Safe Flying

There have been a lot written about safety systems, rules, and regulation. After reading many of these articles, I thought about what really improves the safety of a pilot. Is it systems, rules and regulations, or is there more to it than that?

Let us have a look at the objective data. What are the causes of most aircraft accidents? The vast majority of all aircraft accidents are caused by "pilot error". Since most gliders are simple and highly reliable aircraft, compared to the more complex powered aircraft the portion of accidents caused by pilot error is even higher.

When I learned to fly at age eighteen, I was very lucky to have an instructor that had logged more than 50,000 hours in single engine airplanes. The FAA thought that he might have logged the highest time of any pilot in the U.S. He told me that safe flying is 10% flying ability and 90% good judgment. At the time, I did not fully appreciate what he was saying, but looking back on this statement I have grown to believe that it was one of the most important things he ever said to me.

Given this statement, what is "good judgment". I would suggest that it means that a pilot has good judgment when he flies within the limits of the current situation. The safe pilot allows for a proper margin of safety inside the limits for any given set of conditions. In order to do this the pilot must know what the limits are of the current conditions. These conditions are dynamic and are always changing when one is practicing the art of flying.

The next step in this process, is understanding what I mean by the limits of the current conditions. Below, I have made a list of the limits that should be considered when flying.

1. What are the limits of the aircraft you are flying?
2. What are the limits of your personal knowledge?
3. What are the limits of your physical and mental condition?
4. What are the limits of your flying skill in the current aircraft and conditions?
5. How much experience do you have in the current situation?

Let's have a look at each one of these items and expand on it.

1. What are the limits of the aircraft you are flying?

Here is a partial list of limits to consider in normal flying. If you fly aerobatics the list is much longer and much more dynamic.

a. Stall speed in level flight
b. Stall speed when pulling 2 g's
c. Stall speed when spoilers are extended
d. Vne speed
e. Maximum speed in rough air
f. Maximum tow speed

g. Maximum crosswind that is safe for this aircraft
h. Maximum roll rate for a given airspeed

2. What are the limits of your personal knowledge?

This is yet another partial list.

a. Knowledge of the current aircraft
b. Knowledge of the current wind and weather
c. Local knowledge of the area you are flying in
d. Knowledge about the other pilots flying in the area

3. What are the limits of your physical and mental condition?

Another partial list…

a. Are you well rested?
b. Did you argue with your spouse today?
c. Are there things on your mind other than flying?
d. Do you have a cold or any other illness, no mater how slight?
e. What are your physical limits given your age?
f. Are you well hydrated?

4. What are the limits of your flying skill in the current aircraft and conditions? How precisely can you fly this aircraft?

Another partial list…

a. How accurately can you fly the correct approach speed for this aircraft?
b. How accurately can you enter the pattern at the correct altitude?
c. How accurately can you do a spot landing?
d. How accurately can you predict your landing roll out?
e. Can you do slow flight on the edge of a stall and not stall?
f. Can you accurately control the aircraft at the maximum crosswind?
g. How accurately can you know your current pitch, roll, and yaw attitude?
h. How quickly can you detect that you are not at the desired attitude and correct?
i. Do you make small early corrections or large, abrupt, and late movements of the controls?

5. How much experience do you have in the current situation?

a. What is your total time?
b. How many hours in the last 90 days?
c. How many hours in the last year?
d. When did you do a check ride with a much higher skilled pilot?
e. When was the last time you took training to improve your skills and knowledge?
f. Are you working on an advanced rating?

g. Have you flown with a highly skilled pilot and been able to observe where your skill is at compared to theirs? If you cannot see any difference, your observation skills are lacking.

A safe pilot never flies at the edge of any of these limits. A safe pilot knows exactly where the limits are and then deliberately chooses a safety margin inside these limits. He keeps all of his or her flying inside these margins.

Did you notice that the words Knowledge, Skill, and Experience appeared in many of these lists? Have you noticed that the DOT and FAA to specify the requirements for a given pilot's rating use these three words? They test you to see if you have the minimum Knowledge, Skill, and Experience before you can exercise the privileges of your rating. If you do not use judgment in setting the safety margins within the limits of your Knowledge, Skill, and Experience you will be an unsafe pilot. Keep in mind that these requirements of Knowledge, Skill, and Experience are the minimum level. If you do not practice and keep current you will fall below these limits. It is even better if you are trying to go on to a higher rating and always improving your skills. As you gain Knowledge, Skill, and Experience you should refine your limits and safety margins.

The correct approach speed.

Given this description of judgment let's have a look at how we could apply this knowledge of limits to choosing a correct approach speed for approach and landing. When you are a student the SAC manual teaches you to fly an approach speed equal to 1.3 times the stall speed plus a correction for wind. While this may be OK for basic training it is a very crude way to determine your correct approach speed.

Let's have a look at the limits of this process.

1. If your airspeed is too slow you will stall.
2. If your airspeed is too slow you may not be able to correct for turbulence. This will depend of the maximum roll, pitch, and yaw rate of the glider.
3. If your reactions and attitude judgment are poor you may not be able to detect the error and correct for the conditions quickly.
4. If you are flying too fast the controls may be very sensitive and you may be in danger of over controlling.
5. Too much speed can contribute to PIO's (Pilot induced oscillations).
6. Too much speed can cause too long a float in a held off landing.
7. If you fly the glider on at high speed, your landing roll will be longer and more difficult to predict.
8. If you can only maintain your airspeed to an accuracy of plus or minus 5 knots you will have to choose a speed that will keep you inside the limits with this wide control error.

