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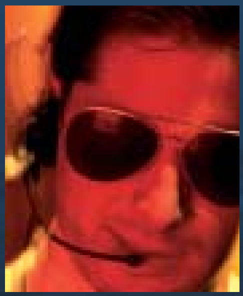
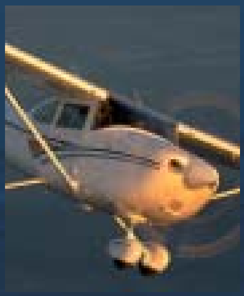
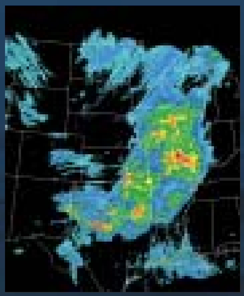
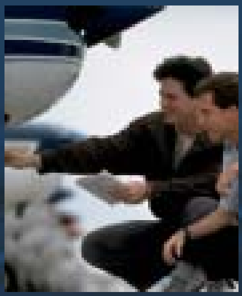


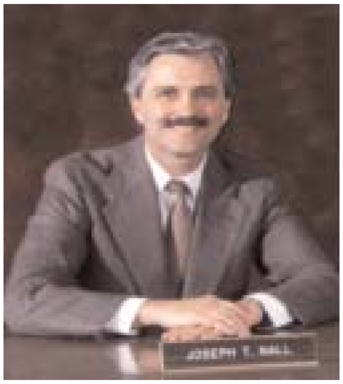






2003 NALL REPORT ACCIDENT TRENDS AND FACTORS FOR 2002

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 (GA) aircraft weighing less than 12,500 pounds. To provide the pilot community with the most current safety information, ASF gathered NTSB data on 2002 accidents throughout 2003. By February 2004, the NTSB had finalized 83.7 percent of the year 2002 reports. The remaining 16.3 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 now offers its accident database online. You may search the database by selecting specific criteria. To view the database, visit www.aopa.org/-asf/ntsb/index.html.

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

National Transportation Safety Board

Federal Aviation Administration

Aircraft Owners and Pilots Association

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Publisher: Bruce Landsberg
Statistician: Kristen Hummel
Editors: Kristen Hummel, Kevin Murphy, David Wright

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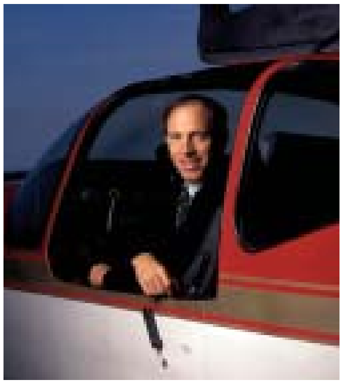


Bruce Landsberg
Executive Director,
AOPA Air Safety Foundation

In all the excitement and reverence that was generated during the Wright Brothers Centennial celebration, it would have been out of place to remind pilots that the first to fly were also the first to crash.

Pilots attuned to history might know that Lt. Thomas Selfridge became the first airplane passenger fatality when an airplane piloted by Orville crashed near College Park, Maryland, on September 17, 1908. What most pilots don't know is that the cause of the crash was failure of an experimental propeller, which caused structural damage to the aircraft. Had the NTSB investigated the accident, they would likely have categorized it as equipment failure with subsequent loss of control. Through the years, careful analysis of accident trends has done wonders to improve aviation safety.

Our equipment, obviously, has improved tremendously. The Wrights were superb pilots and would not have fallen into the low level maneuvering flight accident category. However, as ASF's Nall Report for last year and the year before pointed out, this phase of flight continues to be one of the most likely to result in fatalities to modern aviators. It seems as if it has always been so. This year's Nall Report shows 84 maneuvering flight fatalities, compared to 92 last year and 93 the year before.

Other interesting facts from this year's Nall Report:

- Maneuvering flight still results in the greatest number of fatal accidents, accounting for 23.2 percent of all fatal pilot-related accidents.

- Mechanical/maintenance accidents continue to rise, accounting for 18.1 percent of all accidents for 2002.

- VFR flight into instrument meteorological conditions (IMC) results in the greatest number of fatal weather accidents.

Flight instruction had an unusual bump in fatal accidents in 2003. It will be duly reported next year, but for those interested in instructional accidents, see page 7 in this report and the special ASF report on instructional accidents at www.aopa.org/asf/topics/instructional.pdf.

As always, we are appreciative of the generous support we receive from pilot donors and corporate sponsors who make all ASF activities possible, and for the technical assistance received from many sources inside and outside of government.

Safety, as conscientious pilots know, is an every day, every flight effort—a way of life, if you will—pun intended. Please encourage your flying acquaintances to go to a free ASF seminar, take an online course at www.asf.org, or just browse a print or online publication. It could make a big difference for them.

Safe flights in the coming year!

Bruce Landsberg

Safe Pilots. Safe Skies.

2002 Statistics

In 2002, pilots of GA fixed-wing aircraft under 12,500 pounds gross weight had the fewest total accidents recorded in the ASF database since 1982. The preliminary 2002 total of 1,472 is even lower than the previous record of 1,491 in 2001, when most of GA was effectively grounded for an extended period after the September 11, 2001, terrorist attacks.

Fatal GA accidents in 2002 were up slightly over the previous year, although the number of people killed in those accidents increased by only one. A summary of 2002 accident statistics derived from NTSB reports is presented in Figure 1.

ACCIDENT STATISTICS

	1998	1999	2000	2001	2002
Total Fixed-Wing GA Accidents	1,668	1,680	1,592	1,491	1,472
Fatal Fixed-Wing GA Accidents	337	305	300	295	312
Total Fixed-Wing GA Fatalities	591	552	521	517	518
Estimated GA Flight Hours	25.5M	29.2M	27.8M	25.4M	25.5M

Fig. 1

To keep aviation safety comparisons in perspective, an accident "rate" is commonly used, comparing the number of accidents with the estimated number of hours flown by the subject group. For aviation, rates are commonly calculated as the number of accidents per 100,000 estimated flight hours. Figure 2 shows the NTSB-estimated overall GA accident rates for the last 10 years. The estimated number of hours flown increased from 25.4 million in 2001 to 25.5 million in 2002. The preliminary NTSB-estimated rate for 2002 is 6.69 total accidents and 1.33 fatal accidents, each per 100,000 flight hours.

Please note that the NTSB-estimated yearly accident rates for GA include flight activities not included in the ASF Nall Report, such as helicopter, glider, and balloon flying. Of course, the vast majority of GA flight hours logged are in fixed-wing aircraft under 12,500 pounds gross weight, but there is no separate official estimate of flight hours for this group, making a separate accident rate calculation virtually impossible.

U.S. GENERAL AVIATION ACCIDENTS

per 100,000 Flight Hours 1993-2002

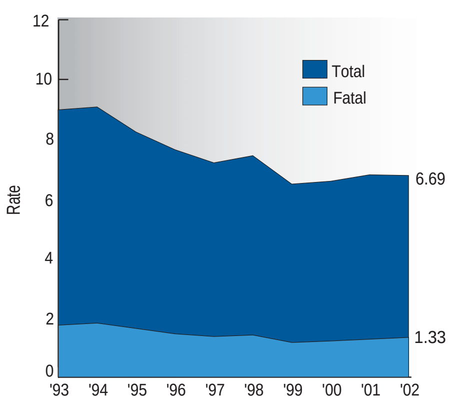


Fig. 2

Once again, there were no surprises regarding the leading accident factors for GA accidents in 2002. About three-quarters of GA accidents were pilot-related, a statistic that changes little from year to year.

In every form of human activity involving machinery, such as automobiles, boats, and aircraft, the hardware is invariably more reliable than the human operator. Humans cannot be re-engineered to improve piloting or decision-making skills, while machinery is improved to make it more reliable. This does not mean that accidents are inevitable, nor does it mean that just by trying harder, or by adding multiple layers of regulation, the safety record will improve significantly. It does mean that a thoughtful approach to every flight by every pilot with a realistic assessment of risk and appropriate training is essential.

GA Safety vs. Airlines

GA accident rates have always been higher than airline accident rates because of the marked differences in the type of flying. Following are some of the important distinctions of GA:

- **Less regulation** — GA pilots conduct a wider range of operations.
- **Wider variance in pilot certificate and experience levels** — GA is the training ground for the industry. Certificates range from ATP to student pilot with similar variability in flight hours, whereas all airline flights are crewed by at least one ATP.
- **Fewer cockpit resources** — Air carrier operations require at least two pilots; GA operations are predominantly single pilot. GA aircraft owners and pilots are individually responsible for the safety of flight. Air carriers and the military have dispatchers, mechanics, and loadmasters to share a variety of duties.
- **More facilities** — GA flies to nearly 14,000 airports; the airlines serve only about 700. Many GA airports lack precision approaches, long runways, approach lighting systems, and the advanced services of airline-served airports.
- **Many operations**, such as aerial application, external load, and banner towing, have special mission-related risks.
- **More takeoffs and landings** — the highest risk phases of any flight. On a per hour basis, GA conducts many more takeoffs and landings than either air carriers or the military.
- **Less weather tolerant aircraft**, which generally must fly though the weather instead of over it, or may not have systems to avoid or cope with adverse conditions.

