SPINNING

By Kai Gertsen

WHY SPIN TRAINING

Spinning is the biggest cause of gliding fatalities. Every year we lose a handful of our fellow glider pilots in this country to spin-ins. This is truly tragic, as I am certain these accidents would not occur if all pilots received adequate spin training. On the other hand, I know of several cases where past spin training saved the day. Pilots who are not prepared are not likely to take proper action when the time comes.

In resent times we have had two spin accidents involving club members. One pilot did not survive, the other miraculously escaped injury, and two gliders were destroyed.

It is not only inexperienced, low time pilots who fall victim to this insidious killer. Pilots with thousands of hours have known to be caught unprepared.

A few years ago the soaring movement lost two very prominent and experienced pilots in a Nimbus 4. The accident was apparently due to miss handling of the controls during an inadvertent spin, causing the glider to enter an extreme nose down attitude resulting in the airspeed getting out of control. The glider exceeded the red line (Vne) and disintegrated. One of the pilots was a former National Soaring Champion, a record holder and had been a member of the US International Team.

Although, the FAA requirement is only for Stall and Spin Awareness Training (AC61-67B), not spin training, I firmly believe spin training should be mandatory for all glider pilots prior to solo. By the nature of our flying we are considerably more susceptible to inadvertent spins than power pilots, although they are not doing all that well either with 25% of fatalities in general aviation being attributable to spins.

It is imperative to be able to immediately recognize an incipient spin. Supposing you are preparing to join several other gliders in the pattern. You are busy trying to figure out what everyone else is going to do when all of a sudden the left wing drops. If you are a little fuzzy on the topic of spinning, my guess is your reaction would be to move the stick over to the right, to pick up the left wing, which only aggravates the situation, and then the nose drops. In a desperate attempt to avoid disaster, you immediately pull back on the stick. To your amazement the nose drops further and the downward motion of the left wing gathers momentum. As the ground is now rapidly approaching, you instinctively pull the stick all the way back in the corner. I will leave the next event in this sequence to your imagination. Don't let a similar scenario be your introduction to incipient spins.

To be meaningful, whatever spin training is done needs to take place in a glider with somewhat the same propensity to spinning, and require the same prompt correct response as any glider you are likely to fly. It is true that all gliders can spin, but some are more reluctant than others.

Attempting spin training in a glider such as a Schweizer 2-33 is counter- productive. Wallowing around in a 2-33 engaged in Herculean efforts to simulate a half hearted spin entrée will only serve to convince you that it is virtually impossible to spin a glider, and that spins are nothing to worry about; thus, setting a deadly trap ready to be sprung when you least expect it.

One purpose of full spin training is to get familiar with the 'feel' of spinning, so that the tendency to panic in a real spin situation is greatly reduced. A low, inadvertent spin does not give a pilot unfamiliar with spins time to work out what is happening before hitting the ground.

Very few pilots recover from inadvertent low level spins.

Be assured that if you fly gliders long enough, sooner or later you will experience an inadvertent spin entrée, and probably when you least expect it. Better be prepared.

WHEN ARE WE MOST AT RISK

Most spin accidents occur while turning onto final from a pattern flown too low *(which unfortunately, is a common practice at Harris Hill).* Typically, encouraged by the close proximity to the ground when turning onto final, the angle of bank is minimized, and more rudder is progressively being applied in an effort to get lined up with the runway while pulling the nose up in an effort to conserve altitude. There you have the perfect set-up for a spin, this classic scenario have brought many pilots to a bad end. This maneuver, spin entree from a flat skidding turn, should be practiced until the resulting incipient spin can be recognized immediately, and recovered from with minimal loss of altitude.

Another classic, attempting to thermal at low levels especially if using shallow banked turns and minimum airspeed.

Turbulence can cause a glider to stall at a significantly higher airspeed than in stable conditions. I have experienced incipient spins from tight turns at 60kts while thermalling off a ridge in windy and turbulent conditions.

