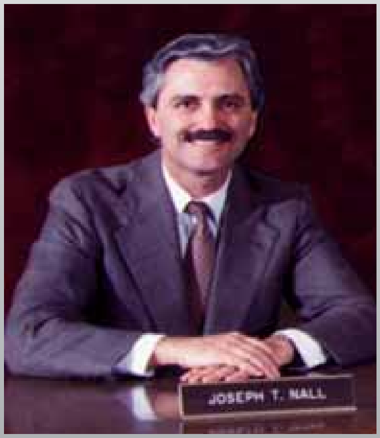
2006 NALL REPORT

Accident Trends and Factors for 2005

AOPA AIR SAFETY FOUNDATION



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 pilot community with the most current safety information, ASF gathered NTSB data on 2005 accidents throughout 2006. By September 2006, the NTSB had finalized 84.5 percent of the year 2005 reports. The remaining 15.5 percent contained preliminary data.

Prior-year comparisons suggest that this mix of preliminary and final data will not significantly change the conclusions presented here when all final reports are analyzed.

As a supplement to the information contained in this report, ASF offers its accident database online. 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:

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Safe pilots.
Safe skies.

Accident Trends and Factors for 2005

The FAA estimated that general aviation (GA) pilots flew 23,167,712 hours in 2005. This resulted in a total accident rate of 7.2 per 100,000 hours, compared to 6.5 per 100,000 hours in 2004. The rate for fatal accidents also increased slightly, rising to 1.4 per 100,000 hours, compared to 1.3 per 100,000 hours in 2004. This represents an approximate 10.9 percent increase in the total accident rate and a 10.3 percent increase in the fatal accident rate, compared to 2004.

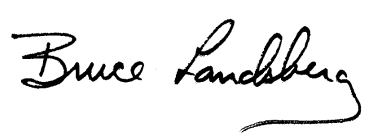
Over the long term (1996 to present), both rates continue a downward trend, but the curve is flattening. While the sky certainly isn't falling, the record could stand some improvement.

In this year's *Joseph T. Nall Report* you'll see exactly where the problems arose and where pilots made poor decisions. Of particular note is a sharp rise in fatal maneuvering accidents. There were 80 in 2005, compared to 52 in 2004. Half of these accidents involved wire strikes or collisions with trees, terrain, or obstacles. In many cases the issue wasn't lack of skill; it was the pilot's decision to fly close to the ground and perhaps to maneuver aggressively. Look for additional ASF emphasis on this next year.

Late in 2005, the AOPA Air Safety Foundation ran a nationwide seminar series titled, "Do the Right Thing: Decision-Making For Pilots." The seminar faithful came to see this excellent program, but they aren't the ones having the accidents. So in 2006 and going forward, ASF began sending a free DVD on decision making to all newly rated private and instrument pilots. The scenarios review VFR into instrument conditions and IFR decision management – two areas that have been shown to be troublesome.

Your next flight will be as safe as you choose to make it. Take into account your proficiency, experience, the aircraft, the weather, your schedule, and your willingness to adhere to the standards that allowed you to earn the coveted title of pilot-in-command. It doesn't always happen to the other guy or gal. Keep training, keep learning, and keep flying.

We want to see you next year. Safe flights!



Bruce Landsberg
Executive Director,
AOPA Air Safety Foundation

If you are looking for perfect safety,
you will do well to sit on a fence and watch the birds;

but if you really wish to learn,
you must mount a machine and
become acquainted with its tricks by actual trial.

—Wilbur Wright, 1901

Overview of 2005 Accident Trends and Factors

The annual AOPA Air Safety Foundation's *Nall Report* is the nation's foremost review and analysis of general aviation (GA) safety for the preceding year. It is designed to help members of the media, the public, and the aviation community 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 2005 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 Nall Report analyzes accident data by cause and category, type of operation, class of aircraft, and other factors. This allows exploration of GA safety in a variety of ways. For instance, pilots can learn more about the accident profile of the particular class of aircraft they fly, or the particular type of flying they do.

The total number of GA accidents is relatively low, but remains significantly higher than the airlines. (See Appendix 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

General aviation's improving safety record took a minor detour in 2005 as the number of fixed-wing accidents increased slightly in both total and fatal categories (Figure 1). Total accidents increased by 23 (1.6 percent) over 2004, while fatal accidents edged up by two (0.7 percent). In spite of the slight increase in fatal accidents, the number of persons killed in those accidents dropped by 19 compared to the previous year. The changes in accident rates represented by these increases are magnified because of the decrease in estimated GA flight hours, which have dropped by 2.6 million in the last two years.

Accident Statistics

	2001	2002	2003	2004	2005
Total Fixed-Wing GA Accidents	1,500	1,477	1,514	1,413	1,436
Fatal Fixed-Wing GA Accidents	300	312	312	290	292
Total Fixed-Wing GA Fatalities	557	518	557	510	491
Estimated GA Flight Hrs. (millions)	25.4	25.5	25.7	24.9	23.1

Fig. 1

Accident Trends

Comparing raw accident numbers to estimated flight hours provides an accident rate, which is a useful way to analyze safety trends. Accident rates reflect changes in the utilization of the GA fleet from year to year and are typically shown as the number of accidents per 100,000 flight hours.

U.S. General Aviation Accidents
per 100,000 Flight Hours 1996-2005

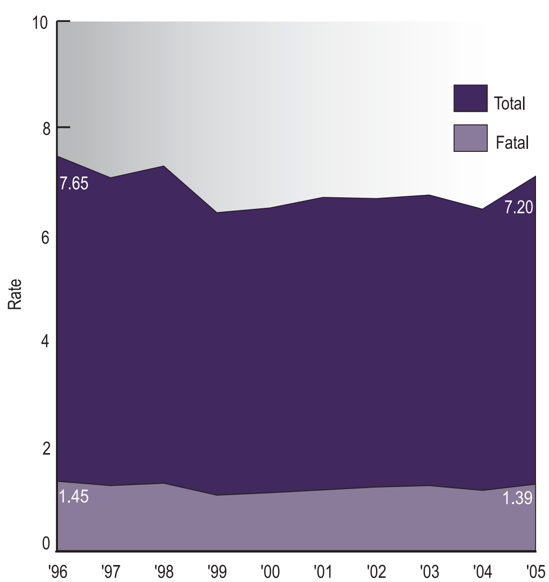


Fig. 2

The total GA accident rate for 2005 (Figure 2) rose to 7.20 accidents per 100,000 flight hours, the highest since 1998. The fatal accident rate of 1.39 per 100,000 hours was also an increase over 2004. Over the past decade, both total and fatal accident rates have generally trended downward, an encouraging statistic. However, complacency has no place in the cockpit: Your next flight is the most important one. Minor changes in rates from year to year can be misleading, and trend information spanning several years should be reviewed to get a more accurate picture.

Accident Causes

In this report, the causes of aircraft accidents have been divided into three groups:

- **Pilot-related** – accidents that arise from the improper action or inaction of the pilot.
- **Mechanical/Maintenance** – accidents that arise from failure of a mechanical component or errors in maintenance.
- **Other/Unknown** – accidents that include causes such as pilot incapacitation, as well as accidents for which a cause could not be determined.

The number of 2005 accidents by cause is shown in Figure 3.

General Aviation Accidents 2005

MAJOR CAUSE	All Accidents	Fatal Accidents
Pilot	1076 (74.9%)	242 (82.9%)
Mechanical/ Maintenance	232 (16.2%)	22 (7.5%)
Other/Unknown	128 (8.9%)	28 (9.6%)
TOTAL	**1436**	**292**

Fig. 3

Accident Category

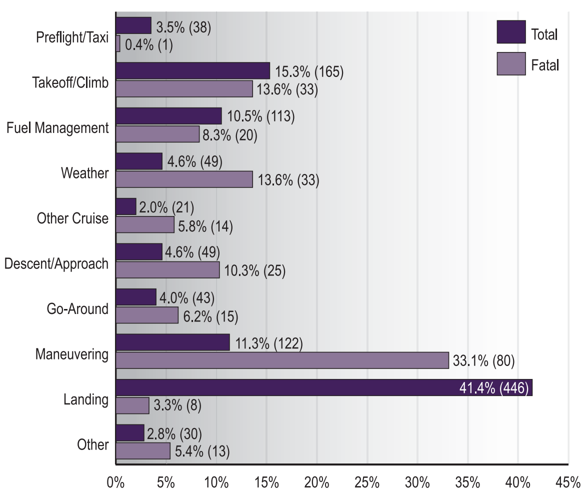
Each of the causes described above can be further divided by accident category. For this report, accident categories are defined by the phase of flight in which the accident occurred (for example, landing or maneuvering), or by primary factor, such as fuel management or weather.

