MANEUVERING FLIGHT – Hazardous to Your Health?

Many pilots think maneuvering flight only includes hazardous operations such as buzzing, but when you fly in a traffic pattern you perform maneuvering flight.

More than one-quarter (26.6 percent) of all fatal accidents in the last 10 years occurred during maneuvering flight, which includes buzzing, formation flying, aerial work, stalls/spins, canyon flying, aerobatics, and normal flight operation. Basically, any type of flying performed close to the ground – the traffic pattern, for example – or involving steep turns and aerobatics is considered maneuvering.

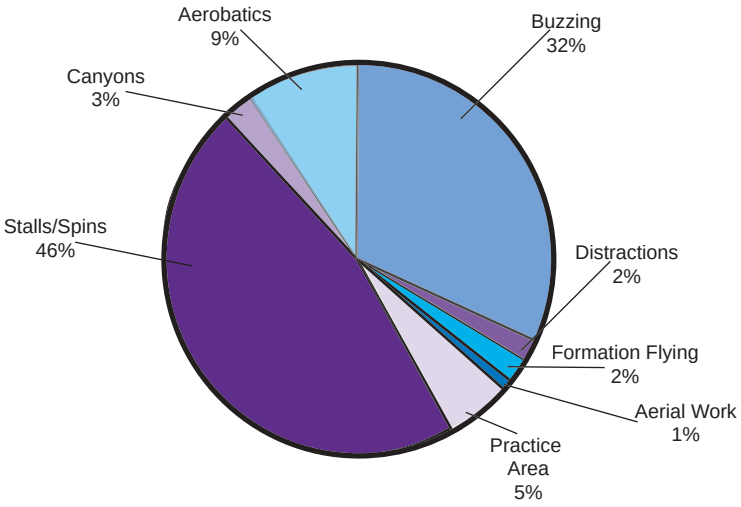
Disclaimer: The purpose of this publication is to inform pilots of the hazards of maneuvering flight. Buzzing is not "cool," and frequently leads to fatalities. To emphasize that point, there will be some pointed commentary as well as candor. As pilots, we understand the emotional aspect of this subject, and the suffering it causes. The objective is simple, however: Reduce the number of maneuvering flight accidents.

Any discussion of maneuvering involves *airmanship*. This may be defined as the physical handling of the aircraft and the ability to put the machine just where you want it. Pilots lacking in airmanship, either because they are rusty or never learned, cause many accidents that can be avoided with appropriate training.

But maneuvering can be further broken down into two segments: legitimate flying activities and recklessness. Pilots in the first group must take additional precautions while performing in a potentially hazardous environment. Staying inside the flight envelope while not hitting the ground is all part of avoiding a maneuvering mishap. **Routinely operating in the traffic pattern is maneuvering flight, so you can't just write this off as something that only happens to buzzing "bozos."**

The second group of pilots fails to understand or deliberately takes significant risks. Some can be led to the path of safety and the others may well become an accident statistic. *No amount of training can compensate for really bad judgment.*

Causes of Maneuvering Flight Accidents



During a recent four-year period, maneuvering flight accidents resulted in 570 fatalities and an estimated *$1.7 billion* in lost wages, insurance claims, lawsuits, etc. That does not take into account serious injuries and accidents where only the aircraft was damaged. Who pays? You do! Higher insurance for pilots, FBOs, and manufacturers, and more regulation add up to higher flying expenses for all of us.

