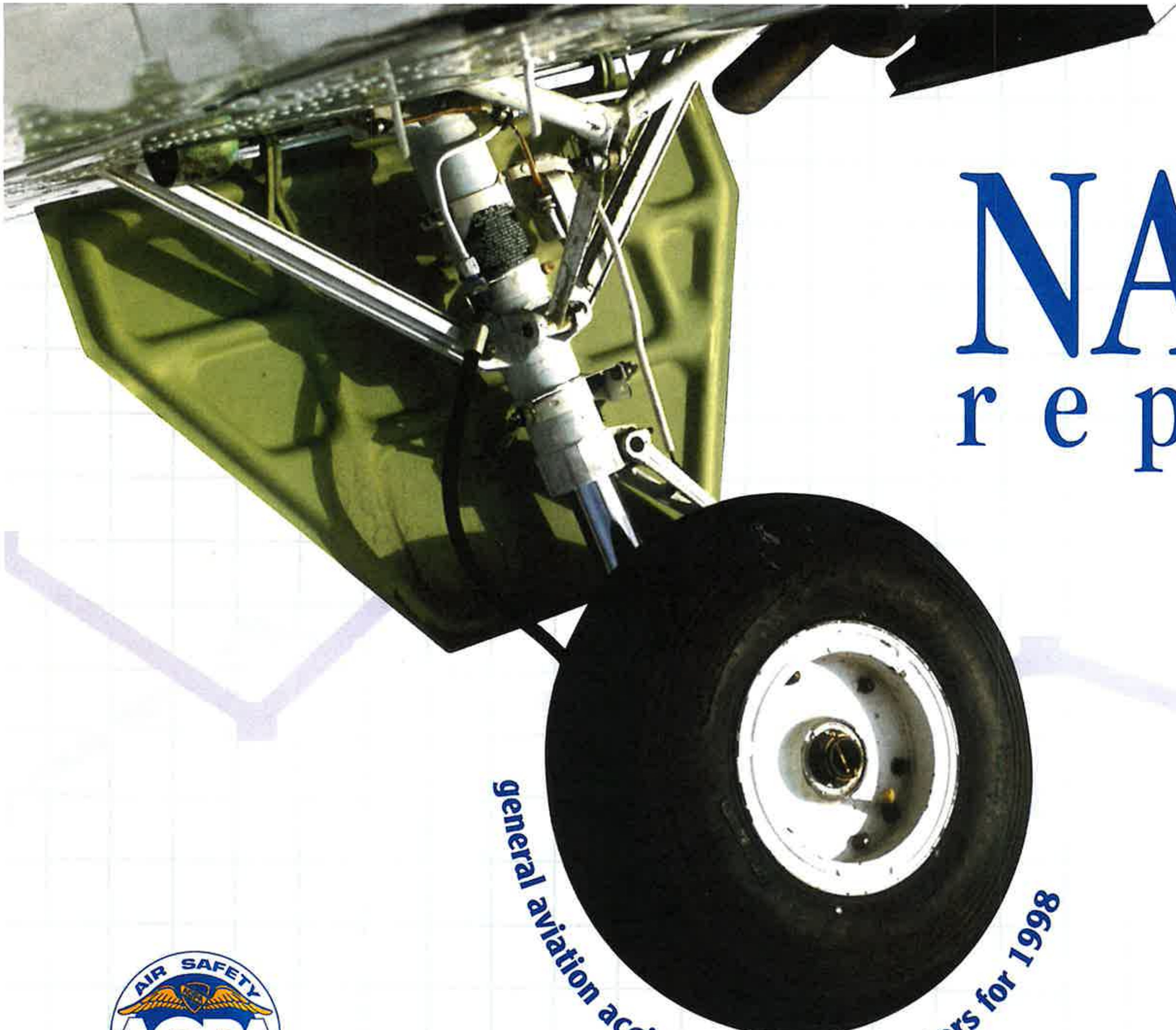
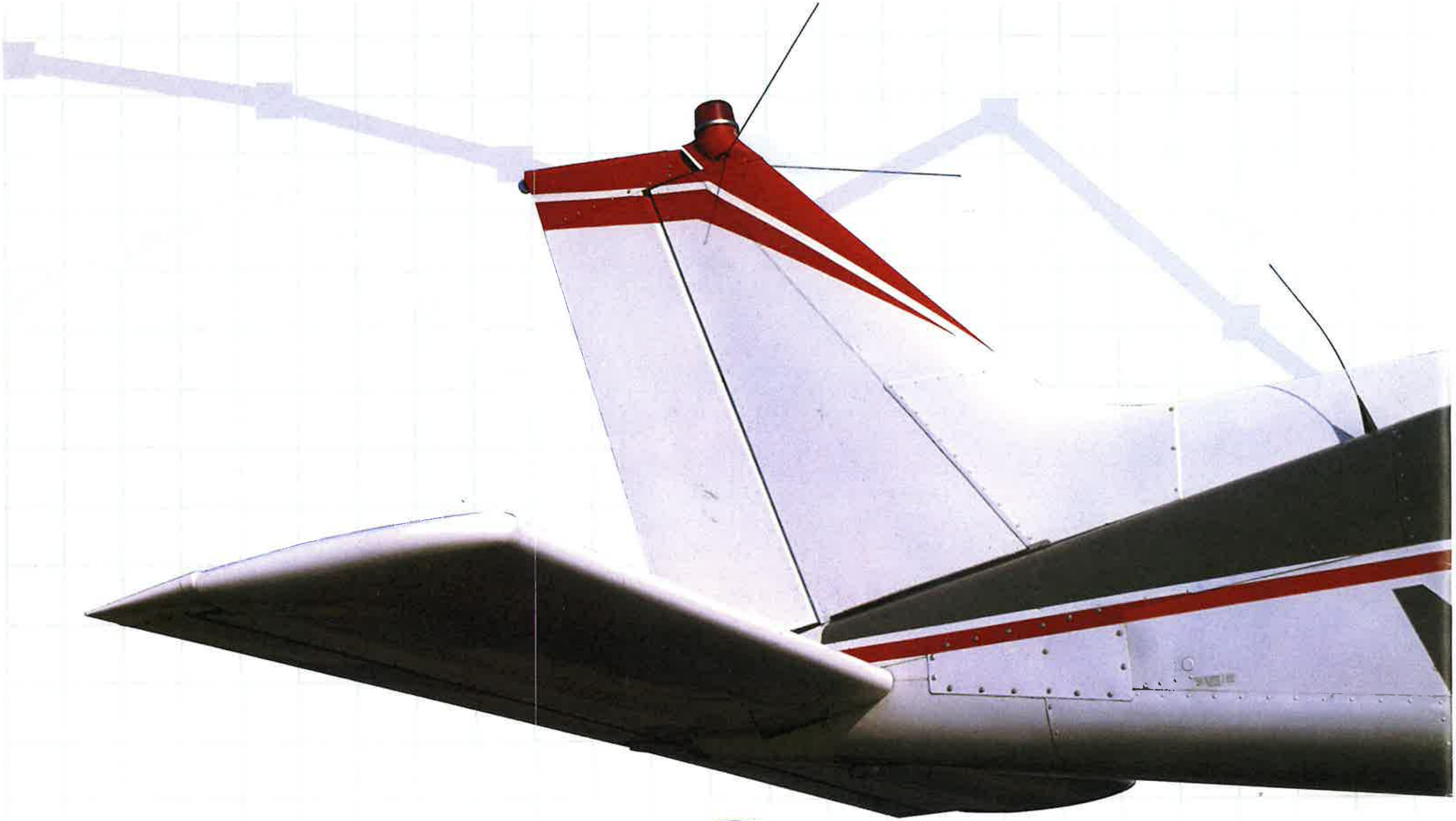


# NALL report

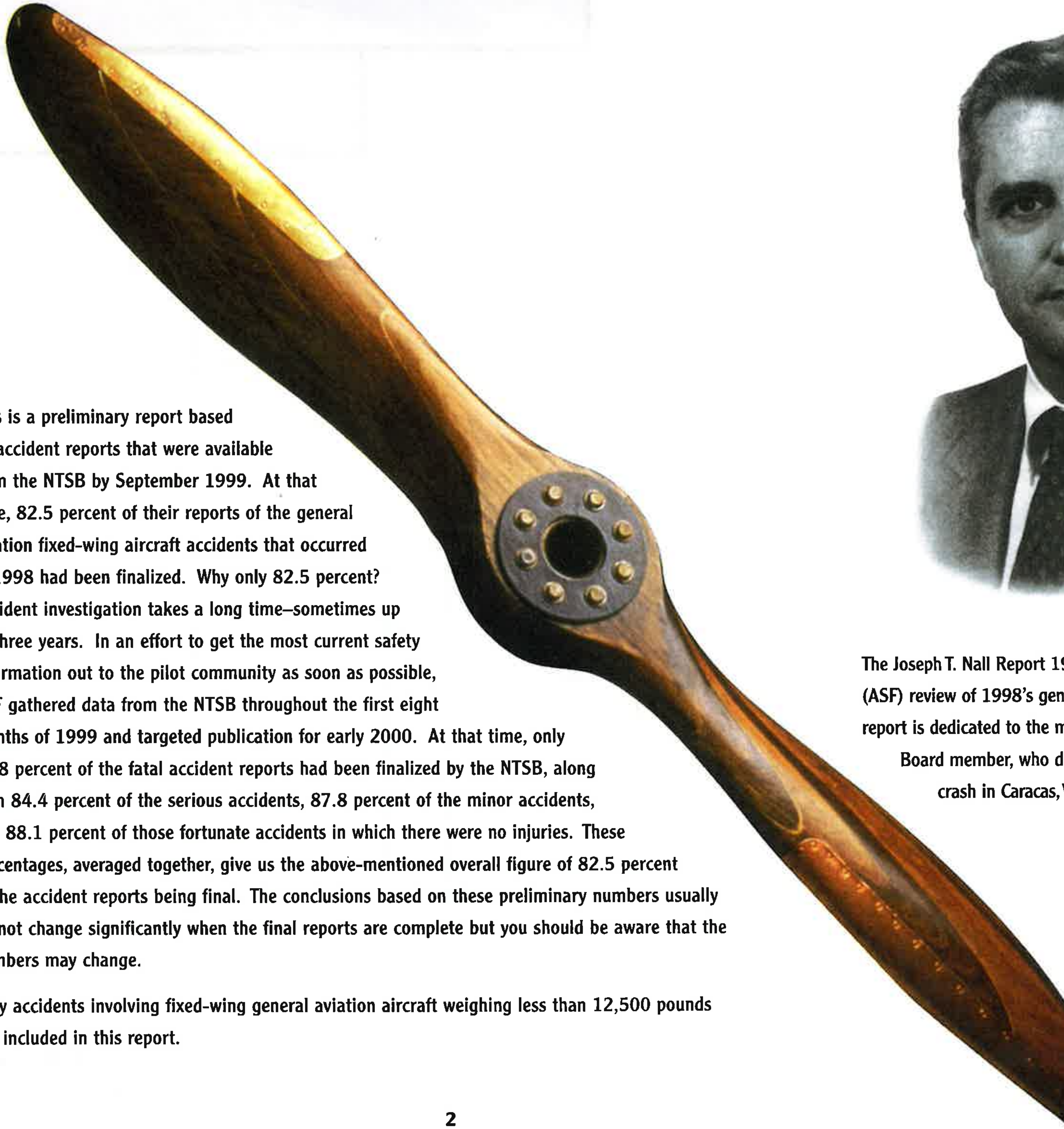
general aviation accident trends and factors for 1998

AIR SAFETY AOPA FOUNDATION 1950 — 2000

# 1999



**AOPA Air Safety Foundation**
421 Aviation Way, Frederick, MD 21701
800/638-3101 www.aopa.org/asf



This is a preliminary report based on accident reports that were available from the NTSB by September 1999. At that time, 82.5 percent of their reports of the general aviation fixed-wing aircraft accidents that occurred in 1998 had been finalized. Why only 82.5 percent? Accident investigation takes a long time–sometimes up to three years. In an effort to get the most current safety information out to the pilot community as soon as possible, ASF gathered data from the NTSB throughout the first eight months of 1999 and targeted publication for early 2000. At that time, only 62.8 percent of the fatal accident reports had been finalized by the NTSB, along with 84.4 percent of the serious accidents, 87.8 percent of the minor accidents, and 88.1 percent of those fortunate accidents in which there were no injuries. These percentages, averaged together, give us the above-mentioned overall figure of 82.5 percent of the accident reports being final. The conclusions based on these preliminary numbers usually do not change significantly when the final reports are complete but you should be aware that the numbers may change.

Only accidents involving fixed-wing general aviation aircraft weighing less than 12,500 pounds are included in this report.

The Joseph T. Nall Report 1999 is Air Safety Foundation's (ASF) review of 1998's general aviation accidents. The report is dedicated to the memory of Joe Nall, an NTSB Board member, who died as a passenger in a plane crash in Caracas, Venezuela, in 1989.

# Executive Overview

Last year's Nall Report played a major role in bringing perspective to the media and political conflagration surrounding John Kennedy Jr.'s accident. AOPA and ASF directed many reporters and pilots to the ASF Web site (www.aopa.org/asf) to get the facts and not get lost in the hysteria of the moment. Despite the negative publicity, general aviation had a good safety year.

Key problem areas remain the same as in previous years. Visual flight into instrument meteorological conditions (IMC) and low-level maneuvering flight continue to be the two areas of flight producing the largest numbers of fatal accidents. Landings produce the most accidents, but with relatively few injuries. Collectively, however, general aviation safety is very gradually improving.

For comparison purposes, in 1997 there were 1,642 total accidents, 331 fatal accidents, and 667 fatalities. In 1998, the total number of accidents increased to 1,679 and the fatal accidents increased to 341. The good news is that fatalities decreased to 619. The flying hours, according to FAA, increased by more than one million from 25.5 million up to 26.8 million. Based on those flying hours, the accident rate improved for the third consecutive record-breaking year and general aviation concluded the year with the lowest number of fatalities since 1955.