Distraction is another culprit. Whenever you are faced with a distraction your are at increased risk, as when your attention is diverted away from the task of flying the glider during a challenging off-airport landing.

WHAT IS AN INCIPIENT SPIN

An incipient spin is that portion of a spin from the time the glider stalls and rotation starts, until the spin becomes fully developed.

WHAT IS A SPIN

A spin is basically a stable condition, in which one wing is stalled and the other wing remains flying.

If the glider stalls asymmetrically due to yaw, air turbulence or non-symmetrical wing profiles (e.g. rigging, aileron deflection, bugs), then one wing will stall before the other, and drop.

The angle of attack of the dropping wing increases, causing further loss of lift and an increase in drag. The up-going wing experiences the reverse.

The difference in drag between the upper and lower wings causes the nose to yaw in the direction of the down-going wing. This results in the lower wing going even slower and becoming more stalled.

Unless the glider is unstalled, it continues to rotate automatically (Autorotation) with the stalled wing inboard, rolling, yawing and pitching simultaneously in a steeply descending helical path.

The spin is characterized by, the nose-down rapid rotation of the glider, a very high rate of descent, and lack of response to ailerons and elevator.

WHAT IS A FLAT SPIN

A flat spin is characterized by near level pitch and bank attitude with the spin axis near the center of gravity.

INTRODUCTION TO SPINS

First let me say that there is no reason to fear spins, providing the specific type of glider is certified for spinning, it is perfectly safe and not nearly as terrifying as you might have imagined. The only reason you may have to fear spins is if you have not had any training or you have failed to stay current.

You should not, under any circumstance practice spins without first being checked out by an instructor.

Your initial introduction to spinning may be a demonstration by the instructor while you have your hands and feet off the controls. For some, the first spin can be an intense experience. On a few occasions the student have been known to get a little uptight and the instructor had difficulties overpowering the student's grip on the stick.

It is not unlikely that you may experience some disorientation, which is perfectly normal during the initial check-out. Another reason this exercise is so important.

INCIPIENT SPIN RECOGNITION AND RECOVERY

A spin entry is recognizable by a sudden wing drop with an abrupt yaw toward the falling wing, the yaw being caused by the wing stalling. It is distinctly different from a wing drop caused by turbulence and with some practice, can easily learned to be recognized.

At the incipient stage, a forward movement of the stick will unstall the inboard wing and the glider will instantly recover. In most cases merely relaxing the back-pressure will do the trick. If the pilot fails to respond immediately the nose will drop as well.

- **It is the failure of the pilot to move the stick forward when the wing drops and the nose is going down that allows the glider to spin.**

Once, the recovery procedure taught was to pick the wing up by the application of opposite rudder. Now, we know better. Applying opposite rudder at this stage can cause the glider to enter a spin in the other direction. Remember, a glider will spin in the direction of rudder deflection.

Conversely, if you should fail to recognize the wing drop as an incipient spin, and attempt to pick-up the wing with the ailerons, which is a natural reaction, the result will be a full spin entry. The reason for this is that the aileron on the stalled wing will move down which effectively increases the angle of attack, thus aggravating the stall.

RECOVERY FROM A FULLY DEVELOPED SPIN

1. **Apply Full Opposite Rudder.**
2. **Neutralize Elevator and Ailerons**
3. **Ease the Stick Gradually Forward till Rotation Stops.**
4. **Neutralize the Rudder After Rotation stops.**
5. **Gently Pull Out of the Recovery Dive.**

- **The crucial action is to move the stick forward to unstall the glider even though the nose is dropping or pointing steeply downwards. It is the inability of pilots to take this action when the nose drops unexpectedly which results in stalling and spinning accidents.**

When applying opposite rudder you will notice considerably more force on the pedals is required than usual. This could lead you to think that the instructor is interfering but it is more likely to be due to the increased air pressure on the rudder. Be sure you apply full rudder deflection.

Do not pause between step 1 and 2. Some flight manuals recommend the elevator and ailerons be neutralized at the same time opposite rudder is applied. In fact, the sequence could be reversed.