Pilot-Related Accidents

1,076 total/ 242 fatal

As with overall GA accident numbers, pilot-related accidents in 2005 (Figure 4) increased to 1,076 from 1,067 in 2004 (0.8 percent). The number of fatal accidents also increased, climbing by 6.1 percent from 228 in 2004 to 242 in 2005.

Accident Categories – Pilot Related



NOTE: Accident counts for each category are displayed in parentheses

Fig. 4

The deadliest pilot-related accident categories were maneuvering, weather, takeoff/climb, and descent/approach. Maneuvering accidents in 2005 constituted only 11.3 percent of all pilot-related accidents, but one in three (33.1 percent) of the fatal accidents. This represents a significant increase over the previous year in the percentage of fatal accidents attributed to maneuvering. Maneuvering accidents often involve questionable pilot judgment, such as decisions to engage in buzzing, low passes, or other high-risk activities.

Weather accidents comprised only 4.6 percent of total accidents, but nearly one in six (13.6 percent) of fatal accidents. Most often, these resulted from pilots continuing VFR flight into instrument meteorological conditions (IMC). Takeoff/climb accidents accounted for another 13.6 percent of fatal accidents.

Pilot-related descent and approach accidents also accounted for only 4.6 percent of total accidents, but 10.3 percent of the fatal accidents. Such accidents are often high-speed collisions with the ground, or the result of loss of control due to stall/spin.

The takeoff/climb and landing categories accounted for 56.7 percent of all pilot-related accidents. These two phases of flight occur close to the ground with slow airspeeds, making the maneuvering skills of the pilot critical. Even though these phases accounted for a high percentage of total accidents, they constituted only 16.9 percent of the fatal pilot-related accidents. This relatively low fatality rate is likely related to slow airspeeds used during these operations and the relative lack of obstructions in the airport environment.

Type of Operation

The versatility of general aviation aircraft is reflected in the wide variety of operations in which they take part, from recreational and personal flying to commercial operations. Figure 5 shows that most 2005 GA flying was for personal (49.4 percent), instructional (18.4 percent), and business (15.1 percent) purposes. Definitions for each type of operation are found in the Appendix.

Type of Operation

Type of Operation	Percent of Flying (2005)	Percent of Total Accidents (2005)	Percent of Fatal Accidents (2005)
Personal	49.4	70.7	81.2
Instructional	18.4	13.2	6.5
Aerial Application	5.1	5.3	3.4
Business	15.1	2.5	2.4
Positioning	*	1.7	0.7
Ferry	*	0.4	0.7
Other Work use	0.5	1.0	0.7
Aerial Observation	3.5	0.6	1.4
Executive/Corporate	4.3	0.1	0.0
Other/Unknown	3.7	4.5	3.0

** Included in Other/Unknown*

Fig. 5

Personal flying – visiting friends or family, traveling to a vacation home, or for recreation – accounted for about half of total GA flight time, but suffered seven out of 10 total accidents (70.7 percent) and four of five (81.2 percent) fatal accidents in 2005, making it significantly more hazardous than other types of operations.

By contrast, instructional flying is relatively safe. While accounting for nearly one out of every five flight hours, it resulted in just 13.2 percent of all accidents and only 6.5 percent of fatal accidents. This is due, in part, to the high level of supervision and structure in the training environment.

Business flying – flights made in furtherance of the pilot's own livelihood or in support of business endeavors – is one of the safest types of GA flying. It comprised

15.1 percent of operations in 2005, but accounted for only 2.5 percent of all accidents and 2.4 percent of fatal accidents. For business pilots, flying is secondary to their business or occupation. This differs from executive/corporate flying, in which professional pilots are hired solely to fly.

Emergency Phase of Flight

In a typical accident scenario, a series of related mistakes and/or failures occurs over time, resulting in the crash. This is called the accident chain. In its investigations, the NTSB tries to determine the phase of flight in which these critical events began. This analysis can be helpful in identifying important safety issues.

Note that there is some overlap in the terms used to describe the emergency phase and the accident category. For example, fuel exhaustion during cruise would be categorized as a fuel management accident, but the emergency phase of flight would be listed as cruise.

Emergency Phase of Flight

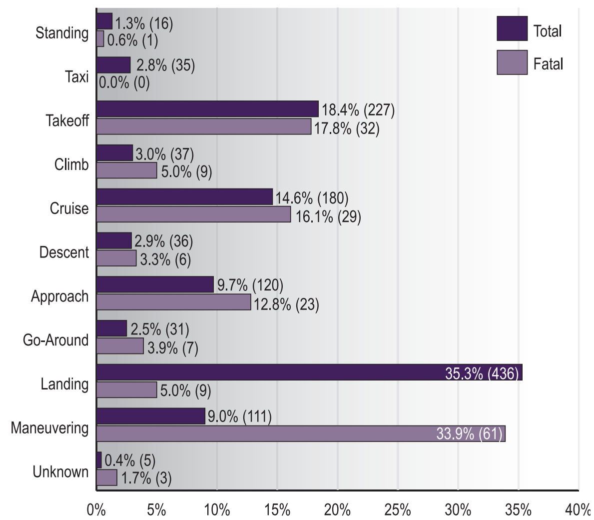


Fig. 6

Figure 6 depicts pilot-related accidents by the phase of flight in which the accident chain began. A significant decrease in the rate of fatal accidents that began in cruise was noted in 2005, from 25.6 percent in 2004 to 16.1 percent. The overall number of accidents that started during approach decreased from 17.2 in 2004 to 9.7 percent in 2005, while the percentage of those that were fatal remained nearly unchanged (13.1 vs. 12.8 percent).

Accidents and Aircraft Class

There are three classes of fixed-wing GA aircraft covered by this report: single-engine fixed-gear (SEF), single-engine retractable-gear (SER), and multiengine (ME). The complexity of operating procedures, cockpit instrumentation, and aircraft systems typically increases with aircraft performance.

Accident/Fatality Rate by Class

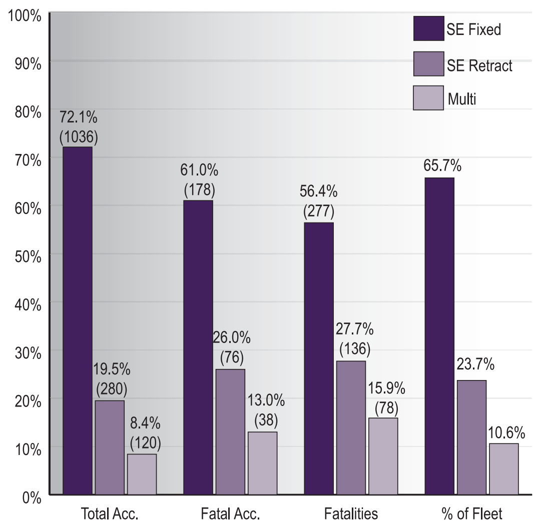


Fig. 7

GA accidents by aircraft class are shown in Figure 7, which indicates that the more complex and capable the aircraft, the greater the chance of a fatality in an accident. In 2005, SEF aircraft, which comprise the majority of the GA fleet, accounted for 72.1 percent of all accidents but only 61.0 percent of those that were fatal. SER aircraft had about one out of five of total accidents (19.5 percent) and one out of four (26.0 percent) of the fatal accidents.

While ME aircraft accounted for only 8.4 percent of all accidents, they accounted for a disproportionately high 13.0 percent of fatal accidents. Even so, this represents a significant improvement over 2004, when ME aircraft accounted for 17.9 percent of fatal accidents. Multiengine aircraft are typically operated in a wider range of weather conditions than the other two classes. Also, with their higher performance and stall speeds, they are less forgiving of pilot mistakes. The accident categories for each individual aircraft class are examined in detail later.