Was anything significantly different in 1998 from previous years? Not really. Pilot judgments regarding weather and maneuvering flight are the leading killer causes. Visual flight into instrument conditions is guaranteed to result in a disproportionate number of fatal accidents. Seventy-two percent of the fatal "weather" accidents (39 accidents) occurred when VFR pilots failed to recognize clouds or loss of visual conditions. Weather is in quotes because the weather did not cause the problem – pilot judgment did. When cheating on VFR, the probability of having a fatal accident increases fourfold to over 83 percent. In many weather accidents the pilot waited just a little too long to change his mind. In a significant number, deciding to divert only a few minutes earlier would have kept the flight out of the clouds and out of danger. Flying in marginal VFR conditions should be considered carefully in light of pilot experience, geographic area, and the potential for the weather to change.

Darkness increases the likelihood of tangling with weather. About one-fifth (19 accidents) of the weather-related accidents involving instrument meteorological conditions (IMC) and nearly one-quarter (five accidents) of the approach accidents occurred at night. That is a higher percentage than the estimated amount of time spent in night flight (11 percent) but remember, the raw numbers are small. About seven percent of all accidents occurred in darkness. Night IMC might translate into "It's More Challenging." At night, more than ever, good judgment comes into play.

Maneuvering flight comes in second in the fatal accident category. Thirty-two pilots lost control, according to the NTSB, and another 20 were involved in low and slow flight. Considerable time is spent in primary training teaching stall recognition and recovery. It is worth noting that the majority of fatal stalls occur at traffic pattern altitudes or below and frequently not at the extreme attitudes that are sometimes seen in contrived training scenarios. Distractions such as following traffic ahead, not allowing for proper drift correction, or reconfiguring the aircraft are enough to put some pilots over the edge.

Personal flights are consistently the most dangerous. An estimated 43 percent of all flying is done for personal reasons and results in almost three-quarters of the fatal accidents. This trend is well established and doesn't change much from year to year. Contrast that with business flying (business people who are not professional pilots), which accounts for about 13 percent of the hours and only four percent of the fatal accidents, or instructional flying with 22 percent of the flight time and less than six percent of the fatal accidents. Business pilots may be more willing to scrub a trip, may fly more capable equipment, or may have more experience. Likely, it is a combination of all these factors.

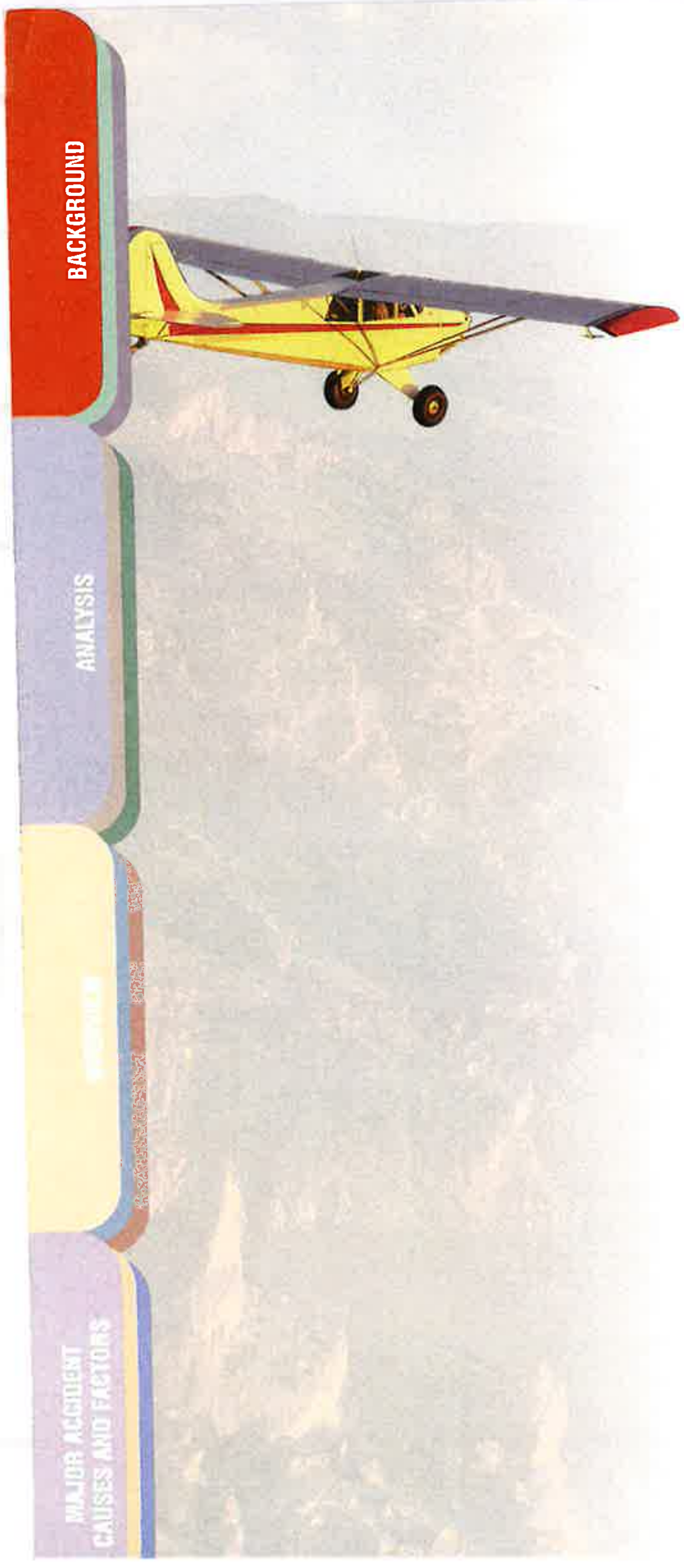
Flight instruction, as mentioned, continues to have a good safety record. However, the exposure to risk is not quite comparable. Relatively little instruction time is devoted to cross-country flight, which is where weather decisions are made. Here is an area where CFIs and flight schools should devote more attention in training. Although it is impossible to make a direct correlation, more experience in weather-related decision making should result in a gradual reduction in some of the VFR into IMC scenarios discussed above.

Takeoffs and landings account for huge numbers of mishaps. About 60 percent of all airplanes are damaged or destroyed in these phases of flight. They are seldom fatal because of relatively slow speeds and are nearly always skill-related. Crosswinds and inadequate eye-to-hand coordination are the factors here. Practicing on a regular basis – particularly when the wind is blowing across the runway – will help reduce this type of mishap.

High-density traffic around nontowered airports is the most likely place for two aircraft to collide. In 1997, there were 13 midair collisions with 11 resulting in fatalities. In 1998, there were 14 midair collisions, again with 11 resulting in fatalities. Collisions tend to be random events. Careful scanning and following proper procedures for nontowered airports are the best defense.

After publishing the Nall Report each year the Air Safety Foundation looks at our mix of educational programs to determine where the emphasis should be. The needs haven't changed much in the last several years and ASF will continue to place more emphasis on pilot decision-making regarding weather. We will also be addressing the issue of collision avoidance as a potential high profile problem.

Bruce Landsberg
Bruce Landsberg
Executive Director
AOPA Air Safety Foundation




## Accident Trends and Factors for 1998

### How Safe Is General Aviation?

In a 1972 decision, the U.S. Supreme Court said that "safe is not the equivalent of risk free." If "safe" meant freedom from the possibility of harm, few human activities would meet the standard. In fact, the only way to eliminate risk from any activity is to avoid participating in it. While risk does not guarantee injury or make an activity unsafe, it should not be ignored. By analyzing mishaps, we can learn about potential risks and take proactive steps to control them.

The accident involving John F. Kennedy Jr. prompted many comparisons, using a variety of statistics, to automobile travel. Some were correct and others were wildly misleading. Without spinning the numbers, here are the facts. Motor vehicles have about 10 times as many accidents per mile as do general aviation aircraft, but the aircraft have about seven times as many fatal accidents per mile as the motor vehicles. Flying in light aircraft is not safer than driving your car, but, as with all statistics, the comparison should be put into context.

Airplanes travel two to four times faster than cars. That is one of the primary reasons we fly. However, should an impact occur, crash physics, unfortunately, work against us. Double the speed, quadruple the impact; triple the speed and the impact force goes up nine times. Add the vertical component introduced by altitude and one has to marvel that aircraft protect their occupants as well as they do. On average, only one aircraft accident in five results in fatalities. To state it another way, the fleet flies almost 10 million miles before there is a fatal loss.

**Safe is not the equivalent of risk free.**

- U.S. Supreme Court, 1972

However, if pilots will heed a few simple precautions, the above numbers can change significantly. As with many other activities, a very small percentage of pilots cause a disproportionate number of accidents – particularly those that display fatal flaws in judgment. There are occasional exceptions in which a careful, well-qualified pilot will get into trouble. That is why recurrent training and a touch of humility mark the very best pilots; they realize that the sky is a wonderful place, but not totally benign. Neither are the highways.

## Background

### What Is General Aviation?

Although general aviation (GA) is typically characterized by recreational flying, there is a lot more to this important segment of aviation. In addition to the personal flying that many find so enjoyable, general aviation is a valuable part of the nation's transportation system, making it possible to perform tasks not easily accomplished by other means. Besides providing personal, business, and freight transportation, general aviation supports diverse activities such as law enforcement, forest fire fighting, air ambulance, and other vital services. For a breakdown of general aviation activities and their accident statistics, see "Analysis of Specific Operations" on page 14.

### What Does General Aviation Fly?

Aircraft used in general aviation are as varied as the pilots and types of operations involved. From the mos recent data available from the FAA, the total number active scheduled airline, on-demand air taxi, and gene aviation aircraft are shown in the table on the next pa

This safety report will address accidents involving mo of the types of aircraft listed in this table. Accidents involving turbojet aircraft, helicopters, gliders, balloo aircraft used in 14 CFR 121 or 14 CFR 135 operation and aircraft weighing more than 12,500 pounds will be covered.

# Analysis

## Interpreting Aviation Accident Statistics

Everyone has heard about "the accident rate," but what does that really mean? How do we compare statistics and arrive at conclusions?

All too often, comparisons are based on the number of events occurring – raw data counts – but that type of comparison does not tell the real story. To be meaningful, comparisons must be based upon equal exposure to risk. The longer we are exposed to a particular risk, or the more times we undertake an activity involving risk, the greater the overall risk. However, this alone does not determine total risk. Reduction factors such as experience, proficiency, equipment, and flight conditions can have significant positive safety impact.

To compare different airplanes, pilots, types of operations, etc., in terms of their accident involvement, we must first level the playing field in terms of exposure to risk. Statisticians call this normalizing. The most common way to normalize factors for aviation safety is to compare accidents per 100,000 flight hours or to compare accidents against total flights. General aviation data are usually compared using 100,000 hours of flight time. The FAA estimates the total flight hours for general aviation based on a survey of a sample of aircraft owners and operators. Scheduled air carriers, on the other hand, must report flight hours, departures, and passengers carried, so their accident statistics may be compared using either departures or flight hours.

To make these comparisons as meaningful as possible, all groups must have approximately equal risk per unit, in this case equal risk per flight hour or per flight. To interpret comparisons accurately, it is important to know which normalizing factor – flight hours or flights – is being used and to understand the likely differences between groups. Comparisons based on equivalent data are more likely to be accurate than other types of comparisons. For example, a comparison between one year's

| | Airlines (1996) | On-Demand Air Taxi (1997) | General aviation (1997) |
|---|---|---|---|
| Experimental | | 150 | 14,530 |
| Piston Single-Engine | 397 | 909 | 139,129 |
| Piston Multiengine | 338 | 1,532 | 14,485 |
| Turboprop Single-Engine | 5 | 100 | 550 |
| Turboprop Multiengine | 1,695 | 1,141 | 3,827 |
| Turbojet | 4,922 | 271 | 4,907 |
| Helicopter | 121 | 837 | 5,949 |
| Total | 7,478 | 4,941 | 183,381 |

general aviation accidents per 100,000 hours and another year's general aviation accidents per 100,000 hours is more likely to be accurate than a comparison of general aviation accidents per 100,000 hours and air carrier accidents per 100,000 hours.

Percentages and ratios are common ways to show relationships within a set of data. This report uses percentages to show what portion of accidents were attributed to particular causes, as well as what portion of accident sequences began in a particular phase of flight. These figures may be used to estimate what statisticians call conditional probabilities. In other words, given an accident that has occurred, what is the probability that it was the result of weather, stall/spin, etc.? This type of analysis makes it easier to identify and concentrate on the accident factors that carry the greatest risk.

## Sequence of Events and Accident Causality

In its studies of accidents involving large transport-category aircraft, the Boeing Commercial Airplane Co. has found that most accidents are the result of a sequence of events rather than a single catastrophic event. Boeing's research into air carrier accidents has identified as many as 20 events in the course of a single flight that had a direct impact upon the outcome. The National Transportation Safety Board (NTSB) uses a similar method to break down each accident into "occurrences."

In this report, the emphasis is on identifying the phase of flight in which the sequence of events began, often referred to as the "first occurrence," and on the types of problems encountered by the pilots. The objective is to find lessons that can be used to prevent future accidents.

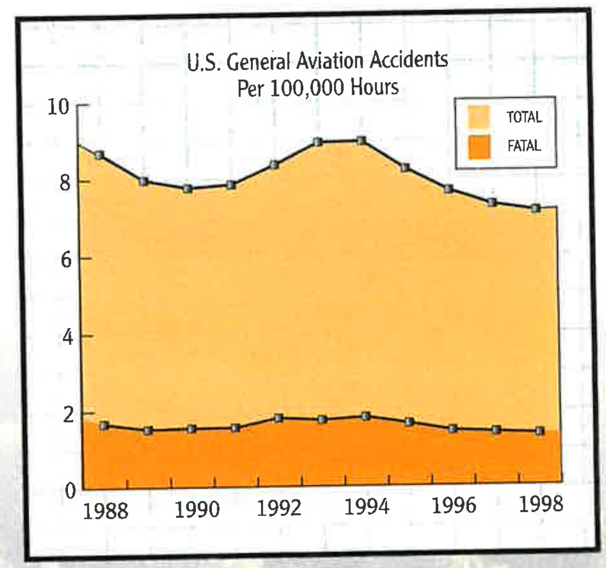
This report concentrates on the first occurrence and uses a simple, single-cause/factor classification scheme. The analyses in this report have been based upon a combination of fully investigated final reports from the NTSB and, where final reports were not available, preliminary reports, describing the accident and providing basic factual data.