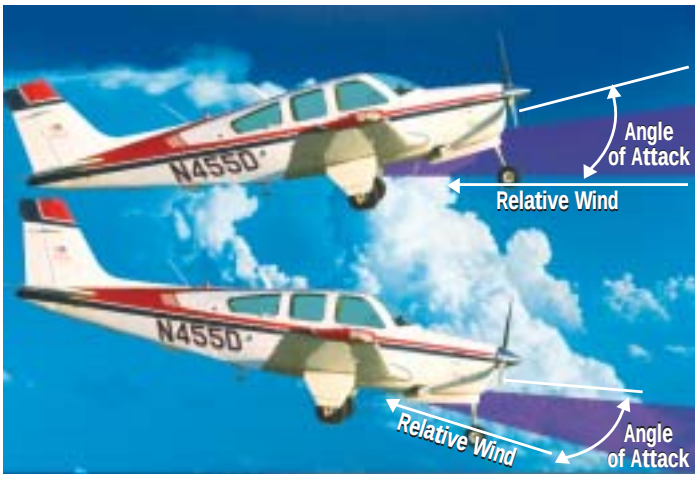
There's also the toll it takes on the public's understanding of general aviation. Recently, AOPA randomly surveyed pilots about their experience with maneuvering flight. The vast majority (87 percent) said buzzing is extremely or moderately damaging to public opinion of general aviation. More than one-third (38 percent) reported being acquainted with or hearing locally of a pilot who gave in to the urge to buzz. Seventeen percent of those surveyed knew three or more pilots who buzz at least sometimes. Nearly half of those surveyed (46 percent) said a temporary license suspension or a small fine would be acceptable punishment for buzzing.

Relative Wind and Angle of Attack

As students, pilots learn that relative wind occurs opposite the direction of flight. That is not to be confused with the direction the nose is pointing. The relative wind is often not directly off the nose.

Any discussion of aerodynamics includes angle of attack (AOA). This is the angle between the chord line of the wing and the relative wind. When the aircraft reaches its critical angle of attack, it will stall. For many GA aircraft, that occurs between 16 and 18 degrees.

AOA accidents happen during "stalling flight." This includes both nose-up and nose-down flight attitudes, in turns and during pull-ups (vertical turns). A too-high AOA and subsequent stall can easily happen with the nose down and plenty of airspeed. *It's the AOA, not the speed* that causes the stall. The chance of an angle-of-attack accident is higher during buzzing, although that type of maneuver can hardly be considered normal flight. GA pilots do not usually receive training on this type of flying.



When a pilot attempts to buzz an object on the ground, he or she is descending nose-down, and then – hopefully – pulls out of the dive in time to recover. If the angle of attack is too steep during that pull-out, the wing will stall – violently. It won't be the garden-variety stall with minor altitude loss that you experienced in training. At low altitude, chalk one up for the Grim Reaper.

While we're on the subject of buzzing, here's one more reason why it's a bad idea: target fixation. The pilot becomes so focused on the target that he/she waits too long to pull out of the maneuver and crashes into terrain. The military learned this long ago and spends considerable time training their pilots on the fine art of survivable strafing.

Fool's Game

If you feel compelled to try this, go to a high altitude, say 6,000 feet agl, put the aircraft into a dive such as one might in a buzz job, and at 5,200 feet pull back firmly on the yoke to break the dive and level out. Let's simulate the ground level at 5,000 feet so that the buzz job is a "reasonable" 200 feet agl. One of several things may happen:

- Most likely the aircraft will hit the "ground" **(game over).**
- The aircraft will go into a violent accelerated stall like nothing you've ever experienced in training and hit the "ground" **(game over).**
- Because the maneuver was entered at higher than maneuvering speed – minor detail that most buzzers ignore – something breaks on the airframe when the pilot pulls hard to break the dive; the airplane begins to disassemble itself and hits the "ground"**(game over).**
- Because the airplane has been abused by other buzzers, it starts coming apart even before you reach maximum load – see above **(game over).**
- You are exceptionally skilled, lucky, or both. You manage to break the dive at a mere 20 feet agl, one tick mark on the altimeter. The crowd goes WILD, except for the one that got the aircraft tail number and reports it to the FAA. **YOU WIN** – sort of.

Of all the possible outcomes, this seems like a losing proposition but hey, you could be the next winner.