Although GA operations are different from air carrier operations, pilots who actively manage risk can significantly improve safety.

AIRCRAFT CLASS

A casual look at accident and fatality rates for the three different classes of fixed-wing GA aircraft under 12,500 pounds might lead to a hasty but erroneous conclusion that flight in a single-engine, fixed-gear aircraft is far more dangerous than in the other two types, single-engine retractable gear aircraft or multiengine aircraft. It's true that there are more total accidents in fixed-gear singles, but that's because there is a much greater exposure. An analysis of Figure 3 reveals the reason for the different rates.

ACCIDENT AND FATALITY RATES BY AIRCRAFT CLASS

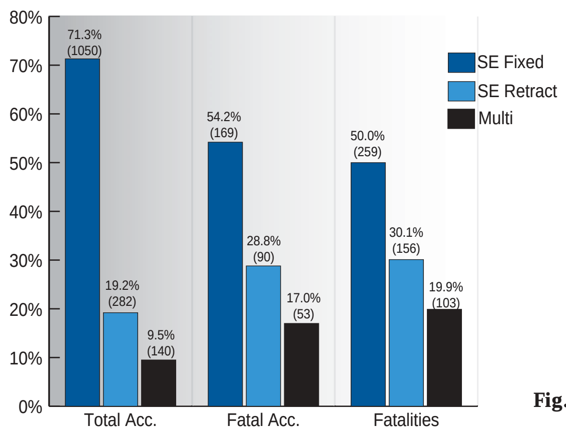


Fig. 3

Of the total of 1,472 total GA accidents analyzed for this year's Nall Report, 1,050 (71.3 percent) were in single-engine fixed-gear (SEF) aircraft. Another 282 (19.2 percent) were in faster, more complex single-engine retractable gear (SER) aircraft, while just 140 (9.5 percent) were in multiengine (ME) aircraft.

SEF aircraft were also involved in more fatal accidents (169, or 54.2 percent) than either SER aircraft (90, or 28.8 percent) or ME aircraft (53, or 17 percent). There were correspondingly more individual fatalities in 2002 in SEF (259, or 50 percent), than in SER (156, or 30.1 percent) or ME (103, or 19.9 percent).

But SEF aircraft are far more numerous than either SER or ME, and fly correspondingly more hours each year.

IFR weather-related and IFR approach accidents are more common in SER and ME aircraft because these aircraft operate more frequently in instrument weather conditions.

Takeoff, landing, and maneuvering flight—dangerous phases

For pilot-related GA accidents, just three phases of flight account for about two-thirds of all accidents, and almost half of all fatal accidents. Weather-related accidents also have high fatality rates, and will be discussed later in this report.

Those three phases are takeoff, landing, and maneuvering. In 2002, there were a total of 395 landing accidents, 194 takeoff accidents, and 89 maneuvering flight accidents.

But of those three, maneuvering flight accidents were far more likely to result in fatalities. In 2002, over half (57.3 percent) of all maneuvering flight accidents were fatal. For takeoff, the fatality percentage was 18 percent; for landing, just 2.5 percent.

An ASF study of GA accidents from 1991–2000 showed that pilot failure to maintain control of the aircraft was the leading factor for both takeoff accidents and landing accidents, accounting for 30.2 and 32.8 percent of all such accidents, respectively. Accident investigators ascribe a variety of factors to such accidents, including failure to establish a positive rate of climb, inability to maintain climb speed, stalling, premature rotation, or spatial disorientation. Other factors often cited are wind conditions, power loss, surface conditions, aircraft configuration, and landing gear malfunction.

But almost without exception, loss of control of the aircraft on takeoff or landing is an issue of either inadequate training or lack of pilot proficiency. In takeoff and landing accidents, insufficient or incorrect rudder and aileron use is often the culprit, and can be corrected only by competent initial instruction and ongoing practice after earning a pilot certificate.

When pilots encounter more complex situations, such as strong crosswinds, short fields, or high density altitudes, competent dual instruction is highly recommended.

As shown in the figure below, the percentage of takeoff and landing accidents varies relatively little year-to-year.

TAKEOFF AND LANDING ACCIDENT TRENDS

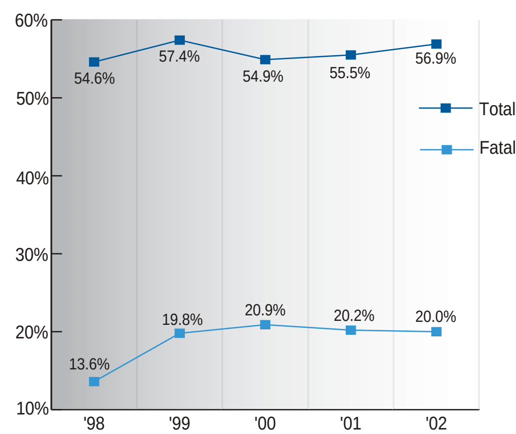


Fig. 4

Weather-related accidents equal high fatality rate

Weather-related accidents continue to have the highest probability of fatalities. In single-engine fixed-gear airplanes, 71.4 percent (15 of 21) of weather-related accidents were fatal. In single-engine retractable-gear airplanes 90 percent (nine of ten) of weather-related accidents were fatal and 75 percent (six of eight) of weather-related accidents in multiengine airplanes resulted in fatal injuries. The only bright side—if you can call it a bright side—is that weather-related accidents accounted for a paltry 3.6 percent of all accidents in 2002.

Over the last few years, weather-related accidents have accounted for only about three percent of total mishaps, but 14.5 percent of the fatal accidents. While the numbers do not show a consistent trend, the percentage of fatal weather-related accidents decreased from 15.2 percent in 2001 to 13.6 percent in 2002.

As shown by Figure 5, no strong trend line for GA weather accidents exists. After a noticeable jump in 1998, weather accidents remained within fairly narrow ranges.

WEATHER ACCIDENT TRENDS

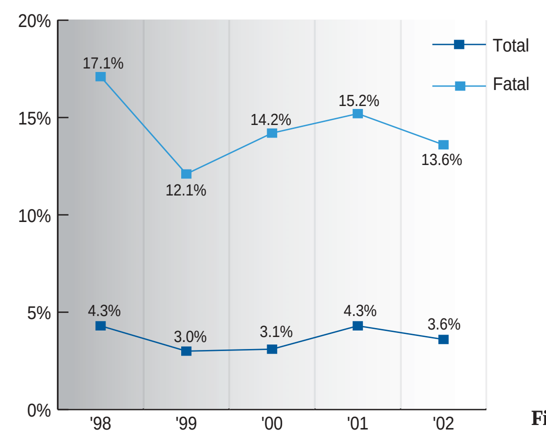
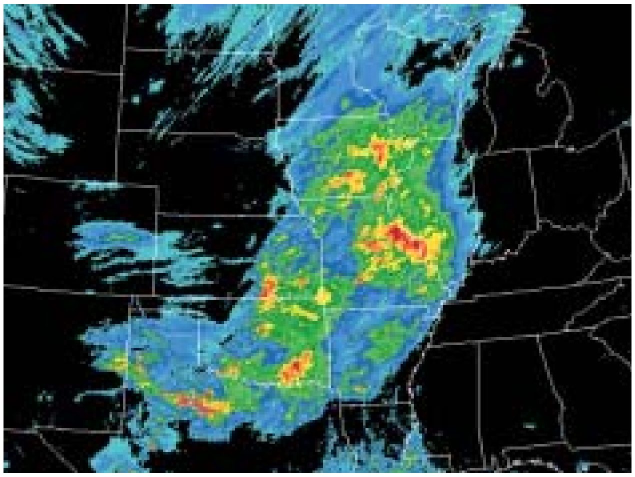


Fig. 5

To clarify, weather is usually cited as a factor, as opposed to a cause in aviation accidents. Generally, these accidents are a result of the pilot's decision to fly into weather beyond his, her, or the aircraft's capability. We will refer to these decision-making errors involving weather as weather or weather-related accidents.

The following paragraphs outline the areas of concern and related statistics in each class of airplane. In each class, the fatal percentages indicate the proportion of accidents in each phase that resulted in the death of at least one person on board the aircraft.



Single-Engine Fixed-Gear Aircraft

797 total/ 123 fatal

The top four areas for fatal accidents in single-engine fixed-gear aircraft in 2002, listed below, are similar to previous years. Together, these areas account for 71.6 percent of all fatal pilot-related accidents in these airplanes.

- Maneuvering: 30.1 percent (37)
- Takeoff/Climb: 17.9 percent (22)
- Weather: 12.2 percent (15)
- Descent/Approach: 11.4 percent (7 VMC, 7 IMC)

ACCIDENT CAUSES SINGLE-ENGINE FIXED-GEAR

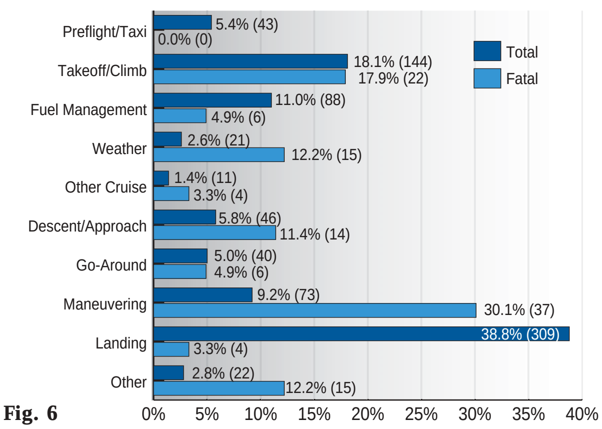


Fig. 6

Single-Engine Retractable-Gear Aircraft

174 total/ 58 fatal

The following top four areas for fatal accidents in single-engine retractable-gear aircraft in 2002 account for 62 percent of all fatal pilot-related accidents in these airplanes.