Resource constraints and the number of accidents occurring annually mean that general aviation accidents are not investigated in nearly as much depth as air carrier accidents, so much will never be known about many mishaps. Despite these limitations, the AOPA Air Safety Foundation believes that pilots can learn valuable lessons from analysis of the most recent year's accidents.

# Overview

## 1998 Statistics

The accident rate per 100,000 flying hours for all general aviation aircraft fell in 1998 compared to previous years in spite of a slightly higher number of accidents than in 1997 (1679 vs. 1642) due to a higher number of hours flown in 1998. The FAA's estimate of the hours flown by general aviation aircraft during 1998 increased to 26.8 million flight hours from 25.5 million flight hours in 1997. However, the change in the accident rate shown in the chart below may not be statistically significant because its magnitude is within the variability or "roughness" of the estimates of flying hours on which the rate is based.

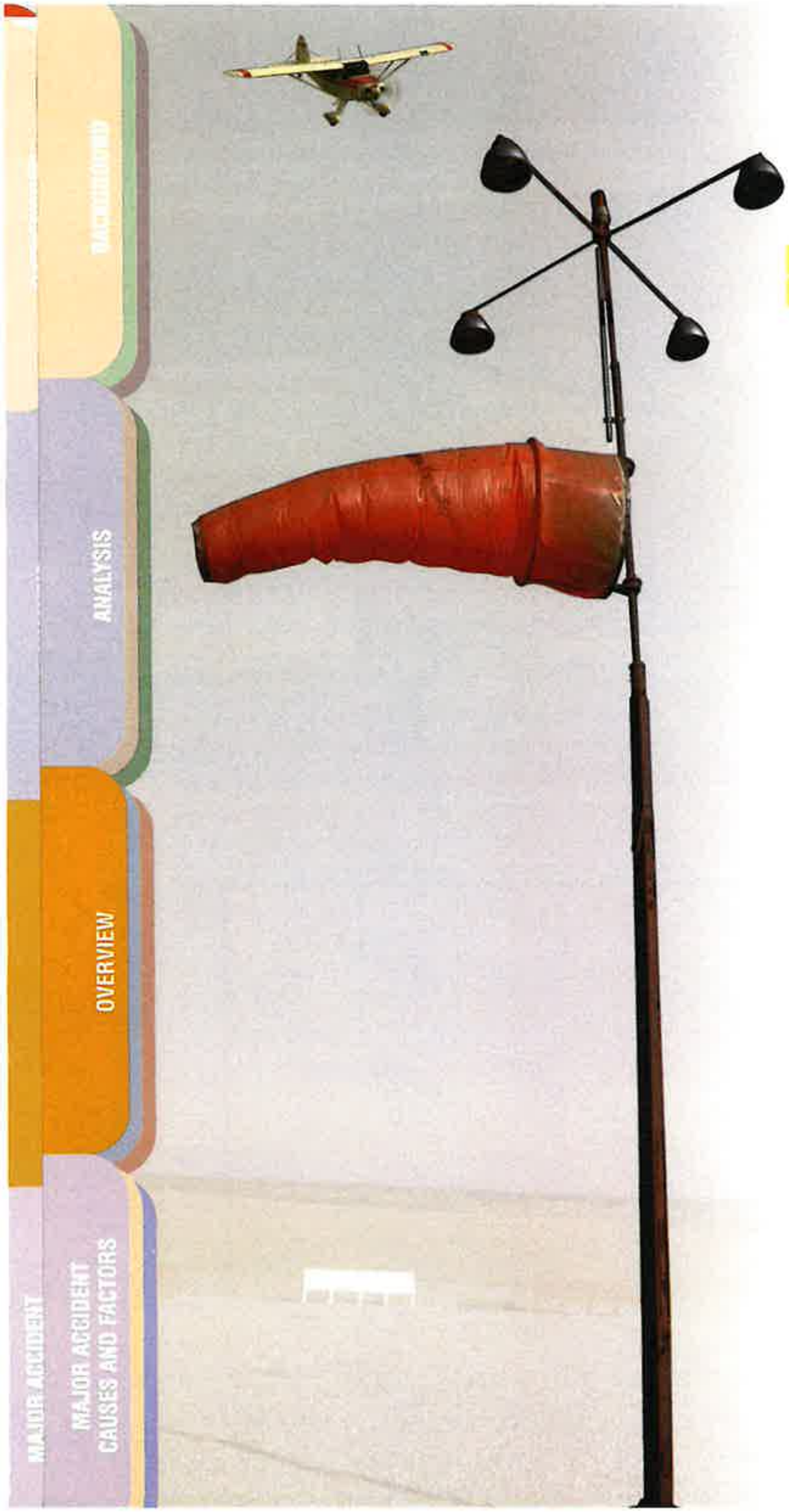


The general aviation accident statistics below are derived from NTSB reports on accidents involving fixed-wing aircraft weighing 12,500 pounds or less. It does not include accidents involving turbojet aircraft, helicopters, gliders, balloons, or aircraft used in 14 CFR 121 or 14 CFR 135 operations. Where possible, final reports that include probable causes and accident sequence of events were used. Preliminary reports without this valuable data had to be used for a small part (17.5 percent) of the accidents analyzed. Because fatal accidents typically take longer to investigate, approximately a third of them had only preliminary data available. This may cause some fluctuations in the data once final reports are completed.

Approximately 82.5 percent of the 1998 accident analyses conducted for this report were based upon the NTSB's final reports that included an assessment of probable cause. Of these, 25.8 percent also included sequence-of-events information. AOPA Air Safety Foundation analysts have classified all of the accidents into groups based on the problem that initiated the accident sequence and that has the most potential for accident prevention.

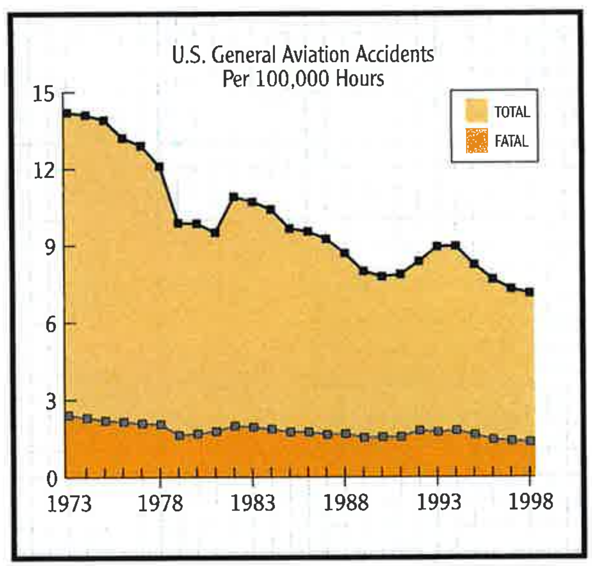
Flying hours are estimated by the FAA using statistical forecasting techniques and data from its General Aviation and Air Taxi Activity and Avionics Survey, which is distributed to a sample population of aircraft owners every year. The FAA estimates that general aviation flying hit a low point in 1994 but then rose slightly over the last four years.

| Accident Statistics<br>Past Eight Years | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|
| Total fixed-wing general aviation accidents | 1,897 | 1,837 | 1,808 | 1,741 | 1,853 | 1,781 | 1,642 | 1,679 |
| Fatal fixed-wing general aviation accidents | 394 | 407 | 360 | 354 | 383 | 355 | 331 | 341 |
| Total fixed-wing general aviation fatalities | 724 | 798 | 652 | 641 | 679 | 653 | 667 | 619 |
| Estimated general aviation flight hours | 27.2M | 24.8M | 22.8M | 22.2M | 24.9M | 24.9M | 25.5M | 26.8M |




## Accident Rate

The chart below shows that the overall accident rate per 100,000 flying hours for all general aviation aircraft has declined significantly over the past 25 years. However, the decline has slowed in the past 10 to 12 years, and the accident rate has remained relatively steady over the past three years. The fatal accident rate also has declined over those 25 years, remaining relatively constant over the past 16 to 17 years. 1998 had the lowest total accident rate and the lowest fatal accident rate since 1938, the first year for which such accident statistics were reported. There was a slight decrease in the number of fatal injuries in general aviation accidents from 1997 to 1998, and the fatality rate (fatalities per hours flown) continued in a slight downward trend from last year.




General aviation accident rates have always been higher than airline rates because general aviation involves risks that other operations do not share. Listed below are some of the important differences between GA and the airlines.

- Less regulation–GA pilots conduct a wider range of operations. Commercial and military operations have many inherent controls and extensive support structures.
- Wide variances in pilot qualifications and training – student pilot to ATP.
- Fewer cockpit resources–Air carrier operations require at least two pilots; GA operations are predominantly single pilot.
- More airports–GA flies to more than 15,000 landing facilities; the airlines serve only about 700. Many GA airports lack the precision approaches, long runways, and excellent lighting of airline-served airports.
- Many operations such as aerial application, banner towing, law enforcement, etc., have special mission–related risks.
- More takeoffs and landings per hour–the highest risk phases of any flight.
- More individual responsibility–GA aircraft pilots are responsible for the safety of their flight. There is no dispatcher or meteorologist to share the responsibility.

Although the freedom and flexibility of general aviation involve some additional risk, that risk does not guarantee an accident. Pilots who actively manage risk can improve their safety.

## Comparison with Other Years

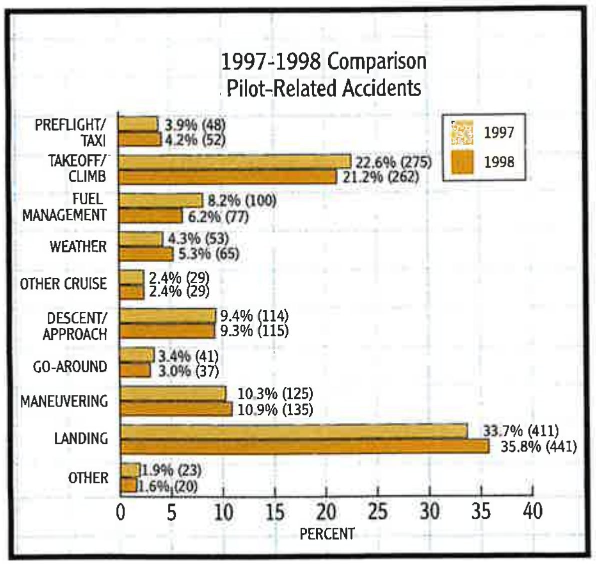
Were last year's statistics unique? In a word, no. The most common accident causes continue to be pilot-related. With a few minor exceptions, the majority of accidents in 1998 were due to the same causes, occurring at roughly the same rates, as over the past several years.

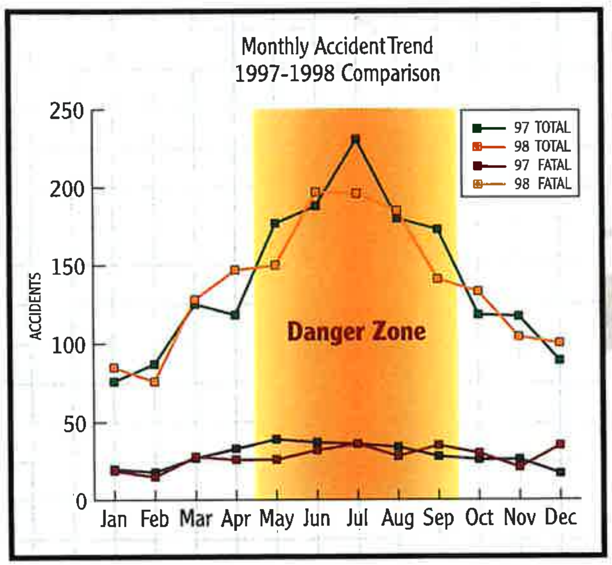
Care must be taken, too, when comparing this year's data with previous years. Over the past two years, the AOPA Air Safety Foundation has converted its Aviation Safety Database to incorporate the latest and most complete data available from the NTSB. This makes more final accident reports available for this year's analysis, but it has also changed some of the ways in which we categorize accidents. Weather-related accidents, for example, used to be lumped under the broad category of cruise-weather when there was less data available to characterize them. Now that more data is available for our analysis, more weather-related accidents can be found in the phase of flight where they occurred, such as takeoff or approach.

## Seasonal Trends

Total accident counts for 1998 were lower than those in seven months of 1997 and higher in five months of the year. The seasonal pattern of accidents in 1998 closely matched those of the previous year. In both 1997 and 1998, fatal accidents occurred at a relatively uniform rate throughout the year, while total accidents nearly doubled from May through September. The higher number of accidents during the spring and summer months were probably the result of the high concentration of flight hours during those months when the weather is better, daylight lasts longer, and more people take time for leisure.

The graph below compares trends in monthly accident rates and fatal accident rates for 1997 and 1998.