Lethality Index – All

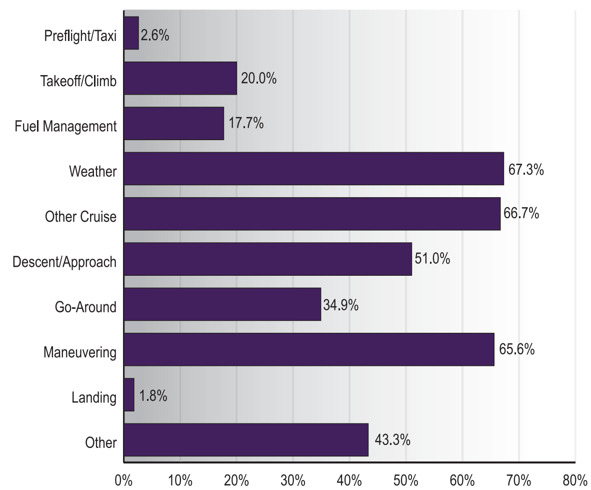


Fig. 8

Lethality Index

The Lethality Index illustrated by Figure 8 provides insight into the likelihood of death in various categories of accidents.

Accidents occurring as a result of weather, other cruise, and maneuvering all resulted in fatalities about two-thirds of the time. In the case of weather, this represents a significant improvement over 2004, when 93.8 percent of accidents were fatal. Lethality of other cruise and maneuvering accidents increased from 47.4 percent and 50.5 percent respectively.

The Lethality Index for each class of aircraft is presented as part of their respective discussions.

Basic flying instructions:

- Try to stay in the middle of the air.
  - Do not go near the edges of it.
    - The edges of air can be recognized by the appearance of ground, buildings, sea, trees, and interstellar space. It is much more difficult to fly there.

—Anonymous

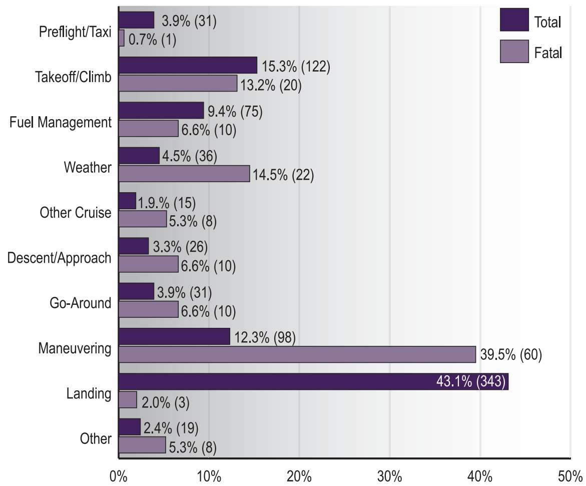
Single-Engine Fixed-Gear Aircraft

796 total/ 152 fatal

Overview

Single-engine fixed-gear (SEF) aircraft are the largest segment of the general aviation fleet. They are used for a wide variety of operations, but their relatively low operating costs make them particularly attractive for pleasure flights and instruction.

Accident Categories
Single-Engine Fixed-Gear (SEF)



NOTE: Accident counts for each category are displayed in parentheses

Fig. 9

SEF aircraft accidents in 2005 increased by eight (one percent) compared to the previous year. Fatal accidents rose by 15, from 137 to 152 (11 percent), during the same timeframe (Figure 9). There were two significant changes in the distribution of accidents compared to 2004: descent/approach fatal accidents dropped by half, from 13.1 percent to 6.6 percent of the total, and fatal maneuvering accidents increased to 39.5 percent from 29.2 percent.

Leading causes of SEF fatal accidents in 2005 were:
Maneuvering: 39.5 percent (60)
Weather: 14.5 percent (22)
Takeoff/Climb: 13.2 percent (20)

Fatal Accident Factors

There were 98 SEF maneuvering accidents in 2005, of which 60 resulted in fatalities. This represents an increase of nine and 20 accidents, respectively. The increase in fatal maneuvering accidents is discussed in this year's Special Emphasis Topic (p. 17). There are three primary reasons for fatal maneuvering accidents, as shown in Figure 10. Collision with terrain, wires, or trees was the most common (45.0 percent), followed closely by loss of control (41.7 percent). Accidents occurring while performing aerobatic maneuvers accounted for 13.3 percent of the SEF fatal maneuvering crashes. Maneuvering accidents are generally preventable through the use of good pilot judgment and decision making, i.e. don't buzz or perform aerobatics at low altitude in non-approved aircraft.

Maneuvering Accidents
Single-Engine Fixed-Gear (SEF)

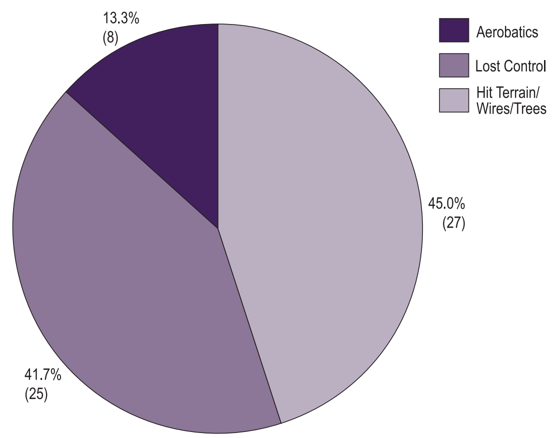


Fig. 10

Weather-Related Accidents
Single-Engine Fixed-Gear (SEF)

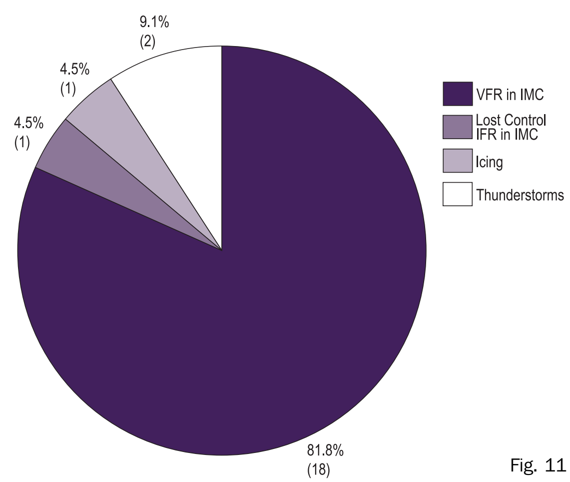


Fig. 11

Weather accounted for only 4.5 percent (36) of the total SEF accidents, but a relatively high 14.5 percent (22) of the fatal ones. Figure 11 shows that 81.8 percent of these fatal weather-related accidents resulted from continued VFR flight into IMC. In such cases, a pilot flying by reference to outside visual cues flies into clouds or low visibility conditions and loses control of the aircraft or hits terrain. Pilots must be able to effectively assess weather-related risks to avoid these situations.

Figure 12 depicts the Lethality Index for SEF aircraft. Results for this class of airplane are similar to the overall GA figures shown in Figure 9 because SEF aircraft represent the majority of the GA fleet. Of note is that SEF experienced a large drop in weather-related lethality in 2005 (from 91.3 percent in 2004 to 61.1 percent in 2005). Large year-to-year increases were experienced in maneuvering (61.2 percent vs. 44.9 percent in 2004), and go-around (32.3 percent vs. 10.3 percent in 2004) lethality.