- Maneuvering: 19.0 percent (11)
- Descent/Approach: 17.2 percent (5 VMC, 5 IMC)
- Weather: 15.5 percent (9)
- Other Cruise: 10.3 percent (6)

ACCIDENT CAUSES SINGLE-ENGINE RETRACTABLE-GEAR

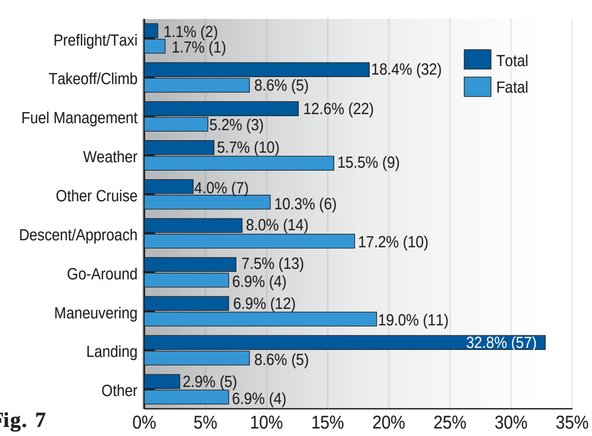


Fig. 7

Multiengine Aircraft
98 total/ 39 fatal

The list below identifies the top four areas for fatal accidents in multiengine aircraft in 2002. Together, these areas accounted for 79.5 percent of all fatal pilot-related accidents in these airplanes.

- Descent/Approach: 33.3 percent (7 VMC, 6 IMC)
- Takeoff/Climb: 20.5 percent (8)
- Weather: 15.4 percent (6)
- Fuel Mismanagement: 10.3 percent (4)

ACCIDENT CAUSES MULTIENGINE

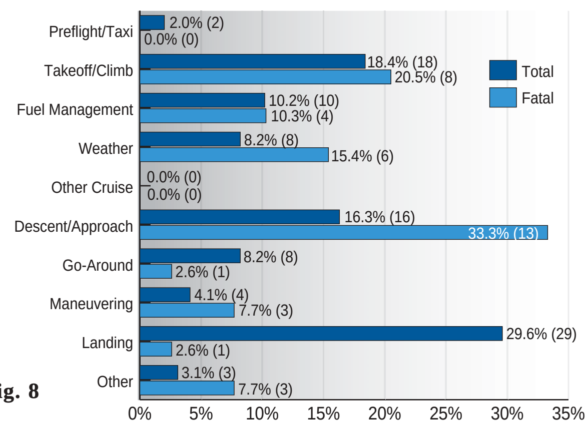


Fig. 8

LEADING ACCIDENT CAUSES AND FACTORS

Phase of Flight
Pilot-related accidents continue to account for about three-quarters of all GA accidents, and the majority of those occur during phases of flight that involve a high number of critical tasks and high task complexity. Takeoffs and landings are a good example: well over one-third of all GA accidents in 2002 occurred during landing. But note that the percentage of fatal accidents during landing is relatively low, a reflection of both relatively low speeds during landing and the paucity of obstructions in the vicinity of most airports.

Another phase of flight with multiple tasks and complexity is maneuvering flight, which includes such activities as practicing emergency procedures at low altitudes. But the outcome of maneuvering flight accidents is much less often benign than landing accidents; the fatality rate for maneuvering accidents is the highest of any phase of flight, by a substantial margin. Weather involvement accidents also produce a very high fatality rate, but weather is a frequently cited factor, not a phase of flight.

Cruise is one phase in which GA accident proportions consistently differ from commercial flying. Weather is usually the culprit in GA cruise accidents, and was the cause in 13.6 percent of all pilot-related fatal accidents in 2002. Weather is especially a factor when GA pilots attempt VFR flight into IMC. About 49 percent of the pilot population is instrument qualified. While IFR flying presents new risk areas that pilots must manage, earning an instrument rating can equip the pilot with vital life-saving skills.

Pilot-Related Causes
1069 total/ 220 fatal

ACCIDENT CAUSES PILOT-RELATED

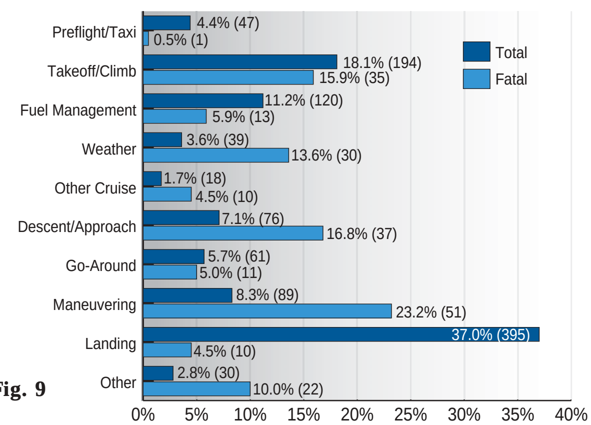


Fig. 9

GENERAL AVIATION ACCIDENT SUMMARY

MAJOR CAUSE	ALL ACCIDENTS	FATAL ACCIDENTS
Pilot	72.6%	70.5%
Mechanical/Maintenance	18.1%	14.1%
Other	7.7%	9.9%
Unknown	1.5%	5.4%
TOTAL	100%	100%

MAJOR CAUSE	ALL ACCIDENTS	FATAL ACCIDENTS
Pilot	1,069	220
Mechanical/Maintenance	267	44
Other	114	31
Unknown	22	17
TOTAL	1,472	312

Fig. 10

As shown in Figure 10 (opposite page), pilot-related problems accounted for 72.6 percent of all accidents and 70.5 percent of the fatal accidents in the accident records reviewed for this report. After all reports are finalized this typically climbs to 75 percent. Many of the mechanical/maintenance accidents are also attributable to human-related problems, such as inadequate preflights, skimpy or no preventative maintenance, or even occasional operation of the aircraft outside its design limits. In addition, as existing GA aircraft get older, more mechanical/maintenance problems can naturally be expected.

Figure 11 shows the phase of flight in which pilot-related accidents began. There is some overlap in the terms used to describe the phase in which the emergency occurred and the accident cause, but the two are not always the same. For example, fuel exhaustion resulting in an accident may have occurred during cruising flight or during a landing approach. The accident cause will be attributed to fuel management and the phase of flight may be listed as approach or cruise. Conversely, problems associated with approach operations, such as descending below the minimum descent altitude, will show approach as both the phase of flight and the cause.

EMERGENCY PHASE OF FLIGHT

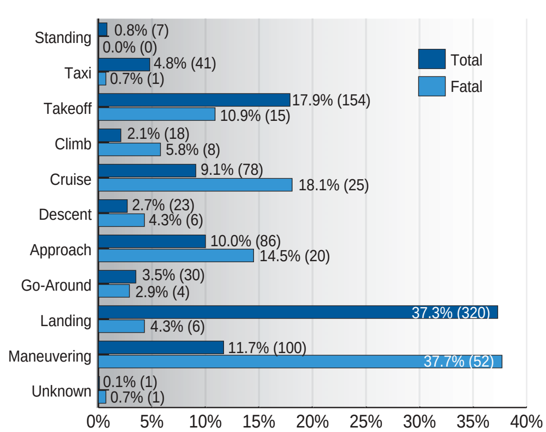


Fig. 11

Pilot Experience

A pilot's flying experience, usually thought of in terms of total flight hours, is often regarded by the public as the best indicator for safety. There is undoubtedly some truth to this, although last year's Nall Report found that student pilots had relatively few accidents (7.7 percent of all accidents) even though they accounted for 15.3 percent of the total pilot population. Private, commercial, and airline transport pilots, however, were all involved in more accidents than their representation in the total pilot population should support. One possible explanation for this apparent anomaly is in the higher degree of supervision exercised over student pilots, and the fact that most flight training is conducted in good weather conditions, and in carefully controlled circumstances.

PILOT IN COMMAND HOURS OF EXPERIENCE

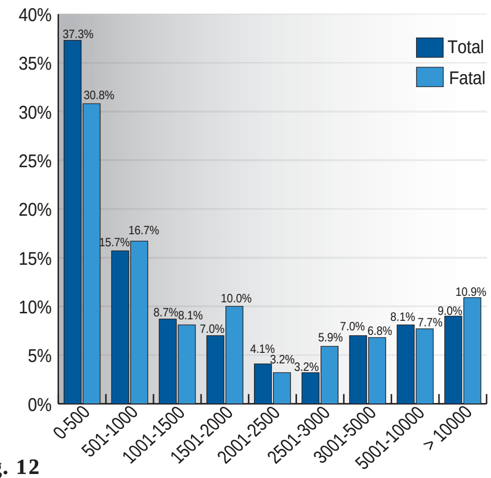


Fig. 12

This year, ASF correlated total and fatal accidents in 2002 with the reported hours of experience of the pilot in command. Not surprisingly, pilots with 500 or fewer total hours accounted for 37.3 percent of all accidents, and 30.8 percent of fatal accidents, while the absolute lowest involvement in fatal accidents was by pilots with between 2,001 and 2,500 total hours. ASF studies have shown that low pilot time in type is often a significant contributing factor in accidents. Transitioning to a new aircraft, even one that is less complex, can cause problems for experienced pilots as well as novices.