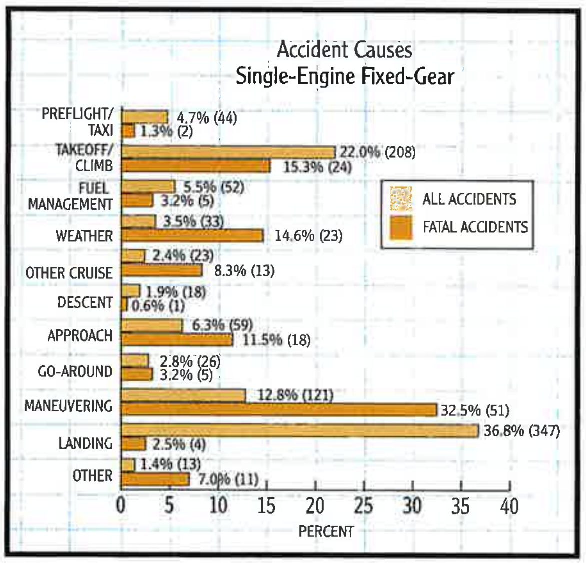



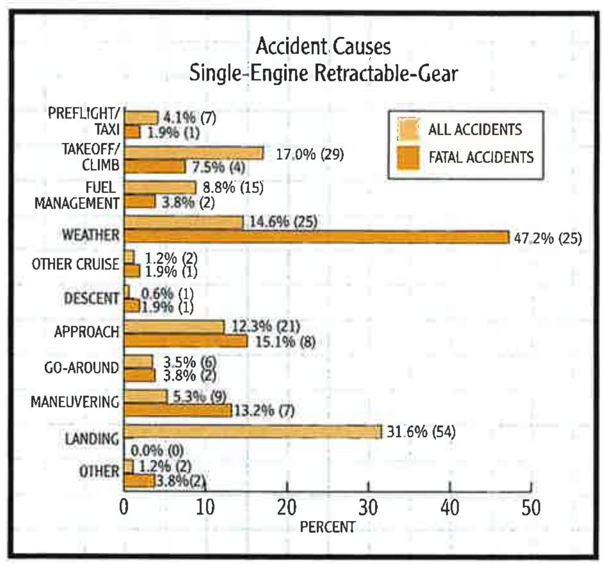


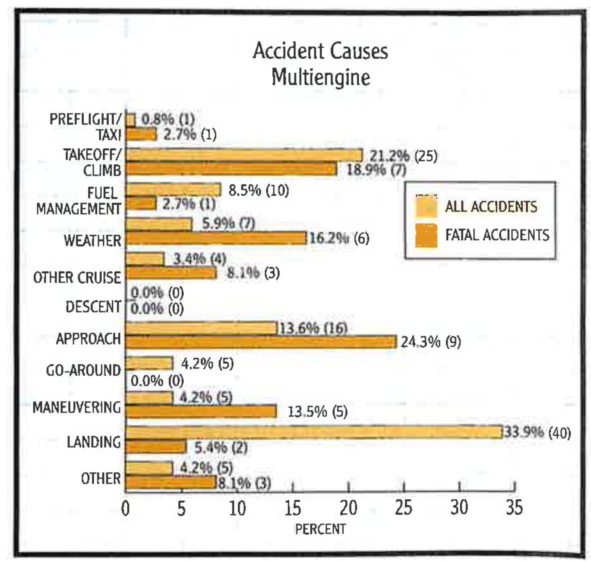
## Breakdown by Aircraft Class

In 1998, as in the past, the number of accidents in each class of aircraft tended to reflect the number of hours and types of operations flown in those aircraft. Individual differences in overall accident rates were more likely to be caused by differences in exposure to risk than by characteristics of the airplanes in which the accidents occurred.

For example, more accidents occurred in single-engine fixed-gear aircraft than in more complex aircraft, not because these aircraft are more dangerous, but because they are more common. Likewise, IFR weather-related and IFR approach accidents were more common in single-engine retractable-gear and multiengine airplanes than in single-engine fixed-gear aircraft because these types of operations are more common in the complex aircraft.



Differences in the complexity of aircraft should not be ignored. Air Safety Foundation studies have shown that low time in type is often a contributing factor in accidents. Transitioning to a new aircraft, even one that is simpler but different from the one the pilot usually flies, can cause problems, even for experienced pilots. Likewise, problems such as stalls during VFR approaches and attempts to continue VFR flight into instrument meteorological conditions (IMC) have affected pilots in all types of airplanes. Pilots never outgrow the need for basic airmanship.

## Some key points:

**Single-Engine Fixed-Gear Aircraft:** 1,262 Total/218 Fatal

- One-third (51) of the fatal accidents occurred during maneuvering flight.
- There was nearly one landing accident each day in this class of aircraft.

**Single-Engine Retractable-Gear Aircraft:** 258 Total/72 Fatal

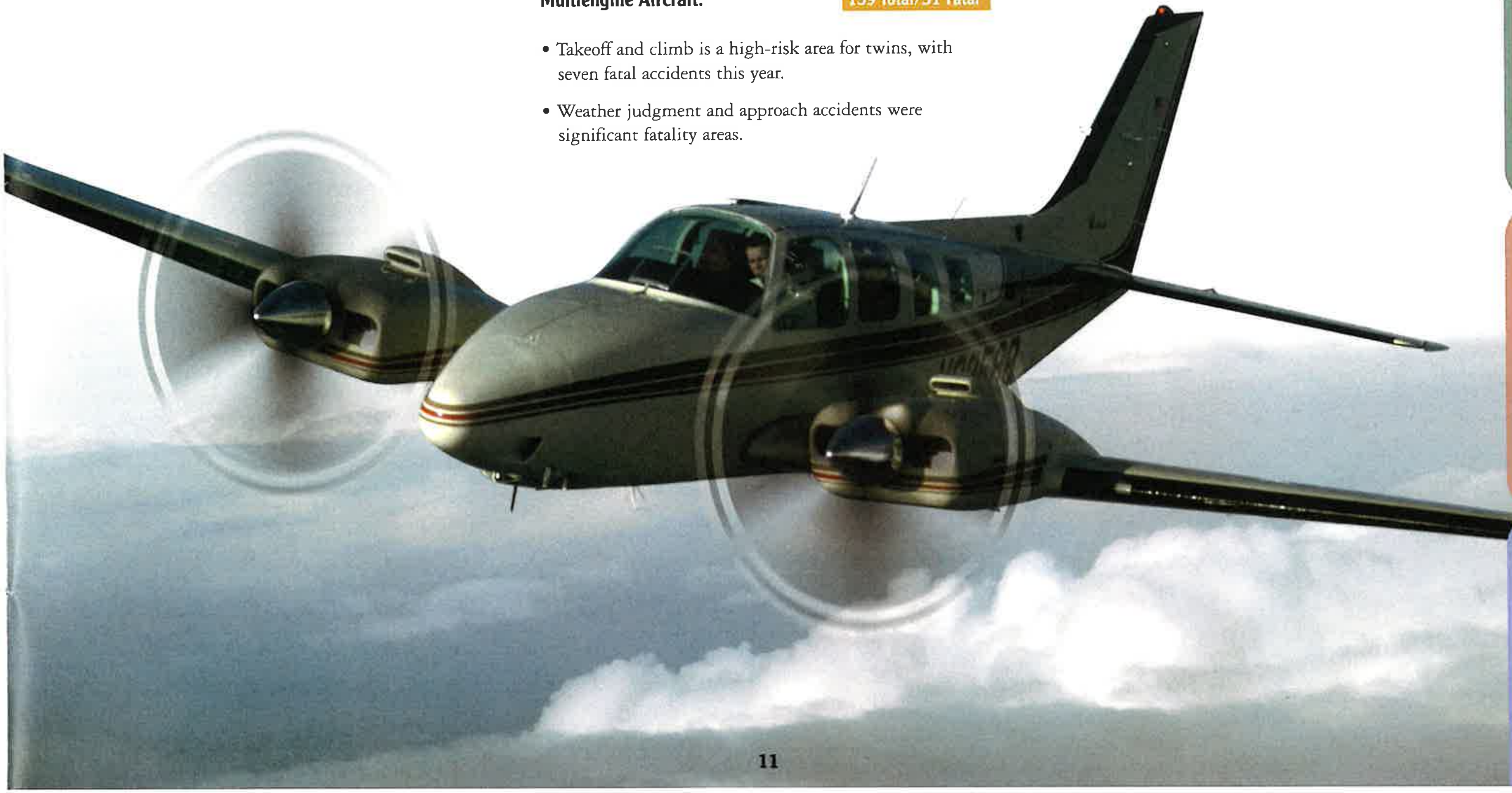
- Pilot judgment relating to weather is clearly the leading killer, with all 25 of these accidents being fatal this year.

**Multiengine Aircraft:** 159 Total/51 Fatal

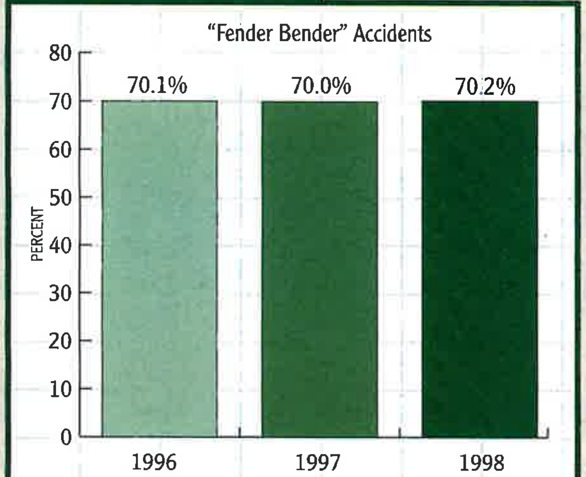
- Takeoff and climb is a high-risk area for twins, with seven fatal accidents this year.
- Weather judgment and approach accidents were significant fatality areas.

**The proper use of mishap experience is reducing mishap potential.**

- U.S. Air Force Guide to Mishap Investigation




## Quick Statistic




Percent of accidents with no serious injuries

# Major Accident Causes and Factors

### Summary of Significant Factors

Both total and fatal accident counts increased slightly during 1998 as compared to 1997, but the increase in the estimated number of hours flown was about twice as large. At the same time, the number of deaths decreased by over seven percent. However, trends in the causes of accidents showed little change from previous years. Seventy percent of all accidents are "fender benders" and result in little or no injury. As the graph shows, this trend remains level from year to year. The majority of accidents – 73.4 percent of all accidents and 72.4 percent of fatal accidents – were pilot-related. This number typically increases slightly when all final reports are tallied.

The following facts about the causes of accidents are worth remembering:

- [1] Takeoff and landing account for less than five percent of a typical cross-country flight, but 60.7 percent of the accidents for which the emergency phase of flight is known. The majority of these accidents were nonfatal. Only 15.6 percent of the fatal accidents occurred during takeoff while 3.1 percent of them occurred during landing.
- Weather-related accidents accounted for 21.9 percent of all fatal pilot-related accidents. In multiengine airplanes, 16.2 percent of fatal accidents were weather – related. For single-engine retractable-gear airplanes, the figure was a whopping 47.2 percent. Fatal accidents during instrument approaches added to this total. These figures are comparable to those for the past decade as reported in the AOPA Air Safety Foundation's Safety Review: General Aviation Weather Accidents.
- [2] Darkness increased the likelihood of having a weather-related accident. Fully 24.7 percent of the IMC accidents and 23.8 percent of the approach accidents happened at night. In addition, 66.7 percent of the instrument approach accidents happened at night. This is significantly higher than the average of 6.9 percent of all accidents that happened at night.
- Maneuvering flight accidents accounted for 25.5 percent of all fatal pilot-related accidents.
- Although only 43.5 percent of general aviation flight hours were logged on personal flights, these flights accounted for 68.8 percent of all accidents and 72.1 percent of all fatal accidents.

[1] Phase information was only available in 21.3 percent of the reports.

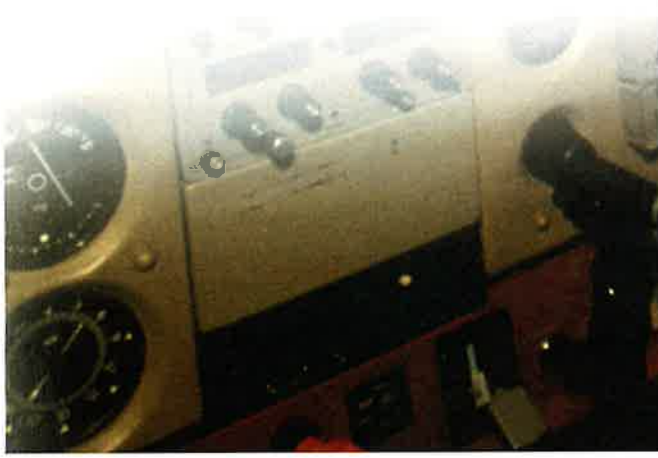
[2] Only 82.1 percent of the accidents included data on light conditions. When final reports are complete, light and phase information exceeds 95 percent.

## The Accident Setting - Phase of Flight

Studies conducted by the Boeing Commercial Aircraft Co. on commercial jet aircraft accidents have estimated that takeoff and landing each constitute only one percent of a typical flight. Initial climb adds another one percent, and final approach accounts for three percent. Cruising flight was estimated to account for sixty percent of a typical flight, with the remainder being distributed fairly evenly between climb to altitude, descent from altitude, and initial approach.

Detailed estimates like this are not available for general aviation flights, and because general aviation operates in different environments than airlines do, the exact percentages of time spent in each phase of flight are probably different. General aviation operations usually involve many more takeoffs and landings per flight hour than airlines. Instructors and students sometimes spend entire flight lessons in the traffic pattern. Nevertheless, the critical relationships between phases of flight remain basically the same. For both general aviation and commercial flights, takeoff and landing, although the most complex phases of flight, are a relatively small portion of the total flight time.

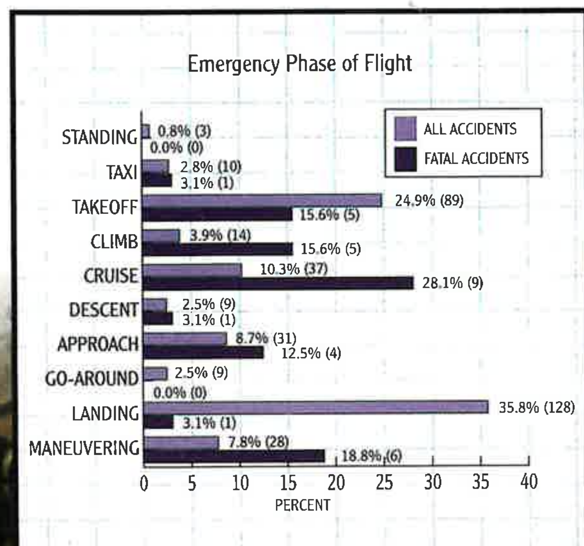
The majority of accident sequences begin during phases of flight that take up relatively little flight time but contain the highest number of critical tasks and the highest task complexity. Compare the proportions of accidents occurring in the takeoff, cruise, approach, and landing phases, and it is easy to see that there are significant hazards in the phases of flight that account for only a small portion of flight time.