Avoid moving the stick further forward than required as this causes excessive pitch down. In the old days students were taught to **'push the stick forward'**, which is really the wrong term. This often resulted in the student doing just that, with far too much vigor causing the glider to go beyond vertical once the rotation had stopped. This we could get away with back then as the post WW II gliders we used, such as the TG-3 was blessed with an enormous amount of drag. To-day's sleek designs are less forgiving, building up speed at an alarming rate once rotation stops and the glider is aimed at the ground. Remember whenever you are at high speed keep a firm grip on the stick.

Notice that ailerons are not used in recovery. To recover from a spin the inboard wing must be unstalled. Applying opposite aileron will only aggravate the stall and keep the glider spinning. Do **not** use the ailerons in an effort to raise the inboard wing.

When autorotation stops, immediately neutralize the rudder. If the rudder is 'held in' too long and the stick too far back the glider will almost always violently flip over and spin in the other direction. Because of the abrupt and unpleasant gyrations, this maneuver is seldom demonstrated. This is a common occurance during spin-ins. The glider is seen to recover from the initial spin only to immediately flip over and spin in the other direction with no hope of recovery, as by this time the hapless pilot is running out of time and altitude. These accidents are solely attributable to a lack of familiarity with spins.

Once the rotation has stopped the objective is to bring about a gradual recovery with minimum height loss, 'G' loads and airspeed build up. To prevent needless height loss, prompt control input is vital, but it must be smooth. You may find some who advocates having your hand on the airbrake lever in case the speed gets away from you, but this is not a good idea. When used as speed limiting, the airbrakes must be extended before the speed gets away. (See section on spiral dives, page 5)

HEIGHT LOSS

The height loss in the first second is 30 feet, the 2nd second 50-60 feet, and the third second 80-90 feet. The rate of descend once the spin is fully developed is about 100 feet per second or 70 MPH. In a modern two-seater trainer the rate of rotation is in the order of 4 seconds per revolution.

Height loss in the recovery dive is in the order of: 150 feet the first second, 250 feet the 2nd second, then about 400 feet per second.

When combining the height loss during spinning with the loss of height during the recovery dive, then the height loss after the first 180º of rotation will be close to 300ft, certainly not something to try while turning from base to final. After 360º of rotation total height loss will be in the order of 550ft. Two revolutions will use up about 750ft.

RECOVERY FROM A FLAT SPIN

With the center of gravity far enough back the glider may spin flat, from which it may not be possible to recover. Full forward stick may not get the nose down enough to get the inboard wing flying.

In case you forget to remove the tail dolly prior to take-off, it is imperative to maintain extra flying speed after release, to preclude any possibility of stalling. Incidentally, should you ever get airborne with the tail dolly on, do not release immediately. Wait till you get some reasonable altitude,

say at least 1500ft., this gives you time to settle down and prepare a conservative pattern. Some have been known to release at the end of the runway and crash, no need for that.

In the unlikely event that you should ever encounter a flat spin, and full forward stick has no effect, moving the stick rhythmically back and forth to get the fuselage oscillating may briefly pitch the fuselage down far enough to unstall the inboard wing.

In some gliders spinning with flaps in the 'landing setting' is, for structural reasons strictly prohibited. If any attempt is made to employ the flaps to assist recovery use extreme caution.

EFFECT OF CONTROLS

At spin entry and during a fully developed spin the glider's reaction to aileron and elevator control inputs are reversed from normal, sure signs of a spin. Moving the stick back will cause the nose pitch down. Moving the stick to the opposite side of the low wing will cause it to drop faster.

Hence, at spin entry, moving the stick to the opposite side in an effort to raise the wing, and pulling back on the stick to raise the nose will assure a full spin entry. In a fully developed spin holding the stick back in the opposite corner will hold the glider in the spin. Unfortunately, this is the intuitive respond, and many have done so in a desperate attempt to recover, all the way down.