Fine print: There are some warnings the lawyers asked us to include – this is for illustration purposes only and isn't intended as an actual training exercise: Your practice buzz job should take place in uncongested airspace, off airways, and preferably with flight following. The aircraft should be in top shape and should have quick release doors such that you can exit quickly, and you should wear a recently packed parachute.

Distractions

Distractions can play a large role in maneuvering accidents. The infamous base-to-final turn is but one example. Flying in the traffic pattern is stressful enough on a busy day, but take into account looking for traffic, running the checklist, configuring the aircraft, and the ingredients are there for distraction. If you overshoot the runway when turning final, steepening the turn to compensate will only make things worse. When banking too steeply, while adding back pressure to maintain altitude, the angle of attack increases. This is the start of a hazardous stall scenario, which would be nearly impossible to recover from at such a low altitude. Instead, keep a normal turn going and once you roll out, if the approach is not salvageable, go around. There's no shame in flying safely – only in showing off or trying to save a bad landing.

In the traffic pattern, small distractions can lead to emergencies if not handled properly. An open door in flight is just that – a distraction. Don't allow it to overwhelm you and cause a fatal accident. There's a reason that distractions are used by examiners.

During the preflight inspection, the pilot added a quart of engine oil. Shortly after liftoff, the oil access door on the cowling came open. The pilot elected to continue the takeoff on the 3,100-foot runway due to a concern that he did not have enough runway remaining to stop. Witnesses observed the airplane turn to the left, enter a steep descent, and impact the ground. The pilot stated that he "must have become fixated on the flopping door." Examination of the engine did not reveal evidence of any pre-impact mechanical discrepancies that would have resulted in a power loss.

Airmanship in the Traffic Pattern

As mentioned earlier, flying in the traffic pattern consists of maneuvering flight that includes low altitudes, slow airspeeds, and high angles of attack. Understand the aircraft's limitations, and follow the basic rules you first learned as a student pilot:

- "Cheating" on a turn is not good airmanship and is hazardous. Trying to maintain a shallow bank but increase the turn rate with rudder results in crossed controls, a skid, and the potential for a low altitude spin. Base-to-final is a dangerous place.

- The famous stabilized approach. The airlines insist that the crew essentially stop maneuvering 1,000 feet above the ground when landing. For lighter aircraft, we might accept 500 feet as the maneuvering "hard deck." This means the flight is on airspeed, at the right altitude, with an appropriate descent rate and aligned with the runway. Not stable on final approach? Go around!

- Distractions are a major source of maneuvering mishaps. Complete the before landing checklist, with the possible exceptions of landing flaps and prop full forward (on aircraft with a controllable pitch propeller), before turning base. Statistics

show that 39 percent of fatal stall/spin accidents begin below 250 feet agl. If interrupted, run the entire list again. It's better to take extra time than miss a critical item. Don't have time before turning final? Go around – you're not ready for landing. Start the checklist earlier next time.

The airplane impacted terrain after losing control while on approach, killing one of the two pilots on board. A witness stated, "On several of these approaches, I noticed that the nose would rise to above level flight slightly during or after the turn, and it appeared that the application of right rudder was used to force the nose to align with the runway, causing a skid during a portion of the turn. It was apparent that the same techniques were being used on this approach, and suddenly the right wing started down, rotation began, and the aircraft contacted the ground nearly straight down, maybe a block from the end of the runway facing west/northwest. The close-in base leg with relatively flat turn (bank angle) and skid from right rudder application were visible before the roll started. The engine was audible, sounding as though normal full throttle had been applied, in an attempt to recover from the obvious spin that had begun. The aircraft spun to the right and hit the ground." The pilot-rated rear seat occupant stated that the aircraft did not have a nose-up attitude before it nosed over. He stated that he and the front seat pilot were alternating flying the takeoffs and landings. The front pilot was flying the accident approach to land. The pilot stated there was no binding in the aircraft controls and the engine was performing normally. The airplane's operator had endorsed both pilots' applications for their instructor ratings.

Impossible Turn

Everyone knows about the dangers of attempting the impossible turn – or do they?