The chart below classifies pilot-related accidents according to the phase of flight in which the situation that resulted in the accident began. For example, fuel exhaustion or an encounter with low weather may have caused the pilot to make a precautionary landing. Although the accident actually occurred during this landing, the "emergency phase" of flight would be cruise.

One phase in which accident proportions in general aviation consistently differ from commercial flying is in cruise. Weather is usually the culprit in these situations where more GA pilots fall victim to VFR flight into instrument meteorological conditions.

Although an examination of all causes may explain any one accident more completely, use of a single classification for each accident based upon the problems that initiated the accident chain helps to identify predominant factors when summarizing a large number of accidents. This is a technique frequently used in analyses of both general aviation and commercial aviation accidents. The emphasis here is on discussing strategies to help pilots avoid the problems that often begin accident sequences.




# Pilot Involvement

## Specific Pilot-Related Causes 1,233 Total/247 Fatal

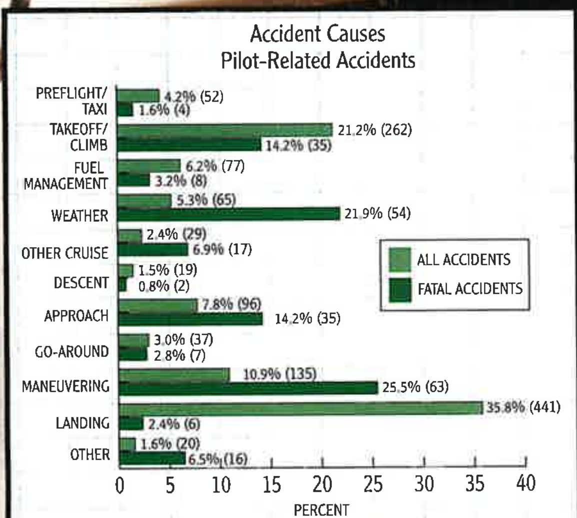
The chart at the lower left compares accidents where the major cause was attributed to the pilot. Although there is some overlap in the terms used to describe the phase in which the emergency occurred and the cause, the two are not always equivalent. For example, fuel exhaustion may have occurred during cruising flight or during a landing approach, resulting in an accident. The cause of the accident is then attributed to fuel management, and the phase of flight is listed as approach or cruise. Conversely, problems peculiar to approach operations, such as descending below the minimum descent altitude, will show approach as both the phase of flight and the cause.

## Analysis of Specific Operations

The accident potential of an individual flight can be highly dependent on the weather conditions, the length of the flight, the time of day, and how important the pilot perceives the flight to be. The purpose of the flight is referred to as "type of operation." Because the factors cited above often vary according to the type of operation, the following sections focus on three of the most common general aviation operations: personal flying, flight instruction, and business flying. The table below shows how those categories compare to other types of operations.

## Personal Flying 1,155 Total/246 Fatal

Personal flying comprises 43.5 percent of all general aviation flight – by far the largest single type of operation. For 1998, as in previous years, accidents during these operations represented an even larger proportion of the total accident picture, accounting for 68.8 percent of all accidents and 72.1 percent of fatal accidents.




| Operation | Percent of Flying (1997) | Percent of Total Accidents (1998) | Percent of Fatal Accidents (1998) |
|---|---|---|---|
| Personal | 43.5 | 68.8 | 72.1 |
| Instructional | 22.0 | 13.4 | 5.6 |
| Aerial Application | 6.5 | 6.6 | 1.8 |
| Business | 13.2 | 2.8 | 4.1 |
| Positioning | * | 1.7 | 2.9 |
| Ferry | * | 1.3 | 2.3 |
| Public Use | 1.8 | 0.8 | 1.5 |
| Other Work Use | 0.6 | 0.7 | 0.9 |
| Aerial Observation | 4.7 | 0.5 | 1.5 |
| Executive/Corporate | 5.0 | 0.2 | 0.0 |
| Other/Unknown | 2.9 | 3.4 | 7.3 |

* Included in "Other/Unknown"

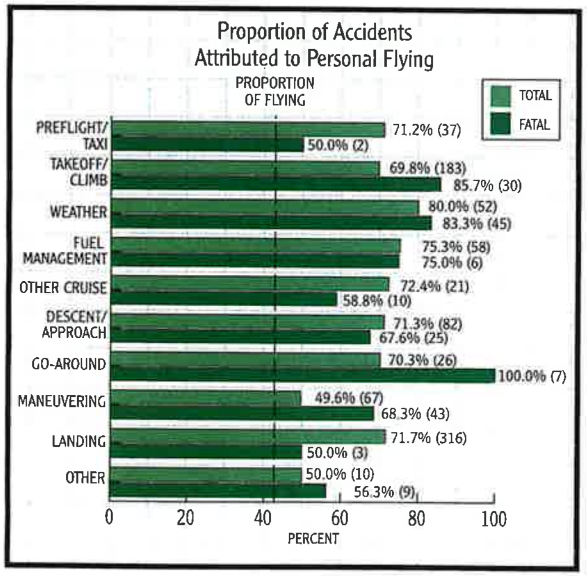
The chart below shows the proportion of accidents due to a particular cause that occurred during personal flights. The reference line shows the 43.5 percent mark – the point at which the percentage of accidents in each category would be equivalent to the percentage of total flight time spent in personal flights. Bars representing individual causes that extend beyond this line indicate that the accidents in that cause category accounted for more than the personal flying "share" of total accidents. Personal flights resulted in far more than their "share" of accidents from all causes.

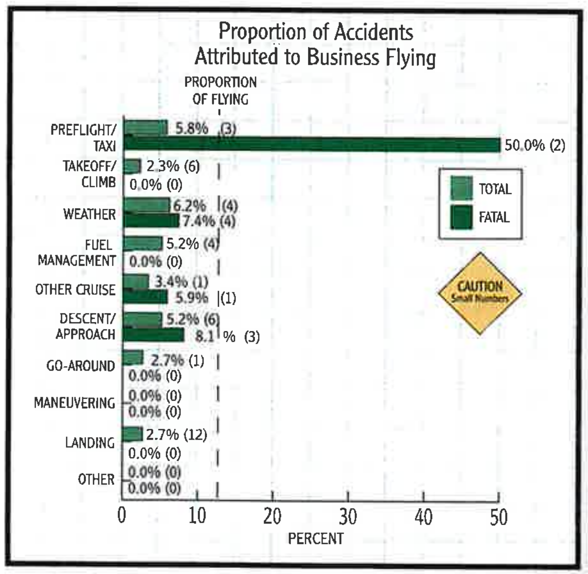
## Business Flying

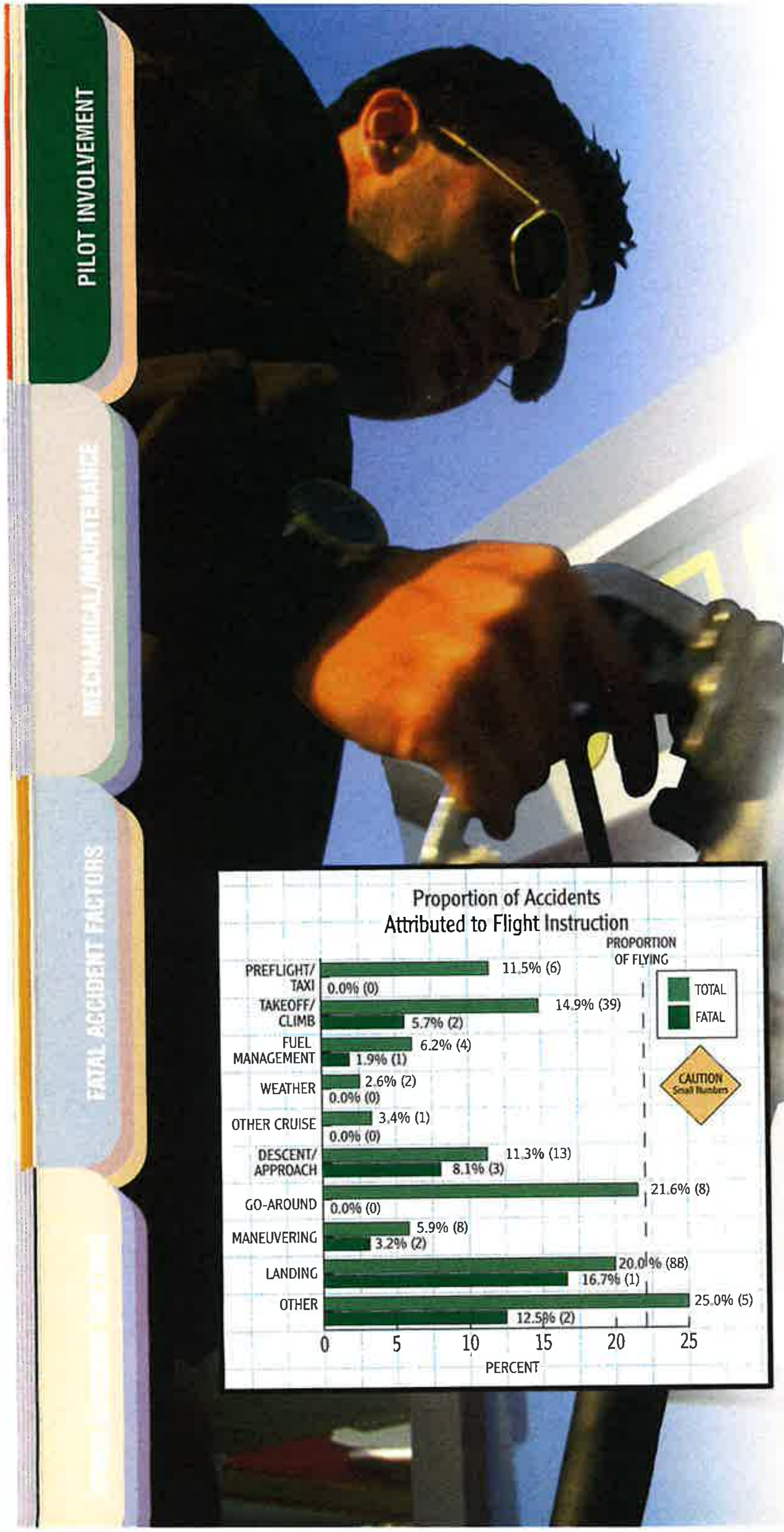
**47 Total/14 Fatal**

The ability to use an airplane gives many business travelers a flexible, economical way to travel on their own schedules. It also allows them to reach destinations that are difficult or impossible to reach via airlines or other modes of travel. Business flights accounted for only 2.8 percent of the total and 4.1 percent of the fatal accidents in 1998 while accounting for 13.2 percent of all general aviation flight hours.

The adjacent chart shows the phases of flight where pilots made mistakes on business travel flights. The reference line at 13.2 percent may be used in the same manner as described above under "Personal Flying." For 1998, all causal areas of business flight accidents were lower than the proportion of business flying hours to total flying hours, except for accidents during preflight/taxi. This particular statistic should be used with caution, however, because of the extremely small number of fatal accidents that took place during preflight/taxi. General aviation saw a total of only four fatal preflight/taxi accidents in 1998, and two of those occurred during business flights. Business flying has a very good safety record.




## Instructional Flying

**225 Total/19 Fatal**

The proportion of total accidents attributed to instructional flying showed a slight decrease in accidents in 1998 over previous years. Flight training accounted for 13.4 percent of the accidents in 1998 as compared to 14.1 percent in 1997. The proportion of fatal accidents suffered during instructional flights remained virtually unchanged with 5.7 percent in 1997 to 5.6 percent in 1998. These figures are still well below the 22 percent of the flying done for instructional purposes. It is difficult to make meaningful generalizations with a small number of accidents, but some interesting facts are worth mentioning.

# Trends

## Significant points include:

- Instructional flights accounted for 39 (14.9 percent) of the 262 total takeoff/climb accidents in all types of operations. In 24 of these cases, the accident occurred during a dual flight. Fatalities were suffered in only two of these accidents, one dual and one solo.
- Stalls/spins accounted for nine instructional accidents, but fortunately they resulted in only one serious and five minor injuries. Only two accidents were listed as a stall/spin, the one with the serious injury and one other with a minor injury. The former was on a solo flight while the latter was on a dual flight. All the others only cited a stall with one stall/mush. Three of these accidents occurred during solo training flights while the other six occurred on dual flights.
- Engine failure for mechanical/maintenance reasons accounted for 11 accidents. Another 10 accidents resulted from engine failures due to unknown reasons.
- Fuel mismanagement was a causal factor in nine accidents, resulting in three minor injuries. Three of these accidents, including the two with minor injuries, were during dual flights. None of the six solo fuel mismanagement accidents caused any injuries.
- Instructional activity included eight go-around accidents, six during dual flights and two during solo flights. Instructors must ensure that their students are prepared to go around before situations deteriorate beyond recovery. During dual flights, they must also intervene while a safe recovery can still be affected.