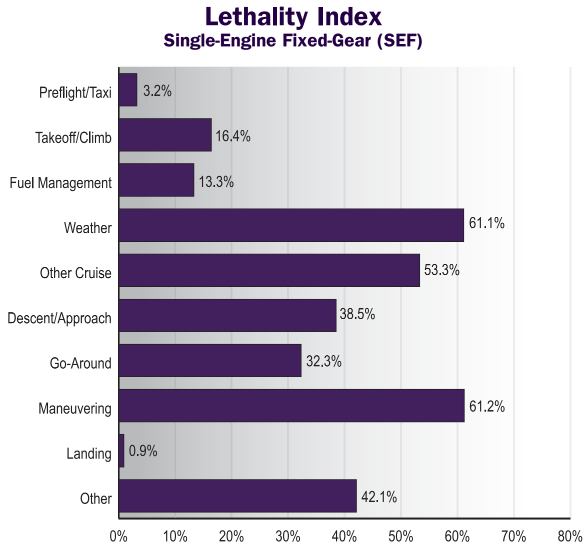


Fig. 12

Single-Engine Retractable-Gear Aircraft

195 total/ 59 fatal

Overview

With their relatively high performance, single-engine retractable-gear aircraft (SER) are popular for personal and business trips. This type of use exposes the pilot to a wider range of weather and operational conditions than pleasure flying.

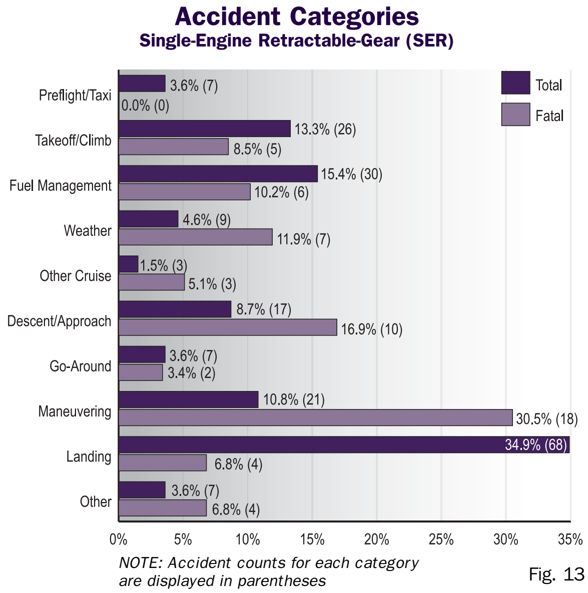


Fig. 13

SER accidents increased 6.0 percent in 2005 (from 184 to 195), while fatal accidents increased 20.4 percent (from 49 to 59). This increase virtually erased the improvements shown in 2004 over 2003. Figure 13 charts the data for accidents in this class.

Leading causes of SER fatal accidents in 2005 were:
Maneuvering: 30.5 percent (18)
Descent/Approach: 16.9 percent (10)
Weather: 11.9 percent (7)
Fuel Management: 10.2 percent (6)

Fatal Accident Factors

Fatal SER maneuvering accidents jumped dramatically in 2005, to 30.5 percent (18) from 12.3 percent (six) in 2004. Over half (55.6 percent) resulted from collisions with terrain, wires, or trees (Figure 14), while 38.9 percent involved loss of control and the remaining 5.6 percent were the result of aerobatic flight.

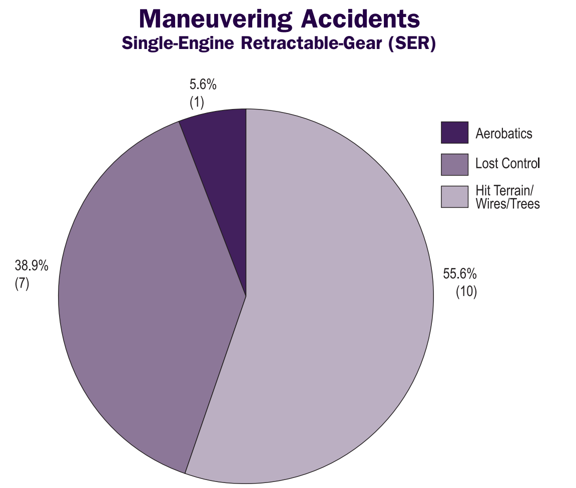


Fig. 14

Fatal descent/approach accidents in SER aircraft were nearly unchanged compared to 2004, climbing slightly from 14.3 percent (seven) to 16.9 percent (10) of the fatal accidents. This high-workload phase of flight can lead to pilot distractions, inducing loss of control or collisions with the ground.

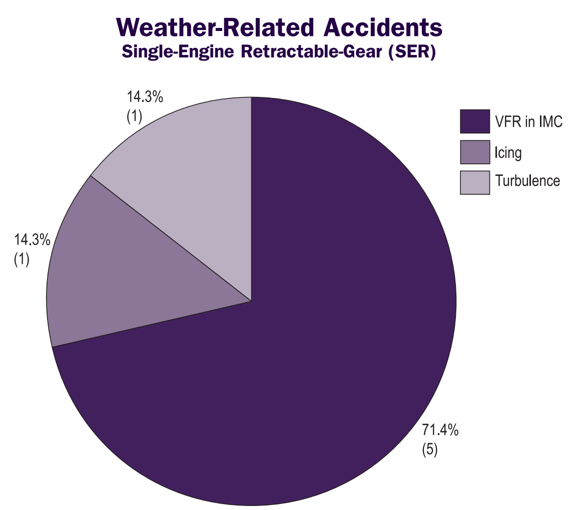


Fig. 15

Fatal weather-related accidents in SER aircraft decreased 61.1 percent in 2005, from 18 in 2004 to seven in 2005. Figure 15 shows the reasons for these accidents, with 71.4 percent resulting from continued VFR flight into IMC. One accident each resulted from loss of control in IFR and an encounter with in-flight icing. Improper fuel management resulted in one in 10 SER fatal accidents. These six accidents represent double the number that occurred in 2004 as a result of fuel management.

SER aircraft had higher lethality indexes in most categories than SEF aircraft (Figure 16). The probability of mortality was highest for accidents attributable to other cruise (100 percent), maneuvering (85.7 percent), weather (77.8 percent), and descent/approach (58.8 percent).

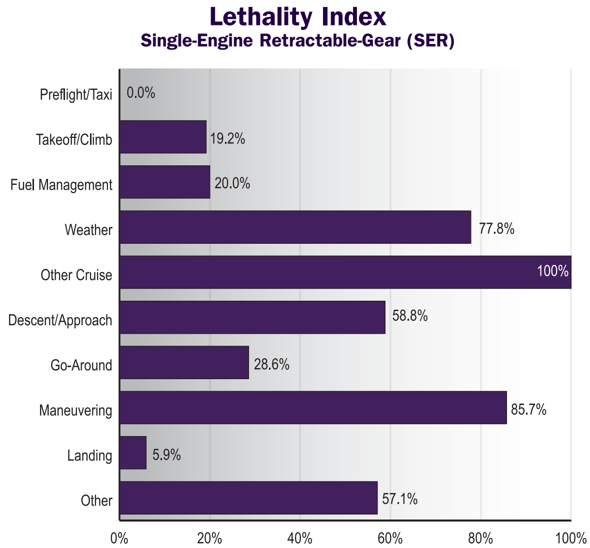


Fig. 16

Multiengine Aircraft

85 total/ 31 fatal

Overview

In normal operations, multiengine (ME) aircraft share the high performance of their retractable-gear single-engine cousins. ME aircraft have a potential safety advantage in the second engine, but higher levels of pilot skill are required if one of the engines does fail, particularly during takeoff or initial climb.

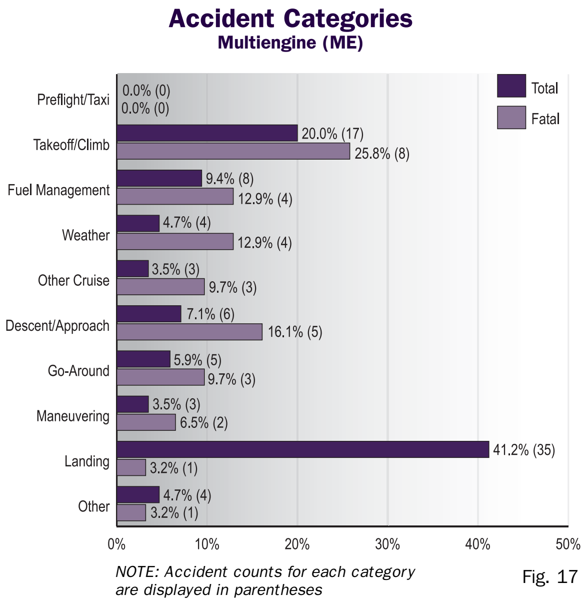


Fig. 17

The number of accidents in ME aircraft decreased to 85 in 2005 from 95 in 2004, while the number of fatal accidents decreased 26.2 percent (to 31 from 42). Figure 17 depicts the data on pilot-related accidents in this aircraft class. The leading categories of fatal ME aircraft accidents were:

Takeoff/Climb: 25.8 percent (8)
Descent/Approach: 16.1 percent (5)
Weather: 12.9 percent (4)
Fuel Management: 12.9 percent (4)

Fatal Accident Factors

As in 2004, 2005 takeoff/climb accidents accounted for one in five ME accidents overall, and slightly over one-fourth of those that resulted in death. A likely contributor to this is the higher takeoff and stall speeds of ME aircraft. Also, in some ME aircraft, loss of power in one engine creates an asymmetrical thrust situation that can challenge an unprepared pilot.