If you experience a complete engine failure after takeoff in a single-engine aircraft, what would you do? Would you attempt to turn back to the airport or land straight ahead? That should be decided prior to takeoff so it is an automatic process if the worst happens.

It's better not to turn unless there is plenty of maneuvering room. A good rule of thumb is to select a landing area no more than 30 degrees to either side of the nose of the aircraft. A greater turn may easily use more altitude than you have available.

Buzzing

Flying low over a friend's house to show off your outstanding piloting skills is never a good idea. Momentary lapses in judgment have proven fatal for many pilots. Buzzing accidents account for one-third of all maneuvering accidents, and are entirely preventable. During the last ten years, buzzing accidents accounted for 914 of 2,865, or 32 percent, of maneuvering accidents. At altitudes below 1,000 agl, no amount of skill will allow recovery from a spin, so prevention means not engaging in such stunts in the first place.

The pilot of a Beech 23 flew over his friend's house and the friend watched from the ground and waved. The pilot rocked the airplane's wings and buzzed the house. During the second circuit, the airplane quickly banked left and rolled out on a southerly heading. It began to descend and the engine revved to full power. The airplane kept losing altitude, then pitched up 10 degrees. It cleared the house by 25-30 feet and struck a tree at 50-60 mph. There was a 5-15 knot tailwind at the time.

Aerial Work

Accidents that occur during legitimate task-oriented flight are the exception to the typical maneuvering accident, accounting for only one percent of all maneuvering flight accidents. Aerial work includes photography, pipeline patrol, banner towing, and crop dusting. (For this publication, ASF categorized crop dusting accidents by their primary cause, i.e. stall/spin or distractions.) These activities require a significant division-of-attention at low altitudes. Pilots performing aerial work are generally highly qualified and use excellent judgment. But, if something goes wrong, there is little time to recover. Equipment malfunction and failure to follow established procedures are the most common causal accident factors.

The pilot had made two successful banner tows before the accident occurred. On the third banner tow, the hook missed the banner rope and grabbed one of the pick-up poles instead. The pilot tried to keep the aircraft and attached pole over the airport to minimize the possibility of property damage or injury to people on the ground if the pole broke free. The pilot tried to stay within the airport boundary and he entered a climbing left turn. He added too much left rudder and entered a spin. Altitude at this point was approximately 300' agl. He attempted to do a spin recovery but the airplane impacted the runway in a 30 degrees nose low attitude. The airplane bounced twice before impacting a jet blast wall.

The National Transportation Safety Board determined the probable cause of this accident was the pilot's failure to maintain control of the airplane which resulted in the inadvertent spin.

Formation Flight

Formation flying accounts for two percent of maneuvering accidents. Since formation flying is routinely performed during aerial photography missions, it's critical to know the pilot you're flying alongside. Discuss the flight beforehand and ensure that he/she is qualified in flying formation. A miscommunication or lack of skill can be deadly. It is not something to be undertaken without training – period. Just because somebody says they're a formation pilot doesn't make it so. Are you willing to bet your aircraft and possibly your life on someone's inflated opinion of their skills?