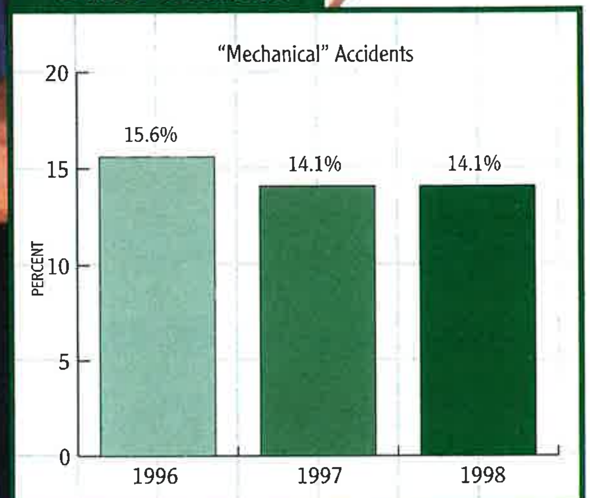
The number of instructional accidents is small, so percentage changes must be interpreted carefully. Some changes in instructional accident trends from 1997 include:

- Proportions of accidents attributable to flight instruction in all operational areas except "other/misc." were below the proportion of total flight hours estimated for flight instruction activity.
- The proportion of pre-flight/taxi accidents attributable to flight instruction fell by 5.2 percent, with no fatalities in this area in either year.
- The proportion of fatal takeoff/climb accidents attributable to flight instruction fell by 7.1 percent. The total proportion of these accidents attributable to flight instruction remained almost unchanged.
- The proportion of descent/approach accidents attributable to flight instruction rose by 4.3 percent while the fatal proportion rose 4.8 percent.
- The proportion of landing accidents attributable to flight instruction dropped by 2.2 percent, while the fatal proportion rose by 5.6 percent.
- Go-around accidents, a high area in 1997, dropped 10.1 percent.
- The maneuvering accident proportion was virtually unchanged from 1997.
- The proportion of fuel management accidents attributable to flight instruction fell by 11.9 percent, still with no fatalities.

# A Word to the Flight Instructor

Studies by a number of researchers have shown that there is a strong association between errors in decision-making and the severity of accidents. While simpler skill problems produce minor injuries and damage, faulty decision-making processes often result in accidents with serious injuries and fatalities. Flight instruction is one of the safest of general aviation activities. CFIs must ensure that their students do not become victims of "substitution risk," where risks in training are minimized but "substituted" with greater risks in later flying. While everyone wants to keep instructional risk as low as possible, the difference between effective instruction and accidents later in the student's career as a pilot is often measured in the time spent relating abstract theory to practical application. This can range from ground instruction in aeronautical decision-making to controlled exposure to challenging flight conditions. In 1996, we cited a conclusion from a study done by Ohio State University regarding weather-related instruction. It bears repeating: "Training programs which relegate weather to a minimum percent of instructional time must begin to realize that cognitive, rather than stick and rudder errors initiate general aviation fatalities." Pilots should understand weather theory but, more importantly, they must be able to apply their knowledge.

## Quick Statistic



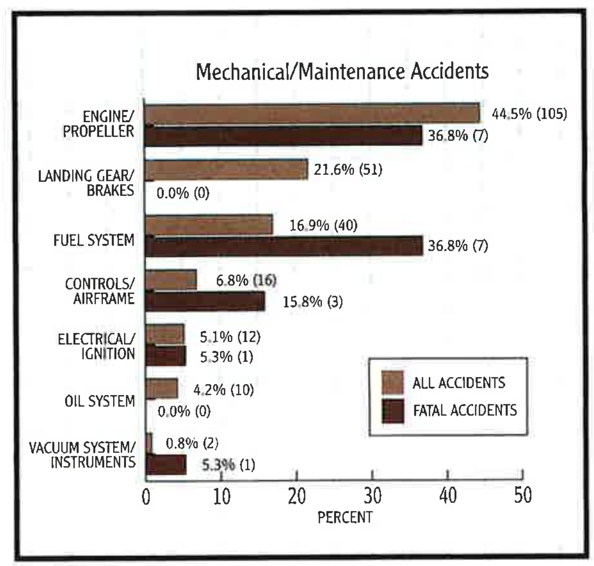

Percent of accidents attributed to mechanical/maintenance problems

## Mechanical/Maintenance

**236 Total/19 Fatal**

There were 236 mechanical/maintenance accidents in 1998, with 19 of them resulting in fatalities. Mechanical/maintenance factors accounted for 14.1 percent of all accidents and 5.6 percent of fatal accidents. This is almost identical to last year's results. By far, the largest percentage of these accidents was the result of powerplant or propeller problems. In addition, 23 other accidents were classified as "power malfunction/loss for unknown reasons" because only preliminary reports were available for them. Although it is probable that some of these accidents will be classified to pilot-related causes, such as fuel mismanagement, once their investigations are complete, some may be confirmed as being mechanical once the mechanical components are analyzed. Thus, the final count of mechanical/maintenance problems may change when the final reports are in.

Several of the mechanical-failure accidents could have been prevented by a thorough preflight.



# Fatal Accident Factors

Based upon the probability of fatalities, the primary causes of fatal accidents across all classes of airplanes for 1998 were:

- Weather
- Maneuvering Flight
- Approaches

As in the past, the causes of fatal accidents were closely linked to the flight profile, including the length of the trip, the time of day, the purpose of the trip, and whether the flight was IFR or VFR.

Although some classes of aircraft were more likely to be involved in specific types of serious accidents, the accidents were not generally caused by characteristics of aircraft involved. For instance, multiengine and single-engine retractable-gear airplanes were involved in a high proportion of IFR accidents, corresponding to the fact that these complex airplanes were more likely to be flown under instrument rules than fixed-gear aircraft.

At the same time, single-engine fixed-gear airplanes were involved in a high proportion of accidents in VFR conditions. Significantly, almost all types of accidents occurred in all classes of airplanes. Good airmanship principles are not class-specific.

### Severity - Probability of Fatalities

The likelihood that a given accident will be fatal can be estimated by comparing the number of total accidents to the number of fatal accidents under the same set of circumstances. Regardless of the cause, however, accidents in single-engine retractable-gear aircraft were more likely to be fatal than those in single-engine fixed-gear aircraft. The fatality rate for multiengine airplanes was even higher. This was most likely the result of higher speeds at impact.

- Weather: Weather-related accidents were more likely to be fatal than accidents with any other cause. Fully 83.1 percent, or 54 out of 65 weather-related accidents, involved fatalities. Most weather-related accidents involved aircraft striking objects or terrain at high airspeed or crashing out of control, sometimes after pilot-induced structural failure.
- Maneuvering Flight: Slightly less than half of all accidents during maneuvering flight (63 of 135 accidents, or 46.7 percent) involved fatalities. Like weather accidents, maneuvering accidents frequently involved aircraft crashing out of control or colliding with terrain, wires, or other structures.
- Approach: Thirty-five of 96, or 36.5 percent, of all approach accidents produced fatalities. Aside from hitting wires/trees, etc., "improper IFR approach" was one of the largest single problems in this area, adding another dimension to the weather-related accident count.

While only 13.4 percent of accidents attributed to takeoff or initial climb-out were fatal, takeoff errors caused 35 fatal accidents, exactly the same number as for approach problems. The low fatality rate was due to the large number of nonfatal takeoff accidents – 227 of 262 total takeoff accidents did not involve fatalities. Takeoff accidents involving loss of control on the runway at relatively low speeds kept the fatality rate down while producing a large number of total accidents.

## Weather

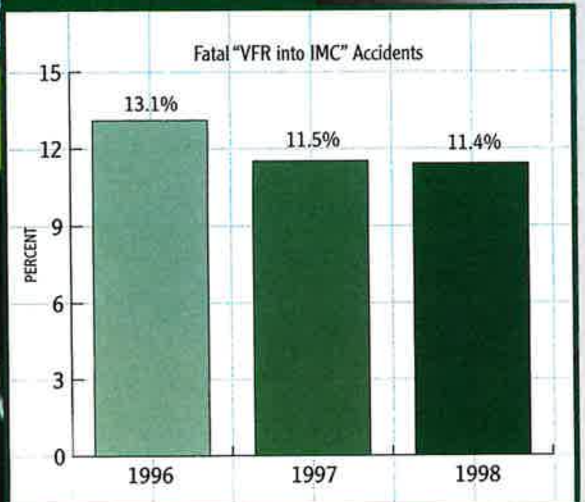
**65 Total/54 Fatal**

With an overall fatality rate of 83.1 percent, weather accidents remain the deadliest of all. Most accidents involving weather were the result of controlled flight into terrain or other objects, spatial disorientation leading to uncontrolled flight, or pilot-induced structural failure of the aircraft.

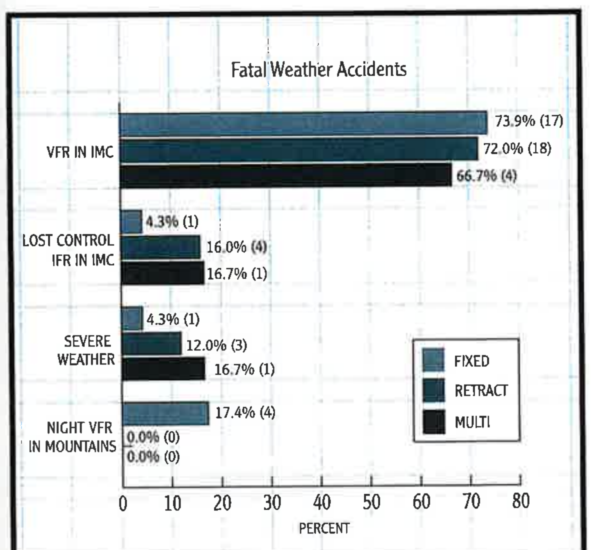
Some accidents attributed to other causes involved weather as a contributing factor, as in the case of improper IFR approach, which was responsible for 11 fatal approach accidents. Wind shear and crosswinds also caused weather-related accidents in VFR conditions.

Thirty-nine of the 54 fatal weather-related accidents, or 72.2 percent, were caused by "attempted VFR flight into instrument meteorological conditions (IMC)." Seventeen of the 23 fatal weather-related accidents in single-engine fixed-gear aircraft (73.9 percent) were in this category. All 25 weather-related accidents in retractable-gear single-engine airplanes were fatal, with 18 of them (72 percent) attributed to "attempted VFR flight into instrument meteorological conditions (IMC)." Six of the seven weather-related accidents in multiengine airplanes were fatal, with two-thirds (four) of them attributed to this same problem area. VFR flight into IMC continued to be one of the most frequent causes of fatal accidents, leading one to the question, "What is it about the fact that they can no longer see the ground that pilots don't understand?" Because so many of these accidents were fatal, there are few surviving pilots to answer the question. Continued VFR into IMC is an area that needs more study and pilots need to understand the extreme risk better. The AOPA Air Safety Foundation has published the Safety Review: General Aviation Weather Accidents, which offers detail and analysis of weather accidents.

Quick Statistic




Percent of fatal accidents caused by VFR into IMC




## Interaction of Night and Weather

The table on the next page shows total and fatal accidents in various light and basic weather conditions. Considering that 20.3 percent of all accidents resulted in fatalities, it is evident that accidents in VMC at night were more lethal than accidents in VMC during the day. Twenty-four percent of the night VMC accidents were fatal as compared to 11.4 percent of the day VMC accidents. While the percentage of accidents that resulted in fatalities during night VMC was double that of accidents during day VMC, the addition of instrument weather conditions significantly magnified the lethality of general aviation accidents. 63.8 percent of the day IMC accidents involved fatalities and 68.4 percent of the night IMC accidents were fatal. Thus, accidents in IMC at night were nearly three times as fatal as those in VMC at night, and accidents in IMC during the day were nearly six times as fatal as those in VMC during the day. The combination of night and IMC proved to be the most lethal, more than tripling the overall fatal accident percentage.

It should be clear from this data that risk increases at night but that weather has an even stronger effect at any time of day. Pilots must analyze weather before the flight and continue to evaluate their situation during the flight. While darkness does increase risk, well-planned night VFR flights need not be hazardous. However, a significantly higher attention to preflight and in-flight decision-making is necessary. VFR pilots must ensure that they remain in good VFR conditions.

The chart at the lower right shows the interaction between night and IMC. The dashed lines show the total and fatal accidents per 100,000 hours for those accidents where weather and light conditions were reported. Bars extending above these reference lines indicate a higher than average accident rate under the indicated conditions. The data show that IMC flight produced approximately 19.7 percent fewer total accidents per 100,000 hours but over four (4.3) times the rate of fatal accidents as visual meteorological conditions (VMC). Information on light or weather conditions was not included in 18.5 percent of the NTSB's accident reports for 1998 and in 39.3 percent of the reports on fatal accidents. When the final reports can be tallied, we expect that night IMC statistics will prove to be worse than shown here.

## Spatial Disorientation

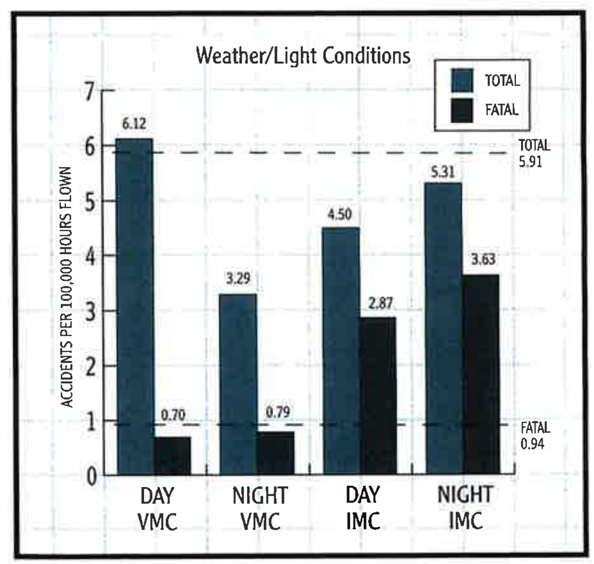
Spatial disorientation occurs when a pilot is deprived of visual references to determine the aircraft's orientation in three-dimensional space. Any conditions which deprive the pilot of natural, visual references to maintain orientation, such as clouds, fog, haze, darkness, or terrain/sky backgrounds with indistinct contrast (such as arctic whiteout or clear, moonless skies over water) can rapidly bring about spatial disorientation. Without a means of controlling the airplane with reference to the earth's surface, loss of control is imminent. The only preventive measure is to rely on references based on the aircraft's instruments. The aircraft must be adequately equipped and maintained and the pilot must be sufficiently trained to fly solely by reference to instruments.

In 1998, six accidents contained specific references to spatial disorientation in the sequence of events or narrative sections of their reports. This number is, however, what statisticians call a "lower bound" on the true number of accidents in which spatial disorientation was a significant factor. The conditions surrounding a number of other weather-related accidents suggest that spatial disorientation might have been contributory there as well.