Please note that these are raw numbers, and have not been adjusted for exposure. Neither the FAA nor the NTSB keeps records that show the distribution of experience levels in the pilot population, nor records that could be used to gauge the amount of flying done in any specific year by any given group of pilots with a similar experience level.

SPECIFIC OPERATIONS

The purpose of a flight is referred to as type of operation. The following paragraphs focus on three of the most common GA operations: personal flying, business flying, and flight instruction. Figure 13 shows how these categories compare to other types of operations.

With just two exceptions, every type of GA flight operation has an accident rate lower than the percentage of flying for that type of activity. For instance, instructional flying accounts for just over 20 percent of all GA flying, but incurs only 12.9 percent of the total accidents.

The two exceptions are aerial application, formerly called crop-dusting, and personal flying. Most pilots understand that aerial application carries an inherent risk, operating close to the edge of both the aircraft performance envelope and of solid, immovable objects on the ground. Despite this, aerial applicators recorded only 4.7 percent of all accidents in the course of doing 3.6 percent of all GA flying. Considering the flight environment, this is an outstanding record!

TYPE OF OPERATION

TYPE OF OPERATION	Percent of Flying (2001)	Percent of Total Accidents (2002)	Percent of Fatal Accidents (2002)
Personal	47.9%	69.8%	72.1%
Instructional	20.1%	12.9%	7.4%
Aerial Application	3.6%	4.7%	1.9%
Business	14.5%	3.9%	7.1%
Positioning	*	2.0%	1.9%
Ferry	*	0.5%	1.3%
Other Work Use	1.3%	1.9%	1.6%
Aerial Observation	4.0%	0.5%	1.6%
Exec./Corporate	5.8%	0.3%	0.0%
Other/Unknown	2.8%	3.5%	5.1%

*Included in Other/Unknown

Fig. 13

Personal Flying

752 total/ 156 fatal

Personal flying, on the other hand, averages about 48 percent of all GA flying, but in 2002 suffered almost 70 percent of all accidents, and an even greater percentage of all fatal accidents. Unfortunately, those rates in 2002 were not an aberration.

Possible reasons for the high accident rate in personal flying include lack of experience, proficiency issues, pilots exceeding personal limitations, showing off, and just plain poor judgment. In some of the other types of GA flight operations, pilots have more stringent proficiency requirements, greater annual flying time, specialized training, and regular recurrent training. Since about three-quarters of all GA accidents involve some type of pilot error, it's apparent that some additional aviation training, proficiency, and knowledge would be a relatively cost-effective way for personal fliers to reduce accidents.

Figure 14 shows the proportion of total and fatal accidents due to a particular cause that occurred during personal flights.

PROPORTION OF ACCIDENTS ATTRIBUTED TO PERSONAL FLYING

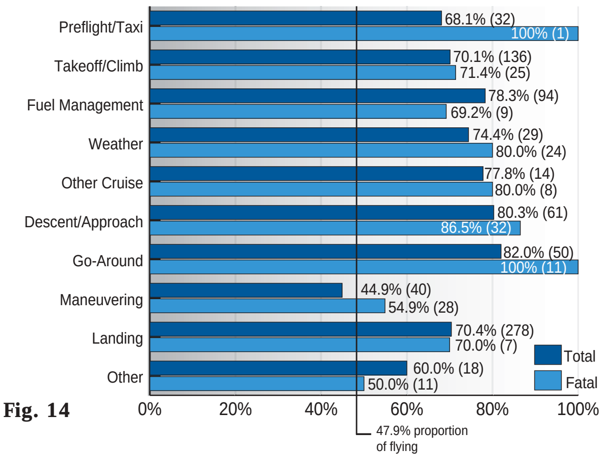


Fig. 14

Business Flying

39 total/ 17 fatal

PROPORTION OF ACCIDENTS ATTRIBUTED TO BUSINESS FLYING

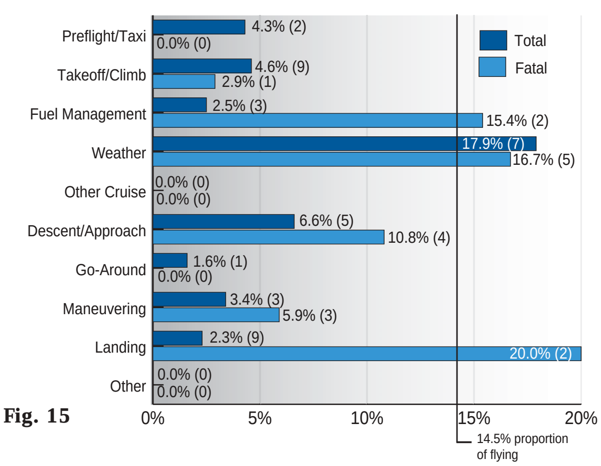


Fig. 15

Flying 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 transportation.

Since the terrorist attacks of 2001 and resulting heightened airline security, GA flying has also become increasingly attractive for its relative security. Passengers are known friends and business associates, and various security measures at GA airports—such as AOPA's Airport Watch program—have provided additional peace of mind for business travelers, without the need for a rigorous and time-consuming program such as that used at larger airports.

Business flights accounted for only 3.6 percent of the total pilot-related accidents and 7.7 percent of the fatal pilot-related accidents in 2002 while accounting for 14.5 percent of all GA flight hours. *Note: The primary distinction between business and corporate flying is that corporate pilots are hired only to fly while, for business pilots, flying is secondary to their primary business function. Many corporations operate turbojet aircraft that weigh more than 12,500 pounds and are not considered in this report. However, smaller piston, turboprop, and light jet airplanes operated by individuals or corporations are included.*

The causes of business travel accidents, as well as the fatality rate for each cause, are shown in Figure 15. Care should be exercised in interpreting this chart, since the low number of accidents may exaggerate specific accident areas. For instance, Figure 15 shows business flying responsible for a full 20 percent of 2002 fatal landing accidents, when in fact there were only 10 total fatal landing accidents in all categories, and just two in the business category. As in most recent years, business accidents in 2002 were lower than the proportion of business flying hours in all causal areas. Overall, business flying continues to have a very good safety record.

Instructional Flying

158 total/ 18 fatal

PROPORTION OF ACCIDENTS ATTRIBUTED TO INSTRUCTIONAL FLYING

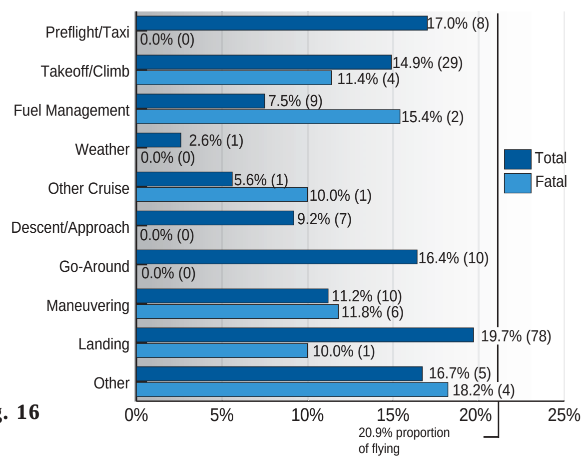


Fig. 16

Flight training, which includes dual instruction and solo flight for instructional purposes, accounted for 14.8 percent of all pilot-related accidents in 2002. Fatal pilot-related instruction accidents declined from 9.7 percent in 2001 to 8.2 percent in 2002. The proportion of total accidents attributed to instructional flying also decreased slightly, from 15.9 percent in 2001 to 14.8 percent in 2002, but is still well below the 20.1 percent of total flight time attributable to instructional flight. Following are some noteworthy facts about instructional flying:

- The total number of accidents attributable to instructional flying decreased by 8.7 percent in 2002 compared to the previous year's figures (158 vs. 173).

- Landing accidents in instructional flights decreased by 18.8 percent in 2002 (78 vs. 96).
- Accidents in takeoff and initial climb increased 26.1 percent from 23 in 2001 to 29 in 2002.
- Instructional accidents due to weather decreased from 2 in 2001 to 1 in 2002, with no fatalities.

Although not included in this year's report, a rise in 2003 instructional accidents is the subject of an ASF special report, found at www.aopa.org/asf/topics/instructional.html. That rise will be analyzed in next year's Nall Report.