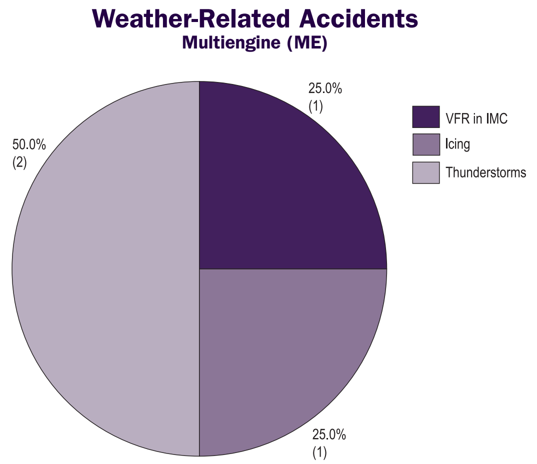


Fig. 18

Accidents that occurred during descent/approach accounted for 7.1 percent of the total ME accidents, and nearly one in six (16.1 percent) of fatal ME accidents.

There were four weather-related ME accidents, all of which were fatal. Figure 18 shows that two were due to thunderstorms, and one each from continuing VFR into IMC and icing.

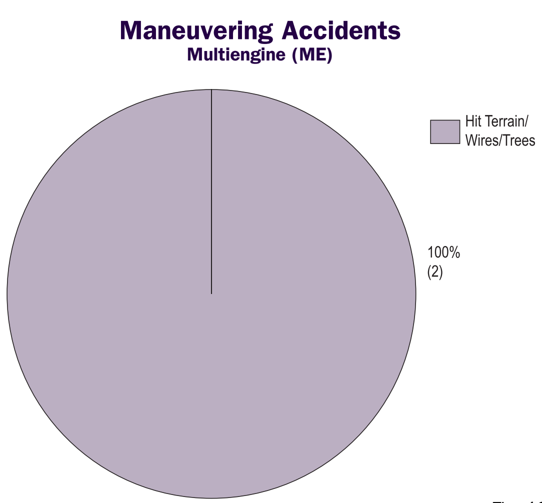


Fig. 19

Fuel management problems resulted in eight ME accidents, four of which were deadly. ME aircraft typically have more complex fuel systems and higher rates of fuel consumption, increasing the possibility of operational errors.

A low number of maneuvering accidents was a bright spot in the ME safety record, with a total of three, two of which were fatal. Both of the fatals (Figure 19) resulted from collision with terrain, wires, or trees.

Figure 20 depicts the lethality index for all accident categories in ME aircraft in 2005. With 47.1 percent fatal, ME accidents during takeoff and climb were much more deadly than those in all single-engine aircraft. Other highly lethal accident categories included weather (100 percent), other cruise (100 percent), descent/approach (83.3 percent), and maneuvering (66.7 percent).

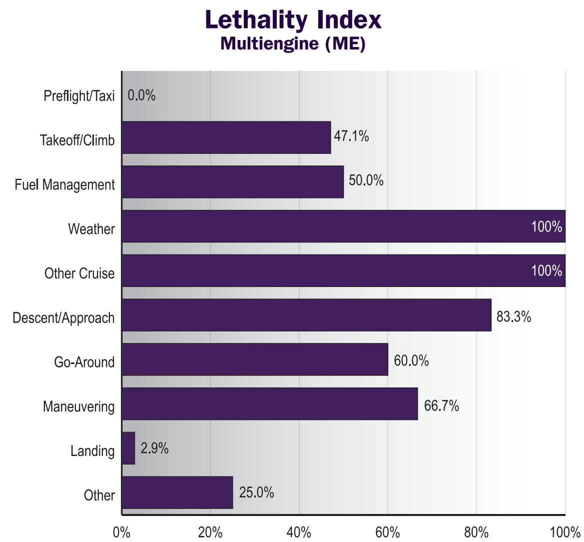


Fig. 20

Pilot-Related Accident Factors

Levels of pilot experience and certification are important elements in aviation safety. Figure 21 shows the correlation between accidents and pilot flight hours in 2005. As in previous years, the more experienced the pilot, the less likely he or she is to be involved in an accident. The first 500 hours of a pilot's flying career are the most critical, with 34.9 percent of the total and 30.7 percent of fatal accidents occurring within that timeframe. It should be noted that pilots at this experience level fly the vast majority of flying hours. As such, these statistics may not reflect the true safety record of less experienced pilots, but rather their increased exposure. The Air Safety Foundation is working to gather data that will allow analysis in this area.

Accident Rates by Hours of Experience

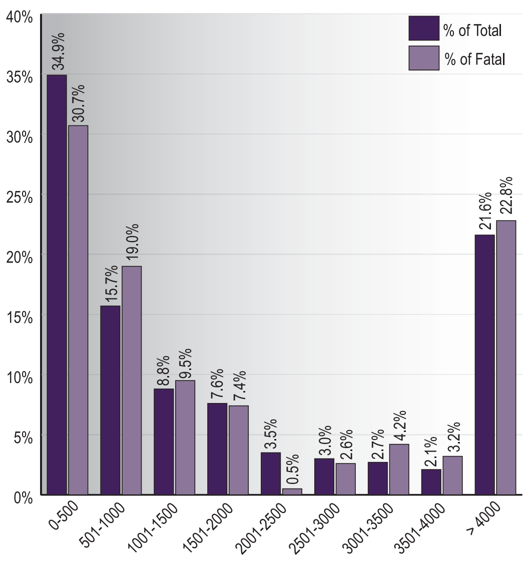


Fig. 21

Time in Type

The number of flight hours in a particular type of aircraft (Figure 22) also has an impact on safety. The more time in type a pilot has, the less likely he or she is to have an accident in that type. For both fatal and nonfatal categories in 2005, about 43 percent of accidents involved pilots with fewer than 100 hours experience in type. Total accident rates fall sharply after the first 100 hours of time in type.

Certificate Level

Accident rates can also be analyzed based on the level of pilot certificate held (Figure 23). Student pilots and airline transport pilots (ATP) have the lowest percentage of accidents relative to their

Accident Rates by Time in Type

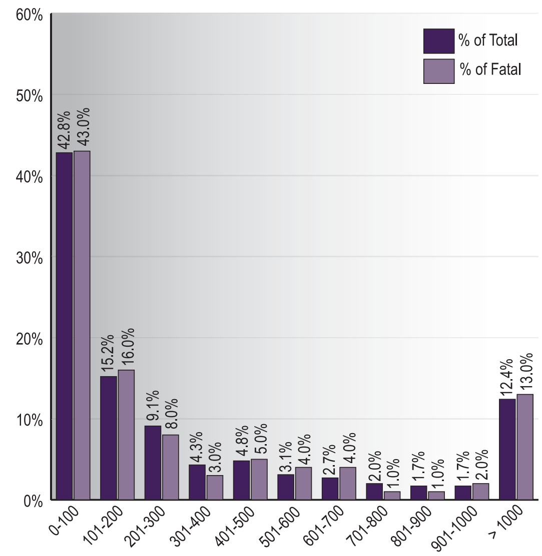


Fig. 22

Accident Rates by Certificate Level

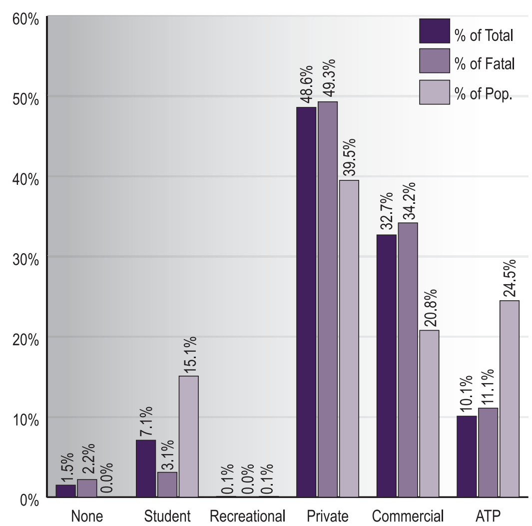


Fig. 23

representation in the overall pilot population, while private and commercial pilots both have disproportionately high percentages.