A detailed analysis of accidents over a ten-year period (1987-1996) with an emphasis on spatial disorientation as a cause or significant contributory factor reveals a much higher involvement of this factor than suggested by the direct references in the 1998 reports. During this period, there was an average of almost 37.6 accidents per year, of which 33.9 were fatal. At this rate, there is one fatal spatial disorientation accident every eleven days. Over 90 percent of all the accidents during this time in which spatial disorientation was a factor resulted in fatalities.

Typically, these accidents are suffered by noninstrument-rated pilots attempting to complete VFR flights in instrument meteorological conditions. At least one accident in 1998, however, occurred when an experienced instrument-rated pilot in a well-equipped turbine-powered airplane became disoriented during the visual portion of a circling IFR approach. In this case, a moonless night exacerbated the weather conditions.

| Conditions | Total | Fatal | Percent Fatal |
|---|---|---|---|
| All | 1,679 | 341 | 20.3% |
| Day VMC | 1,216 | 139 | 11.4% |
| Night VMC | 75 | 18 | 24.0% |
| Day IMC | 58 | 37 | 63.8% |
| Night IMC | 19 | 13 | 68.4% |



## Maneuvering Flight

**135 Total/63 Fatal**

Maneuvering flight in single-engine airplanes continues to be one of the largest producers of fatal accidents. It is also one of the most preventable. Twenty of 58, or 34.5 percent, of fatal maneuvering accidents in these airplanes were the result of "maneuvering during low, slow flight." Twenty-nine of the 58 (50 percent) fatal maneuvering accidents in single-engine airplanes were attributed to "loss of control." Three of the five fatal maneuvering accidents in multiengine airplanes were due to this cause.

Some of these accidents occurred during legitimate activities such as aerial applications, banner towing, and law enforcement. These operations require low, slow flight and considerable mission-related division of attention. In operations where there is a mission beyond just operating the aircraft, the task demands of the mission and the task demands of flying can reach extremes simultaneously, severely taxing the pilot's capability. These operations carry some inherent risk and demand skill and vigilance from the pilot.

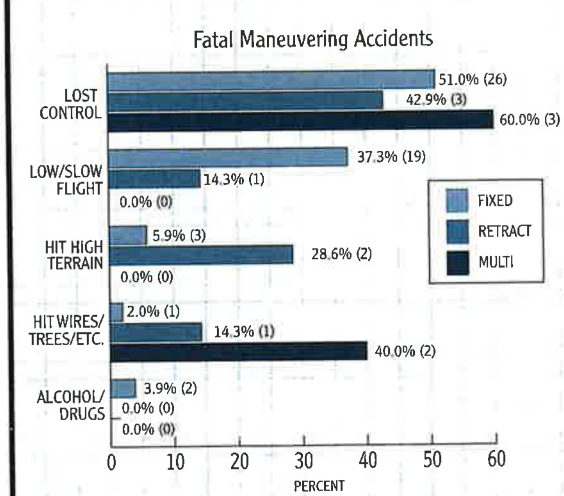
More often than not, maneuvering accidents occurred during personal, not mission-related, flights. In fact, 49.6 percent of all maneuvering accidents and 68.3 percent of fatal maneuvering accidents occurred during flights described as personal.

A few of these accidents were the result of inadvertent loss of control by pilots performing common operations. Some, however, occurred during buzzing or low-level aerobatics. Many involved a degree of recklessness that makes it difficult to term them "accidents" in a true sense. No increase in proficiency can prevent such accidents. Only a change in attitude on the part of the pilots involved can reduce the problem. Such antics are not the mark of a skilled pilot – only a potentially dead one.

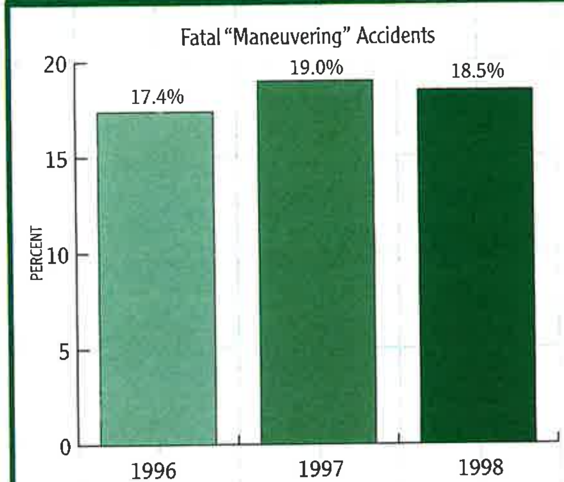
## Approach

**96 Total/35 Fatal**

Accidents resulting from mishandled approaches, although low in number, were fatal 36.5 percent of the time. Most problems were the result of stall/mush or failure to follow instrument approach procedures.




### Quick Statistic

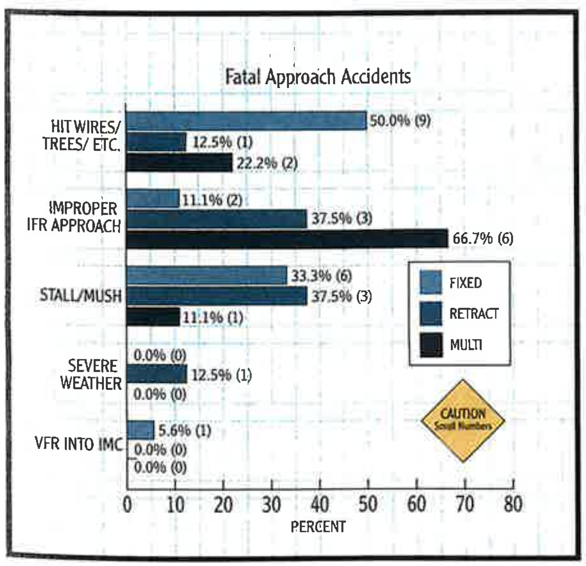



Percent of fatal accidents during maneuvering flight

All classes of aircraft were represented in both of these problem areas. To prevent these accidents, pilots must build and maintain their instrument skills. Train and stay current!

Fatal instrument approach accidents involved six multi-engine, three retractable single-engine, and two fixed-gear single-engine airplanes. Instrument pilots must perform complex tasks after flying for long periods in bad weather. This was a significant factor, especially in single-pilot operations.

Studies conducted by NASA and the FAA for the airlines have shown that takeoff/initial climb and approach/landing phases of flight are the most demanding. These studies have also shown that pilot capabilities erode throughout the flight from the combined effects of fatigue and complacency after an uneventful flight. The most demanding tasks must be performed when the pilot's ability to accomplish complex tasks may be significantly diminished.



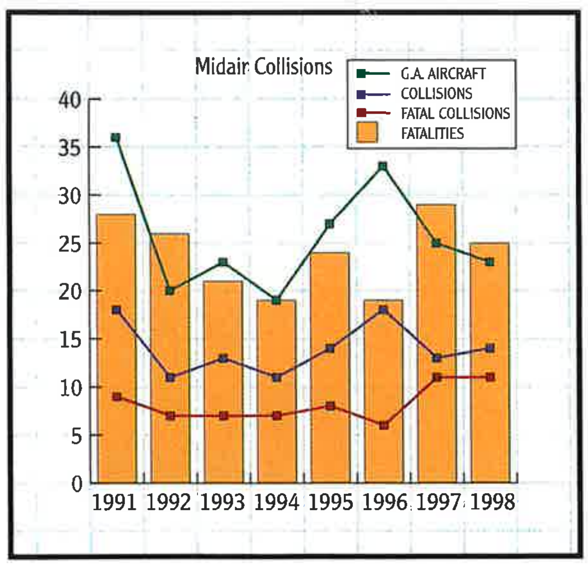

## Other Accident Factors

### Midair Collisions

**14 Total/11 Fatal**

During 1998 there were 14 midair collisions involving a total of 23 general aviation aircraft. Eleven of these accidents were fatal, resulting in 25 deaths. The number of midair collisions involving GA airplanes was nearly the same as the 13 in 1997, and the number of fatal accidents remained the same at 11. The number of deaths fell from 29 to 25. Midair collisions continued to occur mainly on good VFR days, at low altitude, close to airports. The graph shows the trend in these accidents over the past eight years.

A recent AOPA Air Safety Foundation study of midair collisions revealed that 49 percent of them occurred in the traffic pattern or on approach to or departure from an airport. Of the other 51 percent, about half occurred during en route climb, cruise, or descent, and the rest resulted from formation flights or other hazardous activities. Eighty percent of the midair collisions that occurred during "normal" flight activities happened within 10 miles of an airport, and 78 percent of the midair collisions that occurred around the traffic pattern happened at nontowered airports. Important strategies for avoiding these mishaps can be found in the Foundation's Safety Advisor: Operations at Nontowered Airports (www.aopa.org/asf/publications/sa08.html).




### Alcohol and Drugs

**2 Total/1 Fatal**

In 1998, only two accidents were found to involve alcohol and drug use by pilots. It is clear that other factors were also involved in both of these accidents. Although the NTSB had finalized 82.5 percent of the accident investigations by the time we analyzed them for this report, a significant part of the other 17.5 percent may also involve pilot impairment. Such information takes time to develop from pathological studies and could add to this number. Past history shows that typically less than one percent (about 20) general aviation accidents involve alcohol or drugs each year.

In one accident, an unlicensed pilot lost control of a small, unregistered experimental airplane and was killed. The pilot's blood was found to contain a significant amount of an over-the-counter medication that is known to cause drowsiness.

In another accident, a pilot-rated passenger unexpectedly took control of a Cessna 337 twin from its pilot during the landing rollout and initiated a takeoff, resulting in a loss of control. An accident occurred with one serious and two minor injuries. The passenger was found to be impaired by alcohol.

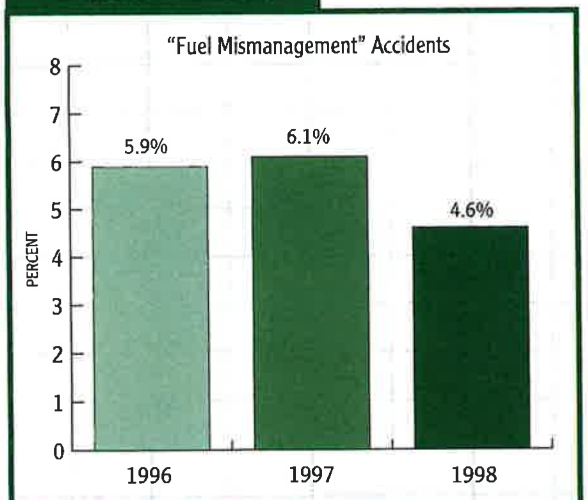
### Fuel Mismanagement

**136 Total/9 Fatal**

Fuel exhaustion is engine stoppage due to the depletion of all available fuel on board the airplane. Fuel starvation is engine stoppage due to an interruption of the fuel supply to the engine, even though fuel remains available in the tanks. In 1998, there were 95 accidents caused by fuel exhaustion, of which seven were fatal, resulting in 13 deaths. Another 29 accidents occurred because of fuel starvation. None of these accidents were fatal. Another 12 accidents were attributed to fuel contamination, a condition that also contributed to some of the fuel starvation accidents. Two of these accidents were fatal, with one fatality in each. ASF recommends a minimum fuel reserve of at least one hour for both VFR and IFR operations.

Knowledge of aircraft performance, realistic preflight fuel planning, and diligent monitoring of fuel consumption and flight time would prevent nearly all fuel exhaustion accidents. Likewise, a thorough knowledge of aircraft systems and a disciplined approach to fuel management are antidotes to most fuel starvation problems.

**Quick Statistic**




Percent of accidents attributed to fuel mismanagement.

### Off-Airport Injuries

**7 Accidents/2 Fatal**
**3 Fatalities/7 Minor Injuries**

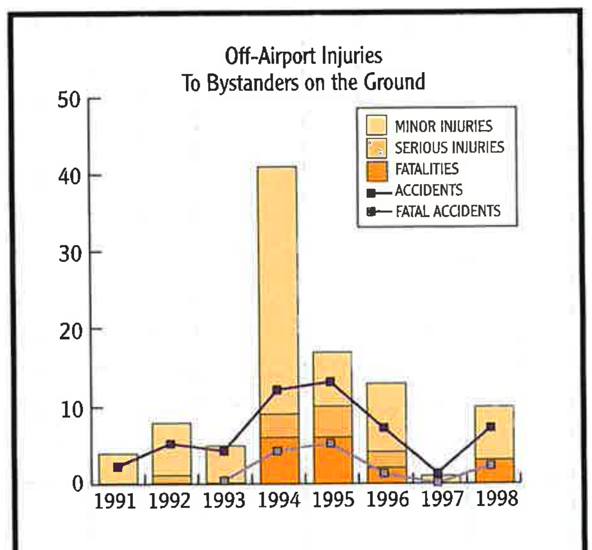
One of the myths surrounding general aviation is the perceived danger of light aircraft falling from the sky. In 1998, three bystanders were fatally injured during off-airport general aviation aircraft accidents. Seven other bystanders received minor injuries throughout this year. This is up from 1997, when only one person suffered a minor injury during an off-airport general aviation aircraft accident. In 1996, bystanders suffered two fatalities, two serious injuries, and nine minor injuries during off-airport general aviation aircraft accidents.

### Pilot Incapacitation

**3 Total/2 Fatal**

Three accidents occurred in 1998 due to pilot incapacitation resulting in three fatalities and one serious injury. These numbers may increase slightly when the final reports are in but incapacitation remains a small portion of the accident picture.

In one accident, the pilot of an Extra 300 suffered serious injuries following an accident due to G-induced unconsciousness during aerobatic flight.




In another mishap, a pilot suffered a fatal heart attack in flight. The pilot's 81-year-old nonpilot passenger successfully landed the airplane with the assistance of a commercial pilot in another airplane. The airplane was substantially damaged but the passenger was not injured.