Mechanical/Maintenance

267 total/ 44 fatal

ACCIDENT CAUSES MECHANICAL/MAINTENANCE

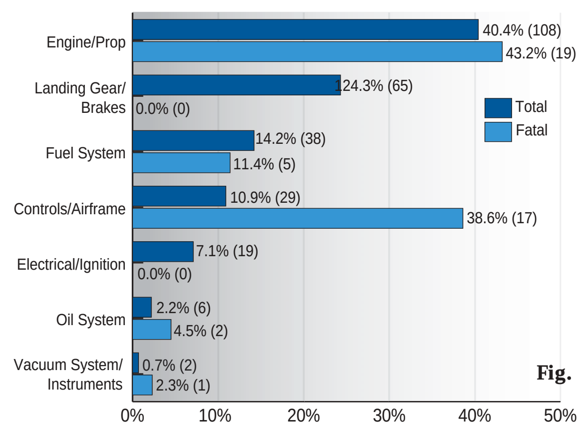


Fig. 17

As most pilots might suspect, problems with the engine or propeller caused the largest percentage of accidents involving mechanical or maintenance issues in 2002. Of all mechanical/maintenance accidents, 40.4 percent were blamed on the engine or propeller, while 43.2 percent of fatal accidents were attributed to the same causes.

Another 51 accidents were classified as "power malfunction/loss for unknown reasons." For example, carburetor icing could cause engine stoppage, but by the time investigators arrive, the evidence may have melted.

Overall, mechanical/maintenance factors accounted for 18.1 percent of all accidents and 14.1 percent of fatal accidents in 2002. Total accidents in this category are up from 2001, when 14.2 percent of all accidents were attributed to mechanical/maintenance issues. Fatal mechanical/maintenance accidents increased substantially in 2002.

Several of the mechanical failure accidents could have been prevented by a thorough preflight. Other accidents resulted when pilots incorrectly performed procedures after system failures occurred. The number and percentage of mechanical-related accidents typically increases slightly once all final reports are in, but the average is 16.0 percent. On all aircraft, but particularly older aircraft, attention to regular maintenance is essential.

The number of mechanical/maintenance accidents has gradually increased since 1997, perhaps as a result of the aging aircraft fleet. Unfortunately, when the NTSB investigates an accident, they do not record the year of manufacture of the aircraft, making any studies relating to aging aircraft almost impossible to conduct. The percentage of total accidents attributed to mechanical/maintenance issues increased from 14.6 percent in 1998 to 18.1 percent in 2002. A thorough preflight will prevent some, but not all, of these accidents. Good maintenance is essential, especially with older aircraft.

MECHANICAL/MAINTENANCE ACCIDENT TRENDS

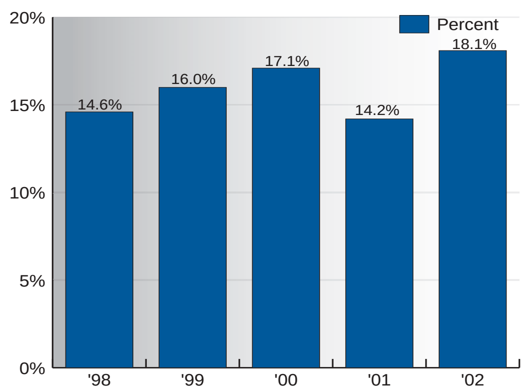


Fig. 18

WEATHER

39 total/ 30 fatal

Attempted VFR flight into instrument meteorological conditions (IMC) continues to be the most deadly weather-related accident cause. While it resulted in only 1.6 percent of all pilot-related accidents in 2002, 89.4 percent of those were fatal. VFR pilots who find themselves in marginal weather must exit immediately before encountering the clouds. Instrument-rated pilots are trained for this condition, but still fall victim to this deadly scenario, especially when not on an IFR flight plan. Before flight, get a weather briefing and ask for pilot reports (pireps) along your route. While en route, give pireps to confirm or contradict the forecast, and help other pilots.

Note: To learn more about pireps, visit www.aopa.org/asf/skyspotter/ and participate in ASF's online SkySpotter® program.

FATAL WEATHER RELATED ACCIDENTS BY AIRCRAFT CLASS

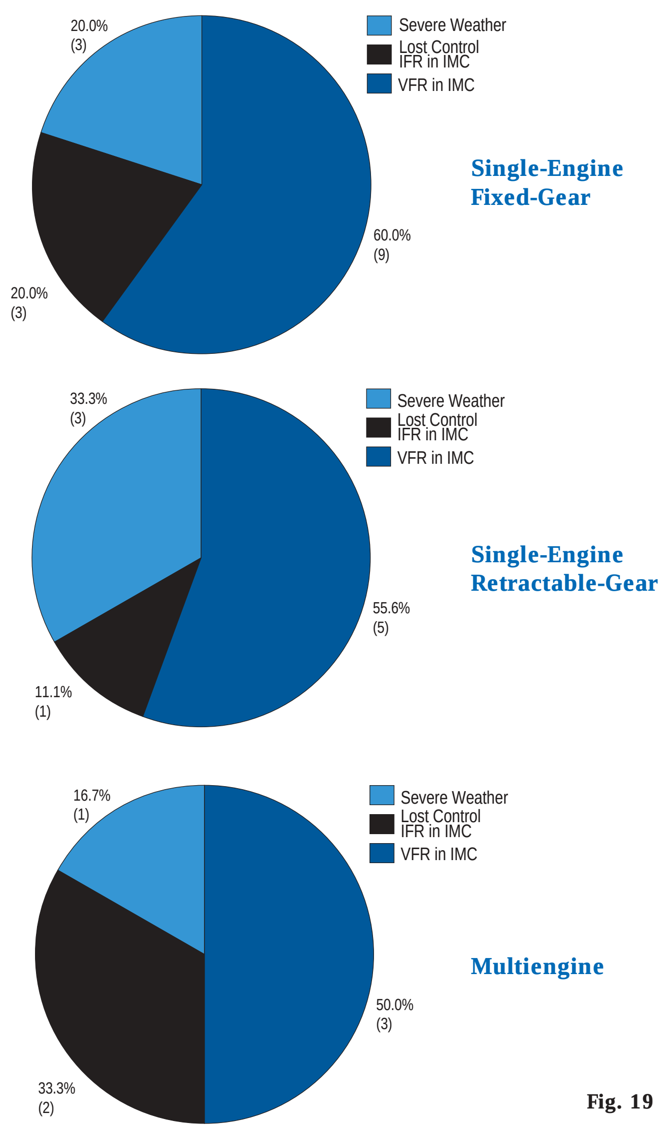


Fig. 19

Figure 19 (opposite page) shows fatal weather-related accident causes, categorized by class of aircraft. While many of these accidents involved inexperienced VFR pilots, high-time commercial and airline transport pilots were also included. For this report, severe weather includes thunderstorms, clear-air turbulence, and icing.

Most weather-related accidents involved aircraft striking objects or terrain at high airspeed or crashing out of control, sometimes after pilot-induced structural failure. Of particular note in 2002 was an increase in the number of accidents during descent and approach, some in IMC. More information is contained in the "Descent/Approach" section, on page 11.

Interaction of Night and Weather

Figure 20 shows total and fatal accidents in various light and weather conditions. Night increases the probability of fatalities; 21.2 percent of all accidents resulted in fatalities, but 23.5 percent of night accidents were fatal. IMC, however, more than doubles the probability of a fatality—66.3 percent of IMC accidents resulted in fatalities. The combination of night and IMC increased the fatality rate to 75.0 percent.

CONDITIONS	Total Accidents	Fatal Accidents	Percent Fatal	Accident Rate/ 100,000 hours
Day	1,072	146	13.6%	5.15
Night	149	35	23.5%	4.61
VMC	1,384	236	17.1%	6.17
IMC	83	55	66.3%	5.1
All Cond.	1,472	312	21.2%	6.12
Day VMC	1,033	135	13.1%	5.27
Night VMC	128	28	21.9%	4.56
Day IMC	37	24	64.9%	3.07
Night IMC	20	15	75.0%	4.74

Fig. 20

SPECIAL EMPHASIS TOPIC

Instructional Safety

There was an unexpected spike in instructional accidents in 2003. That statistical anomaly will be analyzed in next year's Nall Report, with rates and trends of other 2003 GA accidents.

But FAA concern over the spike prompted ASF to conduct a special study of instructional safety, using the ASF Accident Database to analyze dual and solo instructional accidents from 1992 to 2001. The study found 2,295 instructional accidents in the ten years, about nine percent of which were fatal. It also concluded that training for a pilot certificate or rating was still safer than other types of GA flying, especially personal flying, based on the proportion of flying in each category.

But the ASF study also identified four main areas in which the majority of instructional accidents occurred.

Student Ups and Downs

Takeoff and landing accounted for just over 45 percent of all dual instructional accidents. (For GA as a whole, takeoff and landing accidents account for about 55 percent of all pilot-related accidents.)

Solo practice resulted in an even greater percentage of takeoff and landing instructional accidents, with just over half of such accidents during landing. The importance of supervision by CFIs, and the need for continued practice by low-time pilots, was highlighted: 74 percent of the pilots involved in instructional takeoff and landing accidents had fewer than 60 total hours, and students with between 21 and 40 hours were responsible for the greatest percentage of landing accidents. Here is where a little knowledge and skill is dangerous. The level of CFI supervision may have declined from earlier in the program, just when the new pilot is taking on more challenge.

Caution: Maneuvering Flight

ASF found that maneuvering flight, which includes low altitude practice of emergency procedures, accounted for seven percent of all dual instructional accidents. It was also the most deadly type of instructional activity, accounting for nearly one-third of all dual fatal accidents.