Given these limits, what should your approach speed be?
First you must decide your margin above stall speed. For this you must take into consideration the accuracy you can maintain your speed, the speed necessary to maintain control in the turbulence, the length of the float, and the length of your rollout after landing. You must not just think that, "If some speed increase is good, more is better". Remember PIO's and over control.

As you can see the correct approach speed is a dynamic value and must take into consideration many factors.

Precision aerobatics analysis

I used to fly an aerobatic glider routine in air shows. The final maneuver of my routine involved flying through show center to the upwind end of the air show box, rolling inverted and then doing a half loop down to ground level such that I arrived at show center at 10 knots below Vne and six feet off the ground. I then pulled up and did a tear drop approach to landing such that I rolled out and stopped at show center.

A person watched me practicing this maneuver and made the comment that this was very dangerous and did not leave much margin for safety. He thought that I was setting a very poor example for younger pilots.

I sat down and explained the planning process I had gone through before I started performing this maneuver at low altitude.

First I practiced all maneuvers such that I could perform them and hit target speeds within plus or minus 2 knots. I could accurately fly all maneuvers so that I hit target G forces to within 1/4 G without looking at the G meter. I practiced at high altitude the roll to inverted followed by the half loop such that I could predict my exit altitude to within plus or minus 25 ft. This meant that the window of accuracy was 50 ft. After achieving the accuracy that was required I chose the entry altitude of this maneuver such that if I pulled 4 G's at the bottom of the half loop I would be 300 ft above the ground. When I performed the maneuver and started down the backside of the half loop, I would relax the backpressure such that I would drift down to six feet above ground and not pull the full 4 G's. If you realize this you can see that I had a safety factor of six times the accuracy with which I could perform the maneuver. My safety margin was 600%.

This same person regularly encouraged low time licensed pilots to go cross country and get an out landing out of the way. He said that everyone was going to have to do an out landing sooner or later and that they should get it out of the way. After explaining the aerobatic maneuver I pointed out that I believed that there were many more unknowns in making an out landing in a strange field. I suggested that given the knowns and unknowns, the aerobatic maneuver was much safer than a low time pilot making an out landing in a strange field.

I would also like to point out that I had a very good aerobatic instructor that was a student of Les Horvath. Les was the U.S. glider aerobatic champion at that time. I worked with Keith Allen for more than five years and taught aerobatics at his school. I then started working on my air show routine. After practicing for many years I went to Florida to fly with the current U.S. glider aerobatic champion Steve Cohen. He fine-tuned my routine. I then demonstrated my routine for both the FAA in the U.S. and the DOT in Canada and was signed off to perform in air shows with no lower altitude limit. I had to demonstrate Knowledge, Skill, and Experience. I had to pay my dues.

A word about judgment of skill and workload

A few years ago I read an article about out landing in a soaring magazine. In the article the author suggested that as soon as you decided you needed to land out you should turn off the radio so as not to be disturbed by communicating with other people. I was quite taken aback by this suggestion. He was saying that the skill level of the pilot was such that it would take his full attention to select a field, fly an approach, and land in the field. Let's stop and do a little analysis of this situation. Let's compare two workloads. Some years ago I used to instruct in airplanes and was based on Vancouver International airport. This meant that I would be pilot in command of an airplane while communicating with my student, flying the plane via verbal commands, ready to take over at a moments notice, communicating with ground control, tower, outer tower, approach control, switching radio frequencies, and keeping a close eye out for traffic. Now compare this workload with flying a glider. The point is that you should be able to fly the glider and know exactly where you are in airspeed, altitude, and your location with respect to your landing field almost completely automatically. If you cannot do this and communicate you do not have enough skill and experience safety margin to be going cross-country out of gliding distance of an airport. If anything goes wrong, you will be in complete overload and have no reserves to deal with an unexpected problem.

It is important that your basic flying skills not take 100% of your resources. You must be able to divide your resources to give each task the attention that it needs. Remember…Aviate…Navigate…Communicate. Your highest priority is to Aviate, but if it takes all of your attention to do this, your basic flying skills have not reached a high enough level to take on advanced tasks. Go back and build your basic skills.

How judgment changes over time

One more story from my own flying career…When I had 100 hours logged, I thought that my flying skill was very close to my instructor who had 50,000 hours. When I logged 200 hours and got my commercial license, I was sure that my flying skill was top notch. When I had logged 500 hours, I realized that I was just starting to learn how to fly. I finally had enough experience to know roughly where the limits were. Up until that time I did not have the experience to judge how much better more highly skilled pilots were

than me. I now take every opportunity to fly with more experienced pilots and learn from them.

In closing I am pointing out that safety comes from Knowledge, Skill, and Experience such that you know how close you are to the limits. If you do not know exactly what the limits are, and need to guess at it, get more knowledge, skill, and experience. You always should have a safety margin such that you fly well within the limits of the situation. If anything goes wrong you will have some reserves. If you are at the limit and something goes wrong, you will have an accident.

Fly safe…know your limits…always allow for a safety margin.