Personal Flying

759 total/ 193 fatal

Personal flying represents half (49.4 percent) of all GA flying, but accounts for 81.2 percent of fatal and 70.7 percent of all GA accidents.

Personal flights accounted for 83.7 percent each of weather, descent/approach, and go-around accidents. Fatal crashes in these categories were 87.9, 92.0, and 93.3 percent respectively. Over three out of four of the total, and 90.0 percent of the fatal fuel management accidents also occurred during personal flights. Personal missions also accounted for 86.8 percent of all preflight/taxi accidents and 64.1 percent of landing accidents (87.5 percent of the fatals) (Figure 24).

Proportion of Accidents – Personal Flying

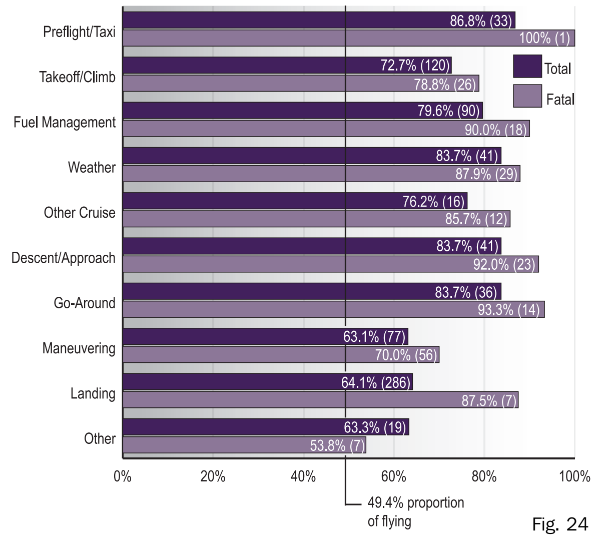


Fig. 24

Special Emphasis Topic: Maneuvering Accidents

In 2005, maneuvering flight accounted for one-third of all fatal accidents. In single-engine fixed-gear airplanes, the percent of fatal maneuvering accidents jumped dramatically, to 39.5 percent from 29.2 percent in 2004. While maneuvering accidents have long been the focus of AOPA Air Safety Foundation educational programs, this year's upward trend warrants additional examination.

While most pilots think first about buzzing when the subject of maneuvering accidents comes up, there is more to it than that. When you operate in the traffic pattern, do aerial work or formation flying, or practice stalls and spins, you perform maneuvering flight. Consider the following accidents:

- A CFI was demonstrating a forced landing by simulating the loss of engine power in a single-engine airplane and struck power lines 30 feet above the ground. Both the CFI and the student were killed.

- After flying low over houses near the airport, the pilot climbed to 200 feet and entered the traffic pattern. Overshooting the final approach course, the pilot steepened the bank and entered an accelerated stall. Proper recovery technique was applied, but there was not sufficient altitude to recover. There were two fatalities and two injuries.

- After departing on an instructional flight, the instructor and three passengers were fatally injured when their airplane hit the ground while maneuvering along a beach. Radar data showed them at 300 feet and 60 knots just before the accident. Flaps were found set at 30 degrees.

- A 1,200-hour pilot lost control while maneuvering at low altitude over land leased for deer hunting. The airplane came to rest in a near vertical position with the engine and nose section driven into the ground. The pilot and two passengers were killed.

Most maneuvering accidents can be traced back to the pilot's decision to engage in a high-risk operation, either willingly or because of lack of understanding. Too often, those decisions set the flight up for a tragic ending.

At the low altitudes where maneuvering accidents occur, distractions can have a devastating effect. Often, the pilot is focused outside the airplane – taking photos, looking at buildings or landmarks, looking at other aircraft or the airport. This outside focus leads the pilot to lose touch with what the airplane is doing, resulting in undesirable airspeed or altitude deviations. Undetected at very low altitudes, these can lead to a stall or collision with the obstructions or the ground. Such loss of "situational awareness" is also linked to the aeronautical decision-making process pilots use during flight.

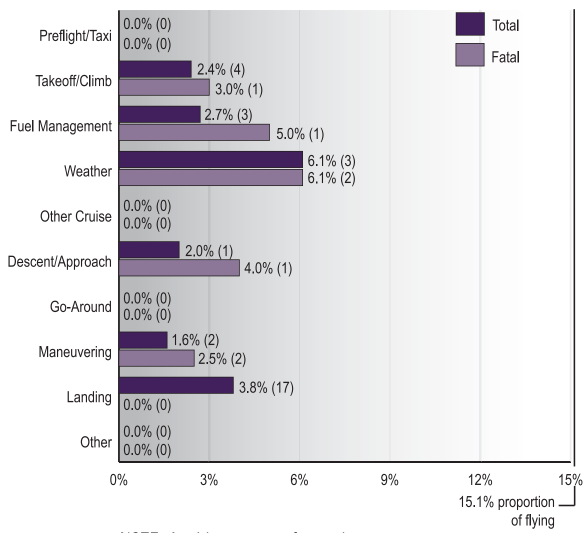
Improving aeronautical decision making is one approach for reducing pilot-related accidents such as those that involve maneuvering. AOPA Air Safety Foundation and FAA initiatives seek to raise awareness and develop skills in this critical area. No amount of skill, enthusiasm, or confidence will overcome inappropriate use of critical angle of attack or insufficient altitude.

Business Flying

30 total/ 7 fatal

GA is a key tool in the conduct of business and extends the national air transportation system to locations without adequate airline service. While scheduled airlines serve 750 airports nationwide, GA can go directly to about 19,000 landing facilities. Many pilots rely on their aircraft for business transportation, accounting for 15.1 percent of all GA operations in 2005. Figure 25 shows that business operations are proportionately safer than other types of flying.

Proportion of Accidents – Business Flying



NOTE: Accident counts for each category are displayed in parentheses

Fig. 25

Business flying operations experienced 30 accidents in 2005, seven of which were fatal. Business flying accounted for 6.1 percent of GA weather accidents, down from 8.3 percent in 2004. The next highest rates were for fuel management and takeoff/climb accidents, tallying 2.7 percent and 2.4 percent of the GA total and 5.0 and 3.0 percent of GA fatal accidents, respectively. Landing accidents during business flights accounted for 3.8 percent of the GA total, but none of the fatal accidents.

Instructional Flying

165 total/ 16 fatal

Instructional flying provides the training and practice that allows pilots to develop and maintain skills, habits, and attitudes that directly contribute to safety.

In 2005, the total number of instructional accidents climbed 6.5 percent from 155 to 165, while fatal training accidents increased 60 percent from 10 to 16. Figure 26 shows the breakdown of instructional flying accidents by category.