A surprising 38 percent of maneuvering accidents occurred while practicing emergency procedures at low altitudes, suggesting that CFIs sometimes fail to set safety criteria for low altitude maneuvers, or do not adhere to them. In the study, ASF suggested that instructors teaching such procedures establish a "hard deck" (altitude) where recovery will be made, allowing some room for a successful landing in the event of an engine failure.

See and Avoid

Midair collisions (MACs) accounted for 16 percent of dual and 20 percent of solo fatal instructional accidents. Most MACs occurred within the first 100 hours of flight for students and new pilots.

Having a CFI on board is not necessarily protection from MACs. A CFI was on board at least one of the aircraft in more than one-quarter of MACs.

Additional research by ASF confirmed that MACs are most likely during peak flight training times—during day VFR, between 10 a.m. and 5 p.m. during the warmer months, within five miles of an airport, and at lower altitudes. More than half of the MACs studied by ASF occurred below 500 feet agl, final approach altitude. This is conventional wisdom and shows that collisions occur where the most aircraft congregate—near airports on nice days. It also stresses the importance a formal collision avoidance plan developed by flight schools and CFIs.

Fuel or Fool?

Fuel mismanagement includes both fuel exhaustion and fuel starvation. Fuel exhaustion occurs when the airplane is completely out of fuel, and fuel starvation means that fuel remains, but the pilot failed to switch tanks after one runs dry. Fuel mismanagement was the primary cause of about seven percent of all dual instructional accidents, and about eight percent of all solo instructional accidents. There is a need for additional fuel awareness. See ASF's Safety Advisor Fuel Awareness online at www.aopa.org/asf/publications/sa16.pdf.

The full report, *Flight Instruction Safety*, is available at www.aopa.org/asf/topics/instructional.pdf.

FATAL ACCIDENT FACTORS

The top few factors in fatal GA accidents usually change little from year to year, and generally involve weather, maneuvering flight, takeoff/climb, and descent/approach. In 2002, however, the number of fatal accidents during cruise flight (excluding weather-caused accidents) rose enough to be included in the top four. For all classes of aircraft, and based on the probability of fatalities, most 2002 fatal accidents occurred under the following conditions:

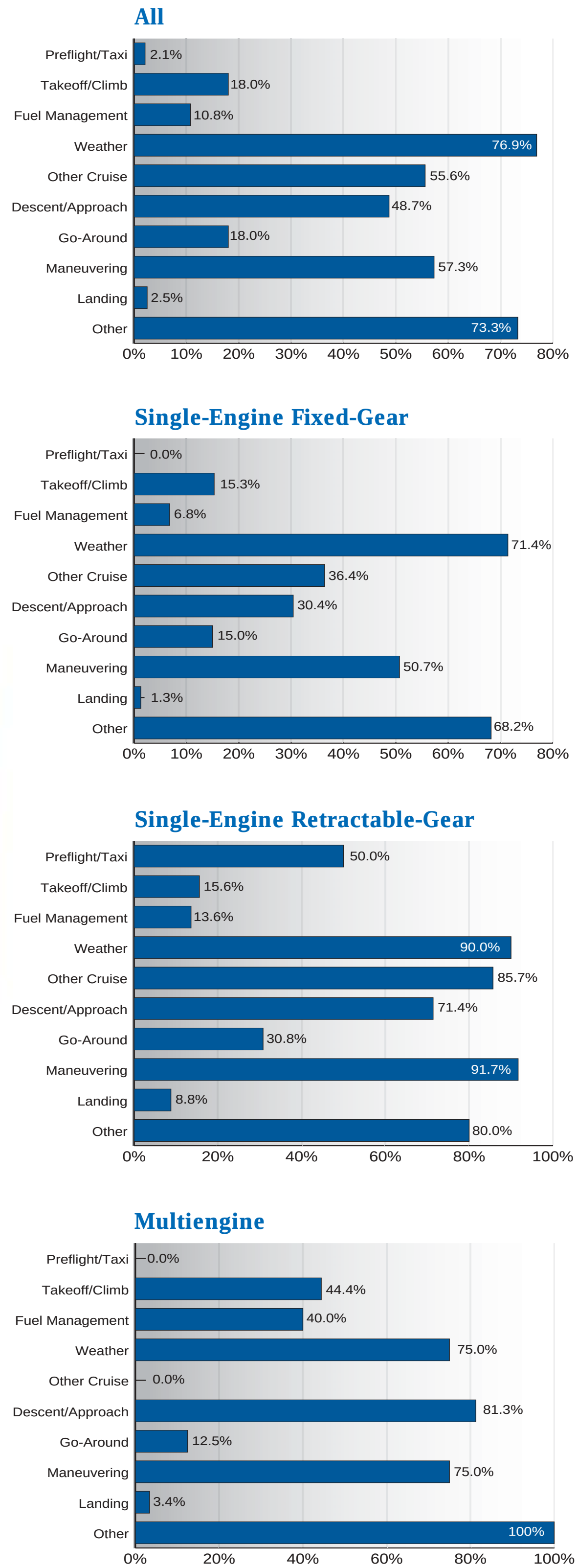
- Weather
- Maneuvering
- Cruise
- Descent/Approach

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.

Probability of Fatalities

Chances that any given accident will result in fatalities can be estimated given the aircraft type and the phase of flight in which the accident occurs.

PROBABILITY OF FATALITIES Figure 21



It may be comforting to pilots flying SEF airplanes that the probability of fatalities in that aircraft type is less, in virtually any phase of flight, than in SER or ME aircraft. While SEF pilots may point to their piloting prowess as the reason, it is much more likely that the higher fatality rates in SER and ME are due to higher speeds at impact, and the fact that SER and ME aircraft are more often flown in weather and in other situations that could contribute to a fatal accident.

The four graphs (opposite page) show the probability that an accident in a certain phase of flight or category of aircraft will result in a fatality.

Weather accidents have the greatest chance of being fatal. For all aircraft categories combined, the probability is 76.9 percent. However, that increases in single-engine retractable gear, to 90.0 percent. Maneuvering flight is another phase of flight with a high probability of fatalities.

An unusual spate of fatal accidents involving cruise flight at low altitudes and subsequent collision with an object or terrain placed cruise flight higher than usual on the fatal accident list for 2002. Those collisions resulted in a fatality rate in cruise of 55.6 percent in 2002.

Maneuvering Flight

89 total/ 51 fatal

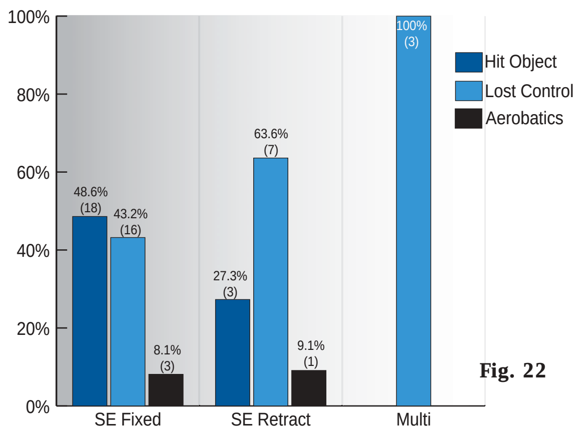


Fig. 22

Maneuvering continues to be the phase of flight producing the largest number of fatal GA accidents. More than half (57.3 percent) of all accidents involving maneuvering flight (51 of 89 accidents) involved fatalities. Like weather-related accidents, maneuvering accidents frequently involved aircraft crashing out of control or colliding with terrain, wires, or other structures. It is also one of the most preventable. Twenty-one of 51, or 41.2 percent, of fatal maneuvering accidents were the result of "hit terrain, wires, trees, etc." Twenty-six of the 51 (51 percent) fatal maneuvering accidents were attributed to "loss of control." All three (100 percent) fatal maneuvering accidents in multi-engine 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.

The majority of maneuvering accidents (44.9 percent) occurred during personal, not mission-related flights.

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 an increase in judgment.

Descent/Approach

76 total/ 37 fatal
56 VMC/ 20 IMC

Aside from steep turn/stall mishaps, "improper IFR approach" was one of the largest single problems in this area, adding another dimension to the weather-related accident count.

Accidents resulting from mishandled approaches, although relatively low in number, were fatal 48.7 percent (37 of 76) of the time. Most problems in this category were the result of stall/mush or failure to follow instrument approach procedures. All classes of aircraft were represented in both of these problem areas.

Fatal instrument approach accidents involved six single-engine fixed-gear, six single-engine retractable gear, and five multiengine aircraft. Training and currency are essential, but pilots must also consider fatigue. Instrument-rated pilots must perform complex tasks, often after flying for long periods in bad weather.

Airline studies conducted by NASA and FAA have shown that the most demanding tasks, landing and approach, must be performed at a time when the pilot's ability to accomplish complex tasks may be significantly diminished.