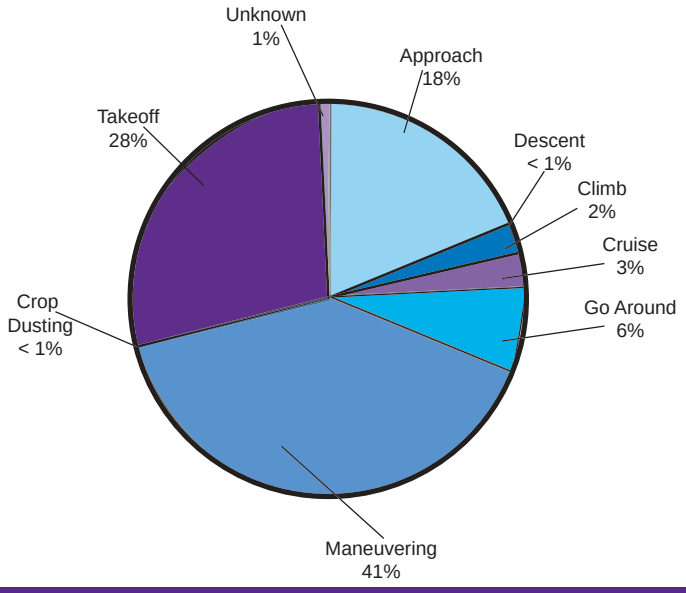
The pilots of a Mitsubishi MU-2 and a Cessna 310 flew in formation at night although neither pilot had formal training in formation flying nor experience in night formation flying. They joined up in flight and the MU-2 pilot was flying on the wing of the C310. The MU-2 pilot communicated that he was going to change positions from the right side to the left side of the C310. The C310 pilot and his passenger lost sight of the MU-2 when it dropped back to a position at the rear of the C310. Soon after, the two aircraft collided and the MU-2 pilot lost control of the aircraft and crashed. The right horizontal stabilizer was torn from the C310 and the empennage, right wing, and propellers were damaged. It landed without injury to its occupants. An investigation revealed the tail light of the C310 was inoperative.

Untrained night formation flight, in greatly different aircraft, and a nav light inoperative makes a mishap almost inevitable.

Stalls/Spins

Stall/spin accidents are responsible for nearly half of all maneuvering flight accidents. Most of these occur at low altitudes, and over one-quarter of them occur on takeoff.

Fatal Stall/Spin Accidents - Phase of Flight



The FAA eliminated spin demonstrations by most pilot applicants in 1949, leaving only the CFI certificate with that requirement. The rationale for eliminating the spins was that emphasis on stall recognition and recovery would provide more benefit than skill in spin recovery. Following the U.S. lead, Canada and the United Kingdom dropped spin demonstrations for non-CFI check rides for the same reasons.

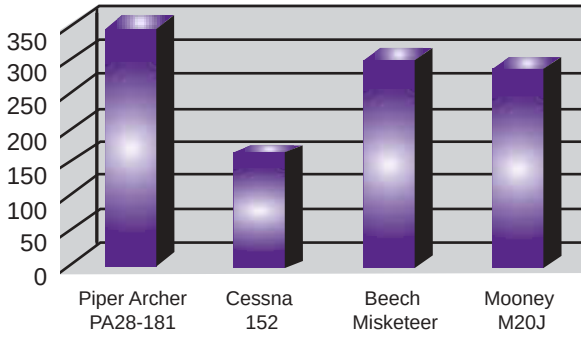
Although the total number of stall/spin accidents has dropped dramatically since 1949, those that do occur usually start at low altitudes. In fact, a recent ASF study of 465 fatal stall/spin accidents that occurred from 1991 through 2000 showed that at least 80 percent (and probably more) of the accidents started from an altitude of less 1,000 feet agl, the usual traffic pattern altitude.

The study found that only 7.1 percent of the aircraft involved in the stall/spin accidents definitely started the stall/spin from an altitude of greater than 1,000 feet agl. Just over 13 percent of the aircraft were reported at an "unknown" altitude at the beginning of the accident, and so were given the benefit of the doubt.

Another study done earlier by the FAA Small Aircraft Directorate, which included some 1,700 stall/spin accidents dating from 1973, concluded that 93 percent of such accidents started at or below pattern altitude.

Pilot Operating Handbooks for various typical GA aircraft estimate average altitude loss during stalls, assuming proper recovery technique, between 100 and 350 feet.

Maximum Altitude Lost During a Stall



Altitude Loss In Spins Is Another Animal

But recovery from a spin is a far different matter, and takes much more altitude, even with skilled pilots. A NASA study done in the 1970s proved that the average altitude loss in spins done with a Grumman American AA-1 (Yankee) and a Piper PA-28R (Arrow), two popular single-engine aircraft, was nearly 1,200 feet. (It should be noted that neither aircraft is approved for spins, but NASA was testing them for possible improvements in spin handling characteristics.)