Proportion of Accidents – Instructional Flying

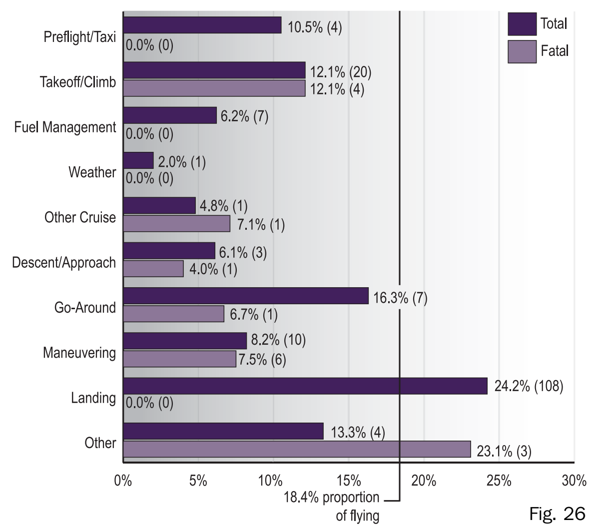


Fig. 26

Some noteworthy points regarding 2005 instructional accidents are:

- Go-around accidents during flight instruction decreased from an unusually high 29.3 percent in 2004 to 16.3 percent in 2005. One 2005 accident was fatal.
- There were significant reductions in the percentages of preflight/taxi (from 15.8 to 10.5 percent) and descent/approach (from 13.1 to 6.1 percent) instructional accidents.

Mechanical/Maintenance Accidents

232 total/ 22 fatal

Properly maintained GA aircraft are very reliable. As a result, failures of the aircraft or its systems are relatively rare. Mechanical/maintenance accidents are caused by mechanical failures that adversely affect the function or performance of the aircraft. Though pilots are responsible for assuring airworthiness, when an equipment failure leads to an accident, it is considered a mechanical/maintenance accident.

Engine and propeller malfunctions accounted for 44.8 percent of all, and 68.2 percent of fatal, mechanical/maintenance accidents in 2005 (Figure 27). As might be expected, loss of thrust can create a very dangerous situation. Oil system issues resulted in 6.9 percent of mechanical/maintenance accidents, and 9.1 percent of those involving death.

Similarly, malfunctions involving aircraft controls or the airframe can be hazardous. These caused 8.2 percent of all, and 22.7 percent of fatal mechanical/maintenance accidents.

Over the past seven years, the number of mechanical/maintenance accidents has varied little (Figure 28).

Accident Causes – Mechanical/Maintenance

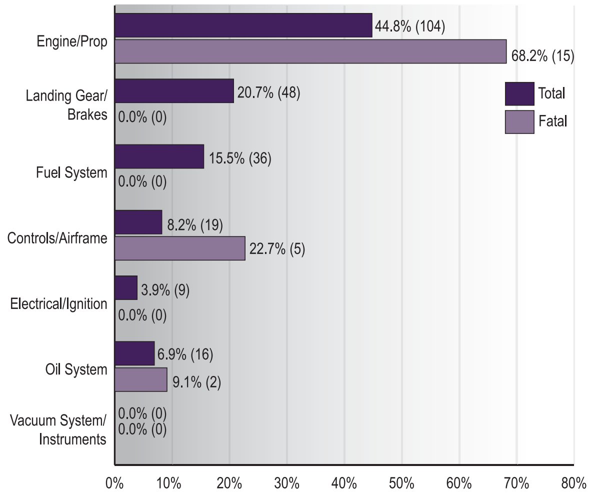


Fig. 27

Accident Trend – Mechanical/Maintenance

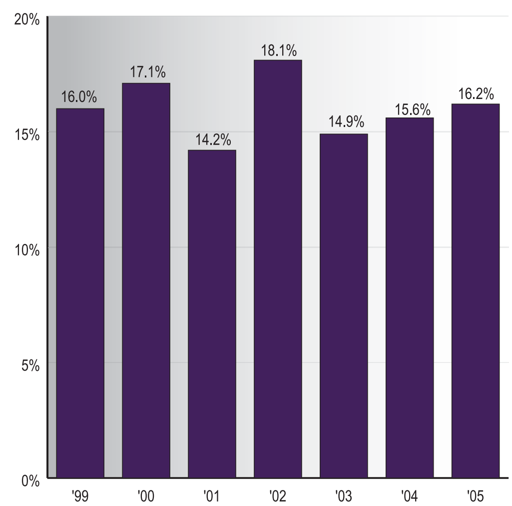


Fig. 28

Night and Weather

Flights conducted at night and/or in adverse weather are more challenging than daytime and/or VMC operations. In spite of this, accidents are more likely to occur during the day than at night (7.9 vs. 7.1 accidents per 100,000 hours), and are also more likely to occur in VMC than IMC (8.0 vs. 5.0 accidents per 100,000 hours). Figure 29 presents 2005 accident data sorted by day vs. night and VMC vs. IMC.

Though the total numbers are lower, accidents at night and in IMC are more likely to be fatal. Only 18.8 percent of daytime accidents resulted in fatalities, but more than one-third (35.9 percent) of all night accidents were fatal. Though only 17.6 percent of accidents in VMC were fatal, in IMC about two-thirds (66.3 percent) claimed a life.

Looking at the combined factors, day VMC accidents had the lowest fatal accident rate of any light/weather condition, with 16.9 percent resulting in death. Day IMC accidents had the second-highest fatality rate at 63.0 percent. At night, slightly more than one in four accidents in VMC conditions was fatal (26.7 percent), compared to slightly over two-thirds of night IMC accidents (67.9 percent).

Even though 2005 saw a marked reduction in fatal weather-related accidents compared to the unusual peak in 2004, these types of accidents are on a gradual increase. Figure 30 charts the trend of weather-related accidents. In 2005, weather was the primary factor in 4.6 percent of all pilot-related accidents, and accounted for 13.6 percent of all fatal pilot-related crashes.

A spike in weather accidents in 2004 led the AOPA Air Safety Foundation, the FAA, and other industry groups to launch educational initiatives for pilots on the hazards of weather, particularly continued VFR into IMC. While weather accidents in 2005 are down, weather education efforts continue.

Accident Causes – Weather and Light

Condition	Accident Total (Fatal)	Percent Fatal	Accident Rate/ 100,000 Hours	Fatal Acc Rate/ 100,000 Hours
Day	1305 (245)	18.8%	7.9	1.5
Night	131 (47)	35.9%	7.1	2.6
VMC	1356 (239)	17.6%	8.0	1.4
IMC	80 (53)	66.3%	5.0	3.3
Day VMC	1250 (211)	16.9%	8.1	1.4
Night VMC	105 (28)	26.7%	6.9	1.9
Day IMC	54 (34)	63.0%	4.3	2.7
Night IMC	28 (19)	67.9%	8.6	5.9

Fig. 29

Accident Trend – Weather

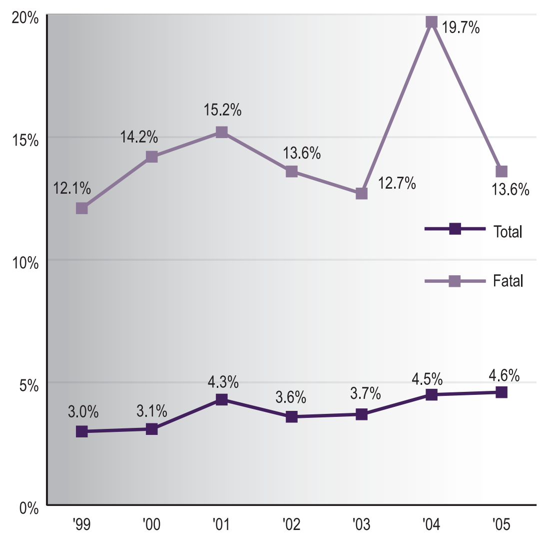


Fig. 30

Homebuilt Aircraft

126 total/ 47 fatal

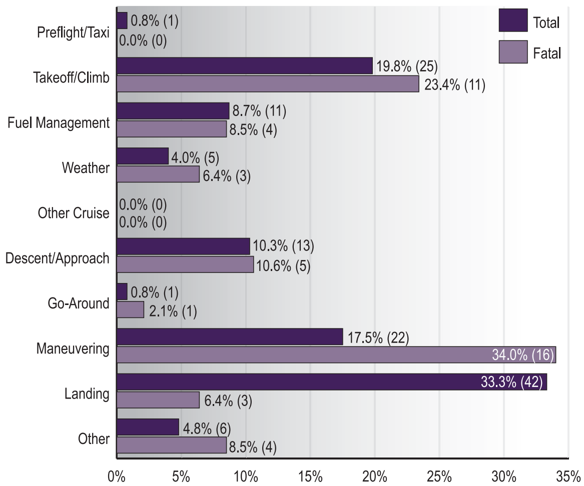
Homebuilt aircraft is a rapidly growing segment of the GA fleet. These aircraft include a wide variety of designs and technologies, and cover the full range from simple, low-performance pleasure craft to high-tech, high-performance models. Most are single engine. Pilots of homebuilt aircraft represent the full range of experience and certification.