HOMEBUILT AIRCRAFT

Pilot-Related Causes

117 total/ 36 fatal

ACCIDENT CAUSES HOMEBUILT PILOT-RELATED

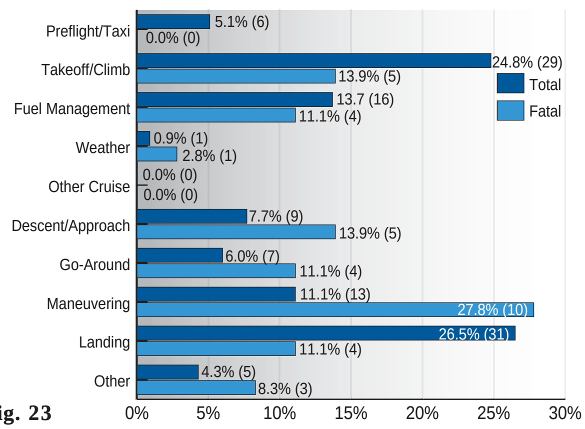


Fig. 23

Figure 23 above shows accident causes for homebuilt airplanes. Some of these accidents were the result of pilots being unprepared for the peculiarities of their aircraft, as shown by the nearly 25 percent of homebuilt accidents recorded during takeoff and climb. Being prepared is particularly important for initial flight-testing, since lack of preparation often shows up in approach accidents. Many of these accidents also involved poor judgment on the part of the pilots involved, rather than any unique features of their aircraft.

HOMEBUILT ACCIDENT SUMMARY

MAJOR CAUSE	ALL ACCIDENTS	FATAL ACCIDENTS
Pilot	59.7%	60.0%
Mechanical/Maintenance	28.1%	25.0%
Other	11.7%	13.3%
Unknown	.5%	1.7%
TOTAL	196	60

Fig. 24

Comparison with Factory Aircraft

In 2002, homebuilt airplanes were involved in 196 accidents. Of these, 60 fatal accidents resulted in 79 fatalities. Factory-built airplanes in 2002 were involved in 1,276 accidents, of which 252 were fatal with 439 fatalities. Just over 30 percent of homebuilt aircraft accidents resulted in fatalities, and 19.7 percent of the accidents in factory-built airplanes were fatal. As in prior years, it appears that there is a significantly higher risk of fatality in the event of an accident in a homebuilt aircraft compared to a factory-built machine.

Although fatal homebuilt aircraft accidents decreased dramatically in 2000, they increased to 19.2 percent in 2002. Historically, homebuilt aircraft are involved in approximately 17 percent of all fatal accidents.

HOMEBUILT ACCIDENT TRENDS

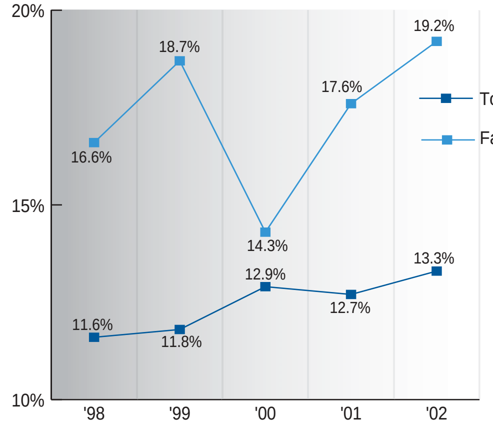


Fig. 25

OTHER ACCIDENT FACTORS

Midair Collisions

9 total/ 5 fatal

During 2002, there were nine midair collisions involving a total of 15 GA aircraft. Five of these accidents were fatal, resulting in nine deaths. This number is up compared to 2001, when there were a total of five collisions, of which three were fatal, and eight total fatalities.

Midair collisions usually occur on good VFR days, at low altitude, close to airports. In 2002, all of the midair collisions occurred in VMC and during the hours of daylight. ASF has made a major effort in the last two years to remind pilots to see and avoid with special emphasis programs in Florida, Illinois, and California. In these high-density traffic areas the potential for collisions is increased.

A recent AOPA Air Safety Foundation study of midair collisions rebutted the popular image of midair collisions as head-on or at an acute angle. The study revealed that the vast majority (82 percent) resulted from a faster aircraft overtaking and hitting a slower moving aircraft. Only five percent were from a head-on angle.

Vigilance around airports is particularly important, the study found. **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 two of the Foundation's Safety Advisors, *Operations at Nontowered Airports*, online at www.aopa.org/asf/publications/-sa08.pdf, and *Collision Avoidance: Strategies and Tactics*, online at www.aopa.org/asf/publications/sa15.pdf.

While not the subject of this report, the number of midair collisions in 2003 rose slightly, to 11. Fatal midair collisions were also up in 2003, to seven. More worrisome was the 2003 rise in fatalities as a result of midair collisions, up to 23 from just nine in 2002. This rise in fatalities will be analyzed further in the 2004 Nall Report.

Fuel Mismanagement

120 total/ 13 fatal

More than twice a week in 2002, on average, pilots mismanaged the fuel flow to the engine.

Fuel exhaustion causes engine stoppage due to the depletion of all available fuel on board the airplane. Fuel starvation results in engine stoppage due to an interruption of the fuel supply to the engine, even though fuel remains available in one or more of the fuel tanks. In 2002, there were 70 accidents caused by fuel exhaustion, of which seven were fatal, resulting in 12 deaths. Another 36 accidents occurred because of fuel starvation, of which four were fatal, resulting in 10 fatalities. An additional 14 accidents were attributed to fuel contamination. The AOPA Air Safety Foundation recommends a *minimum* fuel reserve of at least one hour for both VFR and IFR operations. As with many accident causes, fuel mismanagement is not the sole domain of the inexperienced pilot.

Knowledge of aircraft performance and systems, realistic preflight planning, and diligent monitoring of fuel consumption are essential. For more information see the Foundation's Safety Advisor, *Fuel Awareness*, online at www.aopa.org/asf/publications/sa16.pdf.

Ground Injuries: Off-Airport

9 total/ 3 fatal

One popular worry voiced by residents near airports has to do with off-airport landings, or "What if one of those little airplanes falls on my head?" ASF statistics show that concern to be vastly overrated. In 2002, there were four fatalities, 15 serious injuries, and five minor injuries to off-airport bystanders. Eleven of those occurred as a result of a single accident, when the pilot of a Cessna 310 lost control after takeoff and crashed into a California park on July fourth. It also points to the importance of good zoning and maintaining reasonable runway safety areas.

Seasonal Trends

Since more pilots fly during the spring and summer months, higher accident numbers are seen during those months. Certain types of accidents tend to be season-specific due to changes in weather patterns, shorter days during winter months, and increases in certain types of flying such as recreational flying, aerobatic flying, and vacation trips during the spring, summer, and early fall.

In 2002, the highest number of accidents occurred during the summer months of June, July, and August. The total accident counts for those months were 178, 181, and 180, respectively. The lowest number of accidents occurred during December (75).

Alcohol and Drugs

7 total/ 7 fatal

Drug and alcohol misuse as an accident factor continues to be relatively low. In 2002, seven accidents showed evidence of the possible involvement in the category of alcohol, illicit drugs, or unapproved prescription or over-the-counter medications. Other factors were also involved in several of these accidents. It is also probable that a number of accidents still under investigation will implicate drugs or alcohol. Typically the final average percentage of this type of accidents settles at 1.1 percent. Although there has been much negative publicity about airline pilots flying under the influence of alcohol, general aviation in 2002 continued a five-year downward trend in this already-small category. The number of GA accidents in the alcohol and drug category decreased from 19 in 2001 to seven in 2002, and none of the 2002 accidents analyzed to date were a result of alcohol ingestion.

Pilot Incapacitation

8 total/ 7 fatal

Another widespread fear of non-pilot passengers in GA flying has to do with sudden pilot incapacitation. Although not entirely without basis, it is statistically insignificant. Eight accidents in 2002 were the result of the pilot becoming incapacitated. This number is up from 2001 when only four accidents resulted from pilot incapacitation.

The odds of a pilot becoming incapacitated on any one flight are one in several million, but non-pilot flying companions often relax and start to enjoy flying more after taking ASF's Pinch-Hitter® course. That course, offered both live and on DVD, takes much of the mystery out of piloting and provides basic information on taking over and landing safely in an emergency. For more information, go to www.aopa.org/asf/schedules/pinch.html.

Propeller Strike Injuries
1 total/ 0 fatal

A groundskeeper was the only person struck by a turning propeller during 2002. Such accidents are usually either the result of attempts to hand prop-start airplanes (other than those designed without starters), or people in the ramp area inadvertently coming into contact with moving propellers. The number of serious injuries and fatalities from propeller strikes continues to be very low. Pilots, flight schools, and fixed-base operators must ensure that propeller safety is included in their training and safety programs. View the ASF Safety Advisor, *Propeller Safety*, online at www.aopa.org/asf/publications/sa06.html.

The number of propeller strike injuries fluctuates each year. Of the past five years, 1998 had the most propeller strike accidents, with seven total and four fatal, but the average is two per year.

SUMMARY
There was a slight decrease in the number of total accidents in 2002 over 2001, but a small increase in the number of fatal accidents. The number of persons killed in GA crashes in 2002 rose by just one over the previous year.

Overall, top-level GA accident trends in 2002 didn't change much from previous years. Based on ASF data, using final accident reports for more than 80 percent of the calculations, pilot error continued to account for 72.6 percent of all accidents. This number will likely increase slightly as the last reports for 2002 are finalized. Typically, about three-quarters of all GA accidents are eventually attributed to pilot-related causes. ASF often uses research into these causes as the basis for new free safety programs designed to help pilots avoid accidents.