In the Yankee, it took an average of 210 feet for spin entry, 340 feet for stopping the turn, and another 550 feet for recovery, for a total of 1100 feet. In the Arrow, the figures were 140 feet for entry, 400 feet for stopping the rotation, and 620 for recovery, for a total of 1160 feet.

In short, the average vertical recovery distance was just short of 1,200 feet. Pilots allowing a spin to develop at or below traffic pattern altitude are nearly certain to crash, no matter how quick their reflexes or skillful their recovery.

To learn more, go to www.asf.org, click on the database button, and select the topic specific study of stalls and spins.

By the book–The Federal Aviation Regulations (FARs) state that 1,500 feet agl is the minimum altitude for recovery from aerobatic flight, including spins. One thousand feet can easily be lost in just the entry and one turn. *Allow several thousand feet of buffer on recovery.* Many POHs recommend the minimum safe altitudes to start the maneuver – If you know something the factory test pilots don't, then ignore those recommendations but understand the risks have just increased – significantly

Want to learn how to maneuver? Take an upset or aerobatics course. There are schools that will teach you how to really handle maneuvering flight. There are several positive outcomes. First, most pilots are impressed with the safety precautions taken to prevent an accident. This includes excellent maintenance to ensure aircraft are not overstressed, superb instructors who specialize in this type of instruction, and usually a flight operations manual that clearly outlines minimum altitudes, practice areas, and collision avoidance procedures. Secondly, the programs demonstrate how an

aircraft handles in extreme flight situations. Finally, and perhaps most importantly, pilots learn what is not possible and that they must avoid those situations completely. It's a sensible strategy and far superior to the do-it-yourself approach that most accident pilots follow.

Density altitude can be deceiving and many canyons are not like the Grand Canyon. If the terrain climbs only slightly faster than the aircraft, a sudden stop may be inevitable.

Canyon Flying

Experienced mountain pilots are trained to fly in those unique conditions, and are also familiar with the terrain in which they fly. Sightseeing and following a river at low altitude, with terrain on each side, is a dangerous situation. Rivers turn, and surprises can always be found around the next turn. Wires, hills, rising terrain, another aircraft – the possibilities are endless. Experienced canyon flyers know the terrain, and always have an out. Is your airplane capable of making a 180-degree turn within the confines of the canyon walls to avoid rising terrain? Probably not, and if you're not sure, don't do it. Trying to out climb rising terrain usually proves futile. Avoid the situation in the first place by not flying below canyon rims.

Two Beech Bonanzas collided with terrain while maneuvering near Ojai, California. All aboard both aircraft, six people, died.

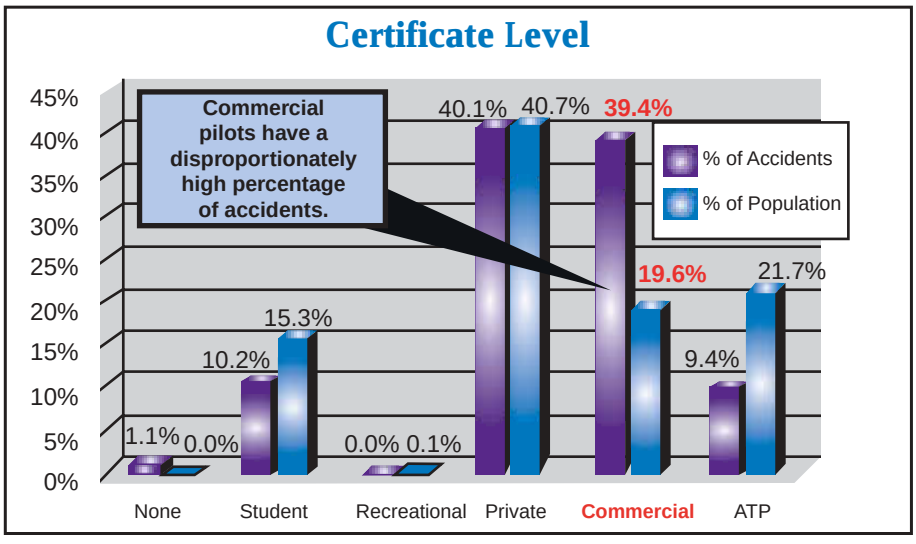
The aircraft were part of a group that routinely flew together on weekends. The accident flight consisted of a group of eight airplanes in formation with the accident pilot as the lead pilot. The group formed up at 4,500 feet. The witness reported that after flying around the area for about 25 minutes, the lead instructed everyone to separate and follow in trail. The lead and the number two airplane stayed in formation, with the second airplane on the right wing. The rest of the airplanes followed in loose trail as the leader maneuvered in a serpentine manner.