For the most part, the rate of rotation, degree of nose down pitch and airspeed are determined by the characteristics of the glider and the position of the center of gravity. However, the position of the ailerons can have some effects on, pitch and roll oscillations, the rate of spin, and degree of pitch and bank. The affects, good or bad, will be unique to each glider. Better to keep the ailerons centered.

CAN ALL TYPE OF GLIDERS SPIN

All gliders will enter a spin given the right conditions. Turbulence can cause a glider to stall at a significantly higher airspeed than in stable conditions. I have experienced incipient spins from tight turns at 60kts while thermalling off a ridge in windy and turbulent conditions.

Any glider will also spin if sufficiently provoked and /or with the center of gravity near the aft limit. Some will recover shortly after entry, e.g. after one or two revolutions, even with the stick back in the corner. The spin will then transition into a spiral dive. Gliders which are reluctant to spin may well enter a spiral dive immediately following the incipient phase.

Other gliders such as the Schweizer 1-26 and 1-34 can enter a spin inadvertently, and will continue spinning until correct recover procedure is applied.

There are variations between gliders, and you should always get yourself acquainted with the spin and recovery characteristics of every glider you fly, as soon as possible. Not only are there variations between gliders, but spinning characteristics can be influenced by the configuration.

Flaps and their effects vary from glider to glider. In general, lowering the flaps will substantially encourage spins, as will an extended landing gear if located forward of the CG. The best example is the ASW-20, which is reluctant to spin with neutral or negative flaps, but spins like a top with gear down and landing flap. **Warning - In some gliders, spinning in the landing flap setting is strictly prohibited. Always check the flight manual for operating limitations.**

EFFECTS OF THE CENTER OF GRAVITY

A trainer such as the Schweizer 2-33 may be impossible to spin in spite of extreme spin provoking control positions when flown with two people on board. However when flown solo, it may be susceptible to spinning. Keep in mind that in most two-seaters the rear seat is generally in front of the center of gravity. Consequently, the center of gravity is further back when the glider is flown solo than it is when the rear seat is also occupied.

With the CG in the middle of the range it generally takes about a second for the autorotation to stop, should the CG be near the rear limit it may take two or three seconds. If the CG is beyond the aft limit, the glider may spin flat (see section on recovery from flat spins, page 4).

SPINS VS. SPIRAL DIVES

A spin may transition into a spiral dive at any time without any input on your part. It is crucial to be able to immediately recognize when a spin transitions to a spiral dive, as the recovery procedure is totally different. Fortunately for us, the spiral dive presents us with one clue that is a dead giveaway – the airspeed. While spinning, the airspeed indicator will show a low and /or flickering airspeed. Conversely, in a spiral dive the airspeed will build up an alarming rate, which is another reason instantaneous recognition is vital.

In a spiral dive –

1. The speed increases rapidly.
2. The controls feel heavy and are effective.
3. 'G' forces increase if the stick is held or moved back.
4. The rate of rotation is markedly slower than when spinning.

To avoid excessive loads, when recovering from a spiral dive always level the wings first before attempting to slow up. Level the wings using coordinated ailerons and rudder. Avoid pulling out and rolling level at the same time – the stresses on the glider can be extremely high.

Do not use the airbrakes to slow down. Most airbrakes are designed to be speed limiting, typically to limit the speed in dives of less than 45º, they are not intended to be <u>opened</u> at high speed. If the speed is very high it is better to slow down by pulling out without using the airbrakes.

Some of the reasons for avoiding opening the airbrakes at very high speeds are –

1. The forces on the airbrakes will be excessive and they will most certainly slam open violently when unlocked.
2. There will probably be damage done to the airbrake mechanism. This damage may make it impossible to close the airbrakes, at any speed.
3. More significantly, the redistribution of the loads on the wings due to opening the brakes at high speed may cause structural damage.

Aside from the dangers of opening the airbrakes at high speeds be aware that you may not be able to close them, even at moderate high speeds. On one type of glider the airbrakes cannot be closed at speeds over 65kts.