Some of the most interesting facts about GA accidents during 2002 were:

- The vast majority of GA accidents in 2002 (79 percent) were fatality-free, a statistic that has held true every year since modern aviation safety record keeping started in 1938. This contrasts strongly with the popular public misconception that a light aircraft crash is nearly always an automatic death sentence.

- While pilot-related causes account for about three-quarters of all GA accidents (72.6 percent), the second largest single category is mechanical/maintenance (18.1 percent).

- For any given accident, the chances of a fatality are lower for single-engine fixed-gear airplanes (16 percent) than for single-engine retractable gear airplanes (31.9 percent) or multiengine airplanes (37.8 percent).

- Takeoffs and landings were the phases of flight that produced the most total accidents for all three airplane types. In those accidents, takeoffs were more often lethal than landings for SEF and ME airplanes, while SER airplanes had about the same percentage of fatal accidents in takeoffs as landings. ASF's "The Ups and Downs of Takeoffs and Landings" is available as a Seminar-in-a-Box®. For further information, go to www.asf.org and click on Seminar-in-a-Box®. To view the free ASF Safety Advisor on the subject, go to www.aopa.org/asf/publications/sa18.pdf.

- Fuel management skills continue to elude too many pilots, particularly in SEF and SER airplanes. There were 120 accidents in 2002 that involved either failure to switch tanks at the correct time, or simply running the airplane out of gas. ASF offers a Seminar-in-a-Box® on fuel management, with helpful hints for both safety and efficiency in flying.

- Of the most common types of GA flying in fixed-wing aircraft weighing less than 12,500 pounds gross weight, business flying had the fewest accidents, while personal flying had the most. When adjusted for percentage of hours flown in each activity, business pilots were still safest, followed closely by instructional flying. Aerial applicators and pilots doing personal flying held the worst records.

- For VFR pilots, flying at night is statistically safer than flying during the day, with an overall accident rate per 100,000 hours in VMC of 4.56. During the day, the VMC rate is 5.27. Those rates should be taken with a grain of salt, however, for several reasons. Pilots who fly at night are often more experienced—and more current—than the average "almost all daytime" pilot. In addition, night landings require somewhat greater skill, forced landings may involve as much luck as skill, and in-flight visibility, especially over sparsely populated terrain, can be virtually IFR.

- Weather involvement and maneuvering flight continue to be the factors most likely to result in accidents with fatalities. Overall, more than three-quarters of weather-related accidents are fatal, and 57.3 percent of maneuvering flight accidents are fatal. The single most common type of weather-related accident continues to be continued VFR into IMC. Pilots anticipating trying continued VFR into IMC may want to read ASF's free Safety Advisor, *Spatial Disorientation*, online at www.aopa.org/asf/publications/sa17.pdf.

ADDITIONAL RESOURCES

If you would like additional information about some of the topics covered in this report as well as many other topics not covered, you can go to ASF's website, www.asf.org, or the following links:

Takeoff and Landing

Ups and Downs of Takeoffs and Landings Seminar-in-a-Box®
(http://www.aopa.org/asf/schedules/sib.html#ups)

***Ups and Downs of Takeoffs and Landings* Safety Advisor**
(http://www.aopa.org/asf/publications/sa18.pdf)

Maneuvering

Watch This! Seminar-in-a-Box®
(http://www.aopa.org/asf/schedules/sib.html#maneuver)

***Maneuvering Flight – Hazardous to Your Health?* Safety Advisor**
(http://www.aopa.org/asf/publications/sa20.pdf)

***Stall/Spin: Entry Point for Crash and Burn?* Special Report**
(http://www.aopa.org/asf/topics/stall_spin.pdf)

Weather

Single-Pilot IFR Online Program
(http://www.aopa.org/asf/single_pilot_ifr/)

SkySpotter® Online Program
(http://www.aopa.org/asf/skyspotter/)

Spatial Disorientation Seminar-in-a-Box®
(http://www.aopa.org/asf/schedules/sib.html#spatial)

***Spatial Disorientation* Safety Advisor**
(http://www.aopa.org/asf/publications/sa17.pdf)

Aircraft Icing Safety Advisor
(http://www.aopa.org/asf/publications/sa11.pdf)

***Weather Strategies* Safety Advisor**
(http://www.aopa.org/asf/publications/wxatcu.pdf)

Weather Tactics Seminar-in-a-Box®
(http://www.aopa.org/asf/schedules/sib.html#tactics)

***Weather Tactics* Safety Advisor**
(http://www.aopa.org/asf/publications/sa13.pdf)

***Single-Pilot IFR* Safety Advisor**
(http://www.aopa.org/asf/publications/sa05.pdf)

Collision Avoidance

Collision Avoidance Seminar-in-a-Box®
(http://www.aopa.org/asf/schedules/sib.html#collision)

***Collision Avoidance* Safety Advisor**
(http://www.aopa.org/asf/publications/sa15.pdf)

Operations at Towered Airports Seminar-in-a-Box®
(http://www.aopa.org/asf/schedules/sib.html#towered)

***Operations At Towered Airports* Safety Advisor**
(http://www.aopa.org/asf/publications/sa07.pdf)

***Operations at Nontowered Airports* Safety Advisor**
(http://www.aopa.org/asf/publications/sa08.pdf)

Fuel Mismanagement

Fuel Awareness Seminar-in-a-Box®
(http://www.aopa.org/asf/schedules/sib.html#fuel)

***Fuel Awareness* Safety Advisor**
(http://www.aopa.org/asf/publications/sa16.pdf)

Instructional Safety

***Flight Instruction Safety* Special Report**
(http://www.aopa.org/asf/topics/instructional.pdf)

Prop Strike Accidents

***Propeller Safety* Safety Advisor**
(http://www.aopa.org/asf/publications/sa06.html)

Visit us on the web for these and many other valuable pilot resources. **www.asf.org**

APPENDIX

What is General Aviation?

Although general aviation (GA) is typically characterized by recreational flying, this important segment of aviation includes 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 "Specific Operations" on page 13.

What Does General Aviation Fly?

General aviation aircraft are as varied as their pilots and the types of operations flown. The number of GA aircraft, sorted by category and class, registered in 2001 (the most recent year available from the FAA) to air taxi operators and GA is shown below:

	Air Taxi	General Aviation
Piston single-engine	569	144,465
Piston multiengine	855	17,426
Turboprop single-engine	95	820
Turboprop multiengine	645	5,036
Turbojet	716	7,071
Helicopter	819	5,964
Experimental	253	20,168
Total	**3,952**	**200,950**

Fig. 26

The following aircraft categories and classes are included in this report:

- Piston single-engine
- Piston multiengine
- Turboprop single-engine
- Turboprop multiengine
- Experimental
- Homebuilt

The following aircraft categories and classes are <u>not</u> included in this report:

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

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 activity survey conducted by the FAA. Whether this accurately reports the total hours has been debated for years but even though the rate may not be accurate, the relationships between accident categories will probably not change significantly with more accurate exposure data. Landing accidents will still account for the lion's share 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 particular causes 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.

Sequence of Events and Accident Causality

The Boeing Commercial Airplane Company, studying accidents of transport-category aircraft, found that most result from a sequence of events rather than a single catastrophic event. Their research identified as many as 20 events in a single flight that directly influenced the accident. The NTSB uses a similar method to break down each accident into "occurrences."

Our objective is to prevent future accidents by learning from the past. This report identifies the phase of flight in which the sequence of events began, often referred to as the "first occurrence." Compensating for hazards associated with the "first occurrence" or breaking a subsequent link in the chain of events should prevent the accident.

NTSB DEFINITIONS

Accident/Incident (NTSB part 830)

The following definitions of terms used in this report have been extracted from NTSB Part 830 of the Federal Aviation Regulations. It is included in most commercially available FAR/AIM digests and should be referenced for detailed information.

Aircraft Accident

An occurrence incidental to flight in which, "as a result of the operation of an aircraft, any person (occupant or non-occupant) receives fatal or serious injury or any aircraft receives substantial damage."

- **A fatal injury is one that results in death within 30 days of the accident.**

- **A serious injury is one that:**

(1) Requires hospitalization for more than 48 hours, commencing within seven days from the date the injury was received;

(2) Results in a fracture of any bone *(except simple fractures of fingers, toes, or nose);*

(3) Involves lacerations that cause severe hemorrhages, nerve, muscle, or tendon damage;

(4) Involves injury to any internal organ; or

(5) Involves second- or third-degree burns, or any burns affecting more than five percent of body surface.

- **A minor injury is one that does not qualify as fatal or serious.**

- **Destroyed means that an aircraft was demolished beyond economical repair, i.e., substantially damaged to the extent that it would be impracticable to rebuild it and return it to an airworthy condition.** *(This may not coincide with the definition of "total loss" for insurance purposes. Because of the variability of insurance limits carried and such additional factors as time on engines and propellers, and aircraft condition before an accident, an aircraft may be "totaled" even though it is not considered "destroyed" for NTSB accident-reporting purposes.)*

- **Substantial damage:**
  (As with "destroyed" 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 sub stantial 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 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/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.

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