The two lead airplanes separated from the group, descended to an estimated 500 to 1,000 feet agl, and flew up a canyon. Moments later, smoke and fire were observed.

The airplanes came to rest within 75 feet of each other at the bottom of the head of the canyon at an estimated elevation of 4,925 feet. The slope of the terrain at the accident site was approximately 45 degrees. The terrain at the head of the canyon was estimated of 5,400 feet, less than 1/2 mile from the accident site.

Who

It's a common myth within the pilot community that student pilots have the most accidents. However, students have a proportionately lower percentage of maneuvering accidents compared to the number of students in the pilot population. In fact, only commercial pilots had more than their share of accidents, with 19.6% of the pilot population and 39.4% of all maneuvering accidents.



This may be due to more experienced pilots becoming complacent, or erroneously believing they are in control of an out-of-control situation.

Before starting a buzz job, canyon running, formation flight, etc., consider this checklist:

- ✔ Inform your passenger of the real risks and whether they'd like to participate.

✔ Become thoroughly informed of the area, wires, terrain, etc.

✔ Practice in the aircraft you are going to use and have it inspected for structural integrity if there will be any high G maneuvers.

✔ Contact your insurance agent to be sure there is appropriate coverage for the damage that may result from a miscalculation. Real damages may exceed low liability limits.

Some Suggestions

DO

- **Do** remember that the majority of fatal stall/spin accidents occur at low altitudes, from which recovery is unlikely. Prevention is essential.
- **Do** practice stalls or approaches to stalls at a safe altitude and only when you are competent. If it's been a while, take an experienced CFI with you.
- **Do** practice spins only with an instructor who is proficient in spins in the specific aircraft make and model.
- **Do** use a properly maintained and approved aircraft. In some cases a parachute may be required.
- **Do** fly at a safe altitude above the ground so that you won't be surprised by terrain, wires, or towers that might require a quick pull-up and a probable stall.
- **Do** remember that turns, vertical (pull-ups) or horizontal, load the wings and will increase the stall speed, sometimes dramatically.
- **Do** fly formation or individual photo missions only after you have received appropriate training, have briefed the operation, and are confident of the other pilot's abilities.

DON'T

- **Don't** explore the corners of the flight envelope close to the ground.
- **Don't** exceed 30 degrees of bank in the traffic pattern. Use coordinated controls.
- **Don't** follow another aircraft in the pattern too closely. If you cannot maintain a safe airspeed (safe AOA) – go around.
- **Don't** buzz or otherwise show off with any aircraft. You don't need to – as a pilot you belong to a special group – less than one third of one percent of the U.S. adult population is certificated to fly.
- **Don't** attempt maneuvers for which you have not been trained.

Safe Pilots. Safe Skies.

421 Aviation Way, Frederick, Maryland 21701• Phone: 800/638-3101
Internet: www.asf.org • E-mail: asf@aopa.org
Publisher: Bruce Landsberg
Editor: Kathleen Roy
Statistician: Kristen Hummel

SA20/10-03