Another pilot and passenger were killed after the pilot apparently succumbed to carbon monoxide poisoning due to an improperly maintained exhaust system. This accident was complicated by the fact that that the relatively inexperienced (75 total flight hours) non-instrument-rated pilot attempted VFR flight on a dark night in instrument meteorological conditions.

### Propeller Strike Injuries

**7 Total/4 Fatal**

Seven pilots/passengers were struck by turning propellers during 1998. Four people were killed, and three were seriously injured. These accidents were a combination of pilots attempting to prop-start airplanes (other than those designed without starters), and people in the ramp area inadvertently coming into contact with moving propellers. This continues to be an area where a small, but consistent, number of serious injuries and fatalities occur. Pilots, flight schools, and FBOs must ensure that propeller safety is included in their training and safety programs.

This problem is also not confined entirely to general aviation. In 1998, an otherwise fatality-free year for the airlines, a ramp worker was killed by the propeller of a turboprop regional airliner.

**Carelessness and overconfidence are usually more dangerous than deliberately accepted risks.**

- Wilbur Wright, 1901

## Homebuilt Aircraft

**199 Total/54 Fatal**

Building an airplane can be a satisfying, rewarding experience. It can also give the builder access to technological advances not yet available in factory-built aircraft. In order to take advantage of these advances, however, the builder assumes many of the same responsibilities met by the engineering, flight test, and production departments of a major manufacturer. The builder, with relatively minimal oversight, is responsible for construction, quality control, initial flight testing, and, in some cases, even basic design. The conscientious builder can avoid most of the risks this generates with careful planning.

Remember the following key points when making decisions regarding homebuilt airplanes:

### Design

- Adhere to the manufacturer's plans or kit instructions.
- Know whether the aircraft qualifies as an ultralight vehicle or a homebuilt airplane.

### Construction

- Get the help and oversight of an experienced builder.
- Comply with required FAA inspections.

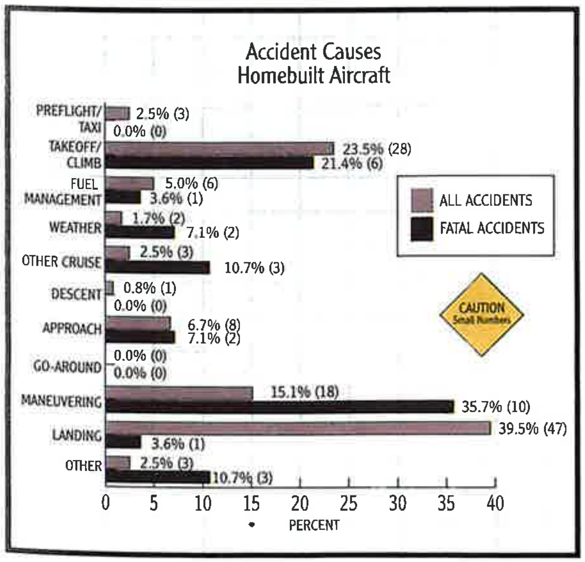
### Test Flying

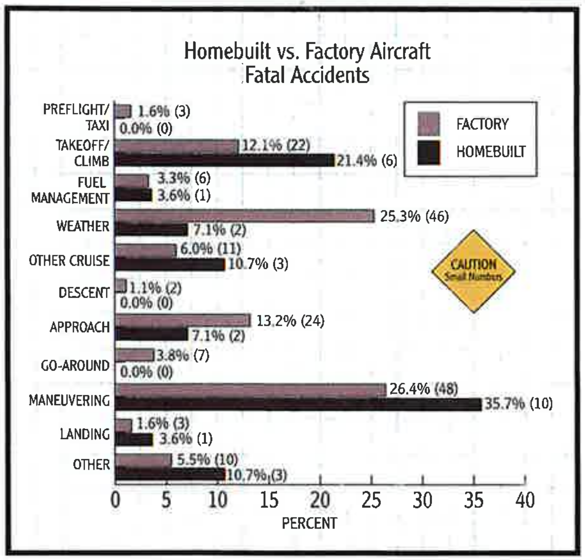
- Plan and take precautions for test flights. Consider hiring a test pilot.
- Understand the stability and other flight characteristics of high-performance homebuilt aircraft.

The Experimental Aircraft Association (EAA) is an excellent source of more detailed information about building and flying homebuilt aircraft. This organization sponsors many educational activities and maintains a network of volunteer technical counselors in every area of the country. Many kit manufacturers also offer training packages and technical support services for builders and pilots of their products. Local FAA Flight Standards District Offices can answer questions regarding homebuilt aircraft and pilot certification requirements.

The charts at the left show accident causes for homebuilt airplanes and how they compare to those for factory-built airplanes. Some of these accidents were the result of pilots being unprepared for the peculiarities of their aircraft. This is particularly important for initial flight testing and shows up in approach accidents. Unfortunately, however, many of these accidents were the result of poor judgment on the part of the pilots involved and not due to unique features of their aircraft. Both graphs represent small numbers of homebuilt aircraft. So, although the percentage bars in the graphs reflect a few significant differences between homebuilt and factory-built aircraft, take into consideration the small numbers being graphed.

| Homebuilt Accidents<br>MAJOR CAUSE | ALL ACCIDENTS | FATAL ACCIDENTS |
|---|---|---|
| Pilot | 119 (59.8%) | 28 (51.9%) |
| Mechanical/Maintenance | 38 (19.1%) | 7 (13.0%) |
| Other | 26 (13.1%) | 10 (18.5%) |
| Unknown | 16 (8.0%) | 9 (16.7%) |
| Total | 199 | 54 |




# Conclusions

## Risk Management and Accident Prevention Strategies

The sections below outline some steps that can be taken by pilots and nonpilots to reduce the risks of an accident.

General aviation flying is not without risk, but pilots can greatly minimize their chances of being involved in an accident. The points below can reduce the risks that have been identified in this report.

- Weather: Consider all aspects of the flight, including weather, time of day, aircraft capabilities, and your own experience, currency, and condition. Be conservative with weather if you are flying VFR, especially at night. Give yourself ample allowance for any deteriorating conditions, and make alternate plans in advance. Forecasts are not guarantees. Get weather updates in flight, and adjust plans accordingly. Learn about weather from more experienced pilots by flying with them when the opportunities exist.
- Maneuvering flight: Many maneuvering flight accidents happen when pilots conduct unauthorized aerobatics, buzzing, or other low-level flight. This is easily prevented. Do not be tempted to show off for your peers or others. Instead, enroll in an aerobatics course with a qualified instructor and the proper equipment. You can increase your piloting skills and enjoy these maneuvers safely and legally.
- Takeoff and landing: These phases of flight produce relatively few serious accidents but a large number of minor accidents. Many of these accidents involve skill errors rather than the decision-making errors that characterize more serious accidents. Lack of proficiency in basic operations, including failure to handle windy conditions properly, leads to many takeoff and landing accidents. Training and currency prevent these problems.

Nonpilots can also contribute greatly to flying safety. Passengers and flying companions are encouraged to learn as much as possible about flight operations and to assist pilots in their duties. Pilots should involve their passengers in the flight. The following checklist for pilots and passengers will increase safety.

### Pilots

- Explain flight operations.
- Enlist passengers' aid in spotting traffic.
- Require a "sterile cockpit" –no conversation that is unrelated to the safety of flight – during takeoff, approach, landing, or high stress phases of flight.
- Make go/no-go/continue decisions solely on the safety of flight, not on convenience or business factors.

### Passengers and Flying Companions

- Show an interest in and offer assistance with flight operations.
- Call attention to hazardous situations. If you are not sure whether a hazard exists, it is better to say something than to remain silent.
- Do not pressure the pilot to complete the flight.
- Support the pilot's safety-motivated decisions.

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Consultant: Don Arendt
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## Frequently Asked Questions


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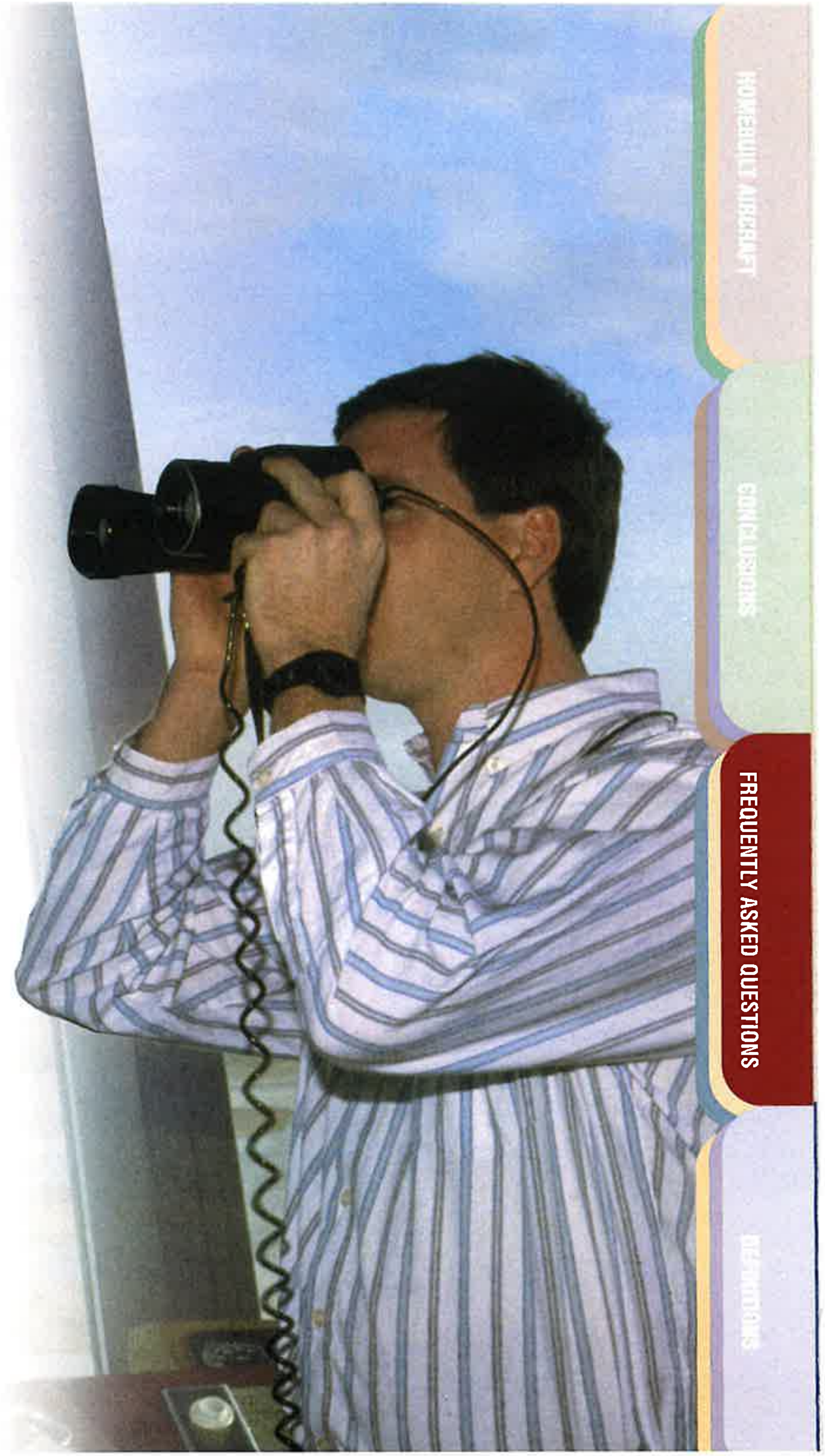


# NTSB Definitions

## 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; that is, 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" above, 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.

# Kind 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 14 CFR 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/powerline 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 Operation

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 (either 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 touch-down 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 airwork, basic airwork, external load operations, etc.

**Unknown**: The phase of flight could not be determined.

# Safe Pilots. Safe Skies.

## AOPA Air Safety Foundation

Chartered in 1950, the AOPA Air Safety Foundation is the nation's largest nonprofit organization providing aviation safety education and programs to the general aviation community.

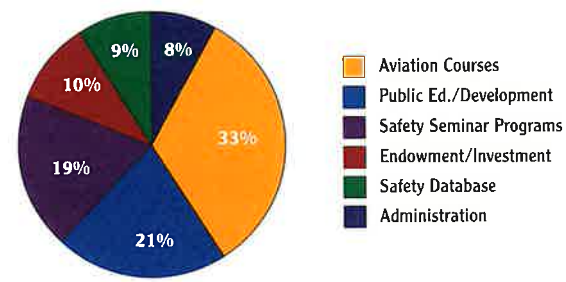
The mission of the Foundation is to save lives and promote accident prevention through pilot education. To serve the nation's 622,000 general aviation pilots, the Foundation:

- **Conducts hundreds of FREE aviation safety seminars nationwide** on topics such as weather, airspace, GPS, and more.
- **Produces and distributes general aviation education and training** videos, pamphlets, books, and *Safety Advisors* to increase safety awareness.
- **Provides specialized aviation training courses** for students, and renews over 7,000 CFIs each year.
- **Publishes the annual Nall Report,** which examines all general aviation accidents from the previous year and provides guidance on what the FAA, the industry, and pilots can do to lower their risk.
- **Performs accident-trend research** to focus Foundation resources on the principal causes of accidents.
- **Maintains a national aviation safety database** that contains NTSB reports on GA accidents since 1982.

*Celebrating 50 years of*
*Safe Pilots. Safe Skies.*

### Where The Money Goes

Gifts to the Foundation qualify for the federal charitable deduction and take many forms, including cash, appreciated stock, insurance, pledges, real estate, and personal property.




All contributors who give $50 or more annually will receive ASF's latest *Safety Advisors*, a part of the Foundation's highly regarded series. Contact ASF to take advantage of this latest opportunity in safety education and awareness.

You can access more information on safer flying on the Internet. Through our AOPA Air Safety Foundation Web site, (**www.aopa.org/asf**), learn more about the ways that together, we can make "Safe Pilots. Safe Skies."

An annual report is available by writing or calling the Foundation.

**AOPA Air Safety Foundation**
421 Aviation Way
Frederick, MD 21701
800/638-3101
www.aopa.org/asf