WHY PRACTICE SPINS

Practice has two prime purposes − The more often seen, the sooner recognized, and only through practice is it possible to cultivate the correct response to become intuitive, which it must be to enable a pilot to recover from a low level spin entree.

It also takes practice to enable the pilot to know how far to move the stick to get an immediate recovery but without causing an excessive nose down pitch resulting in an extra height loss of several hundred feet, or worse. A timely respond is also crucial, even a one second delay will cost 100 ft.

Only practice will enable the pilot to immediately move the stick forward by just the right amount for a minimum height loss recovery.

Another part of the recovery, which typically needs to be worked on, is the recovery dive. Only through practice can we learn the right amount of control input needed to minimize height loss, 'G' loads, and airspeed.

Spinning is one of those maneuvers that many of us tend to neglect after the initial check out, which may be one of the reasons why it remains such a high contributor to serious accidents.

Satisfactory demonstration of a spin entry and recovery during a mentally well rehearsed and prepared exercise at a comfortable altitude does not guarantee immediate and correct action when encountering a completely unexpected spin, especially at low altitude. When aimed straight at the ground we are faced with a strong urge to apply opposite aileron and haul back on the stick, which, of course, will only serve to seal our doom.

Here are excerpts from a report by a British instructor:

> "P2 was a young Bronze badge pilot on a check flight. Confidently pulling up and rolling into a thermal at about 3000ft, he reset the flaps but did not fully engage the flap lever in its détente slot. Before I could point this out the lever sprang out, the flaps went up and the wing already down dropped away as did the nose. He reacted instantaneously – putting the stick in the opposite corner!
>
> Knowing we were clear of other traffic, it seemed fortuitously appropriate to leave him to recover (aircraft and self esteem) but, despite entreaties from the back seat, the controls remained crossed until self-preservation instincts overcame tutorial motivation and I took over to recover (below 1500ft).
>
> Back on the ground, his record showing no problems with pre-solo spin training, he said it was the unexpectedness of the spin which 'completely phased' him and volunteered that, alone, he most likely would have spun to the ground. Later he demonstrated spin and recovery quite satisfactorily but it was of course the usual training set piece performance for which by then he was mentally rehearsed and prepared."

We need to practice spins until the correct recovery control input becomes intuitive. Only then, will we be totally prepared. If you have to think about it, you'll probably run out of time.

Here is another area that needs attention. As the spinning characteristics vary from one type of glider to another, it's a good idea to check out the spinning characteristics on one of the first flights when transitioning to a different type. Also, any modification you make to your present glider may very well make it behave like a different type and it will behoove you to treat it accordingly. Fitting your glider with winglets is just such a modification. Remember, if the glider was not certified with winglets, you are the test pilot. There is no guarantee that a spin will be recoverable.

A friend of mine has an ASW-20. He had been flying it for a number of years and was well acquainted with it, including its spinning characteristics. Then sometime after fitting it with winglets he encountered an inadvertent spin. Having plenty of altitude, why not leave it in for a while and see how it spins, he thought. To his amazement, when he went to recover it did not respond. Only by using the trick of pumping the stick back and forth, establishing a rhythmic oscillating pitch motion to momentarily get the nose down far enough to unstall the wing did it finally recover.

6/4/03

References:

First I want to thank Rick Lafford for all his advice and input.

Material referred to: BGA Instructors' Manual; FAA Document AC 61 – 67B; Innovations in Stall/Spin Awareness Training, Rich Stowell; Spinning Machines, Tony Gee, Sailplane and Gliding Oct/Nov '94; Teaching Spinning, Chris Rollings (at the time BGA senior national coach), Sailplane and Gliding Jun/Jul '94; Teaching Spinning, Chris Rollings, follow-up to article of Jun/Jul '94, Sailplane and Gliding Oct/Nov '94; Spinning Modern Sailplanes, Howard Torode, Sailplane and Gliding Jun/Jul '94.