Pilot-related accidents in homebuilt aircraft increased slightly in 2005 (to 126 from 125 in 2004), while fatal accidents jumped 30.6 percent to 47 from 36 in 2004. Figure 31 depicts the leading categories of pilot-related homebuilt accidents. Four categories accounted for 76.5 percent of fatal homebuilt accidents. They were:

Maneuvering: 34.0 percent (16)
Takeoff/Climb: 23.4 percent (11)
Descent/Approach: 10.6 percent (5)
Fuel Management: 8.5 percent (4)

Figure 32 tracks the proportion of pilot-related accidents in homebuilt aircraft to overall GA accidents over the last eight years. Both total and fatal homebuilt accidents are increasing gradually.

Pilot-Related Accident Rates – Homebuilt



NOTE: Accident counts for each category are displayed in parentheses

Fig. 31

Proportion of Accidents – Homebuilt

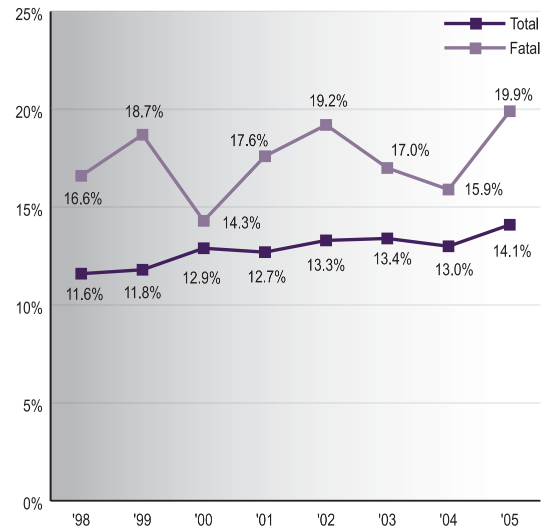


Fig. 32

Other Accident Factors

Fuel Management

113 total/ 20 fatal

Fuel management accidents include fuel exhaustion (the airplane runs out of gas), fuel starvation (fuel remains on board but is prevented from reaching the engine, e.g., failing to switch tanks at the right time), and fuel contamination. In 2005, 68 (nine fatal) accidents were a result of fuel exhaustion. Although easily preventable, fuel starvation caused 35 (10 fatal) accidents. Fuel contamination resulted in 10 (one fatal) accidents. An average of two accidents per week is not a record to be proud of, nor one easily explainable to an insurance company or the FAA.

Midair Collisions

10 total/ 5 fatal

Collisions between aircraft in flight are relatively rare. Most happen in day VFR conditions, frequently in or near an airport traffic pattern. Total midair collisions for 2005 remained at 10 for the second consecutive year. Fatal midair accidents dropped from five to four, with 14 persons killed.

Alcohol and Drugs

5 total/ 5 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 2005, five accidents were attributed to alcohol or drugs, with all being fatal. Of the total, three pilots were impaired by alcohol, one by illicit drugs (marijuana), and one by prescription medication.

Many pilots believe that it is safe to fly if they have recently taken an OTC or prescription medication. Depending on the drug, this may not be the case. A list of drugs commonly approved by the FAA is available to AOPA members on the AOPA Web site (www.aopa.org). Also, the AOPA Medical Certification Department (1-800-USA-AOPA) offers free counseling to AOPA members on a wide variety of medical issues related to flying.

Pilot Incapacitation

3 total/ 3 fatal

Pilot incapacitation happens very rarely. Of the three incapacitation accidents that occurred in 2005, only one had passengers on board, and both passengers survived that accident. Two of the incapacitations were the result of heart attacks, and one was carbon monoxide (CO) poisoning.

Ground Injuries: Off-Airport

7 total/ 2 fatal

8 injured/ 3 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 more fiction than fact. In 2005 there were a total of seven GA accidents that resulted in off-airport ground injuries. Two accidents resulted in three fatalities, one caused serious injuries, and four involved only minor injuries. Two of the fatalities occurred when an airplane on final approach struck a vehicle. The other was a parachutist photographer who was struck by the jump plane during landing.

This is a significant increase from 2004, when only four bystanders were injured.

Propeller Strike Injuries

1 total/ 1 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.

Only one propeller strike accident occurred in 2005, when a pilot was taxiing out for a night flight, stopped on the taxiway, set the parking brake, and got out with a flashlight. The pilot came into contact with the propeller and was killed.

Summary

In the period between 2001 and 2005, the number of GA accidents has declined by 4.3 percent, while annual estimated GA flight hours have decreased by over two million. Overall, the GA accident rate per 100,000 flight hours continues its decade-long decline, and the AOPA Air Safety Foundation continues to work for additional improvements in GA safety.

Here are the highlights of GA accident trends for 2005:

- The accident rates per 100,000 hours for GA aircraft were 7.20 total and 1.39 fatal.

- Pilot-related accidents accounted for three-quarters of all accidents (74.9 percent) and 82.9 percent of the fatal accidents. Total pilot-related accidents in 2005 increased 0.8 percent (to 1,076 from 1,067); fatal pilot-related accidents jumped 6.1 percent (to 242 from 228) compared to 2004.

- Maneuvering flight was the category with the largest number of pilot-related fatal accidents (80). This category accounted for one out of three fatal crashes (33.1 percent) in 2005. Maneuvering flight was also the number one fatal accident category for single-engine fixed-gear aircraft, responsible for over one-third (39.5 percent) of all SEF fatal accidents.

- Weather accident statistics improved in 2005 over the previous year, accounting for 4.6 percent of all pilot-related accidents and 13.6 percent of fatal accidents. The majority of fatal weather accidents in single-engine aircraft resulted from VFR flight into IMC.

- Accidents during personal flying accounted for about seven out of 10 of all accidents (70.1 percent) and four-fifths (81.2 percent) of all fatal accidents. Personal flying accounted for half of GA activity (49.4 percent).

- Accidents are more likely to occur during the day than at night (7.9 vs. 7.1 accidents per 100,000 hours), and are also more likely to occur in VMC than IMC (8.0 vs. 5.0 accidents per 100,000 hours).

Appendix

GA 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 5,000 public-use and 8,000 private-use airports, while airlines are confined to only about 750 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 6.

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
- Homebuilt
- Turbojet

What Does General Aviation Fly?

	Air Taxi	General Aviation
Piston Single Engine	2,585	146,613
Piston Multiengine	1,355	18,576
Turboprop Single Engine	453	2,468
Turboprop Multiengine	786	5,912
Turbojet	1,558	9,298
Helicopter	716	7,821
Experimental	56	22,800
TOTAL	**7,509**	**213,488**

Fig. 33

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

The number of GA aircraft, sorted by category and class, registered in 2005 to air taxi operators and GA is shown in Figure 33 on the previous page.

Figure 33 displays the composition of the powered GA fleet, divided by aircraft class and by the type of operation. The aircraft covered in this report comprise 90.6 percent of the GA fleet, if one totals homebuilt aircraft, all singles, and all piston aircraft.

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 nonoccupant) 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 ASF's Web site: www.asf.org.

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Accident Database/Analysis
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Search the AOPA Air Safety Foundation Accident Database and find the latest statistical data from the FAA and NTSB. Learn more about General Aviation safety issues with ASF's in-depth analysis, including archived versions of the annual Nall Report and Special Reports you won't find anywhere else.

- Searchable Accident Database
- Popular Database Searches
- Special Reports
- Monthly Accident Statistics

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

- Do the Right Thing: Decision Making for Pilots
- Emergency Procedures
- Say It Right! Radio Communication in Today's Airspace
- GPS: Beyond Direct-To

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**Take nothing for granted;
do not jump to conclusions;
follow every possible clue to the
extent of usefulness…**

Apply the principle that there is no limit to the amount of effort justified to prevent the recurrence of one aircraft accident or loss of one life.

— Accident Investigation Manual of the U.S. Air Force

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